

United States of America
PROPOSAL FOR THE WORK OF THE CONFERENCE

Agenda Item 1.5: to consider, in accordance with Resolution **736 (WRC-2000)**, regulatory provisions and spectrum requirements for new and additional allocations to the mobile, fixed, Earth exploration-satellite and space research services, and to review the status of the radiolocation service in the frequency range 5 150–5 725 MHz, with a view to upgrading it, taking into account the results of ITU-R studies;

Background Information: At WRC-2000 there were several proposals for items to be placed on the WRC-03 agenda dealing with spectrum in the 5 GHz range. These items included new allocations to the mobile service for Wireless Access Systems (WAS) including Radio Local Area Networks (RLAN) and the fixed service for Fixed Wireless Access (FWA) in Region 3, an additional allocation to the Earth exploration-satellite service (EESS) (active) and space research service (SRS) (active), and an upgrade of the radiolocation allocation in the 5 350–5 650 MHz band.

Technology has evolved to the point where wireless local area networks can be readily and inexpensively deployed to support the businessman or student that is in a campus environment. These devices are becoming widely used in some parts of the world, particularly in North America and Europe. In the United States, for example, WAS devices are permitted to operate on an unlicensed, non-interference basis in the 5 150–5 350 and 5 725–5 825 MHz bands.

Studies show that the presence of outdoor wireless access system transmitters can cause significant interference to spaceborne active sensors that operate in the EESS and SRS. ITU-R studies have also shown that WAS devices will interfere with radiolocation systems that operate in the 5 250–5 725 MHz band, without appropriate interference mitigation mechanisms being applied.

Considerable effort has been focused within the last two years in the ITU-R to determine if sharing is feasible between diverse services such as radiodetermination and WAS including RLAN. Automated interference mitigation systems such as Dynamic Frequency Selection (DFS) have been proposed to enable sharing on a primary basis between WAS including RLANs and the incumbent services. DFS refers to circuitry within the WAS device that measures the level of unwanted received energy and compares this level to a threshold in order to determine if interference sources are present. These measurements are made during “quiet” times, i.e., when WAS traffic is not present. If the level of unwanted received energy exceeds a predetermined threshold level, the WAS system ceases to use the affected channel and moves traffic to another channel that does not have excess levels of unwanted energy.

The risk to incumbent services can be greatly reduced by a) limiting the new mobile allocation to 5 150-5 350 MHz, b) requiring all WAS including RLAN devices to be equipped with DFS with technical specifications that maintain an acceptable interference to noise ratio at the incumbent receivers, and c) including regulatory text in a footnote that requires WAS including RLAN devices to accept interference from and not cause interference to other services. Incorporating these protection methods will enable exploration of new technology to proceed while managing risk to essential services currently in the 5 GHz band. See Resolution [**5GHz_WAS1**].

It should be noted that studies on the effectiveness of interference mitigation mechanisms to protect other services are ongoing in the ITU-R and that no decision on an allocation to the mobile service for use by WAS in the 5 470-5 725 MHz band should be made until these studies are completed and the effectiveness of DFS to protect existing services is demonstrated. See proposed Resolution [5GHz_WAS2].

Concerning FWA in Region 3, preliminary ITU-R studies of radiolocation sharing with FWA have shown that large separation distances or other mitigation techniques such as receiver standards or error-correction coding are required to prevent mutual interference. The band 5 250 – 5 350 MHz, therefore, should not be allocated to the fixed service for the implementation of fixed wireless access systems at this time.

Active microwave sensors on board spacecraft are an increasingly important tool for monitoring the Earth's environment and oceans through the determination of wave height and oceanic currents as well as for radar imaging of the Earth's surface. The need for additional spectrum adjacent to the current international allocation is well documented within the ITU-R for enhanced vertical resolution for spaceborne altimeters and enhanced horizontal resolution for synthetic aperture radars (SARs). Studies and past operational experience has shown that operation of these services in bands allocated to the radiolocation, radionavigation, and aeronautical radionavigation services has proven to be feasible. Therefore allocation of the EESS (active) and the SRS (active) in the 5 460-5 470 MHz band is appropriate.

