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| **Radiocommunication Study Groups** |  |
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| Source: Document 5A/TEMP/233 | **Annex 10 to**  **Document 5A/650-E** |
| **16 November 2017** |
| **English only** |
| Annex 10 to Working Party 5A Chairman’s Report | |
| Preliminary draft CPM text for WRC-19 Agenda Item 1.16 | |
| Agenda item 1.16 | |

(**WP 5A** / **WP 4A**, **WP 4C**, **WP 5B**, **WP 5C**, **WP 7C**,   
(WP 1B), (WP 3J), (WP 3K), (WP 3M), (WP 5D))

*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* ***239 (WRC-15)****;*

Resolution **239 (WRC‑15)** – *Studies concerning Wireless Access Systems including radio local area networks in the frequency bands between 5 150 MHz and 5 925 MHz*

# 2/1.16/1 Executive summary

*[Text of the executive summary, not more than half a page of text to describe briefly the purpose of the agenda item, summarize the results of the studies carried out and, most importantly, provide a brief description of the method(s) identified that may satisfy the agenda item]*

RLANs [have proven to be a success in providing affordable and ubiquitous broadband access to the Internet]. Introduced by some administrations in the 2.4 GHz band and subsequently expanded into some of the 5 GHz frequency bands, RLANs, specifically Wi-Fi devices, now carry approximately half of all global Internet Protocol (IP) traffic.[[1]](#footnote-1) In fact, mobile carriers have increased their reliance on Wi-Fi offload, voice-over-Wi-Fi (VoWiFi), and similar technologies.[[2]](#footnote-2) 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.

Section 2/1.16/2 provides the background for agenda item 1.16.

Section 2/1.16/3 describes:

– the results of ITU-R studies for the technical and operational requirements for RLANs taking into account that previous studies indicated the minimum spectrum requirement for radio local area networks (RLAN) using the 5 GHz frequency range in the year 2018 is estimated to be 880 MHz;

– the sharing and compatibility studies conducted by the ITU-R [in accordance with Resolution **239 (WRC-15)]** for various frequency ranges;

– analyses of the results of studies for various frequency ranges;

– a list of frequency bands studied: 5 150-5 250 MHz, 5 250-5 350 MHz, 5 350‑5 470 MHz, 5 725‑5 850 MHz, and 5 850‑5 925 MHz.

Methods to satisfy the agenda item are included in section 2/1.16/4. Also, the regulatory and procedural considerations can be found in section 2/1.16/5.

# 2/1.16/2 Background

*[Text of the background, not more than half a page of text to provide general information in a concise manner, in order to describe the rationale of the agenda items (or issue(s))]*

RR No. 5.446A specifies that the use of the bands 5 150-5 350 MHz and 5 470-5 725 MHz by the stations in the mobile, except aeronautical mobile, service shall be in accordance with Resolution **229** **(Rev.WRC‑12)**. Resolution **229** **(Rev.WRC‑12)** resolves that the use of these bands by the mobile service will be for the implementation of WAS, including RLANs. [Resolution **229** **(Rev.WRC‑12)** mandates technical and other requirements to ensure that incumbent primary services are adequately protected.]

Since WRC-03, the demand for mobile broadband applications especially for WAS/RLANs has been growing rapidly. Resolution **239 (WRC-15)** states “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.” [However, more recent studies on spectrum trends indicate that the future needs of spectrum for WAS/RLAN may exceed largely these figures estimated by WRC 15 and consequently, the result of WRC 19 identifying WAS/RLAN applications within current or new Mobile service allocations would only minimally satisfy the needs of WAS/RLAN.]

WRC-15 examined the possibility of additional global allocations to the mobile service for terrestrial mobile broadband applications, including in the 5 GHz range, to facilitate contiguous spectrum for WAS/RLAN, thereby enabling the use of wider channel bandwidths to support higher data throughput. The [sharing and] compatibility studies performed by ITU-R in preparation for WRC-15 indicated 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 band 5 350 to 5 470 MHz may 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.

No studies were agreed for the frequency band 5 725-5 850 MHz. As such, WRC-15 concluded no change (NOC) for these frequency bands and established a WRC-19 agenda item to continue the work.

Resolution **239 (WRC‑15)**, calls for ITU-R to study WAS/RLAN technical characteristics and operational requirements in the 5 GHz frequency range. It also calls for ITU-R to performsharing and compatibility studies between WAS/RLAN applications and incumbent services 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, to consider enabling outdoor WAS/RLAN operations in the band 5 150-5 350 MHz, and potential mobile service allocations to accommodate WAS/RLAN operations in the 5 350‑5 470 MHz and 5 725‑5 850 MHz frequency ranges, and identify potential WAS/RLAN use in 5 850‑5 925 MHz frequency range.

# 2/1.16/3 Summary and analysis of the results of ITU-R studies

## 2/1.16/3.1 Technical and operational requirements for WAS/RLANs

*[Editor’s note: Similar text in also in the background section. Some rationalization of the text between these 2 sections will have to be done.]*

Currently, within the 5 GHz range, RLAN devices utilize the following frequency bands: 5 150‑5 250 MHz, 5 250‑5 350 MHz, 5 470-5 725 MHz and 5 725-5 850 MHz (in some countries). Pursuant to Resolution **229 (Rev.WRC-12)**, operation in the 5 150-5 250 MHz frequency band is limited to indoor use [with a maximum e.i.r.p. of 200 mW (23 dBm),] while dynamic frequency selection rules apply in the 5 250-5 350 MHz and 5 470‑5 725 MHz frequency bands.

