**Explanatory paper[[1]](#footnote-1) related to RLAN equipment using the 5 GHz bands in vehicles, including the usage under the non-specific SRD regulation**

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CEPT/ECC has considered the possibilities for the usage of Radio LAN equipment in the 5 GHz range on-board aircraft, in vehicles (passenger cars, lorries, buses) and in trains.

# Introduction

The current spectrum regulations for WAS/RLAN in the 5 GHz range on ITU, CEPT and EU levels do not directly address the usage of 5 GHz RLAN in vehicles (cars, etc.). The usage of 5 GHz RLAN on-board aircraft is addressed e.g. on CEPT level (see regulation as per ECC Decision (04)08 and information in ECC Report 140).

To avoid a grey area and possible misinterpretations of the regulation, the aim of this explanatory paper is to clarify the usage possibilities for RLAN in the 5 GHz range for the operation in moving vehicles based on the regulation which is already in force (ECC Decision (04)08) of 9th July 2004, latest amendment of 30th October 2009).

This ECC Decision designates the bands 5150-5350 MHz and 5470-5725 MHz for WAS/RLAN. In particular, it has to be underlined that within the frequency band 5150-5350 MHz an indoor restriction applies and that, for spectrum usage above 5250 MHz, a requirement for DFS (Dynamic Frequency Selection) applies to ensure protection of radiodetermination systems.

ECC/DEC/(04)08 defines that indoor use is intended to mean inside a permanent domestic or commercial building which will typically provide the necessary attenuation to facilitate sharing with other services. Use of RLAN inside an aircraft is also considered to be an indoor use, due to the strong attenuation offered by the fuselage of the aircraft, their operational conditions, and taking account of the fact that the installation and use of RLAN equipment on-board an aircraft is regulated by administrations due to the specific certification required from the relevant aviation authorities.

EC Decision 2005/513/EC (amended by EC Decision 2007/90/EC) defines: ‘indoor use’ shall mean use inside a building, including places assimilated thereto such as an aircraft, in which the shielding will typically provide the necessary attenuation to facilitate sharing with other services.

Both definitions for ‘indoor’ are not very clear with regard to RLAN usage in vehicles other than aircraft.

With regard to the WAS/RLAN band 5150-5250 MHz, it is noted that the FCC removed in 2014 the requirement for an indoor restriction in the USA.

The frequency band 5725 MHz to 5875 MHz (25 mW e.i.r.p.) is available for non-specific SRD on a harmonised basis on CEPT (ERC Recommendation 70-03, Annex 1) and on EU level (latest amendment of EC Decision 2006/771/EC on SRD). It provides a quite large frequency band (150 MHz), no duty cycle restriction and a reasonable transmit power of 25 mW e.i.r.p. vs. propagation for the foreseen operations.

# On board aircraft

In this context it was confirmed by aircraft manufacturers and equippers that RLAN access points operating in the frequency band 5725 MHz to 5875 MHz can be operated at low power levels (25 mW).

Taking into account the dimensions of aircraft cabins and the number of passengers (absorption), it does not seem unreasonable to assume that 25 mW e.i.r.p. could also be sufficient for RLAN access points operating in the band 5150-5250 MHz or in the band 5725-5875 MHz in other vehicles.

# In cars

Usage in cars has already been discussed in other bands for UWB equipment and some measurements were carried out a few years ago in order to qualify the car screening attenuation noting that the result of this campaign are included in ECC Report 170. In most cases, there is, in the frequency range from 3-6 GHz and 6-9 GHz, a mean attenuation which is comparable to the indoor/outdoor attenuation (about 12 dB). However, the results also show that the attenuation is variable depending on the location of the equipment in the car and can vary from 2 dB to 37 dB in the range 3.4-4.8 GHz and from 4 dB to 37 dB in the range 6-9 GHz. It is mentioned that compatibility studies between RLAN and EESS (active) which were performed in 2003 assumed an average attenuation of 17 dB to ensure an appropriate protection of EESS (active systems) in the 5250-5350 MHz band.

It can also be assumed that RLAN use inside passenger cars is possible in the band 5150-5250 MHz when operating at a maximum e.i.r.p. of 25 mW. With this power restriction, even at minimum attenuation (e.g. 3 dB) from inside the car to the outside, the resulting e.i.r.p. towards the other systems operating in the band is not more than the e.i.r.p. resulting from RLAN operating within buildings with 12 dB average building attenuation as assumed in 2003. In practice, the attenuation from inside the car to the outside is expected to be higher and the car manufacturer can realise higher attenuation for pre-installed RLAN by choosing an appropriate system configuration. Therefore the necessary attenuation to facilitate sharing is provided.

# In trains

Measurements for determining the attenuation of a German long-distance high-speed train (ICE 4) in the 5 GHz frequency range show that the carriage attenuation (between the internal and external areas of the train) is in the range between 21 and 41 dB. It can be assumed that these measurement results are representative for similar trains with metal coated windows. Therefore, RLAN use within types of trains is considered as indoor operation. Inside other types of trains the operation of RLAN in the band 5150-5250 MHz may also be possible but railway operators are requested to provide evidence that there is sufficient attenuation from the inside to the outside of trains.

# DFS above 5250 MHz

Regarding DFS, the main purpose of CAC is to detect rotating stationary radars but this CAC function assumes the RLAN’s position towards the radar doesn’t change during the CAC time. The In-Service Monitoring was added to the DFS function to cover scenarios for which the CAC function would have failed detecting a radar, e.g. when a radar starts operating after the RLAN uses the corresponding channel or to detect certain mobile radars. It may hence also function when the RLAN is moving but further study would be required to verify whether the In-Service Monitoring function can on its own allow reliable radar detection in certain vehicle use scenarios.

It should be mentioned that studies on the compatibility between RLAN on-board aircraft and radars (military and meteorological) in the bands 5250-5350 MHz and 5470-5725 MHz were already performed in ECC, leading to the adoption of ECC Report 140 (May 2010). This ECC Report concludes that “*RLAN on-board aircraft compatibility with military radars, in these bands is theoretically feasible but should be carefully considered, in the light of the mobile nature of the aircraft. Detection of some specific military radar signals by DFS cannot be ensured. In addition, in some specific scenarios, this may lead to a reduction of the ability of a military radar to identify the required target.*” With regard to meteorological radars, ECC Report 140 concludes that “*when implementing RLAN on board aircraft the aviation industry must avoid the use of the band 5600-5650 MHz*”. It should be noted that ECC Report 140 was not aimed at leading to an amendment of the spectrum regulation for WAS/RLAN (ECC Decision (04)08) but only at providing additional elements pertaining to the RLAN use on-board aircraft.

On a more general basis, this highlights the fact that the protection of meteorological radars (5600-5650 MHz) is challenging for RLAN on-board of vehicles due to the specific protection requirements of these radars, and in particular the need for a Channel Availability Check (CAC) of 10 minutes. The ‘Off-channel CAC’ takes even much longer and hence can certainly not be used as an alternative to a 10 minutes CAC by RLAN on the move. The validity of available channels (as result of a CAC) can also be questioned for RLAN on the move.

# Conclusion

In the light of all available information and in addition to the 2400-2483.5 MHz band, CEPT/ECC has concluded that the existing regulation for non-specific SRD according to Annex 1 (band “j”) to ERC/REC 70-03 appears to be an appropriate way forward for operation of RLAN equipment in vehicles. The introduction in ERC Recommendation 70-03 already explains that ‘The CEPT has considered the use of SRD devices on-board aircraft and it has concluded that, from the CEPT regulatory perspective, such use is allowed under the same conditions provided in the relevant Annex of Recommendation 70-03.’ Additional clarification is provided with a note in the introduction to ERC/REC 70-03.

In addition, it has been noted that technology and equipment already exist due to the fact that CEPT SRD regulation within 5725-5875 MHz overlaps with the U-NII-3 regulation (up to 5825 MHz (centre frequency)) which is implemented in particular in USA, China, Korea and some other countries. However, it is not known whether up to now a European mode has been implemented in the RLAN user equipment such as Smartphones, Tablets etc. which would enable channels 149 to 165 (centre frequencies from 5745 to 5825 MHz) for operation at maximum 25 mW e.i.r.p.

It should also be taken into account that ECC Report 277 investigates the use of SRD applications in the band 5725-5875 MHz in cars equipped with 5.8 GHz road toll equipment, WAS/RLAN use in cars based on the 5.8 GHz SRD regulation (max. 25 mW), as well as co-channel ITS communications (5855-5875 MHz). The aim of this Report is to investigate under the existing regulations potential problems when having all these applications implemented in the same car within close proximity to each other.

Furthermore, CEPT has concluded that RLAN use inside cars (passenger cars, lorries, buses) in the band 5150-5250 MHz is allowed at a maximum e.i.r.p. of 25 mW as this power restriction results in at least an equivalent attenuation as foreseen for RLAN operation inside buildings and therefore the necessary attenuation to facilitate sharing is provided.

CEPT has also concluded that RLAN use within trains with metal coated windows can be considered as indoor operation and therefore the operation of RLAN within those types of trains in the band 5150-5250 MHz is possible.

The following table shows which frequency bands are possible for a RLAN usage according to the spectrum regulations in force and by taking into account the considerations as described above (“ok” means the band may be used):

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency band** | **On-board aircraft** | **In cars (passenger cars, lorries, buses)** | **In trains** |
| 2400 - 2483.5 MHz | **Ok** | **Ok** | **Ok** |
| 5150 - 5250 MHz | **Ok** | **Ok,** Note 6 | **Ok**, Note 4 |
| 5250 - 5350 MHz | Note 5 | Note 1, Note 2 | Note 1 |
| 5470 - 5725 MHz | Note 5 | Note 1 | Note 1 |
| 5725 - 5875 MHz | **Ok** | **Ok**, Note 3 | **Ok** |
| **Summary of spectrum:** | **333.50 MHz** | **333.50 MHz** | **333.50 MHz** |
| Remarks:**Note 1**: RLAN operation while in motion may not allow a proper application of the DFS mechanism. If the bands 5250-5350 MHz and 5470-5725 MHz were envisaged in the future for the ”cars” and ”trains” cases, DFS efficiency to ensure protection of radiodetermination systems would need to be clarified on European level.**Note 2**: Not possible with 200 mW e.i.r.p. because of indoor restriction.**Note 3**: See ECC Report 277 and its conclusions.**Note 4:** Possible for trains with metal coated windows. Possible also for other types of trains if railway operators provide additional information providing evidence that there is sufficient attenuation from the inside to the outside of trains.**Note 5**: See ECC Report 140 and its conclusions.**Note 6:** Possible if the maximum e.i.r.p. is limited to 25 mW. With this power restriction the attenuation from inside the car to the outside is equivalent to RLAN operating inside buildings and therefore the necessary attenuation to facilitate sharing is provided.  |

1. ERC Recommendation 70-03 refers to this explanatory paper in the introduction [↑](#footnote-ref-1)