CEPT Report 64

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

"To study and identify harmonised compatibility and sharing conditions for Wireless Access Systems including Radio Local Area Networks in the bands 5350-5470 MHz and 5725-5925 MHz ('WAS/RLAN extension bands') for the provision of wireless broadband services"

Report approved on 18 November 2016 by the ECC

0 EXECUTIVE SUMMARY

This CEPT Report has been developed within the European Conference of Postal and Telecommunications Administrations (CEPT) in the framework of the EC Mandate on the 5 GHz WAS/RLAN extension bands (see ANNEX 1:).

The mandate requested CEPT to study and identify harmonised compatibility and sharing conditions for a sustainable and efficient use on a shared basis of the frequency bands 5350-5470 MHz and 5725-5925 MHz ('WAS/RLAN extension bands') for wireless access systems including radio local area networks (WAS/RLANs).

Task 1 – Identification of compatibility and sharing scenarios: study and identify harmonised compatibility and sharing scenarios for WAS/RLANs to operate on a shared basis in an uninterrupted band from 5150-5925 MHz under the condition that (i) appropriate protection of EU priority applications, in particular the planned introduction of GMES[1] (Global Monitoring for Environment and Security) in the band 5350-5450 MHz and the use of safety-related ITS applications in the frequency band 5875-5905 MHz, is ensured and (ii) that coexistence of WAS/RLAN with other current civil and/or military radio systems to which the bands 5350-5470 MHz and 5725-5925 MHz and adjacent bands have already been assigned or designated is safeguarded.

Task 2 – Development of compatibility and sharing conditions: develop appropriate compatibility and sharing conditions to ensure a long-term spectrum access resource for WAS/RLANs to operate on the basis of a general authorisation as an essential wireless broadband infrastructure in the internal market.

Task 3 – Review of compatibility and sharing conditions after WRC-15: Taking utmost account of the possibility of international harmonisation[2], to assess the need to review and/or reconfirm the compatibility and sharing conditions developed under task 2 for the Final report based on the result of WRC-15, in the event that this would have a material effect on the parameters chosen for completion of tasks 1 and 2.

CEPT Report 57[1], published in March 2015, covered a significant amount of work that had been carried out by CEPT under the mandate up until that point in time. At that time, CEPT Report 57 was considered to be a final Report from CEPT to the Commission to cover the description of work undertaken under tasks (1) and (2) of the Mandate.

The general conclusions from CEPT Report 57 were that it was not possible at that time to specify any appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands 5350-5470 MHz and 5725-5925 MHz while ensuring relevant protection of incumbent services in these bands. CEPT Report 57 also concluded that these studies (in particular on additional mitigation techniques) that have not been completed in the timeframe for delivering Task (2) of the mandate were also unlikely to be completed and that any further work undertaken by CEPT could be taken into account when reviewing the results of the WRC-15 under Task (3) of the mandate.

This Report is to cover the final part of the mandate which is to address Task (3) of the mandate, to review and/or reconfirm the compatibility and sharing conditions developed under Task (2) of the mandate and take account of the results of WRC-15.

Since the publication of CEPT Report 57, CEPT have carried out some additional work on compatibility studies related to RLANs in the 5725-5925 MHz band and these can be seen in ECC Report 244 [2] and this Report, additional studies on further mitigation techniques are still being investigated both within ETSI and CEPT.

Taking account of the studies shown in CEPT Report 57 and ECC Report 244, a summary of the current status of the various sharing and compatibility studies is presented hereafter:

[1] Also known as Copernicus
[2] Such as resolutions at the ITU WRC-15.

Earth Exploration Satellite Service (Active) in the band 5350-5470 MHz

ETSI have initiated work to look at implementation and feasibility of new alternative mitigation techniques and further studies on these possible additional mitigation techniques continue to be carried out in the ITU-R and CEPT. However, the final results of these studies have not been concluded in the timescales associated with this EC mandate . In addition, no further sharing and compatibility analysis has been carried out for this service since the publication of CEPT Report 57 so the conclusions reported in CEPT Report 57 are still valid at this time.

Work is still required on the specification of appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands 5350-5470 MHz while ensuring relevant protection of EESS (active) and the operation of GMES/Copernicus.

Radiolocation in the bands 5350-5470 MHz and 5725-5850 MHz

ETSI have initiated work to analyse the feasibility of implementation and impact on RLAN operations of the new radar test signals for the bands 5350-5470 MHz and 5725-5850 MHz and further studies on these possible additional mitigation techniques continue to be carried out in the ITU-R and CEPT.

As far as meteorological radars in the 5350-5470 MHz band are concerned, CEPT also proposed to ETSI to consider in this band the application of specific DFS conditions similar to those pertaining in the band 5600-5650 MHz.

It should be noted that the 5725-5850 MHz band is an ISM band and various services and applications already operate in CEPT countries with and without DFS at various power levels under different ECC deliverables. Therefore, when discussing appropriate mitigation techniques for RLANs, the impact of interference from ISM devices and these existing radio communication applications into radiolocation systems would need to be considered for comparison purposes. In addition, no further sharing and compatibility analysis has been carried out for this service since the publication of CEPT Report 57 so the conclusions reported in CEPT Report 57 are still valid at this time.

Work is still required on the specification of appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands while ensuring relevant protection of the radiolocation services in these bands.

Fixed Satellite Services in the band 5725-5925 MHz

Further studies since the publication of CEPT Report 57 [1] have focused on the assessment of the interference from RLAN into FSS using a two-step approach:

- **Step 1** calculates the maximum number of active, on-tune, RLAN transmitters that can be accommodated by the satellite receiver under consideration (considering the satellite footprint) whilst satisfying the FSS protection criteria.
- **Step 2** delivers the number of active, on-tune, RLAN transmitters using a deployment model. The step 2 outputs can be compared with the step 1 values in order to assess the potential for sharing. In theory, if the step 2 values are less than or equal to the step 1 values, then the results suggest that sharing is possible; else if the step 2 values are greater than the step 1 values, sharing is not possible.

As there were a number of options and associated results studied for both steps 1 and 2, it was agreed to perform sensitivity analyses, taking into account ranges of values for some of these factors. Initial calculations and results were presented in ECC Report 244 [2] but, although providing some relevant results, it was too early to draw definite conclusions.

Additional studies on the potential for RLAN-FSS sharing were developed.

The wide range of results available reflects the wide range of inputs to the models considered in the studies. Further work would be required on the modelling including on the range of inputs.

As a result, it has not been possible to arrive at a consensus regarding suitable inputs for the modelling, and further studies would be required. Further mitigation techniques may also need to be investigated and studied for their impact on RLAN operations and results of studies. One possible way forward to address some of the uncertainties currently seen in the range of results is to carry out some airborne measurements

to compare actual RLAN use with the predicted results from the model for defined geographical areas. An example of how to compare real measurements with the results of the model has been presented during the course of the studies.
Work is still required on the specification of appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands while ensuring relevant protection of the Fixed Satellite Services in these bands.

There has been no study on the potential interference from FSS earth stations into RLAN.

Other Applications/Services in the band 5725-5850 MHz

Although CEPT have published ECC Report 244 [2] and ETSI have initiated work to look at implementation and feasibility of new alternative mitigation techniques, only limited further sharing studies and compatibility analysis has been carried out between TTT, BFWA and RLANs since the publication of CEPT Report 57 [1], therefore the conclusions from CEPT Report 57 are still valid.

Other applications/services that have been studied in this band include WIA, where it is expected that compatibility can be achieved through a coordination procedure within factory premises where WIA are expected to be deployed.

Preliminary consideration of the three main categories of radio amateur usage (narrowband, data and amateur satellite) for both directions has been made that may provide guidance for future work (along with ECC Report 206 [3]). This includes an initial identification of relevant mitigation techniques. Whilst some scenarios and directions may require further study, it has already been found that compatibility is achieved between Amateur Satellite downlink transmissions and RLAN receivers

Due to lack of input no sharing and compatibility studies have been conducted for the following services:

- Compatibility between RLAN and non-specific Short range devices in the band 5725-5875 MHz;

Other Applications/Services in the band 5850-5925 MHz

CEPT have continued to carry out sharing and compatibility studies between RLANs and other radio services/applications operating the band 5850-5925 MHz band. Although CEPT have published ECC Report 244 and ETSI have initiated work to look at implementation and feasibility of new alternative mitigation techniques, only limited further sharing studies and compatibility analysis has been carried out between ITS, BFWA and RLANs since the publication of CEPT Report 57 [1], therefore the conclusions from CEPT Report 57 are still valid.

Previous studies showed that an acceptable degree of compatibility could be achieved between WIA, Broadband DA2GC and RLANs therefore no further sharing and compatibility analysis has been carried out for these applications since the publication of CEPT Report 57.

However, the final results of all the studies for this frequency band have not been concluded in the timescales associated with this EC mandate for all of the concerned radio services/applications at the time of finalising this report. There are still a number of open issues related to further studies (particularly on possible mitigation techniques).

Work is still required on the specification of appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands 5850-5925 MHz while ensuring relevant protection of all of the incumbent services and applications.

Considerations on WAS/RLAN characteristics

The studies done in preparation of this Report, CEPT Report 57 and ECC Report 244 are based on RLAN characteristics derived from 802.11ac [4]. Another RLAN technology, i.e. LAA-LTE has been included in the further studies developed within CEPT. These studies concluded that the impact of adding LAA-LTE use case in 5725 - 5925 MHz bands appears to have little additional effect on the overall study results of compatibility and sharing when compared to the original studies as shown in ECC Report 244.

However, other future RLAN technologies (e.g. 802.11ax) might be taken into consideration in future studies. It is expected that all 5 GHz RLAN technologies will have to comply with the same spectrum regulations and a single harmonised standard.

Compliance, illegal use and market surveillance

In CEPT Report 57, consideration of various mitigation techniques proposed for use in the extension bands and the experience gained since 2003 in the current RLAN bands (5150-5350 MHz and 5470-5725 MHz bands) was considered and, in particular, the case of interference to meteorological radars in the band 5600-5650 MHz. To this respect, the situation as presented in ECC Report 192 [5], show that there are interference cases to meteorological radars due to intentional illegal use of RLAN and non-compliant RLAN equipment in the 5600-5650 MHz band and are still being reported according to the interference statistics for 2015 (Annex 23 to the WGFM#85 Minutes). When considering mitigation techniques in potential extension bands 5350-5470 MHz and 5725-5925 MHz bands, and prior to any decision to authorise RLAN in these bands, due consideration would have to be given to improving the situation in the existing bands and avoiding its potential replication in extension bands.

