

ITS Radiocommunication aspects from an ITU-R perspective

Radiocommunication Principles:

1. Spectrum needs and requirements:

- We've come a long way since the first Transportation Research Board (TRB) radiocommunication workshop, in 1995 – that's 20 years ago.
- Significant progress in converging the transportation and telecommunications sector.
- A much better understanding of the radiocommunication and telecommunication needs for vehicular connectivity, including emerging applications.
- Understandably, the spectrum requirements for ITS applications are spread across different bands (i.e. from FM and 220 MHz up-to 81 GHz), depending on the application and the corresponding radio service (i.e. mobile, radiolocation, etc.).
- The original "Mitre" spectrum requirements study (i.e. 75 MHz in the 5850-5925 MHz band) remains relevant today – even more relevant now than back in 1996: a strategic move by the ITS sector (both private and public).

2. Primary or secondary?

- Do you need a Primary or secondary allocation?
- Who will you share with? Can you share with them, and how?
- Can you share "within" the band; and are you "compatible" with the adjacent bands?
- Collaborate with the Radio Local Area Network (RLANs); especially in the 5 GHz band.
- Can you share with the International Mobile Telecommunication (i.e. the 3G/4G/5G folks) community? Or do you prefer to piggy-back on IMT as an application?

3. Standards!!!

- Standards are dynamic; and evolve over time.
- What standard do you plan on using, based on the channelization plan, as well as the technical and operational characteristics allowed in the band?
- Take a look at the TV and Cable industry, as an example. Standards have evolved, packing more data in less bandwidth, in the same band.
- Is the IEEE 802.11p standard (in the 5850-5925 MHz band) still relevant today?
- What about the 3rd Generation Partnership Project (3GPP) standardization activities for "LTE-based V2X services"?
- The implementation gap between the telecommunication and ITS industries remains.

4. Is it a "safety" service?

- Does ITS provide a "safety-of-life" service, to allow the ITS application to claim protection from other services in the same band?
- Article 1.59 of the Radio Regulations defines a *safety service* as: Any radiocommunication service used permanently or temporarily for the safeguarding of human life and property.
- ITS is identified as an application; and not a radiocommunication service.
- The provisions of Article 4.10; which ensures protection from harmful interference, and recognizes the safety aspects of radionavigation systems (for example), do not apply.

ANNEX A

ITS and ITS-related topics on the WRC-19 Agenda

The ITU World Radiocommunication Conference 2015 adopted a Resolution to include an agenda item at the 2019 Conference on Intelligent Transportation Systems (ITS) in the mobile service.

As WRC-15 concluded on the automotive radar in the radiolocation service, it is now time to focus on the harmonization aspects of the ITS radiocommunication in the mobile service.

The WRC-19 agenda item is assigned as AI 1.12 with the following short title:

1.12 to consider possible global or regional harmonized frequency bands, to the maximum extent possible, for the implementation of evolving Intelligent Transport Systems (ITS) under existing mobile-service allocations, in accordance with Resolution **COM6/13 (WRC-15)**;

The associated Resolution **COM6/13 (WRC-15)** is available below.

NOTE: The current number of the Resolution (i.e. **COM6/13**) is a temporary number in the Provisional Final Acts as the output of WRC-15 Committee 6 (which deals with Future Agenda Items). This number will be adjusted as the Radio Regulations are compiled and published.

The Resolution does not seek (and cannot seek) a new or additional allocation for ITS applications in the mobile service. The objective of the Resolution is to harmonize the spectrum for ITS applications, either globally or regionally, in the existing mobile service, with the possibility to identify this spectrum in the Radio Regulations.

The best example is the output of WRC-15 regarding the identification of globally and regionally harmonized spectrum for Public Protection and Disaster Relief (PPDR). In the case of PPDR, this identification was concluded via a Resolution of the Conference. In the previous study cycle, the work on PPDR was also conducted in collaboration with ITS regarding the 5.8/5.9 GHz band. The WRC-19 output for ITS may be modelled after the PPDR outcome.

With respect to WRC-19 Agenda Item 1.12 on ITS, sharing studies with other incumbent Services are not required, as long as the mobile service is allocated in the band as a Primary service. In some (or rare) cases, compatibility studies may be needed; especially for new ITS applications in the mobile service where ITS had not previously operated.

AI 1.12 is assigned to ITU-R Working Party 5A as the responsible Working Party, with participation from the Fixed Service, the Fixed Satellite Service, and the radio amateur service.