[The studies on technical and operational requirements looked at - TBD.]

[In the past several years, given the growth of and reliance on RLANs as a means to connect to the Internet, some administrations[[3]](#footnote-3) have studied the possibility of relaxing the conditions imposed by Resolution **229**. The results of these proceedings have allowed administrations to authorize RLANs to operate at up to 1 Watt conducted power and a power spectral density (PSD) of 17 dBm/MHz with an allowance for a 6 dBi antenna gain, and to permit outdoor operation with the constraint that antenna elevation angles in excess of 30 degrees from the horizon must not exceed 125 mW (21 dBm) e.i.r.p., to minimize the likelihood of harmful interference to the operating MSS system.

It is noted that while higher conducted power may be allowed by some administrations, ITU-R studies have concluded the average e.i.r.p. (19 dBm)[[4]](#footnote-4) transmitted by RLANs is significantly below these limits, minimizing interference while permitting operational flexibility in situations where greater power is required. This is in keeping with Resolution **239 (WRC-15)**, *considering* *c)*, of which notes 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.]

## 2/1.16/3.2 Sharing and compatibility studies

[Editor’s note: Due to the lack of time, the following section **2/1.16/3.2.1 Frequency range 5 150‑5 250 MHz** (including 3.2.1.1 and 3.2.1.2) was not discussed at the November 2017 meeting and will be reviewed during the May 2018 meeting. Contributions from input Documents 5A/533, 5A/537, 5A/542, 5A/587 and 5A/603 are clearly marked below.]

### 2/1.16/3.2.1 Frequency range 5 150-5 250 MHz

The band 5 150-5 250 MHz is allocated to various services as contained in Table of Frequency Allocations including associated footnotes thereto.

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| 5 150-5 250 FIXED-SATELLITE (Earth-to-space) 5.447A  MOBILE except aeronautical mobile 5.446A 5.446B  AERONAUTICAL RADIONAVIGATION  5.446 5.446C 5.447 5.447B 5.447C | | |

#### 2/1.16/3.2.1.1 FSS for Non-GSO MSS FEEDER UPLINKS and the mobile service/RLAN

[*Editor’s note: FSS stations for NGSO MSS Feeder Links operate on a co-primary basis in the frequency band 5 150-5 250 MHz. This frequency band is also used by WAS/RLAN systems.*]

[Views were expressed that consistent with No. **5.446A** and Resolution **229 (WRC-12),** operations of the WAS/RLAN stations in the mobile service are restricted to indoor use with a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band or equivalently 0.25 mW/25 kHz in any 25 kHz band.]

In the past several years, some administrations have authorized WAS/RLAN operations at higher EIRP level and relaxed the indoor-only restriction. Specifically, these administrations authorized RLAN at up to 1 Watt conducted power and a power spectral density (PSD) of 17 dBm/MHz with an allowance for a 6 dBi antenna gain (*i.e.* a total 36 dBm EIRP) with the outdoor operation of WAS/RLANs permitted with the constraint that antenna elevation angles in excess of 30 degrees from the horizon must not exceed 125 mW e.i.r.p., to minimize the likelihood of harmful interference to the operating MSS system. Expressing a limit in terms of e.i.r.p. provides flexibility regarding how to achieve compatibility with non-GSO MSS feeder uplinks. It is noted that one of these administrations that allowed higher power outdoor operations is also one of the two notifying administrations for a non-GSO MSS system (United States HIBLEO-4 FL and France HIBLEO-X) that is currently operating in this band.

Also, while in-band e.i.r.p. was increased, unwanted emission levels were retained such that all WAS/RLAN station unwanted emissions outside of the 5 150-5 350 MHz frequency range shall not exceed an e.i.r.p. of −27 dBm/MHz.

The ITU-R studied sharing and compatibility between WAS/RLAN applications in the 5 150‑5 250 MHz and NGSO systems in the Mobile Satellite Service with FSS Feeder Links operating in the 5 150-5 250 MHz. The study examined the impact to the single incumbent NGSO MSS system sharing the spectrum, which is a bent-pipe system (HIBLEO-4). **The study analysed data from seventeen (17) satellites in the system, and found that the maximum value of the aggregate RLAN interference samples collected from the 18 satellites simulated was less than   
-172.2 dBW and therefore an I/N value of -31.9 dB was never exceeded. Accordingly, the study found no impact to** the **satellite constellation capacity or gateway earth station power and hence no harmful interference to the single MSS system using the 5 150–5 250 MHz band for FSS feeder links. Considering the results of the study, the IUT-R found that allowing RLANs to operate outdoors and at higher powers in the 5 150-5 250 MHz has been shown to pose no harmful interference to the single operational MSS system.**

**Paragraph above revised by USA in response to comments during WP 5A discussions.**

The ITU-R studied sharing and compatibility between WAS/RLAN applications in the 5 150‑5 250 MHz and NGSO systems in the Mobile Satellite Service with FSS Feeder Links operating in the 5 150-5 250 MHz. The study examined the impact to the single incumbent NGSO MSS system sharing the spectrum, which is a bent-pipe system (HIBLEO-4). **The study analysed data from seventeen (17) satellites in the system, and found that the maximum value of the aggregate RLAN interference samples collected from the 17 satellites simulated was less than -154.1 dBW and therefore an I/N value of - 13.8 dB was never exceeded. Considering the results of the study, the ITU-R found that allowing RLANs to operate outdoors and at higher powers in the 5 150-5 250 MHz band has been shown to pose no harmful interference to the single operational MSS system.**

[However, it was noted by one administration, which is a major operator of LEO-D, non-GSO MSS feeder uplinks in the 5 150-5 250 MHz band, that there were concerns with the above text. The administration provided the following Tables to compare the higher e.i.r.p. limits and outdoor operation with the mandatory requirements of Resolution **229 (Rev.WRC-12)**.