Further work on the analysis of additional mitigation techniques

Previous studies have shown that a wide variety of incumbent systems in the bands 5350-5470MHz and 5725-5925MHz would not be able to maintain an acceptable level of performance if RLANs having the same regulatory restrictions and usage parameters used in the rest of the 5 GHz bands (i.e. 5150-5350 MHz and 5470-5725 MHz) were to be introduced in the band. Therefore, a set of additional mitigation techniques aiming at allowing coexistence of RLAN with a variety of incumbent systems had been suggested for further study.

ETSI BRAN is still working on developing technical reports to assess the feasibility of implementation of a number of additional mitigation techniques and their impact on RLAN operations and was not in a position to provide information at the stage of developing the Report. Therefore it was not possible to assess the feasibility and efficiency of these mitigation techniques to ensure protection of incumbent services and applications.

Further studies could also be needed for:

- Compatibility between RLAN and non-specific Short range devices in the band 5725-5875 MHz;
- Compatibility between RLAN and the Amateur (5725-5850 MHz) and Amateur Satellite (Space to Earth, 5830-5850 MHz) services;
- Adjacent band compatibility between RLAN on one hand and the FS and FSS above 5925 MHz, on the other hand;
- Compatibility between RLAN and FS operated in band 5725-5925 MHz.

Impact from WRC-15 Agenda Item 1.1

The results from the WRC 15 did not impact the conclusions of CEPT Report 57 which are confirmed.

In conclusion there are still a number of issues outstanding (particularly on possible mitigation techniques) that remain open for further study after this final response to this mandate.

Taking forward outstanding issues

In order to take forward the work on these outstanding issues, CEPT will be required to continue their studies taking account the future areas of study highlighted in this Report. CEPT will also have to continue to work closely with ETSI and the relevant industry stakeholders on the implementation and impact of any possible mitigation techniques on RLANs as well as studying their feasibility and impact on incumbent users. In addition due to the large ranges being presented in the results of the current studies, CEPT will also be required to gather further information on and study ways to improve, (1) the evidence (including possible measurement campaigns) currently available for estimating aggregate interference from RLAN deployments (particularly w.r.t. satellite services), (2) the evidence available on the mainstream RLAN uses and their technical and operational characteristics today and in the future (including the impact of new technologies such as 802.11ax).

General conclusions

Overall, considering the results of the studies performed under Tasks (1), (2) and (3) of the EC Mandate at the time of finalising this report, it is not possible to specify any appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands 5350-5470 MHz and 5725-5925 MHz while ensuring relevant protection of incumbent services in these bands.

It should be noted that some additional work (in particular on mitigation techniques) outside of the scope of this Mandate is ongoing within CEPT, ETSI and ITU and is expected to be finalised before 2019.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
3GPP	Third Generation Partnership Project
ASECAP	Association Européenne des Concessionnaires d'Autoroutes et d'Ouvrages à Péage (European Association of Operators of Toll Road Infrastructures)
BFWA	Broadband Fixed Wireless Access
CCA	Clear Channel Assessment
CEPT	European Conference of Postal and Telecommunications Administrations
CPM	Conference Preparatory Meeting
DA2GC	Direct-Air-To-Ground Communications
DFS	Dynamic Frequency Selection
EC	European Commission
ECC	Electronic Communications Committee
EESS	Earth Exploration-Satellite Service
e.i.r.p.	Equivalent isotropic radiated power
ERC	European Radiocommunications Committee
ESA	European Space Agency
ETSI	European Telecommunications Standards Institute
ETSI BRAN	ETSI Broadband Radio Access Networks
EU	European Union
FDD	Frequency Duplex Division
FS	Fixed Service
FSS	Fixed-Satellite Service
GMES	Global Monitoring for Environment and Security
IEEE	Institute of Electrical and Electronics Engineers
ISM	Industrial, scientific and medical
ITS	Intelligent Transport Systems
ITS-G5	Intelligent Transport Systems operating in the 5 GHz band
ITU-R	International Telecommunication Union - Radiocommunications sector
LAA-LTE	License-Assisted Access of LTE
P-MP	Point-to-Multipoint
PoD	Probability of detection
RLAN	Radio Local Area Networks
RSPP	Radio Spectrum Policy Programme
RTTT	Road Transport and Traffic Telematics
SRD	Short Range Devices
TDD	Time Duplex Division
TPC	Transmitter Power control
TTT	Transport and Traffic Telematics
WAS/RLAN	Wireless Access Systems including Radio Local Area Networks
WIA	Wireless Industrial Applications
WIFI	Wireless Fidelity
WRC	World Radiocommunication Conference

1 INTRODUCTION

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Taking account of the studies shown in CEPT Report 57 and ECC Report 244 a summary of the current status of the various sharing and compatibility studies are shown in this Report with some suitable conclusions.

[3] Also known as Copernicus
[4] Such as resolutions at the ITU WRC-15.

2 ANY FURTHER INFORMATION ON SERVICES/APPLICATIONS IN THE BANDS UNDER STUDY

In section 2 of CEPT Report 57 [1], CEPT ECC presented an assessment of the services to be studied in the possible extension bands that have been identified for WAS/RLANs, 5350-5470 MHz, 5725-5850 MHz and 5850-5925 MHz.

There have been no changes to the services and applications previously identified for study in CEPT Report 57.

Below we go through a short introduction for each of the services and applications that were studied on a band by band basis.

2.1 5350 - 5470 MHz

2.1.1 Existing users

2.1.1.1 Radiodetermination applications

The band is utilised for a variety of radiodetermination applications falling within the radionavigation and radiolocation services. This includes defence systems including tactical and weapon system radars, position fixing, ship borne and vessel traffic and coastal surveillance radars, ground based and airborne weather radars. The band is also used by tank level probing radars as specified in ETSI EN 302 372 [7] and ERC/REC 70-03 [8]. For more information on the radio determination use of this band see section 2.1.1.1 of CEPT Report 57.

2.1.1.2 Active sensors (Earth Exploration satellites)

The band is used by the Global monitoring for environment and security (GMES) / Copernicus system, that is carried out in partnership with the Member States and the European Space Agency (ESA) for which COM(2012)218 [9] was agreed (not a regulatory text but an Intergovernmental Agreement for the operation of the European Earth monitoring programme (GMES)).

The band is also used by EESS (active) instruments from other countries such as the Canadian constellation Radarsat.

2.2 5725 - 5850 MHz

2.2.1 Existing users

2.2.1.1 Radiodetermination applications

The band 5725-5850 MHz is utilised for a variety of radiolocation applications. This also includes defence systems such as tactical and weapon radars as well as weather radars (ground based and airborne). For more information on the radio determination use of this band see section 2.2.1.1 of CEPT Report 57.

2.2.1.2 Fixed-Satellite Service (Earth to space 5725 - 5925 MHz)

FSS deployments use the whole band 5725-5925 MHz and it is used by transmitting earth stations in the Earth-to-space direction operating only to satellites in geostationary orbits. In the 125 MHz portion of the band up to 5850 MHz, this is a Region 1 allocation only (i.e. only Europe, Africa, and some of the northernmost countries in Asia). Above 5850 MHz the band is part of the heavily utilised FSS global uplink band and most of the currently operating satellites have received transponders in this upper portion of the band (see ECC Report 206 [3]). For more information on the FSS use of this band see section 2.2.1.2 of CEPT Report 57.

2.2.1.3 Amateur Service and Amateur-satellite Service

The amateur and amateur-satellite (space-Earth) services have harmonised allocations in all three ITU Regions in the frequency range 5725-5850 MHz with secondary status. For more information on the Amateur and Amateur-satellite Services use of this band see section 2.2.1.3 of CEPT Report 57 [1].

2.2.1.4 Non-specific SRDs

The frequency band 5725 MHz to 5875 MHz (25 mW e.i.r.p.) has been designated for non-specific SRDs for a very long time (some decades, i.e. even before the ERC/REC 70-03 [8]) and is the only SRD band having a quite large bandwidth capability, no duty cycle restriction and a reasonable transmit power of 25 mW e.i.r.p. vs. propagation for the foreseen operations. For more information on the non-specific SRD use of this band see section 2.2.1.4 of CEPT Report 57.

2.2.1.5 Transport and Traffic Telematics (TTT - former RTTT)

ERC/REC 70-03 designates the frequency band 5795-5805 MHz, with possible extension to 5815 MHz, for TTT. The band 5795-5805 MHz is for use by initial road-to-vehicle systems, in particular road toll systems, with an additional sub-band, 5805-5815 MHz, to be used on a national basis to meet the requirements of multi-lane road junctions. For more information on Transport and Traffic Telematics use of this band see section 2.2.1.5 of CEPT Report 57.

2.2.1.6 Broadband Fixed Wireless Access

ECC Report 101 [10] indicated that Broadband Fixed Wireless Access (BFWA) is used here to refer to wireless systems that provide local connectivity for a variety of applications and using a variety of architectures, including combinations of access as well as interconnection. ECC Report 068 [11] depicts the different architectures of BFWA and provides the relevant information on these different kinds of networks including technical parameters to ensure compatibility with other systems. These reports also provide the main parameters for two BFWA architectures, Point to Multipoint (P-MP) and Mesh. For more information on BFWA use of this band see section 2.2.1.5 of CEPT Report 57.

2.2.2 Proposals for new additional use

Wireless Industrial Applications

Wireless Industrial Applications (WIA) is used for wireless links in industrial environments including monitoring and worker communications, wireless sensors and actuators. For more information on the proposed WIA use of this band see section 2.2.2 of CEPT Report 57.

2.3 5850-5925 MHz

2.3.1 Existing users

2.3.1.1 Non-specific SRDs (up to 5875 MHz)

See section 2.2.1.4

2.3.1.2 Broadband Fixed Wireless Access (up to 5875 MHz)

See section 2.2.1.6

2.3.1.3 Fixed-Satellite Service (Earth to space, 5725-5925 MHz)

See section 2.2.1.2

2.3.1.4 Intelligent Transport Systems (ITS)

ITS means systems in which information and communication technologies are applied in the field of transport and traffic telematics, including infrastructure, vehicles and users, and in traffic management and mobility management. Safety related applications have high requirements on robustness and latency, and may need to operate in a predictable interference environment. Non-safety related applications usually have lower requirements on robustness and latency. For more information on ITS use of this band see section 2.3.1.4 of CEPT Report 57 [1].

