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Electronic Communications Committee

CEPT Report 73

Report from CEPT to the European Commission in response to the Mandate

"to study feasibility and identify harmonised technical conditions for Wireless Access Systems including Radio Local Area Networks in the 5925-6425 MHz band for the provision of wireless broadband services"

Report A: Assessment and study of compatibility and coexistence scenarios for WAS/RLANs in the band 5925-6425 MHz

Report approved on 6 March 2020 by the ECC

0 EXECUTIVE SUMMARY

This CEPT Report contains summaries of technical studies and assessment of coexistence scenarios for Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) systems with incumbent systems in the 5925-6425 MHz band and adjacent bands, in response to Task 1 of the Mandate from the European Commission to CEPT (see Annex 1).

ECC Report 302 [1] studied the coexistence scenarios between WAS/RLAN and the incumbent usages: Fixed Service (FS), Fixed-Satellite Service (FSS), Radio astronomy (RAS) and Ultra Wideband (ÚWB), as well as Road Intelligent Transport Systems (ITS) and Communication Based Train Control (CBTC). The studies considered various WAS/RLAN scenarios with power up to 1 W e.i.r.p., indoor and outdoor devices, and also scenarios that assumed indoor only usage. Guidance is provided in ECC Report 302 on performing compatibility studies between WAS/RLAN and specific radio astronomy sites.

According to studies conducted so far, CEPT expects that coexistence between WAS/RLAN with existing services and systems within and adjacent to the band 5925-6425 MHz would be technically feasible under certain conditions.

For scenarios with indoor only WAS/RLAN deployment with a maximum e.i.r.p. in the range of 200-250 mW, the studies indicated that coexistence was feasible with FS when considering the long-term aggregated interference protection criterion and with FSS.

The studies indicated that coexistence with CBTC systems and Road-ITS would be technically feasible assuming suitable measures such as a guard-band and requirements on WAS/RLAN in band and/or out-of-band emissions. These elements would limit the available spectrum to WAS/RLAN to less than the entire 5925-6425 MHz band.

Complementary studies and analyses have been initiated as part of the work associated with CEPT Report B (Task 2). These studies address FS short-term protection between point-to-point applications and WAS/RLAN indoor only deployments as well as potential WAS/RLAN portable devices that operate outdoor with power levels significantly lower than that for indoor use.

In addition, future investigations may include innovative sharing solutions for geographical protection of incumbent systems.

High power WAS/RLAN devices and outdoor WAS/RLAN devices other than those mentioned in the paragraph above could present a risk of harmful interference to the Fixed Service , Fixed-Satellite Service, Communication based train control systems and Road Intelligent Transport System incumbents when sharing the band without restrictions.

Based on this risk of interference, the feasibility of outdoor WAS/RLAN deployment and high-power WAS/RLAN access points (APs) would require additional studies to address the interference to the incumbent systems, and any additional work to address the feasibility of these deployments could be studied further under a separate ECC deliverable.

At its 50th Plenary, ECC adopted CEPT Report 71 [12], which has been provided to the Commission. The ECC also endorsed its Working Group Frequency Management to start the review of ECC Decision (08)01 [13] on ITS, this includes consideration on CBTC.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
AP	Access Point
BEL	Building Entry Loss
BFWA	Broadband Fixed Wireless Access
CBTC	Communication-based Train Control
CENELEC	European Committee for Electrotechnical Standardization
CEPT	European Conference of Postal and Telecommunications Administrations
CISPR	Comité international spécial des perturbations radioélectriques
DA2GC	Direct Air to Ground Component
EC	European Commission
ECA	European Common Allocation
ECC	Electronic Communications Committee
ECO	European Communications Office
EFIS	ECO Frequency Information System
e.i.r.p.	Effective isotropic radiated power
ERC	European Radiocommunications Committee
ESV	Earth Stations on-board Vessels
ETSI	European Telecommunications Standards Institute
EU	European Union
FDP	Fractional Degradation in Performance
FS	Fixed Service
FSS	Fixed-Satellite Service
I/N	Interference to noise ratio
ISM	Industrial, Scientific and Medical
ITS	Intelligent Transport System
ITU	International Telecommunication Union
MBR	Maritime Broadband Radio
MERLIN	Multi-Element Radio-Linked Interferometer Network
MCL	Minimum Coupling Loss
LPR	Level Probing Radar
OoB	Out-of-band
RAS	Radio Astronomy Service
RLAN	Radio Local Area Network
SRD	Short Range Devices
TLPR	Tank Level Probing Radar
UWB	Ultra Wideband
UK	United Kingdom
VLBI	Very long baseline interferometry
WAS	Wireless Access System
WIA	Wireless Industrial Applications

1 INTRODUCTION

This CEPT Report intends to respond to Task 1 (Assessment and study of compatibility and coexistence scenarios in the band 5925-6425 MHz) of the EC Mandate on WAS/RLAN in the 5925-6425 MHz band (see Annex 1).

The detailed coexistence studies, including technical parameters, which are the basis for this CEPT Report and later the CEPT Report on Task 2 (Development of harmonised technical conditions) of the Mandate, are provided in ECC Report 302 [1].

ECC Report 302 contains summaries of technical studies and assessment of coexistence scenarios for WAS/RLANs and analyses the coexistence of WAS/RLAN systems with incumbent systems in the 5925-6425 MHz band and adjacent bands. This CEPT Report draws some conclusions on those technical studies and provides an assessment of the technical studies and the feasibility of some of the regulatory models that could be implemented for WAS/RLAN in the 5925-6425 MHz band.

2 ALLOCATIONS AND APPLICATIONS IN THE BAND 5925-6425 MHZ AND ADJACENT BANDS

Information contained in this Report reflects upon the current status and usage in the band as drawn from a number of CEPT sources. In addition, a questionnaire was conducted in February 2018 [2] which asked CEPT administrations on detail of the fixed link usage in the band, along with any other usage in the range that might be worthy of noting.

Table 1 below provides an extract of the European Common Allocation (ECA) Table (ERC Report 25 [3]) in the 5925-6700 MHz band. In the first column it shows that the ITU Radio Regulations contain among others a primary mobile service allocation in Region 1 for this band.