In regard to additional spectrum allocations for the earth exploration-satellite service (active) and the space research service (active) above 5 470 MHz, the United States has not yet completed its considerations.

WRC-97 first considered the possibility of an allocation-status upgrade for the radiolocation service in the 2 900–3 400 MHz and 5 350–5 650 MHz bands by placing this matter on the draft WRC-2001 Agenda. A need for 600 MHz of additional primary radiolocation spectrum for radiolocation systems has been determined. Changes in technology are driving the need for larger bandwidth in order to be able to pick smaller and less reflective radar targets out of background clutter. Experience and studies have shown that the radiolocation service can successfully share the band 5 350–5 650 MHz with existing services.

With protection of current services in mind, while balancing the need to explore new technologies, the United States proposes the following for agenda item 1.5:

Proposal:

Article 5

Frequency Allocations

5 150-5 350 MHz

		Allocation to services		
		Region 1	Region 2	Region 3
USA/ / 1 MOD	5 150-5 250 ¹	AERONAUTICAL RADIONAVIGATION FIXED-SATELLITE SERVICE (Earth-to-space) 5.447A <u>MOBILE</u> 5.446 5.447 5.447B 5.447C [ADD <u>5.447x</u> <u>5.447y</u>]		
	5 250-5 255	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION SPACE RESEARCH 5.447D <u>MOBILE</u> 5.448 5.448A ADD <u>5.USA3</u>		
USA/ / 3 MOD	5 255- 5 350	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION SPACE RESEARCH (active) <u>MOBILE</u> 5.448 5.448A ADD <u>5.USA3</u>		

Reasons: The deletion of the footnote **5.448A** is justified based on the sharing situation between the EES (active) and the SR (active) services and the radiolocation service in the band 5 250–5 350 MHz. These two services were found to be compatible in ITU-R studies for the band 5 250–5 350 MHz making footnote **5.448A** unnecessary.

A new mobile allocation in the band 5 150-5 350 MHz will facilitate exploration of the use of DFS to enable sharing between WAS including RLANs and the incumbent services with appropriate protection methods as stated in **5.USA3**. Footnote **5.USA3** addresses protection of incumbent services by requiring all WAS including RLAN devices to be equipped with DFS with technical specifications that maintain an interference to noise ratio of –6 dB at the incumbent radiolocation receivers, and regulatory requirements for WAS including RLAN to accept interference from and not cause interference to radiolocation, Earth exploration satellite and space research services.

¹ Additional proposals for the band 5150-5250 are contained in USA proposals for agenda item 1.6 and are reproduced here for information.

5 350-5 725 MHz

Allocation to services		
Region 1	Region 2	Region 3
USA/ / 4 MOD	5 350-5 460 EARTH EXPLORATION-SATELLITE (active) 5.448B- AERONAUTICAL RADIONAVIGATION 5.449 <u>RADIOLOCATION</u> <u>SPACE RESEARCH (active)</u> Radiolocation ADD 5.USA1 ADD 5.USA2	
USA/ / 5 MOD	5 460-5 470 <u>EARTH EXPLORATION-SATELLITE (active)</u> <u>RADIOLOCATION</u> <u>SPACE RESEARCH (active)</u> RADIONAVIGATION 5.449 Radiolocation ADD 5.USA1 ADD 5.USA2	
USA/ / 6 MOD	5 470- 5 570 MARITIME RADIONAVIGATION <u>RADIOLOCATION</u> Radiolocation 5.450 5.451 5.452	
USA/ / 7 MOD	5 570-5 650 MARITIME RADIONAVIGATION <u>RADIOLOCATION</u> Radiolocation 5.450 5.451 5.452	
USA/ / 8 <u>NOC</u>	5 650-5 725 RADIOLOCATION Amateur Space research (deep space) 5.282 5.451 5.453 5.454 5.455	

Reasons: The existing allocation of the band 5 350–5 650 MHz to the radiolocation service on a secondary basis should be upgraded to primary status as studies have shown that the radiolocation service is compatible with existing primary services in this frequency range.