2.3.1.5 Other Systems that operate on a national basis in some CEPT countries

Public transport automation systems (like subway) are in operation on a national basis in some European countries in the band 5915-5935 MHz. These systems provide primarily trackside/infrastructure to train communications, optionally train to train communications and operate in cities. Current activities are on-going in ETSI in response to EC mandate M/486 [12] (Urban rail) and this work may include looking at other bands allocated for ITS.

2.3.2 Proposals for new additional use

2.3.2.1 Broadband Direct-Air-to-Ground Communications (5855 - 5875MHz)

Two options have been considered for use for Broadband DA2GC systems in the frequency range 5855-5875 MHz to provide broadband connectivity throughout Europe from a terrestrial ground stations to commercial aircraft. Both systems are TDD systems. For more information on Broadband DA2GC proposed use of this band see section 2.3.2.1 of CEPT Report 57.

2.3.2.2 Wireless Industrial Applications (5725-5875 MHz)

See section 2.2.2.

3 PROPOSED WAS/RLAN CHARACTERISTICS FOR STUDY

3.1 CURRENT WAS/RLAN CHARACTERISTICS AND USE IN 5 GHZ BANDS IN EU/CEPT AND WORLDWIDE

EC Decision 2005/513/EC [13] complemented by EC Decision 2007/90/EC [14] addresses the designation of the frequency bands 5150-5350 MHz and 5470-5725 MHz for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs) in EU members states and ECC/DEC/(04)08 [15] addresses their designation within CEPT. At worldwide level these frequency bands have been allocated to the *mobile service except aeronautical mobile service* on a primary basis in all three regions by World Radiocommunication Conference 2003 (WRC-03). Furthermore Resolution 229 (WRC-03) [16] limits the use of this allocation to WAS/RLANs. Resolution 229 (WRC-03) also requires that WAS/RLAN need to protect other specific primary services in these frequency bands. For more information on the current WAS/RLAN used in the current bands see section 3.1 of CEPT Report 57 [1].

3.2 CURRENT MITIGATION TECHNIQUES USED IN 5 GHZ WAS/RLAN

The current mitigation techniques used for WAS/RLANs which are operated in the bands 5150-5350 MHz and 5470-5725 MHz are defined in detail in the latest version of ETSI EN 301 893 [17]. For more information on these current mitigation techniques see section 3.2 of CEPT Report 57.

3.3 ASSUMED WAS/RLAN CHARACTERISTICS

The assumption for the studies are that WAS/RLAN systems will only be operating under a general authorisation regime. Taking into account the current CEPT/ECC and EU regulations for WAS/RLAN in the bands 5150-5350 MHz and 5470-5725 MHz, the following characteristics have been assumed for the compatibility and sharing studies addressed in this Report.

3.3.1 5350-5470 MHz (based on Wi-Fi)

The basic assumptions have been derived from the current CEPT/ECC and EU regulations for the band 5150-5350 MHz: indoor use only, mean e.i.r.p. limited to 200 mW, and use of mitigation techniques such as dynamic frequency selection (DFS) and transmitter power control (TPC). Additional assumptions are outlined below.

The main characteristics of the RLAN systems considered in the Report are derived from the IEEE 802.11ac standard [4] with the following assumptions related to power distribution and channel distribution:

Table 1: WAS/RLAN power distribution in the band 5350-5470 MHz

Tx power e.i.r.p.	200mW (omni)	80mW (omni)	50mW (omni)	25mW (omni)
Device Percentage	19%	27%	15%	39%

Notes: These e.i.r.p. values apply across the entire RLAN channel bandwidth.

RLAN devices are assumed to be indoors only, based on the requirement to help facilitate coexistence. For the purposes of sharing studies, 5% of the devices should be modelled without building attenuation. Alternatively administrations may choose to carry out a parametric analysis in any range between 2% and 10%.

Table 2: RLAN channel bandwidth distribution in the band 5350-5470 MHz

Channel bandwidth	20 MHz	40 MHz	80 MHz	160 MHz
RLAN Device Percentage	10 %	25 %	50 %	15 %

WAS/RLAN antenna gain/discrimination for the compatibility studies.

The RLAN antenna is omnidirectional in azimuth for all scenarios.

In the elevation plane, it was agreed to consider for the studies in the band 5350-5470 MHz the RLAN antenna pattern on a parametric way with the two following options[5] as the two edges of a reasonable range:

- Omnidirectional in elevation (i.e. 0 dBi);
- An average 4 dB antenna discrimination applied to the e.i.r.p. level distribution above in the direction of the satellite.

3.3.2 5725-5850 MHz and 5850-5925 MHz (based on Wi-Fi)

The basic assumptions have been derived from the current CEPT/ECC and EU regulations for the band 5470-5725 MHz: indoor as well as outdoor use allowed, mean e.i.r.p. limited to 1 W, and use of mitigation techniques such as dynamic frequency selection (DFS) and transmitter power control (TPC).

The main characteristics of the RLAN systems considered in the Report are derived from the IEEE 802.11ac standard [4] with the following assumptions related to power distribution and channel distribution:

Table 3: RLAN power distribution in the band 5725-5925 MHz

Tx power e.i.r.p.	1W (directional)	1 W (omni)	200mW (omni)	80mW (omni)	50mW (omni)	25mW (omni)	all
Indoor	0%	0%	18%	25.6%	14.2%	36.9%	94.7%
Outdoor	0.10%	0.20%	0.95%	1.35%	0.75%	1.95%	5.3%

Table 4: RLAN channel bandwidth distribution in the band 5725-5925 MHz

Channel bandwidth	20 MHz	40 MHz	80 MHz	160 MHz
RLAN Device Percentage	10 %	25 %	50 %	15 %

3.3.3 LAA-LTE characteristics for the 5725 – 5925 MHz

Although the studies so far have only considered sharing between LAA-LTE and incumbent services and applications in the 5725 – 5925 MHz, studies for possible LAA-LTE use in the 5350 – 5470 MHz band may also be carried in the future. Characteristics of LAA-LTE in this band will need further consideration. LAA-LTE is expected to be deployed by operators, mainly in hotspots and enterprise environments. Therefore deployments of possible LAA-LTE in the residential environment (user deployed) have not been considered in the current studies. These limited assumptions will have to be considered either in an expansion of future technical studies or as a possible regulatory issue to be studied. Operator-deployed means that the actual deployment will be “somewhat planned”, therefore LAA-LTE will only be used in places where the operator coverage of LAA-LTE is available. Notice that the main target for LAA-LTE is mainly indoor small cells deployments, but outdoor deployment is not precluded.

[5] These options correspond to the options A1 and A3 as considered by the ITU-R JTG 4-5-6-7 in the studies performed in the context of WRC-15 Agenda Item 1.1

3.3.3.1 LAA-LTE transmission power characteristics

LAA-LTE will fulfil same requirements as for RLAN characteristics used in ECC Report 244 [2] in terms of conducted and radiated power and power spectral density limits. Also, available channel bandwidths will be aligned with those assumed for RLAN. In LAA-LTE, basic transmission bandwidth per carrier is 20MHz. Transmissions on bandwidths higher than 20MHz are done via carrier aggregation.

Table 5: Basic LAA-LTE transmitter characteristics in the band 5725-5925 MHz

System Parameters	Indoor	Outdoor
	LAA-LTE	LAA-LTE
Maximum Transmit Power (e.i.r.p. - dBm)	23	30
Bandwidth (MHz)	20/40/80/160	20/40/80/160
Maximum Transmit Power Density (e.i.r.p. - dBm/MHz)	10/7/4/1	17/14/11/8
Typical AP Antenna Type	Omni-directional (azimuth)	Omni-directional (azimuth)
AP Antenna gain + cable loses (dBi)	5	5
AP Antenna Height (m)	6	10
Access method LAA-LTE	OFDMA	

3.3.3.2 LAA-LTE e.i.r.p. distribution

Table 6: depicts LAA-LTE power distribution considering both BS and UE:

Table 6: LAA-LTE e.i.r.p. distribution considering both LAA BS and UE

Tx power e.i.r.p.	1 W	200mW	140 mW	100 mW	50 mW	13 mW	<=1mW	all
indoor	0.00 %	9.55 %	0.96%	20.58 %	7.96 %	21.50%	22.95 %	83.50%
outdoor	0.01%	2.10 %	0.49 %	3.92%	1.91 %	5.28 %	2.79 %	16.50%

3.3.3.3 LAA-LTE channel bandwidth characteristics

LAA-LTE can support different channel bandwidths through the carrier aggregation mechanism. It can be observed that IEEE and 3GPP standards are converging in terms of overall spectral efficiency. Assuming that LAA-LTE and Wi-Fi will be subject to the same traffic demand by the end users, it is reasonable to expect that very similar channel bandwidth distribution will be required by the two systems.

Based on the above observations, it is expected that Wi-Fi and LAA-LTE will have same channel bandwidth distribution as described below:

Table 7: LAA-LTE channel bandwidth distribution and bandwidth correction values

Channel bandwidth	20 MHz	40 MHz	80 MHz	160 MHz
Device Percentage	10 %	25 %	50 %	15 %

4 RESULTS OF SHARING AND COMPATIBILITY ANALYSIS

4.1 EESS IN THE 5350-5470 MHz

ETSI have initiated work to look at implementation and feasibility of new alternative mitigation techniques and further studies on these possible additional mitigation techniques continue to be carried out in the ITU-R and CEPT. However, the final results of these studies have not been concluded in the timescales associated with this EC mandate and WRC-15. In addition, no further sharing and compatibility analysis has been carried out for this service since the publication of CEPT Report 57 [1] so the conclusions reported in CEPT Report 57 are still valid at this time. Therefore, at the time of finalising this report, after consideration of the results of the studies so far and without knowing the conclusions of these further studies, it is not possible to specify any appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands 5350-5470 MHz while ensuring relevant protection of EESS (active) and the operation of GMES/Copernicus.