Table 1: European Common Allocation Table for the frequency band 5925-6700 MHz

RR Region 1 Allocation and Footnotes applicable to CEPT	European Common Allocations and ECA Footnotes	ECC/ERC harmonisation measure	Applications	Standards	Notes
FIXED 5.457 FIXED-SATELLITE (EARTH-TO-SPACE) 5.457A 5.457B MOBILE 5.457C 5.149 5.440 5.458	FIXED FIXED-SATELLITE (EARTH-TO-SPACE) MOBILE Earth Exploration-Satellite (passive) 5.149 5.440 5.458	ECC/DEC/(05)09	ESV	EN 301 447	Within the band 5925-6425 MHz
		ECC/DEC/(05)09	FSS Earth Stations	EN 301 443	Priority for civil networks
		ECC/REC/(14)06 ERC/REC 14-01 ERC/REC 14-02	Fixed	EN 302 217	Point-to-point
			Passive sensors (satellite)		For sea surface temperature, sea surface wind speed and soil moisture measurements
			Radio astronomy		Spectral line observations (e.g. methanol line), VLBI
		ECC/DEC/(11)02 ERC/REC 70-03	Radiodetermination applications	EN 302 372 EN 302 729	Within the band 4500-7000 MHz for TLPR application and 6000-8500 MHz for LPR applications
		ECC/DEC/(06)04 ECC/DEC/(12)03	UWB applications	EN 302 065	Generic UWB as well as UWB on-board aircraft regulation within the band 6.0 8.5 GHz

According to the ECO Frequency Information System (EFIS, www.efis.dk), sixteen CEPT administrations have a primary mobile allocation and two CEPT administrations have a secondary mobile allocation in this band.

The text of the footnotes of the ITU Radio Regulations can be found in the ECA Table https://www.efis.dk/views2/compare-allocations.jsp.

The frequency band 6650.0-6675.2 MHz is important for observations of methanol (CH_3OH). This transition of methanol is a very powerful cosmic maser found exclusively in regions where massive stars form. It is widely observed in Europe using single dishes, Multi-Element Radio-Linked Interferometer Network (MERLIN) interferometry and very long baseline interferometry (VLBI).

Table 2 is an extract of the ECA Table for the frequency band 5850-5925 MHz. In addition to the services/applications in Table 2, the deployment of other services/applications in adjacent bands, including Communication Based Train Control (CBTC), in individual CEPT administrations have to be protected on a national basis.

Table 2: European Common Allocation Table for the frequency band 5850-5925 MHz

RR Region 1 Allocation and footnotes applicable to CEPT	European Common Allocation and ECA Footnotes	ECC/ERC harmonisation measure	Applications	Standards	Notes
FIXED FIXED-SATELLITE (EARTH-TO-SPACE) MOBILE 5.150	FIXED FIXED-SATELLITE (EARTH-TO-SPACE) MOBILE 5.150	ECC/REC/(06)04	BFWA	EN 302 502	Within the band 5725-5875 MHz
		ECC/DEC/(15)03	DA2GC	EN 303 316 EN 303 339	Within the band 5855-5875 MHz
			FSS Earth Stations	EN 301 443	Priority for civil networks
			ISM		Within the band 5725-5875 MHz
		ECC/DEC/(08)01 ECC/REC/(08)01 ERC/REC 70-03	ITS	EN 302 571	Within the bands 5875-5925 MHz and 5855-5875 MHz. Traffic safety applications within the band 5875-5905 MHz
		ECC/REC/(17)03	MBR	EN 303 276	Within 5852-5872 MHz and 5880-5900 MHz

RR Region 1 Allocation and footnotes applicable to CEPT	European Common Allocation and ECA Footnotes	ECC/ERC harmonisation measure	Applications	Standards	Notes
		ERC/REC 70-03	Non-specific SRDs	EN 300 440	Within the band 5725-5875 MHz
		ERC/REC 70-03	Radiodetermination applications	EN 302 372	Within the band 4500-7000 MHz for TLPR application
		ERC/REC 70-03	WIA	EN 303 258	Within the band 5725-5875 MHz
Note 1: Whilst correctly not documented in the current version of the ECA table, EN 55011 [14] is published by CENELEC and is based upon CISPR 11. EN 55011 contains technical details for ISM operation in several bands, including 5725-5875 MHz.					

3 COEXISTENCE SCENARIOS

3.1 FIXED SERVICE SHARING ANALYSES

Fixed Service (FS) point-to-point system characteristics and typical deployment studied are contained in Tables 17 and 18 of Section 4.1.1 of ECC Report 302 [1].

Some administrations may also be considering the use of narrowband FS systems (according to ECC Recommendation 14(06) [8]) in portions of the present frequency range. Considering that these systems were not developed yet and therefore had no agreed system characteristics, narrowband FS systems were not taken into account. Additional information on these FS systems is contained in section 4.1.2 of ECC Report 302.

3.1.1 Considered WAS/RLAN deployment

The agreed characteristics, deployment scenarios and other relevant information on WAS/RLAN operating in the 5925-6425 MHz frequency range are contained in the technical studies of ECC Report 302.

3.1.2 Summary of studies conducted

In order to investigate sharing potential between WAS/RLAN and FS, both Minimum Coupling Loss (MCL) and Monte Carlo analyses were performed. Two protection criteria were used for these studies; I/N –10 dB and I/N -20 dB. Initially -20 dB was examined as the proposed WAS/RLAN usage is presumed for short range devices (SRD), which would be considered alongside primary services meaning the SRD use would be considered as secondary service and subject to be required to meet an I/N of -20 dB. However, unlike the 5 GHz, the 6 GHz band has a co-primary mobile allocation and the WAS/RLAN usage could be considered as an application of this co-primary service. In this case the correct criterion for sharing is I/N = -10 dB. Both criteria were studied, but the -10 dB result is used for consideration for technical and regulatory measures.

In the first study (A), based on an MCL approach, two different types of areas have been identified where a single WAS/RLAN could possibly exceed the protection criterion: a circular area which has a relatively small radius and a peak area which has a relatively large extent down the boresight. This keyhole shaped area is due to the FS antenna pattern (see Recommendation ITU-R F.699 [5]).

Sensitivity analyses have taken into account different WAS/RLAN e.i.r.p. density levels, indoor and outdoor deployments, population density types, FS and WAS/RLAN antenna heights, FS antenna gains and building types. The short term interference was not assessed in this study.

For the long term protection threshold $I/N = -10$ dB, which relates to co-primary status for mobile service as given in the ECA Table, the range of required separation distances has been calculated:

- Circle distances are found to be varying from 43 m to 4017 m, peak distances are found to be varying from 48 m to 40400 m.

For the long term protection threshold $I/N = -20$ dB, which relates to the systems that do not have a co-primary status, the range of required separation distances has been calculated:

- Circle distances are found to be varying from 72 m to 4017 m, peak distances are found to be varying from 103 m to 47100 m.