Table 1 provides a comparison for RLAN emission elevation angles less than or equal to 300 and Table 2 for RLAN emission elevation angles greater than 300 elevation.

TABLE 1

RLAN emission elevation angles between 00 and 300

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Resolution 229 (Rev.WRC‑12) | Higher power administration | Difference |
| Maximum e.i.r.p. | 200 mW (23 dBm) | 4 W (36 dBm) | 13 dB |
| Location constraint | Yes, indoor only | No, outdoor permitted |  |
| Resultant max. outdoor e.i.r.p. | 6 dBm\* | 36 dBm | 30 dB\* |

\* Assumes building loss of 17 dB

TABLE 2

RLAN emission elevation angles >300

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Resolution 229 (Rev.WRC‑12) | Higher power administration | Difference |
| Maximum e.i.r.p. | 200 mW (23 dBm) | 125 mW (21 dBm) | -2 dB |
| Location constraint | Yes, indoor only | No, outdoor permitted |  |
| Resultant max. outdoor e.i.r.p. | 6 dBm\* | 21 dBm | +15 dB\* |

\* Assumes building loss of 17 dB

The administration noted that the higher power and outdoor operation that apply to RLANs in these administrations in the 5 150-5 250 MHz frequency band potentially result in up to 30 dB (i.e. 1,000 times) more radiated power for RLAN emission elevation angles ≤300 and up to 15 dB more radiated power for elevation angles >300 when compared with that prescribed in Resolution **229 (Rev.WRC-12)**.

It was also noted that there had been no technical, operational, sharing or compatibility studies tabled in ITU-R to support the e.i.r.p. increase or for removing the indoor only requirement. Further, the choice of a 300 elevation angle breakpoint for maximum e.i.r.p. was not supported by reference to any ITU-R studies and was inconsistent with the operation of the LEO-D feeder uplinks which carry commercial traffic from 100 to the opposite 100 in elevation.

In the absence of such ITU-R studies, the administration asked for advice on how the 300 elevation angle was chosen and for an analysis of the aggregate noise that would be received by LEO-D as a result of RLANs operating outdoors at the 21 dBm e.i.r.p. level (and also at the 36 dBm e.i.r.p. level).

However, others expressed the view that there is a need to submit studies supporting the above views.]

[One study was submitted indicating that interference to feeder uplinks could exist if the indoor deployment restrictions of Resolution **229 (Rev.WRC-12)** were relaxed in outdoor deployments.]

Another example of a sharing study with realistic conditions was conducted as follows. The parameters and protection criteria of the non-GSO MSS feeder link are assumed to be the same as described in section 4.1 in the Report ITU-R M.[RLAN SHARING] .

The e.i.r.p. distribution is the same as defined in the Table 1A in Report ITU-R M.[RLAN REQ-PAR] (The outdoor usage ratio is 5.3%). The antenna pattern for RLANs is based on Recommendation ITU-R M.1652. If the RLAN uses e.i.r.p. of 1 W, the elevation angle mask defined for 5 250-5 350 MHz band in Resolution **229 (Rev. WRC-12)** is applied. Building entry loss is based on Recommendation ITU-R P.2109. Clutter loss is based on Recommendation ITU-R P.2108 under the assumption that this recommendation is applied to the 5.2 GHz band. The active ratio of RLANs is derived from Report ITU-R M.[RLAN REQ-PAR].

Under these conditions, the total amount of interference level was calculated with Monte Carlo simulations and compared with the allowable interference level with random locations of RLAN devices with variable number of RLANs within the line-of-sight range of the satellite.

The results are the following. If the number of RLANs of the 5 150-5 250 MHz band within the line-of-sight range of the satellite is less than 113.91 million (6.04 million for outdoor use), which corresponds to 63.85 million (3.38 million for outdoor use) RLANs in the footprint of the satellite, the average of the total amount of interference from RLANs is less than the threshold.

Therefore, if the number of RLANs is limited, the sharing with non-GSO MSS feeder links is possible when WAS/RLAN systems are used outdoors.

#### 2/1.16/3.2.1.2 Aeronautical radionavigation service and mobile service/RLAN

This frequency band is used for sense and avoid systems and the typical technical characteristics are given in Recommendation ITU-R M. 2007 “Characteristics of and protection criteria for radars operating in the aeronautical radionavigation service in the frequency band 5 150-5 250 MHz”.

[In one worst case example compatibility study, the results showed that the effective measures for reducing interference for airborne sense and avoid systems operation are to be developed to enable the usage of outdoor WAS/RLAN in the frequency band 5 150-5 250 MHz. One approach based on the worst case results may be the reduction of e.i.r.p values of WAS/RLAN transmitters approximately by 20 dB while increasing the receiver sensitivity can be considered as the effective method for reducing interference. Such method allows to compensate the absence of additional fading in the walls which provided sharing of WAS/RLAN systems with the ARNS systems operating in the considered frequency band.