4.2 RADIOLOCATION IN THE BANDS 5350-5470 MHz AND 5725-5850 MHz

ETSI have initiated work to analyse the feasibility of implementation and impact on RLAN operations of the new radar test signals for the bands 5350-5470 MHz and 5725-5850 MHz and further studies on these possible additional mitigation techniques continue to be carried out in the ITU-R and CEPT.

As far as meteorological radars in the 5350-5470 MHz band are concerned, CEPT also proposed to ETSI to consider in this band the application of specific DFS conditions similar to those pertaining in the band 5600-5650 MHz.

It should be noted that the 5725-5850 MHz band is an ISM band and various services and applications already operate in CEPT countries with and without DFS at various power levels under different ECC deliverables. Therefore, when discussing appropriate mitigation techniques for RLANs, the impact of interference from ISM devices and these existing radio communication applications into radiolocation systems would need to be considered for comparison purposes. In addition, no further sharing and compatibility analysis has been carried out for this service since the publication of CEPT Report 57, so the conclusions reported in CEPT Report 57 are still valid at this time.

Therefore, at the time of finalising this report, after consideration of the results of the studies so far and without knowing the conclusions of any further studies, it is not possible to specify any appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands while ensuring relevant protection of the radiolocation services in these bands.

4.3 SYSTEMS/SERVICES IN THE BAND 5725-5850 MHz EXCEPT RADIOLOCATION

4.3.1 Compatibility with FSS (Earth-space)

Further studies since the publication of CEPT Report 57 have focused on the assessment of the interference from RLAN into FSS using a two-step approach:

- **Step 1** calculates the maximum number of active, on-tune, RLAN transmitters that can be accommodated by the satellite receiver under consideration (considering the satellite footprint) whilst satisfying the FSS protection criteria described in ECC Report 244 [2], section 3.2.2.
- **Step 2** delivers the number of active, on-tune, RLAN transmitters using a deployment model. The step 2 outputs can be compared with the step 1 values in order to assess the potential for sharing. In theory, if the step 2 values are less than or equal to the step 1 values, then the results suggest that sharing is possible; else if the step 2 values are greater than the step 1 values, sharing is not possible.

Concerning step 1, results have been obtained considering 2 different values of building attenuation for indoor use (12 and 17 dB), two values of antenna discrimination (0 and 4 dB), and an approach to service

and geographic apportionment of the FSS protection criteria of ΔT/T=6%. Further modelling takes account of clutter loss and polarisation mismatch loss on the Earth to space interference path.

The different factors used in step 2 are also subject to some uncertainties because of the difficulties involved when deriving values for these factors and in particular when making predictions for 2025.

Therefore it was agreed to perform sensitivity analyses, taking into account ranges of values for some of these factors. Initial calculations and results were presented in ECC Report 244 [2] but, although providing some relevant results, it was too early to draw definite conclusions.

Additional results on the potential for RLAN–FSS sharing were developed in the further studies, taking into account additional considerations, such as:

- Antenna discrimination for outdoor RLANs;
- Further studies on polarisation mismatch;
- Studies supporting Stage 8 of FSS Step 2 (see section 8.1.3.4 of ECC Report 244);
- 5 GHz Spectrum Factor (Stage 5 of FSS Step 2 see section 8.1.3.2 of ECC Report 244);
- Control / monitoring on the long term aggregate effect of RLAN interference into FSS as RLAN deployment increases and investigation of what can be done in a scenario where the interference threshold is reached;
- Further studies on apportionment of the FSS protection criteria.

The wide range of results available reflects the wide range of inputs to the models considered in the studies. Further work would be required on the modelling including on the range of inputs.

As a result, it has not been possible to arrive at a consensus regarding suitable inputs for the modelling, and further studies are required. Further mitigation techniques may also need to be investigated and studied for their impact on RLAN operations and results of studies. One possible way forward to address some of the uncertainties currently seen in the range of results is to carry out some airborne measurements to compare actual RLAN use with the predicted results from the model for defined geographical areas. An example of how to compare real measurements with the results of the model has been presented during the course of the studies.

Therefore, at the time of finalising this report, after consideration of the results of the studies so far and without knowing the conclusions of any further studies, it is not possible to specify any appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands while ensuring relevant protection of the Fixed Satellite Services in these bands.

There has been no study on the potential interference from FSS earth stations into RLAN.

4.3.2 Compatibility with TTT (road-tolling applications) in the band 5795-5815 MHz

Although CEPT have published ECC Report 244 and ETSI have initiated work to look at implementation and feasibility of new alternative mitigation techniques, only limited further sharing studies and compatibility analysis has been carried out between TTT and RLANs since the publication of CEPT Report 57 [1], therefore the conclusions from CEPT Report 57 are still valid.

As a result of the studies carried out in CEPT Report 57, work on possible mitigation techniques has been initiated and the following approaches have been suggested to enable the coexistence between RLAN and road-tolling:

- Implementation in RLAN of a detection mechanism to detect road tolling applications based on energy detection. Under the assumptions considered preliminary analysis indicated that for a RLAN system operating with 23 dBm/20MHz a detection threshold of the order of -100 dBm/500kHz and for a RLAN system with 23 dBm/160MHz a detection threshold of the order of -90 dBm/500kHz would be required for a reliable detection of road tolling. Further consideration is required, including on the feasibility of such a detection threshold and its impact on the RLAN operation.

- Transmission from the road tolling applications of predefined signals (beacons) which indicate that the used channels are busy, similar to one of the mitigation techniques used to facilitate ITS and Road Tolling adjacent channel co-existence.
- Ensure coexistence with the road tolling systems through the detection of ITS. This is based on the assumption that there will always be ITS systems in the close vicinity of road-tolling road-side units. Under this approach, once ITS have been detected by RLAN under the conditions described in section 4.4.2, the road tolling frequency band 5795-5805 MHz / 5805-5815 MHz will also be considered as occupied and thus, not available for RLAN use.
- Use of a database approach. The database should hold actual information from static and, due to construction sites, temporary tolling installations. The implementation of such a platform, its access and, its maintenance should be addressed. In addition, the role and responsibilities or the stakeholders have to be clearly defined. A database containing a list of fixed tolling station locations is being prepared by ASECAP. A first version is planned to be released within 2016 which will be updated over time. The database will include tolling station locations following the data specification for protected zones in ETSI TS 102 894-2 [18].

It has to be noted that time domain effects in regard to sensing procedures (e.g. listening time, dead time) or the effect of RLAN network deployments on POD (Probability Of Detection) and the associated aggregate interference environment have not yet been considered.

Further work is required to assess these approaches.

4.3.3 Compatibility with BFWA (FS)

As a result of the studies carried out in CEPT Report 57 [1], work on mitigation techniques has been initiated. Preliminary analysis on detection mechanisms relying on energy detection indicated that a detection threshold of the order of -90 to -95 dBm/20 MHz would be required either on the RLAN side or on the BFWA side. Further consideration is required, including on the feasibility of such detection thresholds. Due to the similarity between RLAN and BFWA systems using TDD technology, it is also envisaged that more specific coexistence mechanisms may be relevant. This requires further work.

The above considerations on sensing procedures may not apply to FDD BFWA systems.

It has to be noted that time domain effects in regard to sensing procedures (e.g. listening time, dead time) or the effect of RLAN network deployments on POD (Probability Of Detection) and the associated aggregate interference environment have not yet been considered and may be an issue for further work.

4.3.4 Compatibility with Wireless Industrial Applications (WIA)

Previous studies showed that an acceptable degree of compatibility could be achieved therefore no further sharing and compatibility analysis has been carried out for this service since the publication of CEPT Report 57 [1]. Therefore the conclusions reported in CEPT Report 57 are still valid at this time.

4.3.5 Compatibility between RLAN and the Amateur (5725-5850 MHz) and Amateur Satellite (Space to Earth, 5830-5850 MHz) services

Since the publication of CEPT Report 57, some preliminary consideration of the three main categories of radio amateur usage (narrowband, data and amateur satellite) for both directions has been made that may provide guidance for future work (along with ECC Report 206 [3]). This includes an initial identification of relevant mitigation techniques.

Whilst some scenarios and directions may require further study, it has already been found that compatibility is achieved between Amateur Satellite downlink transmissions and RLAN receivers

4.3.6 Compatibility between RLAN and non-specific Short range devices in the band 5725-5875 MHz

No studies have been carried out since the publication of CEPT Report 57, so no sharing and compatibility analysis is available.

4.4 SYSTEMS/SERVICES IN THE BAND 5850-5925 MHz

4.4.1 Compatibility with FSS (Earth-space)

See section 4.3.1.

It should also be noted that most of the currently operating satellites have receive transponders in this upper portion of the band.

4.4.2 Compatibility with ITS in the bands 5855-5875 MHz (non-safety ITS), 5875-5905 MHz (safety-related ITS) and 5905-5925 MHz (ITS extension band)

Although CEPT have published ECC Report 244 [2] and ETSI have initiated work to look at implementation and feasibility of new alternative mitigation techniques, only limited further sharing studies and compatibility analysis has been carried out between ITS and RLANs since the publication of CEPT Report 57 [1], therefore the conclusions from CEPT Report 57 are still valid.

As a result of the studies carried out in CEPT Report 57, work on possible mitigation techniques was initiated to see if they could provide compatibility between individual RLAN devices and ITS. These studies have focused on a “listen-before-talk” process, where the potential interferer tries to detect whether a channel is busy before transmitting a data packet.

Two possible approaches are still under study:

- Generic Energy Detection without any consideration of the interferer and victim signal frames: Under the assumptions considered, preliminary studies show that in the case of an energy detection threshold of -90dBm/10MHz for a RLAN system operating with 23 dBm/20MHz, an ITS device with 23dBm/10MHz is not reliably to be detected. Further consideration is required, including on the feasibility of such a detection threshold and its impact on the RLAN operation.
- Combination of energy detection and specific identification of the ITS signals (e.g. one of the Clear Channel Assessment (CCA) modes defined in the 802.11 standard [4]). Further study is required to assess the applicability to ITS of the interference avoidance techniques currently employed in 5 GHz RLAN systems.

In addition, the different performance requirements in terms of safety and non-safety ITS applications need to be considered by the mitigation techniques.

It has to be noted that time domain effects in regard to sensing procedures (e.g. listening time, dead time) or the effect of RLAN network deployments on POD (Probability Of Detection) and the associated aggregate interference environment have not yet been considered and may be an issue for further work.