Sensitivity analyses showed that reduction of the power density level or limitation to indoor use are examples of measures that can be taken to reduce the calculated separation distances.

MCL calculations have revealed critical scenarios but did not allow final conclusions to be made about the statistical likelihood of occurrence of these scenarios. Therefore, a statistical approach based on Monte Carlo studies was carried out.

A second study (B) looking at providing results for a statistical approach, analysed the publicly available population of fixed links in United Kingdom (UK) and the Netherlands. The results of this Monte Carlo study show that the long-term interference criterion is met ($I/N = -10$ dB not exceeded for more than 20% of time). Furthermore, Fractional Degradation in Performance (FDP) was assessed in study B; the results show that although the FDP < 10%, which is a complementary protection criterion, was exceeded for some of the links studied in the UK, some of the scenarios seemed to be caused by interference events that were highly improbable, but may occur as a result of the parameters of the Monte Carlo simulations that were carried out. It is assumed that these situations would be unlikely to occur. However, if only indoor deployment with a maximum e.i.r.p. of 200 mW is considered, the studies showed that all but 2 cases of FDP exceedances were resolved. Under those conditions, the study considered sharing to be feasible.

A third study (C) assessed two sets of complementary simulations based on three existing FS receivers in France. First, an interference coverage mapping approach studied the geographical area from where a WAS/RLAN (indoor 250 mW and outdoor 1 W) would exceed the interference threshold of $I/N = -10$ dB. It indicated that allowing outdoor WAS/RLAN operating with an e.i.r.p. of 1 W would create interference from a large area around the FS link, depending on the terrain profile. However, when restricting the usage to indoor only utilizing an e.i.r.p. up to 250 mW, the possible interfering area is substantially reduced, bringing the interference area within close proximity to the FS receiver. These simulations also showed that when WAS/RLANs are within close proximity of some FS receivers, the short term protection threshold of 19 dB is exceeded (even in the indoor case). In terms of time percentage, this appears to be more critical compared with the long term protection criterion. Indeed, considering the WAS/RLAN 2% RF activity factor, the short term protection threshold for an access point situated within this area will be exceeded more than the $4.5 \cdot 10^{-4}$% tolerated value, given that the conditions modelled in the static analysis persist over time. A complementary statistical study based on a Monte Carlo approach, using the WAS/RLAN parameters distributions described in ECC Report 302, indicated that the I/N value of -10 dB was not exceeded for more than 20% of the time as advised by Recommendation ITU-R F.758 [4] for the long-term protection criterion. The short term protection criterion was exceeded for two of the three studied links; the number of iterations performed in the study did not allow the assessment of the short term protection criterion for the third studied link. Looking at the critical area of the results from both the Monte Carlo analysis and the interference coverage map, it is believed that the cases where the I/N threshold is exceeded are due to high power outdoor usage or in a rare event of indoor usage with small Building Entry Loss (BEL) situated within the main beam of the FS station.

Both MCL and Monte Carlo studies applied only far-field antenna radiation patterns without taking into account any near-field effects.

3.1.3 Risk of interference and possible regulatory models for the implementation of WAS/RLAN

Based on the results of studies, sharing between the FS and WAS/RLAN is feasible with appropriate technical conditions and regulatory models. Some studies performed showed that interference occurs. This assumed co-location of intended deployment of fixed outdoor WAS/RLAN access points (APs) and deployment of the FS. This interference can be addressed by further regulatory restrictions (e.g. determining the geographic location and limiting density of fixed WAS/RLAN APs operating outdoors).

In order to reduce the risk of interference to FS from WAS/RLAN devices that maybe operating under a general authorisation, some additional techniques/restrictions may need to be applied in order to maintain the indoor WAS/RLAN usage or to mitigate the effects in cases of accidental WAS/RLAN outdoor use. Therefore, high-power indoor and outdoor deployments may require additional technical and or regulatory solutions like databases used for coordination, in particular, a geo-location method that aims at detecting a spatial closeness between victim and interferer. Low-power indoor WAS/RLAN access points and very low power portable devices that can operate outdoors could coexist with FS.

3.2 FIXED-SATELLITE SERVICE SHARING ANALYSES

Fixed-Satellite Service (FSS) Earth-to-space transmitter characteristics used in the sharing studies are summarised in Table 19 in Section 4.2.1 of ECC Report 302. The representative FSS deployment information is contained in Table 20 of section 4.2.3 of ECC Report 302. The satellites are in the visible portion of the geostationary orbit from Europe with beams covering large areas of the Earth using various types of beams.

FSS protection criteria used in the sharing studies took into account the aggregate interference from WAS/RLAN APs, which were considered as time invariant for the purpose of this interference analysis.

3.2.1 Considered WAS/RLAN deployment

The characteristics, deployment scenarios, and other relevant information on WAS/RLAN operating in the 5925-6425 MHz frequency range are contained in the technical studies of ECC Report 302.

3.2.2 Summary of studies conducted

Studies have been performed in order to assess coexistence scenarios for WAS/RLANs and the FSS in the 5925-6425 MHz band and identify technical conditions allowing to enable coexistence between existing usages and WAS/RLAN systems without constraints to the incumbents in CEPT countries. Studies assumed a representative set of FSS satellites with coverage over Europe.

Two studies were conducted to assess aggregate interference from WAS/RLAN into FSS receivers in space, assuming WAS/RLAN deployment models in Europe for 2025. Study A employs a Monte Carlo methodology involving stochastic inputs to the WAS/RLAN deployment model for the “Mid scenario”, while study B delivers a static analysis based on average values for the “Low, Mid and High scenarios” detailed in Table 13 of ECC Report 302. The number of instantaneously transmitting WAS/RLANs within the FSS receive bandwidth used in the simulations is also given in Table 76 of ECC Report 302. The statistical study A has shown that the obtained level is consistent over the Monte-Carlo runs.

Studies show that the calculated levels of interference are highly sensitive to some WAS/RLAN parameters and assumptions in the study, including but not limited to the RF activity factor of WAS/RLAN devices.

Study A considers the Mid scenario for a representative set of FSS satellites. The results show that the protection criterion of I/N = -10 dB is satisfied with more than 8.5 dB of margin available in all cases. Service apportionment was not taken into account.

Study B also considers a representative set of existing FSS satellites (as well as a potential future satellite) and the WAS/RLAN deployment model in Europe for 2025 in accordance with Low, Mid and High scenarios. For the studies that were carried out using agreed Low, Mid and High WAS/RLAN deployment numbers with other agreed baseline parameters, the results showed that no instances of excess interference were found to the FSS receivers studied. However, for the most sensitive satellite case in the High scenario, the calculated levels of interference were close to the FSS protection criteria used in this study (i.e. -13.5 dB, including 3 dB service apportionment), with the smallest margin equal to 0.5 dB when assuming a BEL (14 dB) for normal building types only.