Without development of such measures for reducing the interference the decision of possible outdoor WAS/RLAN systems usage in the considered frequency band cannot be made.

Consideration of multi-source interference could result in different protection distances. Further studies using an aggregate interference are needed for realistic results.]

Another example of a sharing study with realistic conditions was conducted as follows.

The parameters and protection criteria of the ARNS systems are assumed to be almost the same as described in section 4.1 of Report ITU-R M.[RLAN SHARING] (also described in Recommendation ITU-R M.2007) and the threshold of the total amount of interference from RLANs is -101.9 dBm with the following conditions.The e.i.r.p. distribution is the same as defined in the Table 1A in Report ITU-R M.[RLAN REQ-PAR] (outdoor usage ratio is 5.3%). The antenna pattern for RLANs is based on Recommendation ITU-R M.1652. If the RLAN uses e.i.r.p. of 1 W, the elevation angle mask defined for the 5 250‑5 350 MHz band in Resolution **229 (Rev.WRC-12)** is applied. The antenna pattern for ARNS systems is based on Recommendation ITU-R M.1652 and the maximum antenna gain is 36 dBi as defined in Recommendation ITU-R M.2007. Building entry loss is based on Recommendation ITU-R P.2109. Additional loss is 17 dB (defined for airborne radars in Recommendation ITU-R M.1652). The height of ARNS systems is 10 km. The active ratio of RLANs is derived from Report ITU-R M.[RLAN REQ-PAR].

Under these conditions, the total amount and distribution of interference level is calculated based on Monte Carlo simulations and compared with the allowable interference level with random locations of RLAN devices with variable number of RLANs within the line-of-sight range of the ARNS systems.

The minimum distance between RLANs and ARNS systems is assumed to be 0 km or 20 km. The elevation angle of the ARNS antenna is assumed to be -45 degrees.

When no limitation is applied to RLAN locations, if the upper limit of the number of RLANs of the 5 150-5 250 MHz band is 103.15 million (5.47 million for outdoors), the interference is less than the threshold with a probability of 90%. When the minimum distance between RLANs and ARNS systems is 20 km, the upper limit of the number of RLANs is 210.79 million (11.17 million for outdoor use).

Accordingly if the number of RLANs or the separation distance between RLANs and ARNS systems is controlled, the interference level will be less than the threshold with a certain probability. Therefore the sharing with ARNS systems is possible when WAS/RLAN systems are used outdoors.

### 2/1.16/3.2.2 Frequency range 5 250-5 350 MHz

The band 5 250-5 350 MHz is allocated to various services as contained in Table of Frequency Allocations including associated footnotes thereto.

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| 5 250-5 255 EARTH EXPLORATION-SATELLITE (active)  MOBILE except aeronautical mobile 5.446A 5.447F  RADIOLOCATION  SPACE RESEARCH 5.447D  5.447E 5.448 5.448A | | |
| 5 255-5 350 EARTH EXPLORATION-SATELLITE (active)  MOBILE except aeronautical mobile 5.446A 5.447F  RADIOLOCATION  SPACE RESEARCH (active)  5.447E 5.448 5.448A | | |

#### 2/1.16/3.2.2.1 Earth exploration-satellite service (active) and the mobile service/RLAN and Radar systems and the mobile service/RLANs

The current WAS/RLAN operating parameters are specified in Resolution **229 (WRC-12)**.

Since the adoption of Resolution **229 (WRC-12)** at WRC-03**,** millions of WAS/RLAN (e.g., Wi-Fi) devices have been deployed in the band 5 250-5 350 MHz.

In preparation to WRC-19, studies in response to invite c of Resolution 239 have shown that changing the WAS/RLAN operating conditions in 5 250-5 350 MHz as given in Resolution **229 (WRC-12)**, would not ensure protection of the radiodetermination service and EESS (active) sensors. Furthermore, it was confirmed that the current WAS/RLAN operating conditions in 5 250‑5 350 MHz band are sufficient for the operating needs of WAS/RLAN users.

### 2/1.16/3.2.3 Frequency range 5 350-5 470 MHz

The frequency range 5 350-5 470 MHz, or parts thereof, is allocated to the EESS, RLS, ARNS, SRS and RNS. The details of these allocations can be found in RR Article **5**.

#### 2/1.16/3.2.3.1 Earth exploration-satellite service (active) and the mobile service/RLAN

Previous ITU-R sharing studies show that sharing between RLAN and the EESS (active) systems in the 5 350-5 470 MHz frequency band would not be feasible unless additional RLAN mitigation measures are implemented. After further study of currently available mitigation measures, study results show that there are no feasible mitigation techniques to facilitate sharing between RLAN and EESS (active) in this band.

#### 2/1.16/3.2.3.2 Radar systems and the mobile service/RLANs

The regulatory provisions in the 5 150-5 350 MHz and 5 470-5 725 MHz frequency ranges contained in Resolution **229 (Rev.WRC-12)** are insufficient to ensure protection of certain radar types in the 5 350-5 470 MHz frequency band. After further study of currently available mitigation measures, study results show that there are no feasible mitigation techniques to facilitate sharing between RLAN and the different radar systems in the 5350-5470 MHz frequency band.