4.4.3 Compatibility with public transport automation systems in the 5.915-5.935 GHz band

Preliminary calculations have been performed for systems which have been introduced on national level in some CEPT countries. They would need to be reviewed in the light of the recent developments in ETSI towards developing a new ETSI System Reference Document applicable to these systems.

4.4.4 Compatibility with BFWA (FS) in the band 5850-5875 MHz

See section 4.3.3.

4.4.5 Compatibility with Wireless Industrial Applications (WIA)

See section 4.3.4.

4.4.6 Compatibility with broadband Direct air to ground communications (DA2GC) in the frequency range 5855-5875 MHz

Previous studies showed that an acceptable degree of compatibility could be achieved therefore no further sharing and compatibility analysis has been carried out for this service since the publication of CEPT Report 57 [1]. Therefore the conclusions reported in CEPT Report 57 are still valid at this time.

4.5 COMPARISON OF RESULTS OF STUDIES WHEN INCLUDING LAA-LTE USE IN THE 5 GHz EXTENSION BANDS

Three additional studies compared to ECC Report 244 [2] have been made with LAA-LTE as a technology option under WAS/RLAN for use in the 5725-5925 MHz band:

- Compatibility of LAA-LTE with Road tolling: results roughly are the same as for the case of WiFi, the scenario of in car LAA-LTE has not been studied as no deployment scenario is foreseen.
- Compatibility of LAA-LTE with ITS: results are roughly the same as for the case of WiFi, the scenario of in car LAA-LTE has not been studied as no deployment scenario is foreseen.
- Compatibility of WAS/RLAN with FSS, assuming a mix of LAA-LTE and WiFi market share estimations, results are roughly the same as for the case of WiFi only.

Therefore for the cases shown in the bullets above the impact of adding LAA-LTE use case in 5725-5925 MHz bands appears to have little additional effect on the overall study results of compatibility and sharing when compared to the original studies as shown in ECC Report 244.

4.6 FURTHER WORK ON THE ANALYSIS OF MITIGATION TECHNIQUES

Previous studies have shown that a wide variety of incumbent systems in the bands 5350-5470MHz and 5725-5925MHz would not be able to maintain an acceptable level of performance if RLANs having the same regulatory restrictions and usage parameters used in the rest of the 5 GHz bands (i.e. 5150-5350 MHz and 5470-5725 MHz) were to be introduced in the band. Therefore, a set of additional mitigation techniques aiming at allowing coexistence of RLAN with a variety of incumbent systems had been suggested for further study.

ETSI BRAN is still working on developing technical reports to assess the feasibility of implementation of a number of additional mitigation techniques and their impact on RLAN operations and was not in a position to provide information at the stage of developing the Report. Therefore it was not possible to assess the feasibility and efficiency of these mitigation techniques to ensure protection of incumbent services and applications.

Overall, considering the results of the studies performed at the time of finalising this report, it is not possible to specify any appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow RLANs to be operated in the bands 5350-5470 MHz and 5725-5925 MHz while ensuring relevant protection of incumbent services in these bands.

4.7 ISSUES RELATED TO COMPLIANCE, ILLEGAL USE AND MARKET SURVEILLANCE

In CEPT Report 57, consideration of various mitigation techniques proposed for use in the extension bands and the experience gained since 2003 in the current RLAN bands (5150-5350 MHz and 5470-5725 MHz bands) was considered and, in particular, the case of interference to meteorological radars in the band 5600-5650 MHz. To this respect, the situation as presented in ECC Report 192 [5], show that there are interference cases to meteorological radars due to intentional illegal use of RLAN and non-compliant RLAN equipment in the 5600-5650 MHz band and are still being reported according to the interference statistics for 2015 (Annex 23 to the WGFM#85 Minutes). When considering mitigation techniques in potential extension bands 5350-5470 MHz and 5725-5925 MHz bands, and prior to any decision to authorise RLAN in these bands, due consideration would have to be given to improving the situation in the existing bands and avoiding its potential replication in extension bands.

5 RESULTS FROM ITU-R STUDIES AND WRC-15

5.1 STUDIES FOR THE BAND 5350-5470 MHz

The results of studies carried out in the ITU-R in support of WRC-15 agenda item 1.1 can be seen in documents JTG 4-5-6-7/715 annex 34 and annex 35.

The CPM text for WRC-15 [6] only contained the "No change" option (Method A) for the band 5350-5470 MHz. Section 1/1.1/5.17 of the CPM text mentions (see document JTG 4-5-6-7/715 annex 3): Therefore the result of the WRC-15 for this band was:

"No change due to unresolved issues:

a. Results of studies show that with the RLAN parameters utilised, sharing between RLAN and EESS (active) systems in the 5350-5470 MHz range would not be feasible. Sharing may only be feasible if additional RLAN mitigation measures are implemented, but no agreement was reached on the applicability of additional RLAN mitigation techniques. Some additional RLAN mitigation techniques to enable sharing with EESS (active) are being studied by the ITU-R, but no conclusions can be drawn at this time.
b. The regulatory provisions in the 5150-5350 MHz and 5470-5725 MHz frequency ranges contained in Resolution 229 (Rev. WRC-12) [16] are insufficient to ensure protection of certain radar types in the 5350-5470 MHz frequency range. Some additional RLAN mitigation techniques to enable sharing are being studied by the expert groups in the ITU-R but no conclusions can be drawn at this time. Further study by ITU-R is required to determine if these additional mitigation techniques can be utilised to mitigate potential interference to these particular radar types."

5.2 STUDIES FOR THE BAND 5725-5850 MHz

The results of studies carried out in ITU-R in support of WRC-15 agenda item 1.1 can be seen in document number JTG 4-5-6-7/715 annex 34 (terrestrial radar).

The CPM text for WRC-15 [6] only contained the "No change" option (Method A) for the band 5725-5850 MHz. Section 1/1.1/5.18&3.2.12 of the CPM text mentions (see document number JTG 4-5-6-7/715 annex 3): Therefore the result of the WRC-15 for this band was:

"No change due to unresolved issues:

Some administrations submitted contributions indicating that the study results for the 5350-5470 MHz frequency range are applicable to the 5725-5850 MHz frequency range to ensure protection of certain radars that operate across or in portions of the 5250-5850 MHz frequency range. Some other administrations raised concerns regarding these results because no RLAN characteristics were previously agreed for the 5725-5850 MHz frequency range and that the RLAN characteristics utilised for the 5350-5470 MHz frequency range cannot be applied similarly to the 5725-5850 MHz frequency range. Some administrations also highlighted that the sharing environment is significantly different between the two bands due to the ISM designation of the 5725-5875 MHz frequency band. There are current deployments of RLAN in the 5725-5850 MHz band in some countries in all three ITU Regions. Therefore, agreement was not reached on the conclusions in these documents".

"No other sharing/compatibility studies were provided for this frequency band".

6 RESULTS AND CONCLUSIONS

This CEPT Report has been developed within the European Conference of Postal and Telecommunications Administrations (CEPT) in the framework of the EC Mandate on the 5 GHz WAS/RLAN extension bands (see ANNEX 1:).

The mandate requests CEPT to study and identify harmonised compatibility and sharing conditions for a sustainable and efficient use on a shared basis of the frequency bands 5350-5470 MHz and 5725-5925 MHz ('WAS/RLAN extension bands') for wireless access systems including radio local area networks (WAS/RLANs).

It should be noted that CEPT has carried out a significant amount of work and that this is a final Report from CEPT to the Commission to cover the description of work undertaken under Tasks (1), (2) and (3) of the Mandate. In addition although the WRC-15 decided on a “no change” decision to the Radio Regulations under agenda item 1.1 in the 5350-5470 MHz and 5725-5925 MHz bands, there are still a number of open issues related to further studies (particularly on possible mitigation techniques) that are still ongoing within CEPT and ITU-R.

Therefore, at the time of finalising this report, after consideration of the results of the studies so far and without knowing the conclusions of any further studies, it is not possible to specify all of the appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands 5350-5470 MHz and 5725-5925 MHz while ensuring relevant protection of the incumbent services and applications that operate in these bands.

The results of the studies undertaken under the mandate are presented in detail throughout this Report, CEPT Report 57 [1] and ECC Report 244 [2] and a summary of these results for the bands covered under the mandate is presented below.

Earth Exploration Satellite Service (Active) in the band 5350-5470 MHz

ETSI have initiated work to look at implementation and feasibility of new alternative mitigation techniques and further studies on these possible additional mitigation techniques continue to be carried out in the ITU-R and CEPT. However, the final results of these studies have not been concluded in the timescales associated with this EC mandate. In addition, no further sharing and compatibility analysis has been carried out for this service since the publication of CEPT Report 57 so the conclusions reported in CEPT Report 57 are still valid at this time. Work is still required on the specification of appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands 5350-5470 MHz while ensuring relevant protection of EESS (active) and the operation of GMES/Copernicus.

Radiolocation in the bands 5350-5470 MHz and 5725-5850 MHz

ETSI have initiated work to analyse the feasibility of implementation and impact on RLAN operations of the new radar test signals for the bands 5350-5470 MHz and 5725-5850 MHz and further studies on these possible additional mitigation techniques continue to be carried out in the ITU-R and CEPT.

As far as meteorological radars in the 5350-5470 MHz band are concerned, CEPT also proposed to ETSI to consider in this band the application of specific DFS conditions similar to those pertaining in the band 5600-5650 MHz.

It should be noted that the 5725-5850 MHz band is an ISM band and various services and applications already operate in CEPT countries with and without DFS at various power levels under different ECC deliverables. Therefore, when discussing appropriate mitigation techniques for RLANs, the impact of interference from ISM devices and these existing radio communication applications into radiolocation systems would need to be considered for comparison purposes. In addition, no further sharing and compatibility analysis has been carried out for this service since the publication of CEPT Report 57 so the conclusions reported in CEPT Report 57 are still valid at this time.

Work is still required on the specification of appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands while ensuring relevant protection of the radiolocation services in these bands.

Fixed Satellite Services in the band 5725-5925 MHz

Further studies since the publication of CEPT Report 57 [1] have focused on the assessment of the interference from RLAN into FSS using a two-step approach:

- **Step 1** calculates the maximum number of active, on-tune, RLAN transmitters that can be accommodated by the satellite receiver under consideration (considering the satellite footprint) whilst satisfying the FSS protection criteria.
- **Step 2** delivers the number of active, on-tune, RLAN transmitters using a deployment model. The step 2 outputs can be compared with the step 1 values in order to assess the potential for sharing. In theory, if the step 2 values are less than or equal to the step 1 values, then the results suggest that sharing is possible; else if the step 2 values are greater than the step 1 values, sharing is not possible.

As there were a number of options and associated results studied for both steps 1 and 2 it was agreed to perform sensitivity analyses, taking into account ranges of values for some of these factors. Initial calculations and results were presented in ECC Report 244 [2] but, although providing some relevant results, it was too early to draw definite conclusions.

Additional studies on the potential for RLAN-FSS sharing were developed.
The wide range of results available reflects the wide range of inputs to the models considered in the studies. Further work would be required on the modelling including on the range of inputs.

As a result, it has not been possible to arrive at a consensus regarding suitable inputs for the modelling, and further studies would be required. Further mitigation techniques may also need to be investigated and studied for their impact on RLAN operations and results of studies. One possible way forward to address some of the uncertainties currently seen in the range of results is to carry out some airborne measurements to compare actual RLAN use with the predicted results from the model for defined geographical areas. An example of how to compare real measurements with the results of the model has been presented during the course of the studies.

Work is still required on the specification of appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands while ensuring relevant protection of the Fixed Satellite Services in these bands.

There has been no study on the potential interference from FSS earth stations into RLAN.

Other Applications/Services in the band 5725-5850 MHz

Although CEPT have published ECC Report 244 and ETSI have initiated work to look at implementation and feasibility of new alternative mitigation techniques, only limited further sharing studies and compatibility analysis has been carried out between TTT, BFWA and RLANs since the publication of CEPT Report 57, therefore the conclusions from CEPT Report 57 are still valid.

Other applications/services that have been studied in this band include WIA, where it is expected that compatibility can be achieved through a coordination procedure within factory premises where WIA are expected to be deployed.

Preliminary consideration of the three main categories of radio amateur usage (narrowband, data and amateur satellite) for both directions has been made that may provide guidance for future work (along with ECC Report 206 [3]). This includes an initial identification of relevant mitigation techniques. Whilst some scenarios and directions may require further study, it has already been found that compatibility is achieved between Amateur Satellite downlink transmissions and RLAN receivers

Due to lack of input no sharing and compatibility studies have been conducted for the following services:

- Compatibility between RLAN and non-specific Short range devices in the band 5725-5875 MHz;

Other Applications/Services in the band 5850-5925 MHz

CEPT have continued to carry out sharing and compatibility studies between RLANs and other radio services/applications operating the band 5850-5925 MHz band. Although CEPT have published ECC Report 244 and ETSI have initiated work to look at implementation and feasibility of new alternative mitigation techniques only limited further sharing studies and compatibility analysis has been carried out between ITS, BFWA and RLANs since the publication of CEPT Report 57 [1] therefore the conclusions from CEPT Report 57 are still valid.

Previous studies showed that an acceptable degree of compatibility could be achieved between WIA, Broadband DA2GC and RLANs, therefore no further sharing and compatibility analysis has been carried out for these applications since the publication of CEPT Report 57.

However, the final results of all the studies for this frequency band have not been concluded in the timescales associated with this EC mandate for all of the concerned radio services/applications at the time of finalising this report. There are still a number of open issues related to further studies (particularly on possible mitigation techniques).

Work is still required on the specification of appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands 5850-5925 MHz while ensuring relevant protection of all of the incumbent services and applications.

Considerations on WAS/RLAN characteristics

The studies done in preparation of this Report, CEPT Report 57 and ECC Report 244 [2] are based on RLAN characteristics derived from 802.11ac [4]. Another RLAN technology, i.e. LAA-LTE has been included in the further studies developed within CEPT. These studies concluded that the impact of adding LAA-LTE use case in 5725-5925 MHz bands appears to have little additional effect on the overall study results of compatibility and sharing when compared to the original studies as shown in ECC Report 244.

However, other future RLAN technologies (e.g. 802.11ax) might be taken into consideration in future studies. It is expected that all 5 GHz RLAN technologies will have to comply with the same spectrum regulations and a single harmonised standard.

Compliance, illegal use and market surveillance

In CEPT Report 57, consideration of various mitigation techniques proposed for use in the extension bands and the experience gained since 2003 in the current RLAN bands (5150-5350 MHz and 5470-5725 MHz bands) was considered and, in particular, the case of interference to meteorological radars in the band 5600-5650 MHz. To this respect, the situation as presented in ECC Report 192 [5], show that there are interference cases to meteorological radars due to intentional illegal use of RLAN and non-compliant RLAN equipment in the 5600-5650 MHz band and are still being reported according to the interference statistics for 2015 (Annex 23 to the WGFM#85 Minutes). When considering mitigation techniques in potential extension bands 5350-5470 MHz and 5725-5925 MHz bands, and prior to any decision to authorise RLAN in these bands, due consideration would have to be given to improving the situation in the existing bands and avoiding its potential replication in extension bands.

Further work on the analysis of additional mitigation techniques

Previous studies have shown that a wide variety of incumbent systems in the bands 5350-5470MHz and 5725-5925MHz would not be able to maintain an acceptable level of performance if RLANs having the same regulatory restrictions and usage parameters used in the rest of the 5 GHz bands (i.e. 5150-5350 MHz and 5470-5725 MHz) were to be introduced in the band. Therefore, a set of additional mitigation techniques aiming at allowing coexistence of RLAN with a variety of incumbent systems had been suggested for further study.

ETSI BRAN is still working on developing technical reports to assess the feasibility of implementation of a number of additional mitigation techniques and their impact on RLAN operations and was not in a position to provide information at the stage of developing the Report. Therefore it was not possible to assess the feasibility and efficiency of these mitigation techniques to ensure protection of incumbent services and applications.

Further studies could also be needed for:

- Compatibility between RLAN and non-specific Short range devices in the band 5725-5875 MHz;
- Compatibility between RLAN and the Amateur (5725-5850 MHz) and Amateur Satellite (Space to Earth, 5830-5850 MHz) services;
- Adjacent band compatibility between RLAN on one hand and the FS and FSS above 5925 MHz, on the other hand;
- Compatibility between RLAN and FS operated in band 5725-5925 MHz.

Impact from WRC-15

The results from the WRC 15 did not impact the conclusions of CEPT Report 57 which are confirmed.

In conclusion there are still a number of issues outstanding (particularly on possible mitigation techniques) that remain open for further study after this final response to this mandate.

Taking forward outstanding issues

In order to take forward the work on these outstanding issues, CEPT will be required to continue their studies taking account the future areas of study highlighted in this Report. CEPT will also have to continue to work closely with ETSI and the relevant industry stakeholders on the implementation and impact of any possible mitigation techniques on RLANs as well as studying their feasibility and impact on incumbent users. In addition due to the large ranges being presented in the results of the current studies, CEPT will also be required to gather further information on and study ways to improve, (1) the evidence (including possible measurement campaigns) currently available for estimating aggregate interference from RLAN deployments (particularly w.r.t. satellite services), (2) the evidence available on the mainstream RLAN uses and their technical and operational characteristics today and in the future (including the impact of new technologies such as 802.11ax).

General conclusions

Overall, considering the results of the studies performed under Tasks (1), (2) and (3) of the EC Mandate at the time of finalising this report, it is not possible to specify any appropriate mitigation techniques and/or operational compatibility and sharing conditions that would allow WAS/RLANs to be operated in the bands 5350-5470 MHz and 5725-5925 MHz while ensuring relevant protection of incumbent services in these bands.

It should be noted that some additional work (in particular on mitigation techniques) outside of the scope of this Mandate is ongoing within CEPT, ETSI and ITU and is expected to be finalised before 2019.

ANNEX 1: CEPT MANDATE

MANDATE TO CEPT
TO STUDY AND IDENTIFY HARMONISED COMPATIBILITY AND SHARING CONDITIONS FOR WIRELESS ACCESS SYSTEMS INCLUDING RADIO LOCAL AREA NETWORKS IN THE BANDS 5350-5470 MHZ AND 5725-5925 MHZ ('WAS/RLAN EXTENSION BANDS') FOR THE PROVISION OF WIRELESS BROADBAND SERVICES

1. Purpose

To mandate CEPT to study and identify harmonised compatibility and sharing conditions for a sustainable and efficient use on a shared basis of the frequency bands 5350-5470 MHz and 5725-5925 MHz ('WAS/RLAN extension bands') for wireless access systems including radio local area networks (WAS/RLANs). Based on the results of the necessary coexistence studies, the operational sharing conditions for WAS/RLANs should in particular ensure that protection is guaranteed for priority systems supporting EU policies, such as GMES (Global Monitoring for Environment and Security) and ITS (Intelligent Transport Systems) and that coexistence with other systems in these and adjacent frequency bands is safeguarded.

2. Background

Commission Decision 2005/513/EC as amended by Decision 2007/90/EC harmonises the use of radio spectrum in the 5 GHz frequency band (5150-5350 MHz and 5470-5725 MHz) for the implementation of wireless access systems including radio local area networks (WAS/RLANs)[1]. The Commission Recommendation 2003/203/EC on the harmonisation of the provision of public RLAN access to public electronic communications networks and services in the Community invites Member States to allow the provision of such services in the available 2.4 GHz and 5 GHz bands to the extent possible without sector specific conditions. In this regard, the use of the bands for the operation of WAS/RLAN systems shall be subject only to general authorisation and not to the grant of any individual right.

The value of this regulatory framework for WAS/RLAN systems has become evident in recent years through the success of Wi-Fi based wireless broadband usage which is based on bottom-up private infrastructure investments of citizens and the free availability in the internal market of a nearly-globally harmonised spectrum resource that underpins large economies of scale for equipment manufacturers. The low spectrum access barrier has led to a very widespread deployment of interoperable Wi-Fi-capable devices and access points. In addition to the private use of Wi-Fi, wireless broadband access provided via publicly accessible Wi-Fi access points has to be recognised as increasingly important internet connectivity infrastructure that is largely complementary to mobile internet services. Given the inherent limitation of coverage, mainly related to power limits and backhaul needs, such WAS/RLAN-based infrastructures can be considered as an essential competitive element in wireless broadband markets to the extent that such services are used in either nomadic or static situations.

At the same time, they add to the utility of cellular mobile internet services by serving to ease congestion and increasing the attractiveness of smart devices also used for such mobile services, thus also sustaining the demand case for additional cellular network investment. A study[2] funded by the European Commission shows that most smartphone use in fact occurs at home, while relatively little is truly mobile and that the UK, France and Germany have among the highest household penetration of Wi-Fi in the world. The growing proliferation of Wi-Fi hotspots in private homes as well as the increased importance of publicly accessible Wi-Fi access points in Europe for public institutions (libraries, tourist bodies, etc.) and businesses underlines the socio-economic benefits of WAS/RLAN bands. Based on measured

[1] The parts of the 5 GHz range that are currently used in the EU for WAS/RLAN systems are subject to different usage conditions which reflect the results of previous coexistence studies. These conditions include the restriction of the use to indoor use only as well as the implementation of mitigation techniques, such as Transmitter Power Control (TPC) and Dynamic Frequency Selection (DFS). Pursuant to Art. 4(5) of Decision 2005/513/EC Member States shall keep mitigation techniques under regular review and report to the Commission thereupon. In this regard the Commission services are monitoring the investigations that are on-going in CEPT on the current status of DFS in the 5 GHz frequency range.
[2] Study on the "Impact of traffic off-loading and related technological trends on the demand for wireless broadband spectrum", WIK/Aegis, 2013 (SMART 2012/0015).

smart phone and tablet usage patterns[3], it can be observed that in 2012 71% of all wireless data traffic was delivered over Wi-Fi and estimated that this figure will grow to 78% by 2016. In the same period, Wi-Fi traffic is estimated to grow by more than 850% to close to over 1900 PB/month. As such Wi-Fi traffic is supported by fixed line broadband connections to end users' premises, the convenience of such wireless consumption of online content and services with constantly expanding capacity requirements also serves as a major demand "pull" factor for the upgrading of such fixed-line broadband connections.

The socio-economic value of these bands can be compared to the cost for providing the same amount of data capacity with cellular technologies alone. While cellular traffic will itself continue to grow by an annual rate of 66% until 2016, it is estimated that delivering all the 2012 Wi-Fi data traffic in the EU via mobile networks would have required infrastructure investments of € 35bn, while in 2016 around € 200bn would be necessary to cope with the projected demand[4]. In reality, given that such costs would be likely to be passed on to consumers, that demand is probably rather elastic. In the absence of Wi-Fi-based connectivity it must be assumed that a significant part of the measured or projected traffic would either not occur or be delivered through fixed line broadband connections – hence the description of WAS/RLANs as a largely complementary technology. None the less, these estimates of the cost of provision of the same level of wireless connectivity and convenience through cellular technology alone can serve as an indicator of the scale of the direct benefits to citizens and other end users accruing through the availability of Wi-Fi based networks and of sufficient spectrum to sustain them.

In view of the Digital Agenda for Europe and considering the magnitude of the traffic delivered, the Commission is of the view that WAS/RLAN bands for wireless broadband appear to be an essential spectrum resource for the provision and uptake of internet-based services. It is therefore necessary to ensure that sufficient spectrum resources are 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, thereby supporting the convenient and ubiquitous use of high-speed broadband access and thus ultimately the achievement of the infrastructure targets set by the Digital Agenda which also depend on user demand.

However, such an additional harmonised spectrum resource would have to be made available on a shared basis with various other applications which are currently operating in the 5 GHz frequency range. Among these are EU priority uses such as safety-related ITS systems and GMES/Copernicus satellite systems that support EU policies and require protection. ITS systems will facilitate real-time vehicle-to-vehicle as well as vehicle-to-infrastructure communication in order to improve road safety, enhance traffic flows and reduce fuel consumption. The European Earth monitoring programme (GMES), now known as Copernicus, is an EU-lead initiative to provide satellite-based information services, inter alia, as a key tool to support biodiversity, ecosystem management, and climate change mitigation and adaptation. Moreover, there is also a need to ensure coexistence between WAS/RLAN and existing operations of military applications and meteorological radars as well as other primary services.

3. Justification

Pursuant to Article 4(2) of the Radio Spectrum Decision[5], 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[6], the Commission shall, in cooperation with Member States, assess the justification and feasibility of extending the allocations of unlicensed spectrum for wireless access systems, including radio local area networks. In 2012 the Commission has announced its intention to consider the designation of additional harmonised licence-exempt spectrum for RLAN (Wi-Fi) services at 5 GHz through a revision of Decision 2005/513/EC as amended by Decision 2007/90/EC, depending on the outcome of technical sharing studies and of the impact in the market[7].

In addition, 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 to achieving the target for all citizens to have

[3] Based on the use of Android phones and tablet computers in France, Germany, Italy and the UK, see ibid.
[4] Annualised savings in network cost due to off-load, see ibid.
[5] 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
[6] Decision 243/2012/EU of 14 March 2012, OJ L 81 of 21.3.2012
[7] Commission Communication on promoting the shared use of radio spectrum resources in the internal market (COM(2012)478).

access to broadband speeds of not less than 30 Mbps by 2020[8]. Pursuant to Article 8 of the RSPP, Member States and the Commission shall also ensure spectrum availability and protect the radio frequencies necessary for monitoring the Earth's atmosphere and surface, allowing the development and exploitation of space applications and improving transport systems.

The majority of RLAN devices in use today are still operated in the 2.4 GHz band (where, based on EC Decision 2006/771/EC, 83.5 MHz of spectrum is available to a large number of short range devices) because the vast majority of commercially available access points have until recently only been capable of operating there. While there is already 455 MHz of the 5 GHz band harmonised for WAS/RLAN, there is also evidence that an increasing number of client devices including smart phones and tablets now have dual-band capability and that large-scale public Wi-Fi networks are a significant driver of 5 GHz use today, particularly where outdoor coverage is being provided[9]. In this regard, providing an additional spectrum resource on a shared basis without refarming existing usage could provide additional socioeconomic benefits with limited opportunity costs if a sharing possibility can be identified under the applicable preconditions.

In addition, a new generation of RLAN systems (known as IEEE 802.11ac [4]) will be able to achieve throughput rates sufficient to wirelessly extend high-speed fixed broadband infrastructures (of 30 or 100 Mbps or more) to a broad range of client devices without reductions in speeds if operating in 80 MHz and/or 160 MHz channels. This compares to the 20 MHz or 40 MHz channels supported by 802.11n which are typically used today. In addition, the increased throughput rates can also support new applications that rely on uncontended channels for high-speed wireless data transfer between devices, such as for locally streaming HD video. In this regard users will have to rely on an uncontended (in geographic terms) 80 MHz channel to leverage new Wi-Fi generations to deliver what will most likely be on average between 63Mbps and 170Mbps[10]. In high-density residential environments a minimum of eight separate frequency channels are required to ensure that contention between neighbouring access points does not reduce the available bit rate for each user[11].

In the light of these WAS/RLAN technology trends, it is appropriate to assess and study a possible extension of the 5 GHz band for WAS/RLAN usage that would result in WAS/RLAN devices being able to operate on a shared basis within one large uninterrupted block of frequencies starting from 5150 MHz up to 5925 MHz[12]. A recent industry study[13] has estimated that the potential of such a WAS/RLAN extension in improvements in speed for residential users and the increased potential for mobile data-offload alone would results in benefits for Europe of €16.3 billion. Designating an uninterrupted block of spectrum in the 5 GHz range for WAS/RLANs would result in a 70% increase in available spectrum (up to 775 MHz in the range at 5 GHz) but may also result in a 125% increase of possible available 80 MHz channels (from 4 to 9). Realising a beneficial sharing opportunity for WAS/RLAN to operate on a shared basis in an uninterrupted band from 5150 MHz to 5925 MHz would therefore ensure that sufficient spectrum capacity for private and public Wi-Fi deployments will be available throughout the internal market.

However, such an opportunity can only be realised if appropriate coexistence between WAS/RLAN and those civil and/or military radio applications[14] for which the bands 5350-5470 MHz and 5470-5725 MHz are already assigned or designated is duly safeguarded. In particular with regard to radio applications that represent priorities of EU spectrum policy as specifically outlined in the RSPP, such as the European Earth monitoring programme (GMES)[15] in the band 5350-5470 MHz as well as Intelligent Transport Systems (ITS)[16] in the harmonised 5875-5905 MHz band, it will be necessary to ensure full protection of the envisaged usage.

It will therefore be necessary to carry out the appropriate technical studies and identify suitable sharing conditions to fully safeguard the envisaged operation of GMES and of safety-related ITS applications as well as to study the

[8] Article 3(c).
[9] See WIK/Aegis, 2013, current use of the 5 GHz band.
[10] In comparison to the headline speeds, the average usable throughput is considered to be substantially lower in real deployments depending, inter alia, on the user's distance from the access point or the use of one or two streams, whereby most current battery-powered portable devices can only support a single spatial stream. Compare the current status of Wi-Fi technology and its capabilities in Study on "traffic off-loading" (SMART2012/0015).
[11] Ibid, see estimation of Wi-Fi spectrum demand in typical off-load scenarios.
[12] See:
http://www.digitaleurope.org/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=525&PortalId=0&TabId=353
[13] Williamson et al. (2013) Future proofing Wi-Fi – the case for more spectrum. A report for Cisco,
http://www.plumconsulting.co.uk/pdfs/Plum_Jan2013_Future_proofing_Wi-Fi.pdf
[14] These include in some Member States various types of radars operating in the bands 5350-5470 MHz and 5725-5850 MHz for aeronautical and defence purposes.
[15] Based on Regulation (EU) No 911/2010 of the European Parliament and of the Council of 22 September 2010 on the European Earth monitoring programme (GMES) and its initial operations (2011 to 2013) (OJ L 276, 20.10.2010, p. 1) and Article 8(1) RSPP.
[16] Decision 2008/671/EC.

compatibility of WAS/RLAN with all other radio applications currently operated in these bands as well as in bands adjacent to these bands.

In addition, the deliverables of this mandate should contribute to consolidating Member States' positions in the on-going activities at CEPT and ITU on defining the technical and regulatory conditions regarding the proposed allocation to the mobile service of additional bands for radio local area networks (RLANs). Taking into account the current activity in the United States to make available an additional 195 megahertz of spectrum in the 5350-5470 MHz and 5850-5925 MHz bands for RLAN, there is a possibility for global harmonisation that would further strengthen the economies of scale for manufacturers.
In this context the likely use of an additional allocation in the requested bands to the mobile service by unlicensed WAS/RLAN devices and their potential proliferation across borders requires the detailed development of technical parameters in order to prevent EU priority applications such as GMES suffering interference from RLAN systems in large parts of the world.

The scope and schedule of the mandate therefore also reflects the need for the European Union and its Member States to develop a timely and common position on possible harmonised technical conditions in time for WRC-15. In addition and in order to ensure a possible global harmonisation when developing harmonisation measures on the basis of the response to this mandate, it will be necessary to review and/or reconfirm the results of the Mandate based on the relevant outcome of WRC-15.

4. Task order and schedule

The purpose of this Mandate is to (1) study and identify harmonised compatibility and sharing scenarios for WAS/RLANs to operate on a shared basis in an uninterrupted band from 5150 MHz to 5925 MHz under the condition that (i) appropriate protection of EU priority applications, in particular the planned introduction of GMES in the band 5350-5450 MHz and the use of safety-related ITS applications in the frequency band 5875-5905 MHz, is ensured[17] and (ii) that coexistence of WAS/RLAN with other current civil and/or military radio systems to which the bands 5350-5470 MHz and 5725-5925 MHz and adjacent bands have already been assigned or designated (see Annex) is safeguarded; to (2) develop appropriate compatibility and sharing conditions to ensure a long-term spectrum access resource for WAS/RLANs to operate on the basis of a general authorisation as an essential wireless broadband infrastructure in the internal market; and (3) to review and/or reconfirm the compatibility and sharing conditions developed under task 2 for the Final report after WRC-15 taking utmost account of the possibility of international harmonisation.

The CEPT is hereby mandated to undertake the following tasks:

Task 1 – identification of compatibility and sharing scenarios

Taking into account the relevant developments since the completion of the original studies carried out prior to WRC-03 for the bands 5150-5350 MHz and 5470-5725 MHz, to study and identify harmonised compatibility and sharing scenarios for WAS/RLANs in the bands 5350-5470 MHz and 5725-5925 MHz based on the latest generation of WAS/RLAN equipment (EN 301 893 v. 1.6.1. or 1.7.1.) and to define relevant protection parameters and conditions in close cooperation with all concerned stakeholders for:

1.1. Ensuring the planned operation of GMES/Copernicus (such as availability of proper satellite data based on SAR imaging systems) within the band 5350-5470 MHz[18].

1.2. Ensuring safety-related operation of ground-based ITS systems in the band 5875-5905 MHz in line with the provisions of Decision 2008/671/EC.

1.3. Facilitating coexistence between RLAN systems and other existing usage in various Member States in and adjacent to the bands 5350-5470 MHz and 5725-5925 MHz as listed in the annex, including FSS in the band 5725-5925 MHz and radiolocation applications in the bands 5350-5470 MHz and 5725-5850 MHz.

[17] In regard to the protection of the EU priority usages by GMES and ITS the Commission (DG JRC) will invite stakeholders to establish commonly accepted deployments assumptions for RLAN, ITS and GMES/SAR and where technically feasible to conduct laboratory tests with sample equipment to establish accepted interference protection limits.
[18] The centre frequency of the SAR on Sentinel-1 is 5405 MHz with an operating bandwidth of 90 MHz and centre frequency of the Altimeter on Sentinel-3 is 5410 MHz with an operating bandwidth of 320 MHz.

1.4. Assessing the impact, if any, of the future use of WAS/RLAN systems in the WAS/RLAN extension bands on SRDs operating in the bands 4500-7000 MHz, 5725-5875 MHz and 5795-5805 MHz according to the parameters harmonised in Decision 2006/771/EC[19].

For each compatibility and sharing scenario, the risk of interference, the deployment assumptions of all applications and the operational footprint of the actual use of the protected services/applications should be identified[20].

In addition, it should also be assessed whether and how coexistence can be ensured between the future WAS/RLAN usage, as an essential element of the wireless broadband EU priority, and other uses of the 5 GHz band that are currently considered on a shared basis, taking into account studies on-going in CEPT[21].

Task 2 – Development of compatibility and sharing conditions

Taking into account the expected development of WAS/RLAN technology and of the relevant standards until 2020, in particular the use of larger channel bandwidths, as well as the outcome of Task 1, appropriate mitigation techniques and/or operational compatibility and sharing conditions should be developed in close cooperation with all concerned stakeholders.

Based on the working assumption that WAS/RLANs would operate on a co-primary basis under an appropriate mobile allocation in the whole 5150 MHz to 5925 MHz band, and in the light of experience, the compatibility and sharing conditions should in particular identify the technical parameters that would be needed to ensure in the internal market consistent harmonised conditions and requirements for WAS/RLANs operating on a shared basis across the entire 5 GHz band.

To enable WAS/RLANs to operate on the basis of a general authorisation only those requirements should be implementable on the basis of harmonised standards and foster economies of scale in order to meet EU spectrum policy objectives, in particular taking into account sharing technologies and mitigation approaches implemented for existing WAS/RLAN equipment. These requirements should also take into account the regulatory and enforcement context of general authorisation. The compatibility and sharing conditions should also define the coexistence criteria that need to be taken into account by any other potential future use of the 5 GHz band in order to avoid interference with WAS/RLAN usage of the 5 GHz band.

Task 3 – Review of compatibility and sharing conditions after WRC-15

Taking utmost account of the possibility of international harmonisation[22], to assess the need to review and/or reconfirm the compatibility and sharing conditions developed under task 2 for the Final report based on the result of WRC-15, in the event that this would have a material effect on the parameters chosen for completion of tasks 1 and 2.

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, where 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 and the European Telecommunications Standardisation Institute (ETSI) which develops harmonised standards for conformity under Directive 1999/5/EC.

CEPT should provide deliverables according to the following schedule:

[19] Including bands agreed for inclusion in the forthcoming 5th update, such as those for road tolling.

[20] In particular where the use of the bands by primary radio services is not harmonised in the EU. Consistent with the approach to collect on a case-by-case basis comprehensive data for frequency ranges as proposed in CEPT Report 46, and with a view to lightening the administrative burden of individual Member States, the information on the operational footprint of the actual use of the relevant protected services/applications collected for the purposes of this mandate should be made available together with the Final Report in a machine readable format.

[21] Such as on Broadband Direct-Air-to-Ground Communications (DA2GC) in the band 5855-5875 MHz or Wireless Avionics Intra-Communications (WAIC) in the band 5350-5460 MHz as well as Wireless Industrial Applications in the band 5 725-5 875 MHz. This is without prejudice to the final decisions that may be taken on any such usage in this or any other band.

[22] Such as resolutions at the ITU WRC-15.

Delivery date	Deliverable	Subject
March 2014	Interim Report from CEPT to the Commission	Description of work undertaken and interim results under tasks (1) and (2) of this Mandate
November 2014[23]	Final Draft Report A from CEPT to the Commission	Description of work undertaken and final results under tasks (1) and (2) of this Mandate
March 2015	Final Report A from CEPT to the Commission taking into account the outcome of the public consultation	Description of work undertaken and final results under this Mandate taking into account the results of the public consultation
March 2016[23]	Final Draft Report B from CEPT to the Commission	Review and/or reconfirmation of the final results under this Mandate taking into account the results of WRC-15. Description and assessment of relevant results of WRC-15 regarding final results of the Mandate on tasks (1) and (2) and final results of task (3)
July 2016	Final Report B from CEPT to the Commission	Review and/or reconfirmation of the final results under this Mandate based on the results of WRC-15. Final results of task (3), taking into account the results of the public consultation.

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.

[23] Subject to subsequent public consultation.

ANNEX 2: LIST OF REFERENCE

[1] CEPT Report 57 : "Compatibility and sharing conditions for WAS/RLAN in the bands 5350-5470 MHz and 5725-5925 MHz"
[2] ECC Report 244: "Compatibility studies related to RLANs in 5725-5925 MHz"
[3] ECC Report 206: "Compatibility studies in the band 5725-5875 MHz between SRD equipment for wireless industrial applications and other systems"
[4] IEEE 802.11ac-2013: IEEE Standard for Information technology-- Telecommunications and information exchange between systems - Local and metropolitan area networks-- Specific requirements--Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications--Amendment 4: Enhancements for Very High Throughput for Operation in Bands below 6 GHz
[5] ECC Report 192: "The Current Status of DFS (Dynamic Frequency Selection) in the 5 GHz frequency range"
[6] Final Report of the CPM to WRC-15: http://www.itu.int/md/R12-CPM15.02-R-0001/en
[7] ETSI EN 302 372, Tanks Level Probing Radar (TLPR) operating in the frequency bands 5.8 GHz, 10 GHz, 25 GHz, 61 GHz and 77 GHz
[8] ERC Recommendation 70-03 relating to the use of Short Range Devices (SRD)
[9] European Commission COM(2012)218 on the establishment of an Intergovernmental Agreement for the operations of the European Earth monitoring programme (GMES) from 2014 to 2020
[10] ECC Report 101, Compatibility studies in the band 5855-5925 MHz between Intelligent Transport Systems (ITS) and other systems
[11] ECC Report 068, Compatibility studies in the band 5725-5875MHz between Fixed Wireless Access (FWA) systems and other systems
[12] EC Standardisation Mandate M/486: Mandate for programming and standardisation addressed to the European standardisation bodies in the field of urban rail
[13] EC Decision 2005/513/EC on the harmonised use of radio spectrum in the 5 GHz frequency band for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs)
[14] EC Decision 2007/90/EC on the harmonised use of radio spectrum in the 5 GHz frequency band for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs)
[15] ECC Decision (04)08 on the harmonised use of the 5 GHz frequency bands for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs)
[16] Resolution 229 (WRC-03, Rev. WRC-12) on the use of the bands 5150-5250 MHz, 5250-5350 MHz and 5470-5725 MHz by the mobile service for the implementation of wireless access systems including radio local area networks
[17] ETSI EN 301 893, " Broadband Radio Access Networks (BRAN); 5 GHz high performance RLAN; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive"
[18] ETSI TS 102 894-2, Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: applications and facilities layer common data dictionary