As part of Study B, additional analysis looked at the sensitivity of the results by increasing the proportion of outdoor WAS/RLAN usage above the agreed 2% baseline parameter (i.e. 5% outdoor was assumed). The results showed that for the Hhigh scenario that aggregate interference was sometimes close to or exceeded the interference threshold slightly for the most sensitive satellites studied.

Considering coexistence conditions for uncontrolled WAS/RLAN use, taking steps such as limiting the use to indoor only deployment and/or introducing an e.i.r.p. limit would help to further ensure long-term protection of FSS space stations from aggregate interference from WAS/RLAN devices in the band 5925-6425 MHz.

3.2.3 Risk of interference and possible regulatory models for the implementation of WAS/RLAN

Based on the results of studies, sharing between FSS and WAS/RLANs is feasible with limitations on higher power outdoor usage. The studies that were carried out using agreed low, mid and high WAS/RLAN deployment numbers with other agreed baseline parameters showed that no instances of exceeding the protection criteria were found to the FSS receivers studied.

However, an additional study looked at doing a sensitivity analysis examined the effect of increasing the proportion of outdoor WAS/RLAN usage above the agreed baseline parameter. The results showed that for the high WAS/RLAN deployment numbers, aggregate interference showed varying exceedances, but not at a level considered to be excessive, even for the more sensitive satellites studied. These results highlight the risk of excess interference should higher power outdoor usage increase significantly beyond that specified in the agreed baseline parameters. This concern and potential risk could be addressed by controlling the usage of higher power WAS/RLAN devices operating outdoors and indoors. Any regulatory measures considered at a European level to control higher power WAS/RLAN usage should take into account the nature of aggregate interference from devices operating across CEPT countries; such measures could be addressed in CEPT Report B.

3.3 COMMUNICATION BASED TRAIN CONTROL SHARING AND COMPATIBILITY ANALYSES

CBTC is one of the incumbent applications of the mobile service currently used in some CEPT countries as identified in the background section of the Mandate on WAS/RLAN in the 5925-6425 MHz band given in Annex 1. In addition, recommendations on future harmonisation measures at EU level for Urban Rail ITS, using CBTC applications, are addressed in CEPT Report 71 [12].

CBTC systems are used in some metropolitan cities in France (5915-5935 MHz), Denmark (5925-5975 MHz) and Spain (5905-5925 MHz), (see Tables 2b and 3 in CEPT Report 71 for current and planned CBTC systems).

ECC#50 adopted CEPT Report 71 [12], which has been provided to the Commission. The ECC also endorsed WG FM proposal to start the review of ECC Decision (08)01 [13] on ITS; this includes consideration of CBTC up to 5935 MHz.

In-band and adjacent band studies were conducted using current and possible future CBTC technologies as detailed in ECC Report 302.

3.3.1 Considered WAS/RLAN deployment

The characteristics, deployment scenarios, and other relevant information on WAS/RLAN operating in the 5925-6425 MHz frequency range are contained in the technical studies of ECC Report 302. CBTC characteristics considered in the adjacent band studies are listed in Table 45 of Section 9.1.1 of ECC Report 302. CBTC characteristics considered in the in-band studies are listed in Tables 51-56 of Section 9.2 of ECC Report 302.

3.3.2 Summary of studies conducted

A first study, using the MCL methodology, assesses the adjacent band coexistence between WAS/RLAN and CBTC below 5935 MHz; both WAS/RLAN out-of-band (OoB) and in-band emissions were studied. Different scenarios taking into account both indoor only (inside a building) and outdoor (fixed AP and portable device) were studied. The indoor usage scenario results in the least stringent requirement for WAS/RLAN OoB and in-band emissions.

The study shows that, if considering an indoor only WAS/RLAN operation, a density of OoB WAS/RLAN emission of -29 dBm/5 MHz is sufficient to ensure the CBTC operation.

When comparing the results achieved assuming WAS/RLAN operation starting at 5940 MHz and 5935 MHz, it is found that the WAS/RLAN operation above 5940 MHz is less restrictive for the WAS/RLAN emissions. In that case, an in-band e.i.r.p. of 21.5 dBm/20 MHz for indoor WAS/RLAN usage in adjacent channels (restricted to the first 20 MHz WAS/RLAN) would fulfil the CBTC blocking requirement for the three studied CBTC technologies.

Concerning the portable WAS/RLAN device in adjacent channels to CBTC, studies show that a density of OoB WAS/RLAN emission of -42 dBm/5 MHz and an e.i.r.p. density of 4.7 dBm/20 MHz (WAS/RLAN first channel starting at 5940 MHz) are sufficient to ensure the CBTC operation.

Another study, also using the MCL methodology, investigated the impact of WAS/RLAN devices coexisting in the same frequency band as the Copenhagen S-train CBTC system. The results present the required minimum distance between the WAS/RLAN device and CBTC receiver to avoid the interference from the WAS/RLAN device. This distance ranges from 180 to 600 m. If S-train and WAS/RLAN share the same frequency band, it is very probable that WAS/RLAN devices will be present within these distances. Dedicated mitigations techniques, to be locally applied, may need to be defined.

3.3.3 Risk of interference and possible regulatory models for the implementation of WAS/RLAN

Without coordination or mitigation, WAS/RLAN use in the same band as CBTC will have a material impact on the CBTC's operation.

Coexistence between WAS/RLAN and CBTC when operating in adjacent frequency bands is feasible under certain conditions. WAS/RLAN usage would be limited to indoors and/or reduced power levels (in band and/or out of band limits).

Without coordination, mitigation or limitation on out of band emissions, coexistence is not feasible for outdoor fixed higher power WAS/RLAN operation that is co-channel or in adjacent frequency bands.

Studies have also shown that one part of a solution to solve receiver blocking issues, would be to insert a guard band of 5 MHz between CBTC use and WAS/RLAN use.

3.4 ROAD INTELLIGENT TRANSPORT SYSTEMS COMPATIBILITY ANALYSES

ECC Report 244 [9] describes the Road-ITS deployment scenarios and contains sharing analysis between WAS/RLAN and Road-ITS. A study based on this information was carried out and is summarised in Section 8 of ECC Report 302.

3.4.1 Considered WAS/RLAN deployment

The characteristics, deployment scenarios, and other relevant information on WAS/RLAN operating in the 5925-6425 MHz frequency range are contained in the technical studies of ECC Report 302.

