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CEPT Report 087

Draft Report from CEPT to the European Commission in response to the Mandate to review the limit of Out-Of-Band (OOB) Emissions below 5935 MHz applicable to Very Low Power (VLP) WAS/RLAN devices

**approved on DD Month YYYY**

**CEPT Report – subject to public consultation**

# Executive summary

This CEPT Report addresses the response to the Mandate from the European Commission to CEPT to review the limit of Out-Of-Band (OOB) emissions below 5935 MHz applicable to Very Low Power (VLP) WAS/RLAN devices (see ANNEX 1). It is important to note that Communication Based Train Control (CBTC) refers to Urban Rail Intelligent Transport Systems (ITS).

As part of the work in response to Task 1, [draft] ECC Report 355 [1] on measurement-based compatibility studies assessing interference from Very Low Power (VLP) Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) operating in 5945-6425 MHz to Communication Based Train Control (CBTC) systems operating in 5915-5935 MHz has been developed. It contains the results of technical assessment with respect to the OOB emission limit below 5935 MHz for WAS/RLAN VLP devices operating in the 6 GHz band.

Based on the results of the different studies, CEPT decided to relax the OOB emission levels for VLP WAS/RLAN to -37 dBm/MHz.

During the development of this CEPT Report, three administrations expressed the view that due to their national existing implementation of CBTC systems the relaxation of WAS/RLAN VLP OOB emission limit from -45 dBm/MHz to -37 dBm/MHz would be possible only with additional mitigation techniques on VLP devices. As a consequence, these CEPT administrations may pursue a possibility to nationally deviate from the EU harmonisation, also noting Article 4 (5) of Decision 676/2002/EC [11]. The other administrations expressed the view that no additional mitigation techniques are necessary on VLP devices and any remaining national concerns could be addressed by measures on CBTC systems.

In response to Task 2 of the EC Mandate, the proposed amendments on the regulatory framework of Commission Implementing Decision (EU) 2021/1067 for VLP WAS/RLAN devices [6] are provided in Section 4, Table 1 of this Report.

1. This section may be revised or updated depending on the outcome of the public consultation of the draft ECC Report 355, which closes on 2 April 2024.

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**LIST OF ABBREVIATIONS**

|  |  |
| --- | --- |
| **Abbreviation** | **Explanation**  |
| **ANFR** | National Frequency Agency (France) |
| **AP** | Access Point |
| **BNetzA** | Bundesnetzagentur (Federal Network Agency, Germany) |
| **CBTC** | Communication-based Train Control |
| **CEPT** | European Conference of Postal and Telecommunications Administrations |
| **DSSS** | Direct-Sequence Spread Spectrum |
| **EC** | European Commission |
| **ECC** | Electronic Communications Committee |
| **e.i.r.p.** | Effective isotropic radiated power |
| **EU** | European Union |
| **FCC** | Federal Communications Commission of the United States |
| **IEEE** | Institute of Electrical and Electronics Engineers |
| **ITS** | Intelligent Transport Systems |
| **JRC** | Joint Research Centre |
| **MP** | Urban metro type |
| **OOB** | Out-of-band |
| **OOBE** | Out-of-band emission |
| **RER** | Réseau Express Régional |
| **RLAN** | Radio Local Area Network |
| **TPC** | Transmit Power Control |
| **TU** | Train Unit |
| **VLP** | Very Low Power |
| **WAS** | Wireless Access System |

# Introduction

This CEPT Report addresses the response to EC Mandate to review the limit of Out-Of-Band (OOB) emissions below 5935 MHz applicable to Very Low Power (VLP) WAS/RLAN devices (see ANNEX 1).

In 2020, CEPT approved ECC Decision (20)01 [3] on the harmonised use of the frequency band 5945-6425 MHz for Wireless Access Systems including Radio Local Area Networks (WAS/RLAN). At the time, CEPT Report 73 [4] and CEPT Report 75 [5] were developed in response to the EC Mandate to CEPT to study feasibility and identify harmonised technical conditions for Wireless Access Systems including Radio Local Area Networks in the 5925-6425 MHz band for the provision of wireless broadband services [9].

Based on the outcomes provided by CEPT in those CEPT Reports, the European Commission set out Commission Implementing Decision (EU) 2021/1067 of 17 June 2021 on the harmonised use of radio spectrum in the 5945-6425 MHz frequency band for the implementation of wireless access systems including radio local area networks (WAS/RLANs) [6].

Communication-based Train Control (CBTC) is operating in the 5915-5935 MHz band as safety-related Urban Rail Intelligent Transport Systems (ITS). Its regulatory framework is set out in ECC Decision (08)01 [7] on the Harmonised use of the Safety-Related Intelligent Transport Systems (ITS) in the 5875-5935 MHz frequency band, and in the Commission Implementing Decision (EU)2020/1426 of 7 October 2020 on the harmonised use of radio spectrum in the 5875-5935 MHz frequency band for safety-related applications of intelligence transport systems (ITS) and repealing Decision 2008/671/EC [8].

ECC Report 302 [2] studied the coexistence scenarios between WAS/RLAN and the incumbent usages in band and adjacent bands. In the particular case of CBTC application, it contains technical studies performed to assess the compatibility between WAS/RLAN operating in 5925-6425 MHz and CBTC operating below 5935 MHz. A value of -45 dBm/MHz OOB limit below 5935 MHz for VLP WAS/RLAN was agreed for the protection of the Communication-based Train Control (CBTC) operating in the 5915-5935 MHz band as well as to allow VLP WAS/RLAN initial market to take up. CEPT agreed that this OOB emission limit should be valid in time only until 31 December 2024 and be re-examined with regard to an opportunity to relax it based on the real IEEE and Direct-Sequence Spread Spectrum (DSSS) DSSS Urban Rail interference situation. In absence of the justified evidence, a value of -37 dBm/MHz, for the OOB emission limit below 5935 MHz, will be adopted from 01 January 2025.

As a consequence of the ECC Decision, CEPT performed complementary studies contained in [draft] ECC Report 355 [1] on requirements and possible mitigation techniques for protection of Urban Rail ITS and to investigate interference scenarios, based on field measurements, from VLP WAS/RLANs in the 5945-6425 MHz band to Urban Rail ITS operating in the 5915-5935 MHz band.

This CEPT Report presents the outcomes of the CEPT work for the review of this regulatory framework.

# Background

## WAS/RLAN OPERATING IN the 5945-6425 MHZ BAND

ECC Decision (20)01 [3] harmonises the use of the frequency band 5945-6425 MHz for Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) at CEPT level. At European Union level, the regulatory framework of this application in the 5945-6425 MHz band is set out in Commission Implementing Decision (EU)2021/1067 of 17 June 2021 [6].

Very low Power (VLP) WAS/RLAN are portable devices with maximum mean effective isotropic radiated power (e.i.r.p.) of 25 mW that may operate both indoor and outdoor. The VLP WAS/RLAN outdoor use is intended to cover short range applications for small area direct communications. VLP WAS/RLAN shall comply with the harmonised technical conditions listed in Table 2 of Annex A1.2 of ECC Decision (20)01, in the CEPT framework, and in Table 2 of Annex of Commission Implementing Decision (EU)2021/1067 of 17 June 2021, in the European Union.

## URBAN RAIL ITS USING CBTC OPERATING IN the 5915-5935 MHZ BAND

CBTC is a wireless Automatic Train Control (ATC) applications used along urban or suburban railway lines. Due to the short headway of trains, an emergency brake of a single train due to interference will affect operation of the whole line.

ECC Decision (08)01 [7] harmonises the use of Safety-Related Intelligent Transport Systems (ITS) in the 5875-5935 MHz frequency band, where Urban Rail ITS operates in the band 5915-5935 MHz under the conditions specified in *DECIDES* *4* of that ECC Decision.

At European Union level, the regulatory framework of ITS applications operating in 5875-5935 MHz band is set out in Commission Implementing Decision (EU) 2020/1426 of 7 October 2020 [8] .Urban Rail ITS using CBTC systems operates in 5915-5935 MHz band under the conditions specified in Article 3 of this Commission Implementing Decision.

# Summary of technical assessment

1. This section may be revised or updated depending on the outcome of the public consultation of the draft ECC Report 355, which closes on 2 April 2024.

The content of this section is the Executive summary of Draft ECC Report 355 on measurement-based compatibility studies assessing interference from Very Low Power (VLP) Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) operating in 5945-6425 MHz to Communication Based Train Control (CBTC) systems operating in 5915-5935 MHz.

ECC Report 302 [1] and CEPT Report 75 [3] studied the coexistence between Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) operating above 5945 MHz and Communication Based Train Control (CBTC) operating below 5935 MHz. ECC Decision (20)01 [5] harmonises the use of WAS/RLAN in the 5945-6425 MHz band, including Very Low Power (VLP) portable use, with maximum mean[[1]](#footnote-2) 25 mW e.i.r.p., that may operate both indoor and outdoor. VLP WAS/RLAN devices are in the scope of this Report.

ECC Decision (20)01 [5] mentions, at the time of writing of this Report, that “It should be noted that the - 45 dBm/MHz out-of-band (OOB) limit below 5935 MHz for VLP would allow VLP initial market to take up. CEPT also agreed that this OOB limit should be valid in time only until 31 December 2024 and be re-examined with regard to an opportunity to relax it based on the real IEEE and DSSS (Direct-Sequence Spread Spectrum) Urban Rail interference situation. In absence of the justified evidence, a value of -37 dBm/MHz, for the OOB limit below 5935 MHz, will be adopted from 1 January 2025.” Thus, the aim of this Report is to further study OOB emissions from VLP devices operating in the band 5945-6425 MHz to protect CBTC systems operating in the band 5915-5935 MHz.

This Report gathers findings of lab and field measurement campaigns as well as additional studies with the aim of re-examining the OOB emission limit below 5935 MHz for WAS/RLAN VLP devices operating in the 6 GHz band. The measurement campaigns were conducted thanks to the help of the French administration ANFR, the German administration BNetzA, the JRC, and CBTC and WAS/RLAN industry stakeholders.

These measurement campaigns provided new technical elements relevant for interference to a single CBTC link, noting that there was no measurement about overall CBTC systems. The studies in the Report first analyse single link interference scenarios. Then based on these analyses, the Report provides probabilistic assessments of the overall risk of interference to the CBTC system.

This Report considered the following four scenarios:

* Scenario 1: impact of a WAS/RLAN VLP operated on a platform to CBTC Access Point (AP);
* Scenario 2: impact of a WAS/RLAN VLP operated on a platform to CBTC Train Unit (TU);
* Scenario 3: impact of a WAS/RLAN VLP operated on board a train to CBTC TU;
* Scenario 4: impact of a WAS/RLAN VLP operated on board a train to CBTC AP.

Studies conducted in this Report include:

* VLP OOB emissions potential impact on CBTC through an I/N analysis;
* VLP OOB emissions potential impact on CBTC through an SINR analysis;
* VLP in-band and OOB emissions potential impact on CBTC through a protection ratio analysis;
* Statistical assessments of the overall risk of interference to the CBTC system.

From these studies, it can be concluded that the critical scenario for the studied RER train is Scenario 2 (VLP on platform vs. CBTC TU), while the critical scenario for the studied metros (MP14, MP89, and MP05) is Scenario 3 (VLP on board vs. CBTC TU).

Some studies demonstrated that VLP with OOB emission levels at both -37 dBm/MHz and -45 dBm/MHz can lead, for some scenarios, to degradation of performance of a single CBTC radio link. The risk of interference is shown to be increased by relaxing the OOB emissions from -45 dBm/MHz to -37 dBm/MHz.

Some other studies demonstrated that with both OOB emission levels there is no degradation of performance of a single CBTC radio link, except for MP14, lacking 0.5 dB margin, as metro MP14 exhibits a 44.2 dB coupling loss while metros MP89 and MP05 exhibit 50.1 dB and 54.2 dB, respectively. It was observed that the coupling loss between the passenger cabin and the CBTC TU can vary significantly between trains. The variation in the coupling loss has a significant impact on the coexistence between WAS/RLAN and CBTC.

A first statistical analysis further analysed the MP14 case and showed that the likelihood of interference is low.

A second statistical analysis on the impact from a WAS/RLAN VLP on platform to a CBTC TU showed that the risk of interference is increased when relaxing OOB emissions from -45 dBm/MHz to -37 dBm/MHz, and could be mitigated by transmit power control.

A third statistical analysis on the impact from a WAS/RLAN VLP on board to a CBTC TU showed that the likelihood of interference events is low for OOB emissions at -45 dBm/MHz, but substantially increased with OOB emissions relaxed to -37 dBm/MHz. The study also showed that VLP with OOB emissions at - 37 dBm/MHz are unlikely to produce harmful interference to CBTC under the following conditions:

* A VLP would select lower channels below 6105 MHz only if the spectrum access mechanism has failed with the upper channels. When channels below 6105 MHz are used, the channel selection would be reassessed approximately every 100 seconds, for example;
* Transmit Power Control (TPC) would be able to reduce the total power from VLP maximum transmit power Pmax down to at least Pmax – 6 dB.

It has to be noted that the one CBTC receiver with 10 MHz bandwidth measured (Annex 5) responds heterogeneously to changes of OOB emission levels and WAS/RLAN bandwidths. The measurements of characteristics of this receiver were conducted specifically for the purpose of this study and are not meant to be used or referenced outside the scope of this Report.

# Recommended regulatory framework

In order to take into account the different studies results, it is recommended to update and adopt the regulatory framework as follows in:

Table 1: Proposed update to the regulatory framework for Very Low Power (VLP) WAS/RLAN devices

|  |  |
| --- | --- |
| Parameter | Technical conditions |
| Permissible operation | Indoors and outdoors Use on drones is prohibited |
| Category of device | The VLP device is a portable device |
| Frequency band | 5945-6425 MHz |
| Channel access and occupation rules | An adequate spectrum sharing mechanism shall be implemented. |
| Maximum mean e.i.r.p. for in-band emissions (note 1) | 14 dBm |
| Maximum mean e.i.r.p. density for in-band emissions (note 1) | 1 dBm/MHz |
| Narrowband usage maximum mean e.i.r.p. density for in-band emissions (note 1) (note 2) | 10 dBm/MHz |
| Maximum mean e.i.r.p. density for out-of-band emissions below 5935 MHz (note 1) | -37 dBm/MHz  |
| Note 1: The "mean e.i.r.p." refers to the e.i.r.p. during the transmission burst, which corresponds to the highest power, if power control is implemented.Note 2: Narrowband (NB) devices are devices that operate in channels bandwidths below 20 MHz. Narrowband devices also require a frequency hopping mechanism based on at least 15 hop channels to operate at a PSD value above 1 dBm/MHz. |

These harmonised technical conditions would have to be applied in the corresponding ETSI harmonised standard to be developed for adoption under Directive 2014/53/EU [10].

# Conclusions

This CEPT Report addresses the response to the Mandate from the European Commission to CEPT to review the limit of Out-Of-Band (OOB) emissions below 5935 MHz applicable to Very Low Power (VLP) WAS/RLAN devices (see ANNEX 1). It is important to note that Communication Based Train Control (CBTC) refers to urban rail Intelligent Transport Systems (ITS).

As part of the work in response to Task 1, [draft] ECC Report 355 [1] on measurement-based compatibility studies assessing interference from Very Low Power (VLP) Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) operating in 5945-6425 MHz to Communication Based Train Control (CBTC) systems operating in 5915-5935 MHz has been developed. It contains the results of technical assessment with respect to the OOB emission limit below 5935 MHz for WAS/RLAN VLP devices operating in the 6 GHz band.

Based on the results of the different studies, CEPT decided to relax the OOB emission levels for VLP WAS/RLAN to -37 dBm/MHz.

During the development of this CEPT Report, three administrations expressed the view that due to their national existing implementation of CBTC systems the relaxation of WAS/RLAN VLP OOB emission limit from -45 dBm/MHz to -37 dBm/MHz would be possible only with additional mitigation techniques on VLP devices. As a consequence, these CEPT administrations may pursue a possibility to nationally deviate from the EU harmonisation, also noting Article 4 (5) of Decision 676/2002/EC [11]. The other administrations expressed the view that no additional mitigation techniques are necessary on VLP devices and any remaining national concerns could be addressed by measures on CBTC systems.

In response to Task 2 of the EC Mandate, the proposed amendments on the regulatory framework of Commission Implementing Decision (EU) 2021/1067 for VLP WAS/RLAN devices [6] are provided in Section 4, Table 1 of this Report.

1. CEPT MANDATE

Ref. Ares(2021)2664990 - 21/04/2021

EUROPEAN COMMISSION

DIRECTORATE-GENERAL FOR COMMUNICATIONS NETWORKS, CONTENT AND TECHNOLOGY

The Director-General

Brussels,

DG CONNECT/B4

Mandate to CEPT

to review the limit of out-of-band (OOB) emissions below 5935 MHz applicable to very low power (VLP) WAS/RLAN devices

1. **PURPOSE**

The objective of the mandate is to review and identify the limit of maximum mean e.i.r.p. density of out-of-band emissions below 5935 MHz applicable to very low power (VLP) WAS/RLANs in the 5945-6425 MHz from 1 January 2025 onwards.

1. **BACKGROUND**

On 20 November 2020, the CEPT published the Report B (CEPT Report 75) entitled ‘*Harmonised technical parameters for WAS/RLANs operating on a coexistence basis with appropriate mitigation techniques and/or operational compatibility/coexistence conditions, operating on the basis of a general authorisation*’1 in response to the Commission mandate to study feasibility and identify harmonised technical conditions for wireless access systems including radio local area networks in the 5925-6425 MHz band for the provision of wireless broadband services. Harmonised conditions for the availability and efficient use of the frequency band 5945-6425 MHz for wireless access systems including radio local area networks (WAS/RLANs) have been developed on the basis of this report. Regarding the maximum mean e.i.r.p. density limits of VLP WAS/RLAN out-of-band emissions below 5935 MHz, they will be subject to review by the end of 2024 at the latest.

Following the adoption of CEPT Report 75, CEPT launched a review of the maximum mean e.i.r.p. density limits of VLP WAS/RLAN out-of-band emissions below 5935 MHz based on field measurements and the study of protection requirements for urban rail ITS from adjacent bands usage including interference scenarios. This gives an opportunity to review, as appropriate, the RLAN VLP OOB emission limit below 5935 MHz with regard to the possibility to relax the limit.

1 https://docdb.cept.org/download/aefb853d-8780/CEPT%20Report%2075.pdf

Commission européenne/Europese Commissie, 1049 Bruxelles/Brussel, BELGIQUE/BELGIË - Tel. +32 22991111

Office: BU25 06/183 - Tel. direct line +32 229-85788

Ales.Brabinek@ec.europa.eu

In the absence of justified evidence, a value of -37 dBm/MHz will be adopted from 1 January 2025.

1. **JUSTIFICATION**

Pursuant to Article 4(2) of the Radio Spectrum Decision, the Commission may issue mandates to the CEPT for the development and amendment 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.

The maximum mean e.i.r.p. density limits of VLP WAS/RLAN out-of-band emissions below 5935 MHz will be subject to review by the end of 2024 at the latest on the basis of CEPT response to this Commission mandate.

1. **TASKS AND SCHEDULE**

The CEPT is tasked

1. To study requirements and possible mitigation techniques for protection of urban rail ITS and to investigate interference scenarios, based on field measurements, from very low power (VLP) WAS/RLANs in the 5945-6425 MHz band to urban rail ITS operating in the 5915-5935 MHz band, in accordance with Decision (EU) 2020/1426.
2. Based on the results of task 1, to review and identify the limit of the maximum mean e.i.r.p. density of the out-of-band emissions below 5935 MHz of very low power (VLP) WAS/RLAN devices. The identified limit must protect urban rail ITS operating in the 5915-5935 MHz band in accordance with Decision (EU) 2020/1426 and will be adopted from 1 January 2025, taking into account that in the absence of justified evidence, a value of -37 dBm/MHz will apply.

The CEPT should provide deliverables according to the following schedule:

|  |  |  |
| --- | --- | --- |
| **Delivery date** | **Deliverable** | **Subject** |
| February 2024 | Draft Report from CEPT to the Commission | Draft final results of task 1 and 2 |
| June 2024 | Final Report from CEPT to the Commission taking into account the outcome of the public consultation | Final results of task 1 and 2 |

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.

 Electronically signed on 19/04/2021 11:15 (UTC+02) in accordance with article 11 of Commission Decision C(2020) 4482

1. List of References
2. [Draft] ECC Report 355: “Measurement-based compatibility studies assessing interference from Very Low Power (VLP) Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) operating in 5945-6425 MHz to Communication Based Train Control (CBTC) systems operating in 5915-5935 MHz”, [expected to be] approved May 2024

1. [ECC Report 302](https://docdb.cept.org/document/10170): "Sharing and compatibility studies related to Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) in the frequency band 5925-6425 MHz”, approved May 2019

1. [ECC Decision (20)01](https://docdb.cept.org/document/16737): “on the Harmonised use of the frequency band 5945-6425 MHz for Wireless Access Systems including Radio Local Area Networks (WAS/RLAN)”, approved November 2020

1. [CEPT Report 073](https://docdb.cept.org/document/13858): “Report from CEPT to the European Commission in response to the Mandate to study feasibility and identify harmonised technical conditions for Wireless Access Systems including Radio Local Area Networks in the 5925-6425 MHz band for the provision of wireless broadband services). Report A: Assessment and study of compatibility and coexistence scenarios for WAS/RLAN in the band 5925-6425 MHz”, approved March 2020

1. [CEPT Report 075](https://docdb.cept.org/document/16734): “Report from CEPT to the European Commission in response to the Mandate to study feasibility and identify harmonised technical conditions for Wireless Access Systems including Radio Local Area Networks in the 5925-6425 MHz band for the provision of wireless broadband services).Report B: Harmonised technical parameters for WAS/RLAN operating on a coexistence basis with appropriate mitigation techniques and/or operational compatibility/coexistence conditions, operating on the basis of a general authorisation”, approved November 2020
2. Commission Implementing Decision (EU) 2021/1067 of 17 June 2021 on the harmonised use of radio spectrum in the 5945-6425 MHz frequency band for the implementation of wireless access systems including radio local area networks (WAS/RLANs)

1. [ECC Decision (08)01](https://docdb.cept.org/document/412): “on the Harmonised use of the Safety- Related Intelligent Transport Systems (ITS) in the 5875-5935 MHz frequency band”, approved March 2008, latest amendment November 2022
2. Commission Implementing Decision (EU) 2020/1426 of 7 October 2020 on the harmonised use of radio spectrum in the 5875-5935 MHz frequency band for safety-related applications of intelligence transport systems (ITS) and repealing Decision 2008/671/EC
3. Mandate to CEPT to study feasibility and identify harmonised technical conditions for Wireless Access Systems including Radio Local Area Networks in the 5925-6425 MHz band for the provision of wireless broadband services
4. Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC
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 (Radio Spectrum Decision)
1. The "mean e.i.r.p." refers to the e.i.r.p. during the transmission burst, which corresponds to the highest power, if power control is implemented. [↑](#footnote-ref-2)