The band 5 350–5 460 MHz should be allocated to the SRS (active) on a primary basis as the sharing situation is identical to that of the previously allocated EESS (active) and this band is needed to make a contiguous allocation for the SRS (active). The band 5 460–5 470 MHz should be allocated to the EESS (active) and the SRS (active) on a primary basis as studies have shown that spaceborne active sensors operating in these services can share the band with the radars operating in the radionavigation and radiolocation services as long as the active sensors meet the design criteria and utilize the mitigation techniques given in Recommendation ITU-R SA.1280. Footnote **5.USA1** is added in order to ensure the protection of these services in their various allocated bands.

The band 5 470–5 725 MHz should not be allocated at this time to the mobile service for the implementation of wireless access systems including RLANs. Further actions in this band should be considered at the next WRC after exploration of the feasibility of DFS in the band 5 250-5 350 MHz. Resolution [**5GHz_WAS2**], attached, provides a sample resolution that could be utilized for further consideration of mobile implementation in the 5 470-5 725 MHz band.

USA/1.6/1 ADD (Shown for information only. See U.S. proposal for agenda item 1.6)

[5.447x *In order to protect the non-GSO MSS feeder links (Earth-to-space) in 5 150-5 250 MHz from interference caused by devices and stations in the fixed and mobile services, the following measures shall be taken:*

- i) these devices shall be limited to a maximum average e.i.r.p. of 23 dBm and a maximum average e.i.r.p. spectral density of 10 dBm in any 1 MHz;*
- ii) these devices shall be limited to indoor applications only;*
- iii) for signals with occupied bandwidths of 1 MHz or less, the e.i.r.p. spectral density, in the occupied bandwidth B in MHz, shall not exceed $10 \text{ dBm} + 10\log_{10}(B)$ (dBm/B MHz);*

Reasons: *To provide reasonable regulatory measures for the protection of MSS feeder links (Earth-to-space) from interference from mobile and fixed transmitters while not unduly burdening the growth of those services.]*

USA/1.6/2 ADD (Shown for information only. See U.S. proposal for agenda item 1.6)

[5.447y *Administrations should take into account the provisions of Recommendation ITU-R S.1426 for the protection of non-GSO MSS feeder links (Earth-to-space) in the 5 150-5 250 MHz band.*

Reasons: *To provide reasonable regulatory measures for the protection of MSS feeder links (Earth-to-space) from interference from mobile and fixed transmitters while not unduly burdening the growth of those services.]*

USA/ / 9 SUP

5.448A

Reasons: There is no technical justification for this footnote that was adopted at WRC-97.

USA/ / 10 SUP

5.448B

Reasons: This footnote is replaced with the new footnote **5.USA1** that clarifies the sharing situation between EESS (active), SRS (active), and the other allocated services in these bands.

USA/ / 11 ADD

5.USA1 The Earth exploration-satellite (active) and space research (active) services operating in the frequency range 5 350-5 470 MHz shall not cause harmful interference to, or claim protection from harmful interference from operations in accordance with **5.449**. Additionally, the Earth exploration-satellite (active) and space research (active) services operating in the frequency range 5 460-5 470

MHz shall not cause harmful interference to the radiolocation service and should take into account Recommendation ITU-R SA.1280.

Reasons: If spaceborne active sensors operating in the EESS (active) and SRS (active) adhere to the design considerations and mitigation techniques found in Recommendation ITU-R SA.1280, the radiolocation, aeronautical radionavigation and radionavigation services (5.449) will be protected from harmful interference and will not be constrained in any manner.

USA/ / 12 ADD

5.USA2 in the frequency band 5 350-5 470 MHz, stations in the radiolocation service shall not cause harmful interference to, or claim protection from stations in the aeronautical-radionavigation service operating in accordance with 5.449.

Reasons: This footnote defines the aeronautical-radionavigation service operations as having priority over the radiolocation service in the 5 350-5 470 MHz band. The radiolocation operations cannot cause interference to aeronautical-radionavigation systems, nor can the radiolocation service claim protection from the aeronautical-radionavigation service operating in accordance with 5.449.

USA/ /13 NOC

5.452 Between 5 600 MHz and 5 650 MHz, ground-based radars used for meteorological purposes are authorized to operate on a basis of equality with stations of the maritime radionavigation service.

Reasons: Many administrations use the band 5 600–5 650 MHz for these meteorological radars and this usage should be preserved.

USA/ / 14 ADD

5.USA3 in the frequency bands 5 250-5 350 MHz, stations in the mobile service shall not cause interference to and must accept interference from stations in the radiolocation, Earth exploration satellite and space research services (active) services. All mobile devices utilizing these bands shall operate only if equipped with an automated interference mitigation technique that meets the minimum standards as defined in Resolution [5GHz_WAS1]. Technical requirements for DFS include adherence to the following criteria:

1. DFS detection threshold of –67 dBm.
2. DFS integration period of less than 1 microsecond.
3. WAS including RLAN channel move time of 10 seconds.
4. WAS including RLAN channel availability check time of 60 seconds.
5. WAS including RLAN channel non-occupancy period of 30 minutes.

Reasons: To provide regulatory measures for the protection of the existing co-primary services from harmful interference from wireless access systems, including RLANs, authorized under the proposed (restricted) mobile allocation.

USA/ / 15 **ADD**

RESOLUTION [5GHz_WAS1] (WRC-03)

MEASURES TO BE TAKEN BY THE MOBILE SERVICE FOR THE OPERATION OF STATIONS IN THE BAND 5 250 – 5 350 MHz

The World Radiocommunication Conference (Geneva, 2003),

considering

- a) The need to provide globally harmonized spectrum to the mobile service for wireless access systems, including RLANs at 5 250-5 350;
- b) the need to protect existing and planned radiodetermination systems in the band 5 250-5 350 MHz;
- c) the need to protect existing and planned Earth exploration-satellite service (active) and space research service (active) in the band 5 250-5 350 MHz;
- d) that studies have shown that sharing between these services is only possible with the application of mitigation techniques such as Dynamic Frequency Selection (DFS);
- e) Other mitigation techniques may provide sharing approaches which would need to be examined by administrations to determine if adequate protection is afforded to radiodetermination and Earth exploration-satellite service (active) and space research service (active),

noting

- a) that administrations may already allow operations for mobile devices in portions of the 5 150-5 350 and 5 470-5 725 MHz bands;
- b) the need for administrations to develop acceptance testing of devices employing DFS to ensure these devices meet the required operational characteristics,

resolves

- 1) that the mitigation measures found in Annex 1 shall be utilized by devices in the mobile service operating in the 5 250-5 350 MHz band and using for the example the approach in Annex 2;

2) that mobile devices operating in the 5 250-5 350 MHz band shall have the following technical characteristics - Indoor/outdoor operations with peak transmit power of 250 mW or 11 dBm + 10xlogB (where B=26 dB emission bandwidth in MHz) and a maximum average e.i.r.p of 30 dB or 17 dBm in any 1 MHz). For signals with occupied bandwidths of 1 MHz or less, the e.i.r.p. spectral density, in the occupied bandwidth B in MHz, shall not exceed 17 dBm + 10log₁₀(B) (dBm/B MHz).

ANNEX 1 TO RESOLUTION [5GHz_WAS1] (WRC-03)

The use of dynamic frequency selection (DFS) in wireless access systems including RLANs for the purpose of protecting the radiodetermination service in the 5 250–5 350 MHz Band

Scope of this Annex

In order to ensure protection radiodetermination and EES/SR (active) services specific technical mitigation techniques are required. Mobile systems in the 5 250-5 350 MHz band will employ DFS. An example of how a DFS mechanism could be described is given in Annex 2.

The specific technical implementation of radar detection mechanisms and procedures used by WAS are outside the scope of this annex. The main reasons for this are that:

- a) WAS design affects implementation;
- b) practical experience may lead to innovative and more efficient means than can be formulated today;
- c) different manufacturers may make different implementation choices to achieve the lowest cost for a given level of performance; therefore only performance criteria rather than specifications for a particular mechanism should be given in regulatory documents.

Objective of the use of DFS with respect to radars

The objective of using DFS in WAS is to protect radiodetermination service operations in the 5 GHz band. This is achieved by avoiding the use of or vacating a channel identified as being occupied by radar equipment based on detection of radar signals.

DFS Performance Requirements

The DFS performance requirement is stated in terms of response to detection of an interference signal. 5 GHz WAS shall meet the following detection and response requirements listed below.

Procedures for compliance verification should be incorporated in relevant industry standards for RLANS.

Detection Requirement

The DFS mechanism shall be able to detect interference signals above a minimum threshold. Radar signal detection criteria as specified below:

1 Detection Criteria

- the received signal strength (RSS) shall be greater than a DFS detection threshold level of -67 dBm within the WAS channel bandwidth averaged over a period of less than 1 μ s;
- pulse repetition rates in the range 200-400 pulses per second;
- nominal pulse widths in the range 1-100 μ s.

2 Behavioral Criteria

The following table provides values for the specified parameters associated with the behavior of WAS. The operating procedures and the definition of these parameters are given in the Annex 2.

Parameter	Value
DFS Detection Threshold	-67 dBm
Channel Availability Check time	60 sec prior to use of channel
Non-occupancy Period	30 min
Channel Move Time	10 sec

Response Requirement

If the WAS has not previously been in operation, it shall not start transmission in any channel where the detection mechanism has determined that there is a radar signal present.

NOTE – For WAS to resume operation on another channel in a coordinated fashion, some communication is required between the devices making up the WAS. Thus, operational traffic can be stopped very quickly upon detection of the radar signal, but some intermittent control traffic will be needed after that.

ANNEX 2 TO RESOLUTION [5GHz_WAS1] (WRC-03)

Example radar detection and associated DFS procedures

The purpose of this annex is to describe how a WAS *could* implement radar detection and the associated procedures for clearing a channel so as to avoid interfering with a radar system. The actual

operation may vary with the type of WAS and with the actual design of a specific RLAN implementation, however, the general definitions and rules described in this annex should be followed. The description is given in terms of a set of *definitions* and *rules*.

1 Definitions

The following definitions are given for use within this document:

Available Channel	A radio channel on which a <i>Channel Availability Check</i> has not identified the presence of a radar.
Channel Availability Check	A check during which the WAS listens on a particular radio channel to identify whether there is a radar operating on that radio channel.
In-Service Monitoring	Monitoring of the <i>Operating Channel</i> to check that a co-channel radar has not moved or started operation within range of the WAS.
Received Radar Signal	A signal as defined in Section 1 of Appendix 2. This definition contains parameters for the received signal strength (field strength) threshold, pulse duration and pulse repetition rate.
Operating Channel	Once a WAS starts to operate on an <i>Available Channel</i> then that channel becomes the <i>Operating Channel</i> .
Channel Move Time	The time needed by a WAS to cease all transmissions on the <i>Operating Channel</i> upon detection of an interfering signal above the DFS detection threshold. Transmissions during this period will consist of intermittent management and control signals required to facilitate vacating the <i>Operating Channel</i> .
DFS Detection Threshold	The required detection level defined by detecting a received signal strength (RSS) that is greater than a threshold specified, within the WAS channel bandwidth.
Non-Occupancy Period	The required period in which, once a channel has been recognized as containing a radar signal by a WAS, the channel will not be selected as an available channel.

2 Procedures

2.1 Finding an initial Available Channel

Before operating a WAS station must identify at least one *Available Channel*. Having identified an *Available Channel*, the WAS can start operation on that channel; the checking of other radio channels to identify other *Available Channels* is optional.

2.2 Starting Operation

Once a WAS starts to operate on an *Available Channel* then that channel becomes the *Operating Channel*.

2.3 Monitoring the Operating Channel

In-Service Monitoring is performed by the WAS to re-check the *Operating Channel* for co-channel radar signals that may have come within range of the WAS or started operation on the *Operating Channel* WAS transmits, and if no *Available Channel* has yet been identified, it shall undertake a *Channel Availability Check* on a radio channel before it is used for transmission. Consequently, when a network is installed and first powered on, *Channel Availability Check(s)* should be undertaken.

3 Implementation Aspects

WAS should incorporate the following mechanisms in order to fulfill radar interference mitigation:

- Means to perform the detection of signals that meet the specifications in this Resolution.
- Means to inform the associated stations of the WAS of the presence of a radar and/or change of status of the *Operating Channel* and of the status of other Channels.

3.1 Radar Signal Detection

Radar signals may occur at any time and they may occur in the presence of co-channel WAS signals. While finding an initial *Available Channel*, the WAS will not be operational and this will assure rapid and reliable detection of any radar signal with the possible exception of very slowly rotating radars. However, these will be detected by the *In-Service Monitoring*.

During *In-Service Monitoring* the radar detection function continuously searches for radar signal patterns - during or in between normal WAS transmissions by averaging detected power over a period of less than 1 μ s. For weak received radar signals, this may increase the time needed for radar signal detection. This is reflected in the criteria in this Resolution. Once a radar has been detected on a particular channel it will be marked for the *Non-occupancy Period* to ensure that an existing radar has not changed operational mode giving a false indication that the channel is available.

3.2 Channel Move Time

Every WAS has at least one device - e.g. an Access Point - that plays a coordinating role. This device also has the responsibility to coordinate, after a radar presence has been detected, the cessation of use of the *Operating Channel* and the move to an *Available Channel*.

Such coordination requires the broadcasting of commands to cease all operational transmission and to affect a move to (one of) the *Available Channels* identified by the *Channel Availability Check*. This broadcast will be repeated a number of times to assure reception by all member devices. Part of the RLAN population may be in so-called **Sleep Mode** in which the devices re-awaken at intervals of typically hundreds of milliseconds but extremes of up to 60 seconds are possible. Disregarding the

latter, the broadcast has to be repeated a number of times during the *Channel Move Time* to assure that for all practical purposes, all of the RLAN devices will have left the channel.

USA/ / 16 ADD

RESOLUTION [5GHz_WAS2] (WRC-03)

CONSIDERATION BY A FUTURE COMPETENT WORLD RADIOCOMMUNICATION CONFERENCE CONCERNING AN ALLOCATION TO THE MOBILE SERVICE IN THE BAND 5 470–5 725 MHz

The World Radiocommunication Conference (Geneva, 2003),

considering

- a) The need to provide globally harmonized spectrum to the mobile service for wireless access systems, including RLANs at 5 470-5 725 MHz;
- b) the need to protect existing and planned radiodetermination systems in the band 5 470-5 725 MHz
- c) that studies have shown that sharing between services in the 5 470-5 725 MHz is only possible with the application of mitigation techniques such as Dynamic Frequency Selection (DFS);
- d) that in the future, other mitigation techniques may provide sharing approaches which will need to be examined to determine if adequate protection is afforded to other services,

noting

administrations may already allow operations for mobile devices in portions of the 5 470-5 725 MHz band;

resolves

that based on proposals from administrations and taking into account the results of continued studies in ITU and the Conference Preparatory Meeting, WRC-[07] should consider:

- 1 allocation of frequencies to the mobile service in the band 5 470-5 725 MHz for the implementation of wireless access systems including RLANs;
- 2 adoption of necessary provisions for wireless access systems including RLANs to protect other services in the 5 470-5 725 MHz band;

Invites ITU-R

to continue, and complete in time for WRC-[07], the appropriate studies leading to technical and operational recommendations to facilitate sharing between wireless access systems including RLANs and other services.