3.4.2 Summary of studies conducted

One adjacent band compatibility study, using the MCL methodology, was conducted to assess the impact of WAS/RLAN out-of-band (OoB) emission on Road-ITS below 5925 MHz, considering a protection criterion of I/N = -6 dB. WAS/RLAN deployment scenarios of indoor, outdoor (fixed AP and portable device) and in-vehicle were studied. The results of this compatibility study show that, depending on the scenario, the WAS/RLAN OoB emissions below 5925 MHz should meet a limit between -69 dBm/MHz and -36 dBm/MHz for the main-lobe case and between -59 dBm/MHz and -26 dBm/MHz for the side-lobe case. The scenario where the ITS antenna is integrated inside the vehicle resulted in the most stringent requirement. However, it is noted that this scenario is unlikely to occur since the ITS antennas are usually installed outside the vehicle. The indoor WAS/RLAN usage scenario results in the least stringent requirement for WAS/RLAN OoB emissions below 5925 MHz.

3.4.3 Risk of interference and possible regulatory models for the implementation of WAS/RLAN

The results of the technical studies conducted show that the coexistence between Road-ITS and WAS/RLAN is feasible if the WAS/RLAN OoB e.i.r.p density is limited. The indoor usage scenario results in the least stringent requirement for WAS/RLAN out of band emissions.

3.5 ULTRA WIDEBAND COEXISTENCE ANALYSES

Ultra Wideband (UWB) systems are considered short-range devices and follow the characteristics contained in ECC Decision (06)04 [6]. UWB devices are authorised to use this frequency only on a non-interference and non-protected basis as per European Commission Decision 2007/131/EC (as amended) [7]. Studies conducted between WAS/RLAN and UWB provide information on the coexistence conditions which the UWB community may want to take into account for future developments and where users wish to deploy both WAS/RLAN and UWB in the same location. These studies are not intended to form the basis of, or justify any changes to, existing regulations concerning UWB.

Information on UWB characteristics and deployments used in the coexistence study is contained in Section 11 of ECC Report 302.

3.5.1 Considered WAS/RLAN deployment

The characteristics, deployment scenarios, and other relevant information on WAS/RLAN operating in the 5925-6425 MHz frequency range are contained in the technical studies of ECC Report 302.

3.5.2 Summary of studies conducted

A minimum coupling loss study of a range of e.i.r.p. levels (from 0 dBm to 30 dBm) has shown that an individual WAS/RLAN interferer between 30 m and 946 m away, respectively, causes more than 3 dB sensitivity reduction in UWB communications and location tracking systems. For UWB sensing applications, the equivalent distances range from 7 m to 212 m.

Aggregate interference evaluations with Monte Carlo simulations show that when taking the WAS/RLAN RF activity factor into account, the probability that the sensitivity reduction to UWB communications and location tracking devices exceeds 3 dB ranges from 0.0024% to 3.3%, depending on the scenario considered. For UWB sensing devices, the probability that the sensitivity reduction is more than 3 dB varies from 0.042% to 1.7%.

3.6 RADIO ASTRONOMY SERVICE COEXISTENCE ANALYSES

The radio astronomy service (RAS) uses this frequency band for observations of spectral lines for hydroxyl (6030 and 6035 MHz) and methanol (6650-6675.2 MHz). The 6650-6675.2 MHz frequency band is listed in No. **5.149**, which urges administrations to take all practical steps to protect the radio astronomy service from harmful interference.

References for characteristics and guidelines for assessing interference to radio astronomy observations are contained in Recommendations ITU-R RA.769 [10] and RA.1031 [11].

A comprehensive list of references, especially on RAS site locations within CEPT, is contained in Annex 2:.

3.6.1 Considered WAS/RLAN deployment

The characteristics, deployment scenarios and other relevant information on WAS/RLAN operating in the 5925-6425 MHz frequency range are contained in the technical studies of ECC Report 302 [1].

3.6.2 Summary of studies conducted

The number of RAS sites in Europe observing in this frequency range is small, possibly around 19 (see Annex 2:). The local environment of each site is very well understood. Compatibility between WAS/RLAN and those sites could be addressed on a case-by-case basis at national level.

An I/N threshold can be used to derive a contour around the RAS site following applicable ITU-R Recommendations and taking into account the details of the site and possibly the typical observation schedule. The contours, which can be considered as a coordination zone or exclusion zone, represent a zone which needs to be managed by the regulator.

3.6.3 Risk of interference and possible regulatory models for the implementation of WAS/RLAN

Based on the results of studies, sharing between RAS and WAS/RLANs is feasible with additional conditions. Noting the very sensitive RAS receivers, interference is assumed if outdoor WAS/RLAN AP deployments and the known RAS sites overlap. This interference can be addressed by determining the geographic location (e.g. with exclusion and coordination zones) and limiting density of WAS/RLAN APs operating outdoors at higher power; or applying other conditions, such as limiting the power in general or using lower-power WAS/RLAN equipment indoor only and making regulations that control outdoor WAS/RLAN usage (e.g. using a database where necessary).

4 CONCLUSIONS

This CEPT Report contains summaries of technical studies and assessment of coexistence scenarios for Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) systems with incumbent systems in the 5925-6425 MHz band and adjacent bands, in response to Task 1 of the Mandate from the European Commission to CEPT (see Annex 1).

ECC Report 302 [1] studied the coexistence scenarios between WAS/RLAN and the incumbent usages: Fixed Service (FS), Fixed-Satellite Service (FSS), Radio astronomy (RAS) and Ultra Wideband (ÚWB), as well as Road Intelligent Transport Systems (ITS) and Communication Based Train Control (CBTC). The studies considered various WAS/RLAN scenarios with power up to 1 W e.i.r.p., indoor and outdoor devices, and also scenarios that assumed indoor only usage. Guidance is provided in ECC Report 302 on performing compatibility studies between WAS/RLAN and specific radio astronomy sites.

According to studies conducted so far, CEPT expects that coexistence between WAS/RLAN with existing services and systems within and adjacent to the band 5925-6425 MHz would be technically feasible under certain conditions.

For scenarios with indoor only WAS/RLAN deployment with a maximum e.i.r.p. in the range of 200-250 mW, the studies indicated that coexistence was feasible with FS when considering the long-term aggregated interference protection criterion and with FSS.

The studies indicated that coexistence with CBTC systems and Road-ITS would be technically feasible assuming suitable measures such as a guard-band and requirements on WAS/RLAN in band and/or out-of-band emissions. These elements would limit the available spectrum to WAS/RLAN to less than the entire 5925-6425 MHz band.