### 2/1.16/3.2.4 Frequency range 5 725-5 850 MHz

The band 5 725-5 850 MHz is allocated to various services as contained in Table of Frequency Allocations including associated footnotes thereto.

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| 5 725-5 830  FIXED-SATELLITE (Earth-to-space)  RADIOLOCATION  Amateur | 5 725-5 830  RADIOLOCATION  Amateur | |
| 5.150 5.451 5.453 5.455 | 5.150 5.453 5.455 | |
| 5 830-5 850  FIXED-SATELLITE (Earth-to-space)  RADIOLOCATION  Amateur  Amateur-satellite (space-to-Earth) | 5 830-5 850  RADIOLOCATION  Amateur  Amateur-satellite (space-to-Earth) | |
| 5.150 5.451 5.453 5.455 | 5.150 5.453 5.455 | |

A number of systems/applications operate in several countries in Region 1 including RTTT, WIA, BFWA and SRDs. Appropriate mitigation measures may be required to be applied in these countries, in order to achieve coexistence between WAS/RLAN and some of these systems/applications, if WRC-19 decides to allocate the frequency band 5 725-5 850 MHz to the mobile service in Region 1, with the purpose to accommodate WAS/RLAN use. [In the 5 725‑5 825 MHz frequency band RR No. **5.453** one country operates ITS under the mobile allocation of this footnote.]

WAS including RLANs already operate in several countries within the 5 725-5 850 MHz frequency range. In Region 2, the 5 725-5 825 MHz frequency range is also used by WAS including RLANs. The FSS allocation in 5 725‑5 850 MHz is in Region 1 only, therefore wireless WAS/RLAN and FSS sharing issues are not relevant in Regions 2 and 3.

#### 2/1.16/3.2.4.1 Radar systems and the mobile service/RLANs

In some countries, various radars operate throughout the whole frequency range 5 250–5 850 MHz.

In one study of a single interferer to the ground-based radiolocation radars, the protection distances range from several tens km for outdoor WAS/RLAN and indoor WAS/RLAN as well. Consideration of multi-source interference result in additional increase of the required protection distance defined by the WAS/RLAN transmitter density and directivity characteristics of the considered radar. Thus based on this one study providing compatibility of WAS/RLAN with the radars operating in this frequency band will be difficult.

### 2/1.16/3.2.5 Frequency range 5 850-5 925 MHz

The band 5 850-5 925 MHz is allocated to various services as contained in Table of Frequency Allocations including associated footnotes thereto.

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| 5 850-5 925  FIXED  FIXED-SATELLITE (Earth-to-space)  MOBILE | 5 850-5 925  FIXED  FIXED-SATELLITE (Earth-to-space)  MOBILE  Amateur  Radiolocation | 5 850-5 925  FIXED  FIXED-SATELLITE  (Earth-to-space)  MOBILE  Radiolocation |
| 5.150 | 5.150 | 5.150 |

The mobile service is co-primary in the 5 850-5 925 MHz band. Applications under the mobile service have already been implemented in various countries throughout the world. Therefore any sharing analysis carried out under this agenda should not prejudice usages of the mobile service while not imposing any additional constraints on other services to which the band is allocated.

This band is used for FSS uplink operations in all three ITU regions supporting a variety of FSS applications including broadband service and studies should take account the protection of the current and planned FSS use.

[The 3 400-3 700 MHz, or portions thereof, which in certain cases are use for downlinks associated with the 5 850-5 925 MHz uplink band, and both bands have also been allocated for terrestrial services.]

The study of mitigation techniques would be necessary to mitigate the risk of cumulative interference from WAS/RLAN into FSS, if an identification in the RR for WAS/RLAN is made in this band.

Concerns were raised about different applications operating under the primary mobile service in this band. Some sharing studies carried out so far on a national or regional basis looking at WAS (RLAN) as an interferer into ITS showed the need for appropriate separation distances, in cases of co-channel operation. As a result, work by some regions on possible mitigation techniques was initiated to help improve the compatibility between individual RLAN devices and ITS applications. Based upon the results of these studies so far, conclusions on the feasibility of coexistence could not be reached.

#### 2/1.16/3.2.5.1 Fixed service and the mobile service/RLANs

#### 2/1.16/3.2.5.2 Fixed-satellite service and mobile service/RLANs

# 2/1.16/4 Methods to satisfy the agenda item

*[This section should contain the brief description of the Method or Methods to satisfy the agenda item as per section 4 of Annex 2 to Resolution ITU-R 2-7.]*

The following methods are considered to satisfy this agenda item and may be applied to each candidate frequency band.

**Method A** – No change, which may be accompanied by reasons.

**Method B** – Make an allocation to the mobile service to be used by RLANs under the MS on a primary basis (either by a new allocation or the upgrade of an existing secondary allocation) with a view to facilitate the development of terrestrial mobile broadband applications.

**Method B1** – **Table of Frequency Allocations (ToA)** - Make an allocation to under the MS on a primary basis in the Table of Frequency Allocations for use by WAS including RLANs.

**Method B2** – **Footnote (FN)** - Make an allocation to the MS for use by RLANs on a primary basis in a footnote.

**Method C** – To identify different technical conditions for RLANs under an existing MS allocation either in a new or existing footnote. This Method can be applied individually if there is already a primary mobile allocation or in conjunction with Method B.

In addition, any condition of use specific to a frequency band by the MS or RLAN systems will be described under the specific frequency band under Methods B and/or C.

**Other considerations** – TBD

The frequency bands considered under this agenda item together with the applicable methods identified to satisfy the agenda item are summarized in the table below:

Methods and options\* that may be applicable to the potential candidate frequency bands, taking into account   
existing frequency allocations contained in Article 5 of the RR

| Number / Bands (MHz) | Applicable Methods and Options\* (shown in *italics*) | | | | |
| --- | --- | --- | --- | --- | --- |
| Method A | Method B-ToA | Method B-FN | Method C | Section |
| 1 / 5 150-5 250 | A | Under Review | Under Review | C | 2/1.16/5.1 |
| 2 / 5 250 -5 350 | A | Not Proposed | Not Proposed | Not Proposed | 2/1.16/5.2 |
| 3 / 5 350-5 470 | A | Not Proposed | Not Proposed | Not Proposed | 2/1.16/5.3 |
| 4 / 5 725-5 850 | A | Under Review | Under Review | Under Review | 2/1.16/5.4 |
| 5 / 5 850-5 925 | A | Not Proposed | Not Proposed | Not Proposed | 2/1.16/5.5 |

\* Methods can be applied without any options. WRC-19 may decide to apply any of these options or others not already stated in this Report.

## [Editor’s note: Due to the lack of time, the following section 2/1.16/4.1 for the frequency band 5 150-5 250 MHz was not discussed at the November 2017 meeting and will be reviewed during the May 2018 meeting. Contributions from input Documents 5A/533, 5A/537, 5A/542, 5A/587 and 5A/603 are clearly marked below.]

## 2/1.16/4.1 For the frequency band 5 150-5 250 MHz

In light of real-world, operational experience of some administrations, **Method C** is applicable. Technical conditions for WAS/RLANs can be adjusted to allow WAS/RLAN operations at higher e.i.r.p. levels and without indoor-only restriction, provided that appropriate measure are implemented to protect non-GSO MSS feeder links and ARNS systems [and all WAS/RLAN station unwanted emissions outside of the 5 150-5 250 MHz band shall not exceed an e.i.r.p. of −27 dBm/MHz].

*[Japan’s note: Regarding the limitation of unwanted emissions with the proposed e.i.r.p. density threshold of -27 dBm/MHz, it is necessary to evaluate the value of the threshold and whether the value should be included in the conditions of Method C.]*

*[USA: Changes to above paragraph are shown below to address Japan’s note.]*

In light of real-world, operational experience of some administrations, **Method C** is applicable. Technical conditions for WAS/RLANs can be adjusted to allow WAS/RLAN operations at higher e.i.r.p. levels and without indoor-only restriction, provided that appropriate measure are implemented to protect non-GSO MSS feeder links and ARNS systems. For WAS/RLAN transmitters operating in the 5 150-5 250 MHz band, all unwanted emissions outside of the 5 150-5 350 MHz band shall not exceed an e.i.r.p. of −27 dBm/MHz].**Method A (NOC)** is applicable. There were numerous ITU-R sharing studies developed that led to the decisions of WRC-03 and WRC-12 to apply the provisions of Resolution **229 (Rev.WRC-12)** to RLANs in this band and ITU-R studies to date in support of WRC-19 agenda item 1.16 have similarly shown the need to retain the Resolution **229 (Rev.WRC-12)** requirements to ensure that non-GSO MSS feeder uplinks will continue to be adequately protected.

## 2/1.16/4.2 For the frequency band 5 250-5 350 MHz

**Method A (NOC)** is applicable. Technical conditions for RLANs to coexist with incumbent services have been demonstrated and RLANs have been successfully deployed in this band since WRC-03.

## 2/1.16/4.3 For the frequency band 5 350-5 470 MHz

**Only Method A (NOC)** is applicable. With the use of WAS/RLAN mitigation measures limited to the regulatory provisions of Resolution **229 (Rev.WRC-12)**, sharing between WAS/RLAN and EESS (active) and RLS systems in the frequency bands 5 350 to 5 470 MHz are not be feasible. After extensive study of current proposed additional mitigation techniques, results show that there are no feasible mitigation techniques available to facilitate sharing between RLAN and incumbent services in this band.

## 2/1.16/4.4 For the frequency band 5 725-5 850 MHz

[**Method A (NOC)** is applicable. WAS including RLANs already operate in many countries within the 5 725-5 850 MHz frequency range. It should also be noted that the 5 725-5 875 MHz frequency band is designated for Industrial, Scientific, and Medical (ISM) applications under RRNo. **5.150.** In addition, No. **5.453** includes over 40 countries which have allocated the 5 650‑5 850 MHz frequency range to the fixed and mobile services on a primary basis for which the provisions of Resolution **229 (Rev.WRC-12)** do not apply. Therefore any sharing analysis carried out in this band should not prejudice any current or future RLAN use on a national or regional basis (i.e. any recommendations developed should be of an advisory and non-binding nature).] [In this band a new mobile allocation to accommodate WAS/RLANs use would only be possible if sharing and compatibility studies could demonstrate the effectiveness of any new proposed interference mitigation techniques to ensure the protection of radars, fixed service (see No. **5.455**) and FSS space station receivers.]

[Editor’s note: RUS proposed to delete the sentence “Therefore any sharing analysis carried out in this band should not prejudice any current or future RLAN use on a national or regional basis (i.e. any recommendations developed should be of an advisory and non-binding nature)”]

## 2/1.16/4.5 For the frequency band 5 850-5 925 MHz

Only Method A (NOC).

After the studies conducted so far the only agreed method is Method A (NOC).

Based on these studies it was agreed not to propose an RLAN identification in this primary mobile allocation 5 850-5 925 MHz under Resolution **239 (WRC-15)**.

# 2/1.16/5 Regulatory and procedural considerations

[Editor’s note: Due to the lack of time, the following section **2/1.16/5.1 for the frequency band 5 150-5 250 MHz** was not discussed at the November 2017 meeting and will be reviewed during the May 2018 meeting. Contributions from input Documents 5A/533, 5A/537, 5A/542, 5A/587 and 5A/603 are clearly marked below.]

**2/1.16/5.1 For the frequency band 5 150-5 250 MHz**

**2/1.16/5.1.1 Method C**

## 2/1.16/5.1 For all frequency bands

SUP

RESOLUTION 239 (WRC-15)

## 2/1.16/5.2 For the frequency band 5 150-5 250 MHz

NOC to RR

[DG Chair Note: RUSSIA Doc. 542 proposes to supress this Resolution]

[**USA NOTE:** the proposed modifications to Resolution 229 are being re-introduced in track changes format from Document 5A/378 since they are not shown as such in Annex 10 of Doc. 5A/469]

[MOD

RESOLUTION 229 (Rev.WRC‑19)

Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz   
by the mobile service for the implementation of wireless access systems   
including radio local area networks

The World Radiocommunication Conference (TBD, 2019)

considering

*a)* that WRC‑03 allocated the bands 5 150-5 350 MHz and 5 470-5 725 MHz on a primary basis to the mobile service for the implementation of wireless access systems (WAS), including radio local area networks (RLANs);

*b)* that WRC‑03 decided to make an additional primary allocation for the Earth exploration-satellite service (EESS) (active) in the band 5 460-5 570 MHz and space research service (SRS) (active) in the band 5 350-5 570 MHz;

*c)* that WRC‑03 decided to upgrade the radiolocation service to a primary status in the 5 350-5 650 MHz band;

*d)* that the band 5 150-5 250 MHz is allocated worldwide on a primary basis to the fixed‑satellite service (FSS) (Earth-to-space), this allocation being limited to feeder links of non‑geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);

*e)* that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**) subject to agreement obtained under No. **9.21**;

*f)* that the band 5 250-5 460 MHz is allocated to the EESS (active) and the band 5 250‑5 350 MHz to the SRS (active) on a primary basis;

*g)* that the band 5 250-5 725 MHz is allocated on a primary basis to the radiodetermination service;

*h)* that there is a need to protect the existing primary services in the 5 150-5 350 MHz and 5 470-5 725 MHz bands;

*i)* that results of studies in ITU‑R indicate that sharing in the band 5 150-5 250 MHz between WAS, including RLANs, and the FSS is feasible under specified conditions;

*j)* that studies have shown that sharing between the radiodetermination and mobile services in the bands 5 250-5 350 MHz and 5 470-5 725 MHz is only possible with the application of mitigation techniques such as dynamic frequency selection;

*k)* that there is a need to specify an appropriate e.i.r.p. limit and, where necessary, operational restrictions for WAS, including RLANs, in the mobile service in the bands 5 250‑5 350 MHz and 5 470-5 570 MHz in order to protect systems in the EESS (active) and SRS (active);

*l)* that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services,

further considering

*a)* that the interference from a single WAS, including RLANs, complying with the operational restrictions under *resolves*2 will not on its own cause any unacceptable interference to FSS receivers on board satellites in the band 5 150-5 250 MHz;

*b)* that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these WAS, including RLANs, especially in the case of a prolific growth in the number of these systems;

*c)* that the aggregate effect on FSS satellite receivers will be due to the global deployment of WAS, including RLANs, and it may not be possible for administrations to determine the location of the source of the interference and the number of WAS, including RLANs, in operation simultaneously,

noting

*a)* that, prior to WRC‑03, a number of administrations have developed regulations to permit indoor and outdoor WAS, including RLANs, to operate in the various bands under consideration in this Resolution;

*b)* that, in response to Resolution **229 (WRC‑03)**, ITU‑R developed Report ITU‑R M.2115, which provides testing procedures for implementation of dynamic frequency selection,

*c)* that since WRC-03, reliance on RLANs to access the Internet at broadband speeds has grown to the point where more than half of global IP traffic is carried on RLANs and operators increasingly use RLAN offload to manage congestion on their networks,

recognizing

*a)* that in the band 5 600-5 650 MHz, ground-based meteorological radars are extensively deployed and support critical national weather services, according to footnote No. **5.452**;

*b)* that the performance and interference criteria of spaceborne active sensors in the EESS (active) are given in Recommendation ITU‑R RS.1166;

*c)* that a mitigation technique to protect radiodetermination systems is given in Recommendation ITU‑R M.1652;

*d)* that Recommendation ITU‑R RS.1632 identifies a suitable set of constraints for WAS, including RLANs, in order to protect the EESS (active) in the 5 250-5 350 MHz band;

*e)* that Recommendation ITU‑R M.1653 identifies the conditions for sharing between WAS, including RLANs, and the EESS (active) in the 5 470-5 570 MHz band;

*f)* that the stations in the mobile service should also be designed to provide, on average, a near-uniform spread of the loading of the spectrum used by stations across the band or bands in use to improve sharing with satellite services;

*g)* that WAS, including RLANs, provide effective broadband solutions, the demand for which has increased dramatically since the frequency range was first identified for this application;

*h)* that there is a need for administrations to ensure that WAS, including RLANs, meet the required mitigation techniques, for example, through equipment or standards compliance procedures,

resolves

1 that the use of these bands by the mobile service will be for the implementation of WAS, including RLANs;

2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to a maximum mean e.i.r.p.1 of 1.0 W and a power spectral density (PSD) of 17 dBm/MHz with an allowance for a 6 dBi antenna gain (*i.e.* a total 36 dBm EIRP). Also, the outdoor operation of stations in the mobile service with antenna elevation angles in excess of 30 degrees from the horizon shall not exceed 125 mW e.i.r.p. [Furthermore, all WAS/RLAN station unwanted emissions outside this band shall not exceed an e.i.r.p. of −27 dBm/MHz];

*[Japan’s note: Regarding the limitation of unwanted emissions with the proposed e.i.r.p. density threshold of -27 dBm/MHz, it is necessary to consider whether the threshold should be included in the revision of Resolution* ***229 (Rev. WRC-12)*** *and to evaluate the value of the threshold if necessary. Regarding the elevation angle mask, it may be preferred to be the same as defined for the 5 250-5 350 MHz band in Resolution* ***229 (Rev. WRC-12)*** *since the 5 150-5 250 MHz and the 5 250-5 350 MHz bands may be used at the same time when a transmission with a bandwidth of 160 MHz is allowed, and the consistent conditions on e.i.r.p. and antennas may be preferred. In addition, this elevation angle mask may reduce interference to ARNS systems.]*

*[USA: Changes to above paragraph are shown below to address Japan’s note.]*

2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to a maximum mean e.i.r.p.1 of 1.0 W and a power spectral density (PSD) of 17 dBm/MHz with an allowance for a 6 dBi antenna gain (*i.e.* a total 36 dBm EIRP). Also, the outdoor operation of stations in the mobile service with antenna elevation angles in excess of 30 degrees from the horizon shall not exceed 125 mW e.i.r.p. Furthermore, for WAS/RLAN transmitters operating in the 5 150-5 250 MHz band, all unwanted emissions outside of the 5 150-5 350 MHz band shall not exceed an e.i.r.p. of −27 dBm/MHz;3 that in the band 5 250-5 350 MHz, stations in the mobile service shall be limited to a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band. Administrations are requested to take appropriate measures that will result in the predominant number of stations in the mobile service being operated in an indoor environment. Furthermore, stations in the mobile service that are permitted to be used either indoors or outdoors may operate up to a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band, and, when operating above a mean e.i.r.p. of 200 mW, these stations shall comply with the following e.i.r.p. elevation angle mask where θ is the angle above the local horizontal plane (of the Earth):

−13 dB(W/MHz) for 0° ≤ θ < 8°

[[5]](#footnote-5) −13 − 0.716(θ − 8) dB(W/MHz) for 8° ≤ θ < 40°

−35.9 − 1.22(θ − 40) dB(W/MHz) for 40° ≤ θ ≤ 45°

[[6]](#footnote-6) −42 dB(W/MHz) for 45° < θ;

4 that administrations may exercise some flexibility in adopting other mitigation techniques, provided that they develop national regulations to meet their obligations to achieve an equivalent level of protection to the EESS (active) and the SRS (active) based on their system characteristics and interference criteria as stated in Recommendation ITU‑R RS.1632;

5 that in the band 5 470-5 725 MHz, stations in the mobile service shall be restricted to a maximum transmitter power of 250 mW2 with a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band;

6 that in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, systems in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

7 that, in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the mitigation measures found in Annex 1 to Recommendation ITU‑R M.1652‑1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems,

invites administrations

to adopt appropriate regulation if they intend to permit the operation of stations in the mobile service using the e.i.r.p. elevation angle mask in *resolves*4, to ensure the equipment is operated in compliance with this mask,

[[7]](#footnote-7)invites ITU‑R

1 to continue studies on mitigation techniques to provide protection of EESS from stations in the mobile service;

2 to continue studies on suitable test methods and procedures for the implementation of dynamic frequency selection, taking into account practical experience.]

## 2/1.16/5.2 For the frequency band 5 250-5 350 MHz band

NOC to RR

## 2/1.16/5.3 For the frequency band 5 350-5 470 MHz band

NOC to RR

## 2/1.16/5.4 For the frequency band 5 725-5 850 MHz

NOC to RR

## 2/1.16/5.5 For the frequency band 5 850-5 925 MHz

NOC to RR

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1. Cisco Systems, Inc., *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015-2020*, 24-25 (3 Feb. 2016), available at <http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.pdf> [↑](#footnote-ref-1)
2. *Id.* at 25. [↑](#footnote-ref-2)
3. ITU Constitution, Article 44, paragraph 1964. [↑](#footnote-ref-3)
4. Document [5A/469](https://www.itu.int/md/R15-WP5A-C-0469/en) Annex 27, M.[RLAN REQ-PAR] Table 1a [↑](#footnote-ref-4)
5. 1 In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented. [↑](#footnote-ref-5)
6. [↑](#footnote-ref-6)
7. [2 Administrations with existing regulations prior to WRC‑03 may exercise some flexibility in determining transmitter power limits.] [↑](#footnote-ref-7)