The study cycle will commence at the next meeting of WP 5A, currently planned for May 9 – 20, in Geneva. All technical and regulatory studies, including preparation of Regional proposals, must be completed in time for WRC-19 (dates: TBD).

At this time, no one has been identified as the Agenda Item rapporteur/editor. No one, including no Administration, has stepped forward at the end of WRC-15. At its next meeting (May 2016), ITU-R WP 5A will have to identify an individual(s) to lead this effort.

Liaison activities, including input contributions from external organizations and standards organizations, are strongly encouraged. In particular, input contributions are invited at least 2-weeks prior to the start of any scheduled Working Party 5A meeting.

In addition, to the identification of globally/regionally-harmonized spectrum, a definition of ITS radiocommunication service may be useful, if not required, to articulate the applications that may be covered under this service. A number of national regulatory bodies currently use such a definition for their domestic rules. Collaboration with ISO/TC 204, CEN, ETSI, 3GPP, etc. may be needed in order to converge on a unified definition, which in turn may facilitate the spectrum harmonization task.

Lastly, the ITS Resolution (COM6/13) remains silent regarding a specific band, in order not to pre-judge the outcome of the studies. The *resolves* part does not reference any particular band to be studied.

Other Relevant Work - RLANs:

WRC-19 also includes on its agenda, Agenda Item 1.16 on radio Local Area Networks (RLANs) between 5150 – 5925 MHz. The short title of AI 1.16 is:

1.16 to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution **COM6/22 (WRC-15)**;

Agenda Item 1.16 (RLANs) will also be assigned to ITU-R WP 5A.

Unlike the ITS Agenda Item (1.12), this Agenda Item includes regulatory implications with the potential for additional spectrum allocations in the identified range 5150 – 5925 MHz.

Collaboration between the advocates of AI 1.12 (ITS) and 1.16 (RLANs) is recommended in order to reach a successful outcome at WRC-19 which satisfied both communities.

The text of Resolution **COM6/22 (WRC-15)** is also provided below for information.

Additional Relevant Work – Train radiocommunication system:

In addition, WRC-19 includes on its agenda, Agenda Item 1.11 on radiocommunication system for trains (including the possibility for Positive Train Control). The short title of AI 1.11 is:

1.11 to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands to support railway radiocommunication systems between train and trackside within existing mobile service allocations, in accordance with Resolution **COM6/12 (WRC-15)**;

Agenda Item 1.11 (Train) will also be assigned to ITU-R WP 5A.

It is important to note that Agenda Item 1.11 (train), which was advocated by one Administration, went forward in tandem with AI 1.12 (ITS). Existing ITS radiocommunication services may be used, and may be identified to satisfy AI 1.11.

Unlike AI 1.12 (ITS), spectrum requirements for AI 1.11 have to be finalized in order to commence with the studies.

Other Interesting Work – Wireless Power Transmission (WPT):

WRC-15 requested a study (not an Agenda Item) concerning Wireless Power Transmission (WPT) for electric vehicles, in order to:

- a) to assess the impact of WPT for electric vehicles on radiocommunication services;
- b) to study suitable harmonized frequency ranges which would minimize the impact on radiocommunication services from WPT for electrical vehicles.

These studies should take into account that the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO) and the Society of Automotive Engineers (SAE) are in the process of approving standards intended for global and regional harmonization of WPT technologies for electric vehicles.

This study will be assigned either to ITU-R WP 1B or 1A, which already have on-going work in this topic. The request is advocated by one Administration. The next meeting is tentatively scheduled for June 2 – 9, 2016.

WRC-15 instructed the Director of the Radiocommunication Bureau to report on this study as part of his overall report WRC-19. WRC-19 will then decide on the next appropriate action.

Other Interesting Work – Internet-of-Things (IoT):

WRC-15 also requested a study (not an Agenda Item) concerning the radiocommunication aspects of the Internet-of-Things, in particular for Smart Cities. The focus of the study is: Studies on the technical and operational aspects of radio networks and systems, as well as spectrum needed, including possible harmonized use of spectrum to support the implementation of narrowband and broadband machine-type communication infrastructures, in order to develop Recommendations, Reports and/or Handbooks, as appropriate, and to take appropriate actions within the ITU Radiocommunication Sector (ITU-R) scope of work.

This study will also be assigned either to ITU-R WP 1B or 1A, due to the global interest on the Internet-of-Things. The next meeting is tentatively scheduled for June 2 – 9, 2016.

WRC-15 instructed the Director of the Radiocommunication Bureau to report on this study as part of his overall report WRC-19. WRC-19 will then decide on the next appropriate action.

RESOLUTION COM6/13 (WRC-15)

Intelligent Transport Systems applications

The World Radiocommunication Conference (Geneva, 2015),

considering

- a) that information and communication technologies are integrated in a vehicle system to provide Intelligent Transport Systems (ITS) communication applications for the purpose of improving traffic management and assisting safe driving;
- b) that there is a need for consideration of spectrum harmonization for ITS applications, which are being used globally or regionally;
- c) that there is a need to integrate various technologies, including radiocommunications, into land transportation systems;
- d) that many new connected vehicles use intelligent technologies in the vehicles' combined advanced traffic management, advanced traveller information, advanced public transportation management systems and/or advanced fleet management systems to improve traffic management;
- e) that the International Organization for Standardization (ISO) is standardizing ITS (non-radio aspects) in ISO/TC204, including applications for "cooperative systems" which require vehicle-to-vehicle and vehicle-to-infrastructure radiocommunications;
- f) that the 3rd Generation Partnership Project (3GPP) is standardizing radio interface, system architecture and service requirements of "LTE-based V2X Services" for ITS application;
- g) that future vehicular radiocommunication technologies and ITS broadcast systems are emerging;
- h) that some administrations have harmonized frequency bands for ITS radiocommunication applications,

recognizing

that harmonized spectrum and international standards would facilitate worldwide deployment of ITS radiocommunications and provide for economies of scale in bringing ITS equipment and services to the public,

noting

- a) that the guidelines for radio interface requirements of ITS are described in Recommendation ITU-R M.1890;
- b) that outlines of technologies and characteristics for dedicated short-range communications at 5.8 GHz are described in Recommendation ITU-R M.1453-2;
- c) that some administrations in each of the three Regions have deployed radiocommunication local area networks in the frequency band 5 725-5 825 MHz, which is also identified for industrial, scientific and medical (ISM) applications;

d) that studies and feasibility tests on advanced ITS radiocommunications have been actively conducted towards the realization of traffic safety and a reduction of environmental impact as described in Report ITU-R M.2228;

e) that radio interface standards of vehicle-to-vehicle and vehicle-to-infrastructure communications for ITS applications are described in Recommendation ITU-R M.2084,

emphasizing

a) that ITS applications currently operate within frequency bands allocated to a number of radiocommunication services in accordance with the relevant provisions of the Radio Regulations;

b) that the provisions of Nos. **1.59** and **4.10** do not apply to ITS applications,

resolves to invite the 2019 World Radiocommunication Conference

taking into account the results of ITU Radiocommunication Sector (ITU-R) studies, to consider possible global or regional harmonized frequency bands for the implementation of evolving ITS under existing mobile-service allocations,

invites ITU-R

to carry out studies on technical and operational aspects of evolving ITS implementation using existing mobile-service allocations,

invites administrations

to contribute actively to the ITU-R studies on this issue.

RESOLUTION COM6/22 (WRC-15)

Studies concerning Wireless Access Systems including radio local area networks in the frequency bands between 5 150 MHz and 5 925 MHz

The World Radiocommunication Conference (Geneva, 2015),

considering

- a) that there has been considerable growth in the demand for Wireless Access Systems including radio local area networks (WAS/RLAN) applications with multimedia capabilities;
- b) that WAS/RLAN applications contribute to global economic and social development by providing a wide range of multimedia applications;
- c) that there is a need to continually take advantage of technological developments in order to increase the efficient use of spectrum and facilitate spectrum access;
- d) that as technology evolves to meet increasing performance demands and traffic on broadband WAS increases, the use of wider bandwidth channels in order to support high data rates creates a need for additional spectrum;
- e) that the frequency band 5 350-5 460 MHz is allocated worldwide on a primary basis to the aeronautical radionavigation service (No. **5.449**);
- f) that the frequency band 5 460-5 470 MHz is allocated worldwide on a primary basis to the radionavigation service (No. **5.449**);
- g) that the frequency band 5 350 to 5 470 MHz is allocated worldwide on a co-primary basis to the Earth exploration-satellite service (active) (No. **5.448B**), the space research service (active) (No. **5.448C**) and the radiolocation service (No. **5.448D**);
- h) that the frequency bands between 5 725 and 5 850 MHz are allocated worldwide on a primary basis to the radiolocation service and, in Region 1, to the fixed-satellite service;
- i) that the frequency band 5 850-5 925 MHz is allocated worldwide on a primary basis to the mobile service, the fixed service and the fixed-satellite service;
- j) that there is a need to protect the incumbent primary services including their current and planned use;
- k) that there may be a need to specify potential technical and operational restrictions for WAS/RLAN operating in the mobile service within the 5 GHz frequency range to facilitate sharing with systems of incumbent services,

considering further

- a) that adequate and timely availability of spectrum and supporting regulatory provisions are essential to support future growth of WAS/RLAN applications;
- b) that harmonized worldwide bands that support future growth of WAS/RLAN applications are highly desirable in order to achieve the benefits of economies of scale,

noting

- a) that the frequency bands 5 150- 5 250 MHz, 5 250- 5 350 MHz and 5 470- 5 725 MHz are allocated to the mobile service on a primary basis for the implementation of WAS/RLAN applications in accordance with Resolution **229 (Rev.WRC-12)**;
- b) that the frequency band 5 250-5 850 MHz is allocated worldwide on a primary basis to the radiolocation service;
- c) that in the frequency bands 5 350 -5 470 MHz there are no primary mobile allocations;
- d) that in the frequency band 5 725-5 850 MHz there is no primary mobile allocation, however, the band is allocated by footnote to the fixed and mobile service in some countries, and additionally WAS/RLAN use is already authorized in some countries situated in each of the ITU-R regions;
- e) that the Earth exploration-satellite service (active) allocations in the frequency bands 5 350- 5 460 MHz and 5 460-5 470 MHz are essential for Earth-observation programmes such as Copernicus (Sentinel-1 and Sentinel-3), Jason, Sentinel-6 and RADARSAT (RADARSAT-2 and RADARSAT-3) and that the data these provide is vital for reliable and up-to-date information on how our planet and its climate are changing;
- ebis)* that future Earth exploration-satellite service (active) systems are being planned to utilize up to 300 MHz of bandwidth within the 5 GHz EESS allocated frequency band to improve image resolution and provide improved applications to users;
- f) that the frequency band 5 150-5 250 MHz is also allocated worldwide on a primary basis to the aeronautical radionavigation service and to the fixed-satellite service (No. **5.447A**);
- g) that the frequency bands between 5 250 and 5 350 MHz are also allocated worldwide on a primary basis to the Earth exploration-satellite service (active), the space research service and the space research (active) service;
- h) that protection and performance criteria for systems of incumbent services are available in ITU-R,

recognizing

- a) that the compatibility studies performed by ITU-R in preparation for this conference indicate that when assuming the use of WAS/RLAN mitigation measures limited to the regulatory provisions of Resolution **229 (Rev.WRC-12)**, sharing between WAS/RLAN and the EESS (active) systems in the frequency bands 5 350 to 5 470 MHz would not be feasible, as well as being insufficient to ensure protection of certain radar types in this frequency band; for these cases, sharing may only be feasible if additional WAS/RLAN mitigation measures are implemented, however, no agreement was reached on the applicability of any additional WAS/RLAN mitigation techniques;
- b) that the results of ITU-R studies indicate that the minimum spectrum need for WAS/RLAN in the 5 GHz frequency range in the year 2018 is estimated at 880 MHz; this figure includes 455-580 MHz already utilized by non-IMT mobile broadband applications operating within the 5 GHz range resulting in 300-425 MHz additional spectrum being required;
- c) that WAS/RLAN devices utilize the following frequency bands in the 5 GHz frequency range: 5 150-5 250 MHz, 5 250-5 350 MHz, 5 470-5 725 MHz and, in some countries 5 725-5 850 MHz;

- d) that the frequency band 5 850-5 925 MHz is extensively used in some countries by the fixed-satellite service;
- e) that additional global allocations to the mobile service in the frequency bands 5 350-5 470 MHz and 5 725-5 850 MHz would facilitate contiguous spectrum for WAS/RLAN, thereby enabling the use of wider channel bandwidths to support higher data throughput;
- f) that sharing studies should consider additional mitigation techniques to ensure that WAS/RLAN devices would not result in degradation of the performance for existing systems;
- g) that the application of possible additional WAS/RLAN mitigation measures referred to in *recognizing a)* may also be relevant to enable WAS/RLAN outdoor operation in other frequency bands;
- h) that the frequency band 5 725-5 875 MHz is also designated for industrial, scientific and medical (ISM) applications and that radiocommunication services operating within this frequency band must accept harmful interference which may be caused by these applications in accordance with No. **5.150**,

resolves to invite the 2019 World Radiocommunication Conference

to consider the results of the ITU-R studies and take appropriate actions,

invites ITU-R

to conduct and complete the following in time for WRC-19:

- a) to study WAS/RLAN technical characteristics and operational requirements in the 5 GHz frequency range;
- b) to conduct studies with a view to identify potential WAS/RLAN mitigation techniques to facilitate sharing with incumbent systems in the frequency bands 5 150-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz and 5 850-5 925 MHz, while ensuring the protection of incumbent services including their current and planned use;
- c) to perform sharing and compatibility studies between WAS/RLAN applications and incumbent services in the frequency band 5 150-5 350 MHz with the possibility of enabling outdoor WAS/RLAN operations including possible associated conditions;
- d) to conduct further sharing and compatibility studies between WAS/RLAN applications and incumbent services addressing:
 - i) whether any additional mitigation techniques in the frequency band 5 350-5 470 MHz beyond those analysed in the studies referred to in *recognizing a)* would provide coexistence between WAS/RLAN systems and EESS (active) and SRS (active) systems;
 - ii) whether any mitigation techniques in the frequency band 5 350-5 470 MHz would provide compatibility between WAS/RLAN systems and radio determination systems;
 - iii) whether the results of studies under points i) and ii) would enable an allocation of the frequency band 5 350-5 470 MHz to the mobile service with a view to accommodating WAS/RLAN use;

e) to also conduct detailed sharing and compatibility studies, including mitigation techniques, between WAS/RLAN and incumbent services in the frequency band 5 725- 5 850 MHz with a view to enabling a mobile service allocation to accommodate WAS/RLAN use;

f) to also conduct detailed sharing and compatibility studies, including mitigation techniques, between WAS/RLAN and incumbent services in the frequency band 5 850-5 925 MHz with a view to accommodating WAS/RLAN use under the existing primary mobile service allocation while not imposing any additional constraints on the existing services,

invites administrations

to participate in the studies by submitting contributions to ITU-R.

ANNEX B

Automotive Radar at WRC-15

The regulatory text (below) reflects the final outcome of the World Radiocommunication Conference (WRC-15) agenda item on automotive radar (i.e. WRC-15 AI 1.18).

The Table of Allocation adds the Radiolocation Service in the 500 MHz gap, which previously existed between 77.5 to 78 GHz. As such, the Radiolocation Service now has a contiguous 5 GHz band, from 76 to 81 GHz, available for the operation of high-resolution, short-range automotive radar.

The allocation is limited to the operation of any ground-based applications (i.e. non-airborne), in a mandatory reference (i.e. “shall”). “Ground-based” refers to mobile (not fixed) applications.

The availability of a 5 GHz band has attracted many ground-based applications, such as aircraft wing tip radar for airport taxiing as well as other applications.

The technical characteristics of such radars are provided in the most recent version of Recommendation ITU-R M.2057. This ITU-R Recommendation currently includes the operational and technical characteristics of 6 available radars that were used for the sharing studies with other incumbent radiocommunication Services in the band, such as the radio amateur (which is a Primary Service in the band) and radio astronomy (which is secondary).

As the technology of high-resolution radar evolves, revision to ITU-R M.2057 is advised in order to ensure that the most recent characteristics are captured with respect to this allocation.

Due to concerns expressed by 2 Member States, a separate Resolution was adopted to invite the ITU radiocommunication sector to conduct studies for the protection of the radio astronomy service in the next study cycle. Such studies will not have any impact of the Table of Allocation or the associated Footnote. This Resolution is not related to WRC-2019 or any future WRCs.

Lastly, the regulatory text (below), including the reference to the Footnote as FN 5.A118, is based on the Provisional Final Acts. The Footnote number (i.e. 5.A118) will be adjusted as the final Radio Regulations are compiled and published, later in 2016.

The entry-into-force of the Radio Regulations will be 1 January 2017.

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD **B4/260/1**

66-81 GHz

Allocation to services		
Region 1	Region 2	Region 3
77.5-78	AMATEUR AMATEUR-SATELLITE RADIOLOCATION ADD 5.A118 Radio astronomy Space research (space-to-Earth) 5.149	

ADD **B4/260/2**

5.A118 The use of the frequency band 77.5-78 GHz by the radiolocation service shall be limited to short-range radar for ground-based applications, including automotive radars. The technical characteristics of these radars are provided in the most recent version of Recommendation ITU-R M.2057. The provisions of No. **4.10** do not apply. (WRC-15)