Complementary studies and analyses have been initiated as part of the work associated with CEPT Report B (Task 2). These studies address FS short-term protection between point-to-point applications and WAS/RLAN indoor only deployments as well as potential WAS/RLAN portable devices that operate outdoor with power levels significantly lower than that for indoor use.

In addition, future investigations may include innovative sharing solutions for geographical protection of incumbent systems.

High power WAS/RLAN devices and outdoor WAS/RLAN devices other than those mentioned in the paragraph above could present a risk of harmful interference to the Fixed Service , Fixed-Satellite Service, Communication based train control systems and Road Intelligent Transport System incumbents when sharing the band without restrictions.

Based on this risk of interference, the feasibility of outdoor WAS/RLAN deployment and high-power WAS/RLAN access points (APs) would require additional studies to address the interference to the incumbent systems, and any additional work to address the feasibility of these deployments could be studied further under a separate ECC deliverable.

At its 50th Plenary, ECC adopted CEPT Report 71 [12], which has been provided to the Commission. The ECC also endorsed its Working Group Frequency Management to start the review of ECC Decision (08)01 [13] on ITS, this includes consideration on CBTC.

ANNEX 1: CEPT MANDATE

Ref. Ares(2017)6222764 - 19/12/2017

EUROPEAN COMMISSION
Directorate-General for Communications Networks, Content and

Technology Director-General

Brussels,
DG CNECT/B4

MANDATE TO CEPT
TO STUDY FEASIBILITY AND IDENTIFY HARMONISED TECHNICAL CONDITIONS FOR WIRELESS ACCESS SYSTEMS INCLUDING RADIO LOCAL AREA NETWORKS IN THE 5925-6425 MHZ BAND FOR THE PROVISION OF WIRELESS BROADBAND SERVICES

1. PURPOSE

The objective of the Mandate is to study feasibility and identify harmonised technical conditions for a sustainable and efficient use on a coexistence basis of the 5925-6425 MHz band for wireless access systems including radio local area networks (WAS/RLANs). Based on the results of the compatibility and coexistence studies covering the 5925-6425 MHz band to be carried out under this Mandate, the relevant harmonised technical conditions should enable the coexistence with other systems in this and adjacent frequency bands.

2. BACKGROUND

Regarding the frequency band 5925-6425 MHz, the European Table of frequency allocations and applications in the frequency range 8.3 kHz to 3 000 GHz (ERC Report 25 (ECA Table))[1] includes primary allocations to the Fixed Service and to the Fixed- Satellite Service (Earth-to-space). According to the ECA Table, radio applications in this band include Satellite Earth Stations on board Vessels, Fixed Satellite Service Earth Stations, Fixed Service systems (point-to-point), Passive Sensors (satellite), SRD (Radiodetermination) and UWB applications. The band 5925-6425 MHz is allocated by ITU Radio Regulations (RR) to the Mobile service on a primary basis.

The frequency band 5925-6425 MHz is used by medium/high capacity, long distance fixed terrestrial links (point-to-point) for backhauling of mobile broadband networks[2]. Some Member States have also authorised urban rail systems (such as CBTC) in parts of this band. The band 5925-6425 MHz is also part of the so-called "standard C band".

A considerable amount of WAS/RLAN devices currently in use are operated in the 2.4 GHz band (2400-2483.5 MHz) where, based on the Commission Implementing Decision (EU) 2017/1483 amending Decision 2006/771/EC on short-range devices, 83.5 MHz of

[1] ERC Report 25 available at http://www.erodocdb.dk/Docs/doc98/official/pdf/ERCREP025.PDF, EFIS database at www.efis.dk

[2] See ERC Recommendation 14-01"Radio-frequency channel arrangements for high capacity analogue and digital radio-relay systems operating in the band 5925 to 6425 MHz" at http://www.erodocdb.dk/Docs/doc98/official/pdf/ERCREC1401.PDF

spectrum is available for such usage on a non-exclusive, non-interference and non- protected basis to a large number of RLANs and non-specific short-range devices.

Commission Decision 2007/90/EC amending Decision 2005/513/EC harmonises the use of radio spectrum in the 5 GHz band (5150-5350 MHz and 5470-5725 MHz) for wireless access systems including radio local area networks (WAS/RLANs). The use of the 5 GHz band for the operation of WAS/RLAN systems is subject to general authorisation only (Commission Recommendation 2003/203/EC)[3]. Currently 455 MHz of harmonised spectrum is available on a non-exclusive, non-interference and non-protected basis.

The existing regulatory framework for WAS/RLAN systems using the 2.4 GHz and 5 GHz bands has led to a rapid take-up of WAS/RLAN usage which is based on the availability in the internal market of a nearly-globally harmonised spectrum resource that fosters large economies of scale for equipment manufacturers. The low spectrum access barrier has led to a large-scale deployment of interoperable WAS/RLAN-capable devices and access points. In addition to the private use of WAS/RLANs, wireless broadband access through publicly accessible WAS/RLAN access points is now recognised as important connectivity infrastructure that is largely complementary to mobile internet services provided by mobile network operators.

Moreover, large-scale public networks for WAS/RLAN are today a significant driver of 5 GHz band use, especially where outdoor coverage is being provided. This type of WAS/RLAN usage is nevertheless not always compliant with the national authorisation framework and is an ongoing source of interference e.g. to meteorological radars without resolution.

Making available additional spectrum resources on a coexistence basis without refarming existing usage would provide additional socioeconomic benefits under the condition that spectrum coexistence with incumbent services is feasible and robust. In this context, harmonised standards being developed by ETSI should ensure operational conditions for WAS/RLANs in order to enable the coexistence with other systems in the 5925-6425 MHz band and in the adjacent bands.

In order to identify additional spectrum resources for WAS/RLAN on a shared basis, the Commission submitted a Mandate[4] to CEPT in 2013 to study and identify harmonised compatibility and sharing conditions for WAS/RLANs in the “5 GHz extension bands” 5350-5470 MHz and 5725-5925 MHz.

CEPT Report 64[5] of November 2016 concluded that considering the results of the studies, it is not currently possible to specify any appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the 5350-5470 MHz and 5725-5925 MHz while ensuring relevant protection of incumbent services in these bands. However, studies are ongoing into mitigation techniques in these bands, and in addition, the studies done in CEPT Report 57 and 64 are being updated by further work that is currently taking place under the WRC-19 Agenda Item 1.16.

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[3] Commission Recommendation of 20 March 2003 on the harmonisation of the provision of public R-LAN access to public electronic communications networks and services in the Community at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:078:0012:0013:EN:PDF

[4] document RSCOM13-32rev3 at https://ec.europa.eu/digital-single-market/en/news/radio-spectrum-cept-mandates-0

[5] http://www.erodocdb.dk/Docs/doc98/official/pdf/CEPTREP064.PDF

The outcome of the Mandate submitted to CEPT in 2013 does not allow the Commission to proceed with a harmonisation measure on WAS/RLANs in the bands 5350-5470 MHz and 5725-5925 MHz. However, there is an interest[6] to explore new opportunities for making available additional spectrum in the 5925-6425 MHz band for WAS/RLANs while protecting other radio services / applications currently using the 5925-6425 MHz band.

Relevant coexistence solutions for possible usage of the band 5925-6425 MHz by WAS/RLAN systems still need to be identified, defined and developed. They may imply operational developments enabling the implementation of a coexistence framework. An innovative coexistence solution increases the complexity and needs time before the practical implementation, in particular due to the need to validate and to implement solutions.

3. JUSTIFICATION

Pursuant to Article 4(2) of the Radio Spectrum Decision[7], the Commission may issue mandates to the CEPT for the development of technical implementing measures with a view to ensuring harmonised conditions for the availability and efficient use of radio spectrum necessary for the functioning of the internal market. Such mandates shall set the tasks to be performed and their timetable.

Pursuant to Article 6 of the Radio Spectrum Policy Programme (RSPP)[8], the Commission shall, in cooperation with Member States, assess the justification and feasibility of extending the allocations of spectrum for wireless access systems, including radio local area networks operating under general authorisations regime. In addition, Article 3(c) of the RSPP requires Member States, in cooperation with the Commission, to take all steps necessary to ensure that sufficient spectrum for coverage and capacity purposes is available for achieving the target for all citizens to have access to broadband speeds of not less than 30 Mbps by 2020. In order to meet future broadband connectivity needs, the Commission proposes that by 2025 all schools, transport hubs and main providers of public services as well as digitally intensive enterprises should have access to internet connections with download/upload speeds of 1 Gigabit of data per second[9]. In addition, all European households, rural or urban, should have access to networks offering a download speed of at least 100 Mbps, which can be upgraded to 1 Gigabit.

In view of the above broadband connectivity objectives as part of the Digital Single Market Strategy and Digital Agenda for Europe and considering the steadily increasing amount of data traffic delivered through fixed broadband networks, the Commission

6 ETSI ERM is developing a System Reference document (SRdoc) TR 103 524 on Wireless access systems including radio local area networks (WAS/RLANs) in the band 5925 MHz to 6725 MHz, https://portal.etsi.org/webapp/workprogram/Frame_WorkItemList.asp?SearchPage=TRUE&qSORT=HIGHVERSION&qINCLUDE_SUB_TB=True&butSimple=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=103+524&qMILESTONE=&qACHIEVED_DAY=&qACHIEVED_MONTH=&qACHIEVED_YEAR=&qREPORT_TYPE=SUMMARY&optDisplay=10&qTB_ID=&includeNonActiveTB=FALSE .

7 Decision 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community, OJL 108 of 24.4.2002

8 Decision 243/2012/EU of 14 March 2012, OJ L 81 of 21.3.2012

9 See the Communication Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society (COM(2016) 587 final)

considers WAS/RLAN frequency bands as part of the solutions for the provision of internet-based services. It is therefore necessary to ensure that sufficient spectrum resources are made available on a harmonised basis to support a long-term future for new generations of WAS/RLAN technologies that will provide increasing data capacity and speed.

Recent studies carried out by WAS/RLAN industry point to the ever growing number and diversity of devices for WAS/RLAN along with increased connection speeds and data traffic volumes will exceed the capacity of spectrum currently available in the 5 GHz band by 2020. Between 500 MHz and 1 GHz of additional spectrum in various world regions may be needed to support expected growth in WAS/RLAN usage by 2020. Additional spectrum identified for WAS/RLAN should support wide channels which are required for a growing number of applications which need a large bandwidth to achieve Gigabit speeds.

The Commission focuses on the 5925-6425 MHz band as a promising alternative to 5 GHz where spectrum currently available for WAS/RLAN cannot be extended given the outcome of the previous Mandate (2013).

However, such an opportunity can only be realised if appropriate coexistence conditions between WAS/RLAN and radio applications in the band 5925-6425 MHz are identified and able to provide confidence to all spectrum users. It will therefore be necessary to carry out the appropriate technical studies and identify suitable compatibility and coexistence conditions to fully safeguard the operation of all radio services / applications currently using the band 5925-6425 MHz as well as the bands adjacent to this band.

CEPT should work in cooperation with ETSI and take into account international harmonisation, as appropriate, in order that any opportunities for even greater economies of scale for manufacturers of WAS/RLAN equipment can be realised.

4. TASK ORDER AND SCHEDULE

The objective of this Mandate is to (1) study regulatory and technical feasibility of the introduction of WAS/RLANs in the band 5925-6425 MHz, including an assessment of coexistence scenarios for WAS/RLANs to operate on a coexistence basis to (2) develop harmonised compatibility and coexistence conditions and propose relevant harmonised technical conditions for WAS/RLAN usage subject only to general authorisations, if technically feasible.

The CEPT is thereby mandated to carry out the following tasks:

Task 1 – Assessment and study of compatibility and coexistence scenarios in the band 5925-6425 MHz

To study and assess compatibility and coexistence scenarios for WAS/RLANs in the 5925-6425 MHz band and identify relevant parameters and coexistence conditions to be implemented in the regulatory framework in order to enable coexistence between existing usages and WAS/RLAN systems without constraining incumbent uses in various Member States in and adjacent to the band 5925-6425 MHz including at the outer EU border.

For each compatibility/coexistence scenario, the risk of interference, the deployment assumptions of all applications, the geographical extent of usage and consequential restrictions in WAS/RLAN deployment should be identified as well as requirements for implementing such scenarios, e.g. in terms of harmonised technical parameters or in terms of other regulatory and operational aspects which support the implementation of a coexistence framework.

Task 2 – Development of harmonised technical conditions

Taking into account the results of task 1, for the band 5925-6425 MHz develop appropriate mitigation techniques and/or operational compatibility/coexistence conditions. In the light of experience, these conditions should in particular identify the harmonised technical parameters that would be needed to ensure in the internal market consistent harmonised conditions for WAS/RLANs operating on a coexistence basis, if technically feasible. This should be developed in close cooperation with ETSI which is working on harmonised standards which include operational coexistence conditions for WAS/RLANs with other systems in the band and in adjacent bands.

It is assumed in this Mandate that WAS/RLANs could operate on the basis of a general authorisation only. With a view to achieving a scope for worldwide harmonisation of additional spectrum for WAS/RLAN that would strengthen the economies of scale for manufacturers of RLAN equipment and thereby benefit all end-users, the work carried out under this task should take into account developments in other ITU Regions, e.g. through the organisation of a workshop.

In the work carried out under the Mandate, the overall policy objectives of the RSPP, such as effective and efficient spectrum use and the support for specific Union policies shall be given utmost consideration. In implementing this Mandate, the CEPT shall, whenever relevant, take utmost account of EU law applicable and support the principles of service and technological neutrality, non-discrimination and proportionality insofar as technically possible.

CEPT is also requested to collaborate actively with all concerned stakeholders, as for instance, (i) the European Telecommunications Standardisation Institute (ETSI), which develops relevant voluntary harmonised standards for the presumption of conformity under Directive 2014/53/EU and (ii) the Coordination of the Notified Bodies under the same Directive (REDCA), which ensures a harmonised approach in the certification of equipment when manufacturers do not use harmonised standards.

CEPT should provide deliverables according to the following schedule:

Delivery date	Deliverable	Subject
November 2018	Interim Report from CEPT to the Commission	Description of work undertaken and interim results of task (1)
March 2019	Final Draft Report A[10] from CEPT to the Commission	Draft results under task (1)
March 2020	Final Report A from CEPT to the Commission taking into account the outcome of the public consultation Final Draft Report B[10] from CEPT to the Commission	Final results under task (1) Draft results under task (2)
July 2020	Final Report B from CEPT to the Commission taking into account the outcome of the public consultation	Final results under task (2)

In addition, CEPT is requested to report on the progress of its work pursuant to this Mandate to all meetings of the Radio Spectrum Committee taking place during the course of the Mandate.

The Commission, with the assistance of the Radio Spectrum Committee and pursuant to the Radio Spectrum Decision, may consider applying the results of this mandate in the EU, pursuant to Article 4 of the Radio Spectrum Decision.

In light of the timing of meetings of the Radio Spectrum Committee, the delivery date is amended to July 2019.

[10] subject to a public consultation

ANNEX 2: COORDINATES OF RADIO ASTRONOMY SITES IN CEPT IN THE 6 GHZ BAND

Table 3: Coordinates of Radio Astronomy sites in CEPT in the 6 GHz band

Radio Astronomy Station Site Name	Country	Longitude	D	M	S	Latitude	D	M	S
Effelsberg	Germany	EAST	006	53	01.0	NORTH	50	31	29.4
Westerbork	Netherlands	EAST	006	35	38.1	NORTH	52	54	55.0
Jodrell Bank Lovell	United Kingdom	WEST	002	18	30.9	NORTH	53	14	11.5
Merlin/Jodrell2	United Kingdom	WEST	002	18	14.0	NORTH	53	14	02.3
Merlin/Tabley	United Kingdom	WEST	002	26	43.3	NORTH	53	17	19.4
Merlin/Knockin	United Kingdom	WEST	002	59	49.7	NORTH	52	47	25.0
Merlin/Darnhall	United Kingdom	WEST	002	32	08.3	NORTH	53	09	22.7
Merlin/Cambridge	United Kingdom	EAST	000	02	13.7	NORTH	52	10	01.0
Ny-Ålesund, Svalbard	Norway	EAST	011	51	17.7	NORTH	78	56	34.6
Medicina	Italy	EAST	011	38	49.0	NORTH	44	31	13.8
Sardinia	Italy	EAST	009	14	42.5	NORTH	39	29	35.1
Noto	Italy	EAST	014	59	20.6	NORTH	36	52	33.8
Onsala	Sweden	EAST	011	55	04.0	NORTH	57	23	35.1
Yebes	Spain	WEST	003	05	12.7	NORTH	40	31	28.8
Torun	Poland	EAST	018	33	50.6	NORTH	53	05	43.7
Irbene	Latvia	EAST	021	51	17.0	NORTH	57	33	12.0
Svetloe	Russia	EAST	029	46	55.0	NORTH	60	31	56.5
Zelenchuskaya	Russia	EAST	041	33	54.6	NORTH	43	47	16.1
Badary	Russia	EAST	102	14	02.1	NORTH	51	46	12.9

ANNEX 3: LIST OF REFERENCES

[1] ECC Report 302: “Sharing and compatibility studies related to Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) in the frequency band 5925-6425 MHz”

[2] Doc. FM(18)078R1: “Summary of responses on WGFM questionnaire to CEPT administrations on current and future trends for the Fixed Services and status of other incumbent uses in Europe in the frequency band 5925-6425 MHz”

[3] ERC Report 25: “The European table of frequency allocations and applications in the frequency range 8.3 kHz to 3000 GHz (ECA Table)”, October 2018. Available: https://www.ecodocdb.dk/document/593

[4] Recommendation ITU-R F.758-6: “System parameters and considerations in the development of criteria for sharing or compatibility between digital fixed wireless systems in the fixed service and systems in other services and other sources of interference”

[5] Recommendation ITU-R F.699: “Reference radiation patterns for fixed wireless system antennas for use in coordination studies and interference assessment in the frequency range from 100 MHz to about 70 GHz”

[6] ECC Decision (06)04: “Harmonised conditions for devices using UWB technology in bands below 10.6 GHz”

[7] European Commission Decision 2007/131/EC on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community

[8] ECC Recommendation 14(06): “Implementation of Fixed Service Point-to-Point narrow channels (3.5 MHz, 1.75 MHz, 0.5 MHz, 0.25 MHz, 0.025 MHz) in the guard bands and center gaps of the lower 6 GHz (5925 to 6425 MHz) and upper 6 GHz (6425 to 7125 MHz) bands, May 2015

[9] ECC Report 244: “Compatibility studies related to RLANs in 5725-5925 MHz”

[10] Recommendation ITU-R RA.769-2: “Protection criteria used for radio astronomical measurements”

[11] Recommendation ITU-R RA.1031: “Protection of the radio astronomy service in frequency bands shared”

[12] CEPT Report 71: “Report from CEPT to the European Commission in response to the Mandate to study the extension of the Intelligent Transport Systems (ITS) safety-related band at 5.9 GHz”

[13] ECC Decision (08)01: “Harmonised use of the 5875-5925 MHz frequency band for Intelligent Transport Systems (ITS)”, amended on 3 July 2015

[14] CENELEC - EN 55011: “Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement”