ETSI TR 103 853 V1.1.1 (2023-01)

TECHNICAL REPORT

System Reference document (SRdoc);
Road ITS equipment operating in the 5,9 GHz band
with channel bandwidths larger than 10 MHz

Reference

DTR/ERM-601

Keywords

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Executive summary

The present document provides information on the intended applications, the technical parameters, the relation to the existing spectrum regulation and additional new radio spectrum requirements for road Intelligent Transport Systems (ITS) applications operating in 5,9 GHz with 20 MHz channel bandwidth. This information is to support potential CEPT activities in the band 5 855 MHz to 5 925 MHz for road ITS applications.

A presentation of the different road ITS radio technologies is given in the present document with a focus on their support of channel bandwidths larger than 10 MHz. ITS-G5/IEEE 802.11p™ [i.33], LTE-V2X sidelink, IEEE 802.11bd™ [i.34] and NR-V2X sidelink are considered. Market information is provided, and the spectrum need for advanced safety applications, like collective perception and maneuver coordination, is discussed. From those observations it is concluded that a single channel with 10 MHz bandwidth is not sufficient to support the advanced use cases. The spectrum needs of advanced safety applications have been reviewed and it is concluded that 20 MHz are sufficient to transmit all messages of the same service in the same channel. Therefore, usage of 20 MHz channel bandwidth is proposed in the present document.

A detailed technical description of the aforementioned ITS radio technologies is given. Details about the use cases and services are provided. The technical parameters and their implications on spectrum are given. This includes description of the transmitter parameters, including transmitter output power/radiated power, antenna characteristics, operating frequency, bandwidth, and unwanted emissions (spurious emissions and transmit mask). The receiver parameters are also provided next to the channel access parameters.

The purpose of the present document is to consider the possibility to use channels with a bandwidth up to 20 MHz for road ITS use in the frequency band 5 855 MHz to 5 925 MHz. The current regulations are summarized, and it is clarified that there is no request for additional radio spectrum. The intention is therefore to adapt the frequency arrangement in the European regulation to also support channels with up to 20 MHz bandwidth in the band 5 855 MHz to 5 925 MHz for road ITS applications, noting that the existing regulations allow channels up to 10 MHz bandwidth.

Introduction

The frequency band 5 875 MHz to 5 925 MHz has been designated for road safety applications to support the European Union eSafety initiative with its goals to reduce the number of road fatalities and improving the efficiency of road traffic with Intelligent Vehicle Safety Systems. This enables the use of Intelligent Transport Systems (ITS) with direct communication. Recent developments of road ITS technologies enable to support advanced road safety use cases. Those use cases require larger bandwidths than the 10 MHz allowed in the current regulation. Therefore, the channel bandwidth needs to be increased to support the spectrum requirement of one service and to allow all messages of the same service to be transmitted in the same channel.

The present document provides the justification for enabling a more flexible channelization of the ITS band and requests a modification to the regulatory rules of the 5 855 MHz to 5 925 MHz frequency range to enable the use of channels with 20 MHz bandwidth.

1 Scope

The present document provides information on the intended applications, the technical parameters, the relation to the existing spectrum regulation and additional new radio spectrum requirements for road ITS applications operating in 5,9 GHz with channel bandwidths larger than 10 MHz. This information is to support potential CEPT activities in the band 5 855 MHz to 5 925 MHz for road ITS applications.

It includes in particular:

- Market information.
- Technical information including expected sharing and compatibility issues.
- Regulatory issues.

NOTE: The present document does not cover coexistence between different road ITS technologies.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] IEEE Std 802.11™-2016: "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".

[i.2] ETSI EN 302 663 (V1.3.1): "Intelligent Transport Systems (ITS); ITS-G5 Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".

[i.3] ETSI TS 136 101 (V14.19.0): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (3GPP TS 36.101 version 14.19.0 Release 14)".

[i.4] ETSI TS 136 101 (V15.15.0): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (3GPP TS 36.101 version 15.15.0 Release 15)".

[i.5] ETSI TS 138 101-1 (V16.8.0): "5G; NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone (3GPP TS 38.101-1 version 16.8.0 Release 16)".

[i.6] 5GAA TR S-200137 (June 2020): "Study of spectrum needs for safety related intelligent transportation systems - day 1 and advanced use cases".

NOTE: Available at https://5gaa.org/wp-content/uploads/2020/06/5GAA_S-200137_Day1_and_adv_Use_Cases_Spectrum-Needs-Study_V2.0-cover.pdf.

[i.7] 5GAA: "A Visionary Roadmap for Advanced Driving Use Cases, Connectivity Technologies, and Radio Spectrum Needs", September 2020.

NOTE: Available at https://5gaa.org/wp-content/uploads/2020/09/A-Visionary-Roadmap-for-Advanced-Driving-Use-Cases-Connectivity-Technologies-and-Radio-Spectrum-Needs.pdf.

[i.8] CAR 2 CAR Communication Consortium: "Position Paper on Road Safety and Road Efficiency Spectrum Needs in the 5.9 GHz for C-ITS and Cooperative Automated Driving", February 2020.

NOTE: Available at https://www.car-2-car.org/fileadmin/documents/General_Documents/C2CCC_TR_2050_Spectrum_Needs.pdf.

[i.9] CAR 2 CAR Communication Consortium: "Guidance for day 2 and beyond roadmap", July 2021.

NOTE: Available at https://www.car-2-car.org/fileadmin/documents/General_Documents/C2CCC_WP_2072_RoadmapDay2AndBeyond_V1.2.pdf.

[i.10] CEPT ECC Decision (08)01 (2020-03): "The harmonised use of Safety-Related Intelligent Transport Systems (ITS) in the 5875-5935 MHz frequency band", approved 14 March 2008 latest amendment on 06 March 2020.

NOTE: Available at https://docdb.cept.org/download/b470d271-048b/ECCDEC0801.PDF.

[i.11] CEPT ECC Recommendation (08)01 (2020-03): "Use of the band 5855-5875 MHz for Intelligent Transport Systems (ITS)", approved 21 February 2008 latest amendment on 06 March 2020.

NOTE: Available at https://docdb.cept.org/download/798c1836-20c6/REC0801.pdf.

[i.12] ETSI TS 102 792 (V1.2.1): "Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (CEN DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range".

[i.13] ETSI EN 302 571 (V2.1.1): "Intelligent Transport Systems (ITS); Radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

[i.14] ITU Radio Regulations, Edition of 2020.

[i.15] Commission Implementing Decision (EU) 2020/1426 of 7 October 2020 on the harmonised use of radio spectrum in the 5 875-5 935 MHz frequency band for safety-related applications of intelligent transport systems (ITS) and repealing Decision 2008/671/EC (notified under document C(2020) 6773).

NOTE: Available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020D1426.

[i.16] EC Implementation Decision 2019/1345: "Commission implementing Decision (EU) 2019/1345 of 2 August 2019 amending Decision 2006/771/EC updating harmonised technical conditions in the area of radio spectrum use for short-range devices", Band No 77.

[i.17] ECC Report 101 (2007-02): "Compatibility studies in the band 5855- 5925 MHz between Intelligent Transport Systems (ITS) and other systems".

NOTE: Available at https://docdb.cept.org/download/441.

[i.18] ECC Report 228 (2015-01): "Compatibility studies between Intelligent Transport Systems (ITS) in the band 5855-5925 MHz and other systems in adjacent bands".

NOTE: Available at https://docdb.cept.org/download/1197.

[i.19] ECC Report 290 (2019-01): "Studies to examine the applicability of ECC Reports 101 and 228 for various ITS technologies under EC Mandate (RSCOM 17-26Rev.3)".

NOTE: Available at https://docdb.cept.org/download/1369.

[i.20] ETSI TR 102 654 (V1.1.1) (2009-01): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Road Transport and Traffic Telematics (RTTT); Co-location and Co-existence Considerations regarding Dedicated Short Range Communication (DSRC) transmission equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range and other potential sources of interference".

[i.21] ETSI TR 102 960 (V1.1.1) (2012-11): "Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (RTTT DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range; Evaluation of mitigation methods and techniques".

[i.22] ETSI EN 303 613 (V1.1.1) (2020-01): "Intelligent Transport Systems (ITS); LTE-V2X Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".

[i.23] ETSI TR 103 688 (V1.1.1): "Intelligent Transport Systems (ITS); Study on receiver requirements in ETSI EN 302 571".

[i.24] ERC Recommendation 74-01: "Unwanted emissions in the spurious domain", Approved 1998, amended 29 May 2019.

[i.25] ERC Recommendation 70-03: "Relating to the use of Short Range Devices (SRD)".

[i.26] ERC Report 25: "The European table of frequency allocations and applications in the frequency range 8.3 kHz to 3000 GHz (ECA TABLE)".

[i.27] ACEA (2021-09): "Automobile Industry Pocket Guide 2021-2022".

NOTE: Available at https://www.acea.auto/files/ACEA_Pocket_Guide_2021-2022.pdf.

[i.28] ETSI TS 136 213 (V14.6.0): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (3GPP TS 36.213 version 14.6.0 Release 14)".

[i.29] 3GPP TR 38.885 (V16.0.0) (2019-03): "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Study on NR Vehicle-to-Everything (V2X) (Release 16)".

[i.30] 5GAA (10-2020): "C-V2X Use Cases Volume II: Examples and Service Level Requirements".

NOTE: Available at https://5gaa.org/wp-content/uploads/2020/10/5GAA_White-Paper_C-V2X-Use-Cases-Volume-II.pdf.

[i.31] ETSI TR 103 562 (V2.1.1) (2019-12): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Analysis of the Collective Perception Service (CPS); Release 2".

[i.32] ETSI EN 302 637-2 (V1.4.1) (2019-04): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[i.33] IEEE 802.11p™: "IEEE Standard for Information technology-- Local and metropolitan area networks-- Specific requirements-- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 6: Wireless Access in Vehicular Environments".

[i.34] IEEE 802.11bd™: "IEEE Approved Draft 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 5: Enhancements for Next Generation V2X".

[i.35] ETSI EN 301 893: "5 GHz RLAN; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

[i.36] ETSI EN 303 798: "Intelligent Transport Systems (ITS); LTE-V2X and NR-V2X Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band; Release 2".

[i.37] ETSI TS 136 331 (V14.6.2): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (3GPP TS 36.331 version 14.6.2 Release 14)".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

channel: continuous part of the radio-frequency spectrum used for transmission and reception by an ITS device and identified by a centre frequency and a nominal bandwidth which is agnostic to the radio access technology

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3GPP	3rd Generation Partnership Project
5G	5th Generation
5GAA	5G Automotive Association
AACR	Alternate Adjacent Channel Rejection
ACR	Adjacent Channel Rejection
BW	Bandwidth
C2C-CC	CAR 2 CAR Communication Consortium
CAM	Cooperative Awareness Message
C-ITS	Cooperative Intelligent Transport Systems
CPM	Collective Perception Message
DENM	Decentralized Environmental Notification Message
DSRC	Dedicated Short Range Communication
EC	European Commission
ECA	European Common Allocation table
ERC	European Radio Committee
EU	European Union
FDMA	Frequency Division Multiple Access
FS	Fixed Service
FWA	Fixed Wireless Access
HARQ	Hybrid Automatic Repeat Request
I2V	Infrastructure-to-Vehicle
IVC	Inter Vehicle Communication
IVI	In-Vehicle-Information
LTE	Long Term Evolution
MAPEM	road/lane topology and traffic maneuver message
MCM	Maneuver Coordination Message
MCS	Modulation and Coding Scheme
NACK	Negative ACKnowledgement
NR	New Radio
OFDM	Orthogonal Frequency Division Multiplex
PCM	Platooning Control Message
PHY	Physical (layer)
PSD	Power Spectral Density
PSFCH	Physical Sidelink Feedback Channel
QPSK	Quadrature Phase-Shift Keying
RF	Radio Frequency
RSU	Road Side Unit
SPATEM	Signal Phase And Timing Extended Message
SRD	Short-Range Device
V2V	Vehicle-to-Vehicle
V2X	Vehicle to everything

VAM	VRU Awareness Message
VRU	Vulnerable Road User

4 Comments on the System Reference Document

4.1 Statements by ETSI Members

4.1.1 Statement by ETSI Members BMWK (Germany), BMF (Austria), Kapsch Trafficcom AG, NXP Semiconductors Netherlands

"ETSI has been working on different standards for road ITS technologies including co-channel coexisting methods, as requested by CEPT. At the time of preparation of the present document this work has only considered bandwidths of 10 MHz resulting in four channels for safety applications, where road ITS has priority. And at the time of preparation of the present document there is no agreement on only one method solving that problem.

The present document proposes the use of channels with 20 MHz bandwidth with a possible combination of 2 x 10 MHz and 1 x 20 MHz bandwidth. The introduction of 20 MHz channels or of a mixture of channels with different bandwidths will add additional complexity to the current problem. It is important still to have the option of using only 10 MHz channels, without restricting the implementer's choice. Having no agreement on a coexistence method for channels with equal bandwidth there is no indication that an agreement in the more complex situations with different bandwidths will be possible."

4.1.2 Statement by ETSI Members NXP Semiconductors Netherlands, Kapsch Trafficcom AG

"From a spectral efficiency and ITS application perspective, wider channels (e.g., 20 MHz channels) will not add any improvement compared to 10 MHz channels. The same amount of traffic can be accommodated either with 20 MHz channels or with twice as many 10 MHz channels (the latter realized with channel bonding). Furthermore, it should be noted that Multi-Channel Operation (MCO) is not an alternative for wider channels but an unavoidable functionality in C-ITS, as functional requirement management from 5GAA and C2C-CC have shown that more than 70 or even 100 MHz of bandwidth will be required to facilitate safety related data exchange. Furthermore, several 10 MHz channels can be used in a more flexible manner, either totally independent or simultaneously bonded together, just as needed for a certain application.

From a spectrum management and medium access protocol perspective, having a 10 MHz channel scheme is significantly more straight forward and more flexible. It is actually beneficial to have several radio channels with less bandwidth than only fewer channels with higher bandwidth. Furthermore, a 20 MHz channel will complicate the coexistence with all channel bandwidths specified today including 10 MHz and 5 MHz channels as used for ITS communication including Urban Rail. And very simply, a half-way faltered deployment of a technology on a single 10 MHz channel will have a substantially more modest impact than a half-way faltered deployment of a technology on a 20 MHz channel.

From a technical perspective, it is simpler in receivers and transmitters to have to manage only a single channel bandwidth (e.g., 10 MHz), both in terms of analog as well as digital implementation complexity. For instance, for the reduction of out of band emissions, that could cause interference to other radio services, the implementation complexity also reduces for narrow transmitter bandwidths.

From a functional perspective, balancing several message types in a same channel is not straightforward. For example, the combination of CAM and DENM services is balanced at the system level by giving them specific privileges so that they can perform their task simultaneously, and was proven to work well in a single 10 MHz channel. Having a wider channel conveying more message types requires multiple priority levels and a more sophisticated priority scheme, adding complexity and overhead. Such a prioritization scheme is not in place for any existing radio technology. Clustering messages for certain vehicle types, or application types, on distinct radio channels improves system performance and reduces the computational effort necessary to filter and process relevant messages for the receiver (e.g., truck platooning messages are irrelevant for other vehicles, VRU may only transmit messages). Finally, usage of wider channels implies additional complexity in the system & software development, test and validation."

4.1.3 Statement by ETSI Members QUALCOMM Europe Inc. - Italy, Intel Deutschland GmbH

"From a spectral efficiency and ITS application perspective, 20 MHz channels show a clear improvement compared to 10 MHz channels. In case of the transmission using two adjacent channels with 10 MHz bandwidth each, the guard band necessary between them due to the individual spectrum mask needs to be considered, thus decreasing the total amount of frequency resources available. On the other hand, in the case of one continuous channel with 20 MHz bandwidth, no gap within the 20 MHz channel is needed, thus increasing the overall spectrum utilization. Furthermore, to obtain, e.g., 60 MHz of bandwidth for Multi-Channel Operation (MCO) operation, an aggregation of six channels with 10 MHz bandwidth would be required in contrast to three channels with 20 MHz bandwidth. This shows that the bandwidths required to facilitate safety related road ITS data exchange in the future cannot be reasonably satisfied with 10 MHz small channels since it would result in the double amount of transceiver chains compare to 20 MHz wide channels.

From a spectrum management and medium access protocol perspective, different technologies can be adapted to achieve suitable performance. Technologies that can multiplex their transmissions in frequency domain (FDMA) offer higher flexibility when wider channels are employed. Depending on the payload and application, the appropriate transmission bandwidth is selected. Technologies that always use the full channel bandwidth for transmission can make efficient use of 20 MHz channels by either transmitting with a 20 MHz transmit configuration or by deploying channel bonding with two channels each with 10 MHz bandwidth. Wider channels need less load balancing and congestion control due to an increased statistical multiplexing gain, resulting in less limitation of communications range and message transmission rates.

From a technical perspective it is simpler to implement receivers and transmitters that support two channel bandwidths, e.g., supporting 10 MHz and 20 MHz bandwidths, than having to support the bonding or aggregation of two 10 MHz wide channels. Since channels with 20 MHz bandwidth are used and allocated for ITS applications in many regions of the world, already well-established global solutions can be reused, which increases the economy of scale.

From a functional perspective, when applications and services require a channel bandwidth of more than 10 MHz the challenge of how to distribute the messages on two 10 MHz channels is avoided by having one channel with 20 MHz bandwidth, i.e., the distribution of the same message type over, e.g., two 10 MHz channels in a distributed system is not straightforward. On the other hand, balancing several message types in the same channel has been addressed and solved for a long time. Limiting certain message types and applications to specific channels would reduce the trunking efficiency significantly and would lead to capacity issues when more applications get introduced over time and could hinder deployments if existing number of channels are already occupied by certain applications. This is one of the reasons why other regions, e.g., USA or China, have allocated 20 MHz wide channels for road ITS. Both IEEE and 3GPP based ITS technologies support 20 MHz channels."

4.1.4 Statement by ETSI Member Ministry of Economic Affairs and Climate Policy (Netherlands)

"The Netherlands would like to make the following statements about the proposals in this SRDoc:

1) *It is unclear from this document how 20 MHz channels help improve the performance of ITS applications. There seems to be no substantial justification for the request for 20 MHz channels. In case this request is founded on implementation constraints of NR-/5G-V2X requiring 20 MHz for efficient operation, it is sobering to see that this seem to have been developed without taking into account the consideration of the existing ITS channelization. Also this issue is not brought forward by this document.*

2) *20 MHz channels complicate co-channel coexistence with 10 MHz channel based systems and complicate co-channel operation with Rail ITS.*

3) *20 MHz channels increase the risk of higher waste of spectrum in case of unsuccessful rollouts and overall lower spectrum efficiency.*

4) *It would be good to understand how this SRDoc fits in an approach where interoperability between communication technology and ITS applications is taken into account. Note that traffic safety is the prime justification for the spectrum allocation for ITS. This SRDoc seems to be taking a next step in creating more communication technology diversity.*

Because of these concerns we do not support the proposals in the SRDoc at this moment."

4.1.5 Statement by ETSI Member BMF (Austria)

"Figure 3 suggests that 20 MHz channels will be replacing 2 x 10 MHz, which is hopefully not intended. It is state of the art (eg. ETSI EN 301 893) in other channelised bands to combine smaller operational channels into bigger ones without replacing them. Thus the device has the choice of using a 20 MHz channel or one of the underlying 10 MHz channels. It is worth noting that there is existing deployment in 10 Mhz channels within 5875 - 5905 MHz."

4.1.6 Statement by ETSI Member Volkswagen AG

"Volkswagen AG supports the proposals of this TR 103 853. As written in this TR "The CAR 2 CAR Communication Consortium (C2C-CC) position paper on road safety and road efficiency spectrum needs in the 5.9 GHz for C-ITS and cooperative automated driving [i.8] *and their guidance for day 2 and beyond roadmap [i.9] clearly show the need for more than 10 MHz to support certain services" we see this as one valid reason to study wider channels.*

We propose to study wider channels so that afterwards there are facts on which to judge which channelization is the most appropriate."

5 Presentation of the system or technology

One key pillar of Intelligent Transport Systems (ITS) is the possibility for direct communication in the 5,9 GHz ITS band. The objective of the frequency designation of the band 5 875 MHz to 5 935 MHz for road safety applications is to support the European Union eSafety initiative with its goals to reduce the number of road fatalities and improving the efficiency of road traffic with Intelligent Vehicle Safety Systems. Road ITS traffic safety and traffic efficiency communication include Inter Vehicle Communication (IVC or V2V), Infrastructure to Vehicle (I2V) communication and ITS stations in highly dynamic ad hoc networks.

Recent development of road ITS technologies enable advanced road safety use cases. An essential element to support such new use cases is the possibility to adopt channels larger than 10 MHz. One possibility is to transmit with a transmission bandwidth wider than 10 MHz. Another solution is to aggregate or bond two or more channels with 10 MHz bandwidth. Based on these recent technology developments and the necessity to support advanced use cases for road ITS applications, there is an essential need to enable wider channelization (larger than 10 MHz) in the 5 855 MHz to 5 925 MHz frequency band, i.e. excluding the 5 925 MHz to 5 935 MHz band which is designated for safety related rail ITS.

In the following a brief overview of ITS technologies and their possibilities to adopt channels larger than 10 MHz is given.

IEEE 802.11p: The physical layer is based on clause 17 of IEEE 802.11-2016 [i.1]. The OFDM PHY supports three different frequency channel bandwidths, i.e. 5 MHz, 10 MHz and 20 MHz.

LTE-V2X sidelink communication is based on the technical specifications of 3GPP. In band 47, which is the 3GPP LTE band equivalent to the 5,9 GHz ITS band, channel bandwidths of 10 MHz and 20 MHz are supported [i.3]. Furthermore, intra-band multi-carrier configurations are defined to support a maximum aggregated bandwidth of 20 MHz in Release 14 [i.3] and 30 MHz in Release 15 [i.4].

IEEE 802.11bd (still under development), which can be viewed as an evolution of the IEEE 802.11 [i.1] based vehicular communications, will support channel access with 10 MHz and 20 MHz.

NR-V2X sidelink communication is based on the technical specifications of 3GPP. In band n47, which is the 3GPP band equivalent to the 5,9 GHz ITS band, channel bandwidths of 10 MHz, 20 MHz, 30 MHz, and 40 MHz are supported [i.5].

ITS-G5 is an access layer profile of IEEE 802.11p [i.33] (see above) and specified in ETSI EN 302 663 [i.2]. LTE-V2X sidelink in ETSI is an access layer profile based on LTE-V2X sidelink Release 14 and specified in ETSI EN 303 613 [i.22]. Both currently specify the use of 10 MHz frequency channels.

Table 1: Channel bandwidth supported by different technologies

Technology	10 MHz	20 MHz	30 MHz	40 MHz
IEEE 802.11p [i.33]	X (1)	X		
LTE-V2X sidelink	X (2)	X	X (3)	
IEEE 802.11bd [i.34]	X	X		
NR-V2X sidelink	X	X	X	X
NOTE 1: ETSI EN 302 663 [i.2] specifies the use of 10 MHz frequency channels. NOTE 2: ETSI EN 303 613 [i.22] specifies the use of 10 MHz frequency channels. NOTE 3: Via intra-band multi-carrier configuration in Release 15, while ETSI EN 303 613 [i.22] is based on Release 14.				

The channel access procedures of IEEE and 3GPP based ITS technologies use a different approach to access the spectrum resources. ITS technologies based on 3GPP specifications, e.g. LTE-V2X sidelink [i.22], use a fixed time duration for the transmissions and adapt the frequency resources, which are used during the transmission, depending on the payload size. On the other hand, IEEE based ITS technologies, e.g. ITS-G5 [i.2], use a fixed transmission bandwidth and adapt the time duration of the transmission depending on the payload size. This means that for 3GPP based ITS technologies the channel bandwidth can be shared at the same time via frequency multiplexing by several ITS stations. IEEE based ITS technologies purely rely on time multiplexing of the transmissions.

6 Market information

The EU has an ambitious vision for connected and automated mobility across the EU. The main goal is to further improve the road safety. To this end road ITS applications are key to achieve this important imperative. Advanced ITS use cases will further improve the road safety by supporting, e.g. collective perception, maneuver coordination, etc. According to [i.27] the auto industry generates an annual trade surplus of €76 billion for the EU. The data in [i.27] shows that for EU + EFTA + UK per year approximately 14 million new vehicles were sold in 2020. It is expected that most of the vehicles will support advanced safety applications in the near future. Assuming that on average 50 % of the new vehicles will be equipped within the next 10 years with advanced ITS safety features, this means approximately 70 million vehicles in EU + EFTA + UK will use the 5,9 GHz ITS band by 2032. Additional data about the vehicle distribution in Europe is provided in [i.27], which can be used to assist potential sharing studies with incumbent systems.

At the time and preparation of the present document the channel from 5 895 MHz to 5 905 MHz, which is one of the ITS safety channels, is used for the ITS-G5 control channel, e.g. for Cooperative Awareness Messages (CAMs), Decentralized Environmental Notification Messages (DENMs) and Signal Phase And Timing Extended Messages (SPATEMs).

Several studies have been performed where the spectrum needs of use cases for ITS and advanced driving are investigated. For example, the 5GAA study of spectrum needs [i.6] and the roadmap for advanced driving use cases, connectivity technologies, and radio spectrum needs [i.7] outline in detail the use cases and their spectrum needs:

> *"Our estimate of spectrum needs for cooperative perception is 40 MHz or more depending on the extent of sensing per vehicle, and the number of vehicles required to share their sensor information."* [i.6].

> *"The white paper finally highlights the spectrum needs for basic and advanced driving use cases. For direct communication, this corresponds to between 10 and 20 MHz at 5.9 GHz for basic safety, and an additional 40 MHz or more at 5.9 GHz for advanced driving."* [i.7].

The CAR 2 CAR Communication Consortium (C2C-CC) position paper on road safety and road efficiency spectrum needs in the 5,9 GHz for C-ITS and cooperative automated driving [i.8] and their guidance for day 2 and beyond roadmap [i.9] clearly show the need for more than 10 MHz to support certain services.

Table 2 in [i.8] contains a summary of the spectrum needs with the required bandwidth for different use cases and shows that several message types, e.g. Collective Perception Message (CPM) and Maneuver Coordination Message (MCM) have each a spectrum need that exceeds 10 MHz bandwidth and is approximately 20 MHz. Since it is beneficial to have the same message type within one channel this shows that 20 MHz channel bandwidth can improve efficiency.

The present document will assess the technical parameters for channels broader than 10 MHz to support advanced safety use cases. As shown in Table 2 of [i.8], a channel with 10 MHz bandwidth is not enough to support the advanced use cases. Those use cases could be also supported by transmitting and receiving on multiple channels with 10 MHz bandwidth in parallel, which requires separate transceiver chains for each 10 MHz channel. This is avoided by leveraging wider channel bandwidths, where 20 MHz channel bandwidth is supported by all current ITS access technologies, to realize those use cases. By extending the channel bandwidth to support at least the spectrum requirement of one service, all messages of the same service can be transmitted in the same channel.

7 Technical information

7.1 Detailed technical description

7.1.1 Overview

Clause 7.1 contains the technical description of the different existing ITS technologies and a description of the use cases. The technical parameters which are applicable for these ITS technologies are explained in detail in clause 7.2 and therefore omitted in clause 7.1.

7.1.2 ITS-G5

Clause A.1 provides an overview of the access layer parameters to be used for ITS-G5.

7.1.3 IEEE 802.11bd

The technical details defined in IEEE 802.11bd [i.34] (still under development) will most likely be very similar to the ones from IEEE 802.11-2016 [i.1] for the Modulation and Coding Scheme (MCS) that overlap between IEEE 802.11p [i.33] and IEEE 802.11bd [i.34].

7.1.4 LTE-V2X

The technical parameters specific to LTE-V2X operating in channels with 20 MHz bandwidth are summarized in Table 2. The access layer specification in ETSI EN 303 613 [i.22] can be used as a basis. Clause A.2 provides an overview of the updated LTE-V2X information elements to support channels with 20 MHz bandwidth.

Table 2: Technical parameters specific for LTE-V2X operating in channels with 20 MHz bandwidth

Parameter	Value	Comments
Channel bandwidth	20 MHz	
Communication mode	Half-duplex, broadcast	Half-duplex and broadcast are believed to be adequate for most applications considered to date.
Receiver noise power	-88 dBm	3 dB higher than for channels with 10 MHz bandwidth.
Transmit duration	Subframes of length 1 ms	Potential to use retransmissions.
Subcarrier spacing	15 kHz	
Frequency allocation	Channel bandwidth is split into 10 subchannels; number of subchannels used for transmission depends on data payload	One Physical Resource Block (PRB) consists of 12 subcarriers, i.e. it is 180 kHz wide in frequency. The subchannel size is 10 PRBs, i.e. it is 1,8 MHz wide in frequency. The subchannel size is the same as for channel with 10 MHz bandwidth, while the number of subchannels is doubled.
Modulation and coding scheme	QPSK and 16QAM MCS0 to MCS 11 supported for non-RSU ITS station; MCS0 to MCS 17 supported for RSU ITS station	Details can be found in ETSI EN 303 613 [i.22] and references therein.

Parameter	Value	Comments
Data rates	206 bits to 16 992 bits per 1 subframe	Calculated for non-RSU ITS stations based on 1 subchannel with MCS0 and 10 subchannels with MCS 11, various modulation and coding schemes supported, see ETSI TS 136 213 [i.28], Table 7.1.7.2.1-1 and Table 8.6.1-1.

7.1.5 NR-V2X

The technical parameters specific to NR-V2X sidelink operating in channels with 20 MHz bandwidth are summarized in Table 3.

Table 3: Technical parameters specific for NR-V2X operating in channels with 20 MHz bandwidth

Parameter	Value	Comments
Channel bandwidth	20 MHz	
Communication mode	Half-duplex, broadcast, groupcast, and unicast	NR-V2X supports broadcast, groupcast and unicast
Receiver noise power	-88 dBm	Identical to LTE-V2X with 20 MHz
Transmit duration	Slots of length 500 µs (see below for details about slot usage)	Potential to use retransmissions based on feedback (see text below with details on feedback)
Subcarrier spacing	30 kHz	
Frequency allocation	Channel bandwidth is split into 5 subchannels; number of subchannels used for data transmission depends on data payload, feedback uses PRB level allocation in feedback part of slot (see details below on feedback)	One Physical Resource Block (PRB) consists of 12 subcarriers, i.e. it is 360 kHz wide in frequency. The subchannel size is 10 PRBs, i.e. it is 3,6 MHz wide in frequency
Modulation and coding scheme	QPSK, 16QAM, 64QAM, and 256QAM with variable coding rate	64QAM and 256QAM might be only used for specific applications
Data rates	24 bits to 94 248 bits per 1 slot (500 µs)	Based on 1 subchannel with MCS0 and 5 subchannels with MCS27 (256QAM table), various modulation and coding schemes supported, single and dual layer transmission supported
NOTE: The parameters provided in this table are based on preliminary parameters since the ETSI access layer specification for NR-V2X sidelink communication DEN/ITS-00446 (ETSI EN 303 798 [i.36]) is still work in progress.		

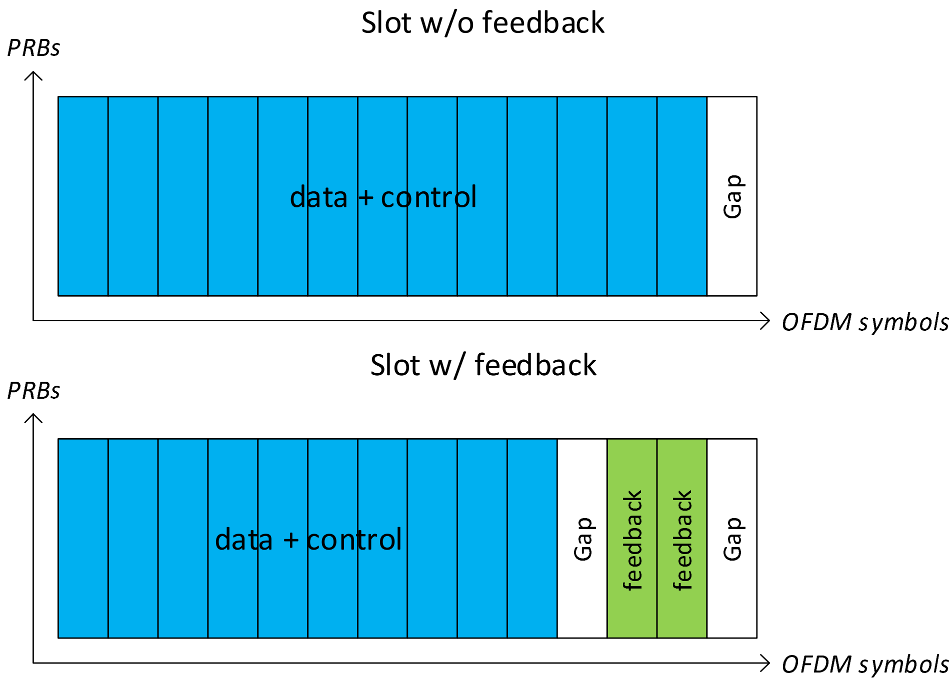

Figure 1: Examples for NR-V2X slots with and without feedback

NR-V2X introduces the use of feedback via the so-called Physical Sidelink Feedback CHannel (PSFCH) in unicast and groupcast communications [i.29] to increase the reliability of sidelink transmissions. The feedback consists of a Hybrid Automatic Repeat Request (HARQ) and is transmitted on one Physical Resource Block (PRB) within two OFDM symbols (1/7 of the slot duration). The receiving vehicles send the HARQ feedback on specific feedback symbols in response to a unicast or groupcast transmission carried on the data part. Therefore, this has an impact on the transmit duration in the slot.

Figure 1 depicts an example of two slots. The data and control OFDM symbols are depicted in blue, while the feedback related OFDM symbols are depicted in green. Gap symbols are used to enable transmit to receive switching and vice versa. It is noted that for a slot with feedback resources a transmitter can either use both data + control and the feedback OFDM symbols or transmit only on data + control or feedback symbols. Based on system wide pre-configuration the slots with feedback can occur every 1, 2 or 4 slots or can be disabled. The feedback information for one packet is transmitted on the same time/frequency resource by every station that sends feedback.

The ETSI access layer specification for NR-V2X sidelink communication DEN/ITS-00446 (ETSI EN 303 798) is still work in progress. Therefore, the feedback configuration is not fixed yet. A preliminary assumption is that every fourth slot contains feedback. Negative ACKnowledgement (NACK) only based feedback can be assumed based on a per transmission indicated maximum communication range.

7.1.6 Description of use cases

This clause presents two different options as how channels with 20 MHz bandwidth might be used.

Option 1 Advanced use cases:

Advanced safety use cases are described in detail for example in [i.30]. For sharing studies with channels with 20 MHz bandwidth one potential use case is Collective Perception Services, as studied in [i.31]. It can be assumed that CPMs are disseminated in a similar way as Cooperative Awareness Messages (CAMs). Therefore, ETSI EN 302 637-2 [i.32] can be assumed.

Option 2 Multiplexing of different services:

The message types currently supported by road ITS communications are Cooperative Awareness Message (CAM), Decentralized Environmental Notification Message (DENM), Signal Phase And Timing Extended Message (SPATEM), road/lane topology and traffic maneuver (MAPEM), In-Vehicle-Information (IVI), Vulnerable Road User (VRU) Awareness Message (VAM), Platooning Control Message (PCM), Collective Perception Message (CPM) and Maneuver Coordination Message (MCM).

Given the amount of different use cases and message types that are supported already and will be supported in the future, the multiplexing of different services is one option how wider channel can be used.

7.2 Technical parameters and implications on spectrum

7.2.1 Status of technical parameters

7.2.1.1 Current ITU and European Common Allocations

ECC Decision (08)01 [i.10], amended on 6th of March 2020, addresses frequency designation within the band 5 875 MHz to 5 935 MHz for the harmonized implementation of safety-related Intelligent Transport Systems (ITS). Furthermore, the frequency band 5 855 MHz to 5 875 MHz has been made available for ITS (non-safety applications) by ECC Recommendation (08)01 [i.11]. The overall frequency band is allocated to the Mobile Service, the Fixed Service and the Fixed-Satellite Service (Earth-to-space) on a primary basis in ITU Region 1 and in accordance with the European Common Allocation table (ECA). The objective of frequency designation of the band 5 875 MHz to 5 935 MHz for road safety applications is to support the European Union eSafety initiative with its goals to reduce the number of road fatalities and improving the efficiency of road traffic with Intelligent Vehicle Safety Systems. Road ITS traffic safety and traffic efficiency communication include Inter Vehicle Communication (IVC or V2V), Infrastructure to Vehicle (I2V) communication and ITS stations in highly dynamic ad hoc networks. The decision harmonizes the use of safety-related Intelligent Transport Systems (ITS) in the 5 875 MHz to 5 925 MHz frequency band and the use of safety-related Urban Rail ITS in the 5 925 MHz to 5 935 MHz frequency band. The road ITS applications have priority below 5 915 MHz and Urban Rail ITS applications have priority above 5 915 MHz, so that protection is afforded to the applications having priority.

7.2.1.2 Sharing and compatibility studies (if any) already available

ECC Report 101 [i.17] contains initial compatibility studies in the band 5 855 MHz to 5 925 MHz between ITS and other systems. The compatibility studies were performed for the following services and applications:

- Fixed Satellite (E-s) Service.
- Radiolocation service.
- Non-Specific Short-Range Devices (SRDs) introduced in accordance with the ERC Recommendation 70-03 [i.25].
- Fixed Wireless Access (FWA) devices.
- Fixed Service (FS) above 5 925 MHz.
- Radio amateur below 5 850 MHz.
- Road Transport and Traffic Telematics (RTTT) below 5 815 MHz.

ECC Report 228 [i.18] contains further compatibility studies between ITS in the band 5 855 MHz to 5 925 MHz and the following systems in adjacent bands: road tolling in the band 5 795 MHz to 5 815 MHz and FS in the band above 5 925 MHz. ECC Report 290 [i.19] studies the applicability of ECC Reports 101 [i.17] and 228 [i.18] for various ITS technologies, including LTE-V2X sidelink. Those reports and the assumptions can be reused to evaluate ITS operating with channel bandwidths larger than 10 MHz.

ETSI TR 102 654 [i.20] contains initial considerations for the coexistence between CEN DSRC tolling systems and ITS and ETSI TR 102 960 [i.21] contains coexistence evaluations for CEN DSRC tolling systems and ITS.

7.2.1.3 Sharing and compatibility issues still to be considered

It is proposed to evaluate the sharing studies indicated in clause 7.2.1.2 and evaluate the coexistence of the services and applications with road ITS equipment using a channel with 20 MHz bandwidth.

7.2.2 Transmitter parameters

7.2.2.1 Transmitter Output Power/Radiated Power

The maximum RF output power is limited to 33 dBm e.i.r.p. independent of the channel bandwidth, which is in line with the limits in ETSI EN 302 571 [i.13] and Commission Implementing Decision (EU) 2020/1426 [i.15] for channels with 10 MHz bandwidth. Furthermore, the Power Spectral Density (PSD) is limited to 23 dBm/MHz.

7.2.2.1a Antenna Characteristics

ECC Report 101 [i.17] contains two antenna types. ITS deployments today typically use omni directional antennas, consequently those have been used in ECC Reports 228 [i.18] and 290 [i.19]. Therefore, it is recommended to use the omni directional antennas for sharing and compatibility studies. The antennas characteristics as described in section 2.4 of ECC Report 228 [i.18] should be used.

7.2.2.2 Operating Frequency

For the following tables indicating the nominal carrier frequency for different channel bandwidths, potential channels spanning across non-safety and safety or safety and shared with urban rail ITS channels, respectively, are not listed. The actual carrier centre frequency for any given channel will be maintained within the range $f_c \pm 20$ ppm. Table 4 denotes the nominal carrier centre frequency for channels with 10 MHz bandwidth.

Table 4: Nominal charrier frequency allocation for channels with 10 MHz bandwidth

Carrier centre frequency f_c (MHz)	Maximum channel bandwidth (MHz)
5 860	10
5 870	10
5 880	10
5 890	10
5 900	10
5 910	10
5 920	10

For channels with 20 MHz bandwidth Table 5 summarizes all possible carrier frequency allocations.

Table 5: Nominal charrier frequency allocation for channels with 20 MHz bandwidth

Carrier centre frequency f_c (MHz)	Maximum channel bandwidth (MHz)
5 865	20
5 885	20
5 895	20
5 905	20

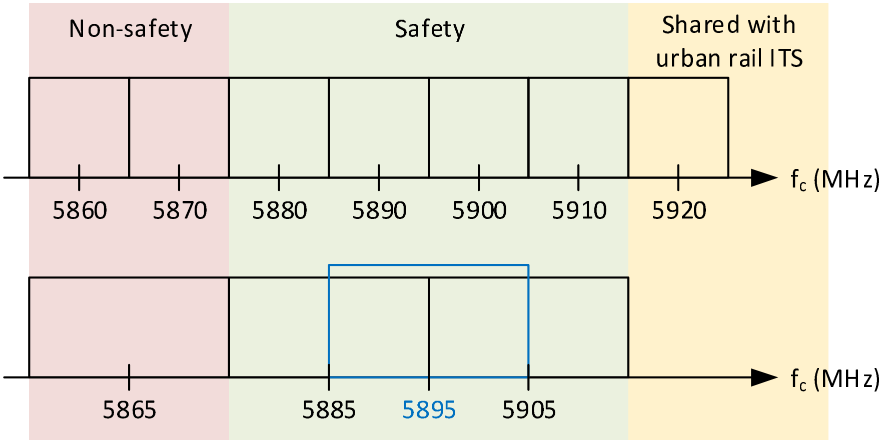

Figure 2: Non-overlapping channel bandwidth combinations for 10 MHz and 20 MHz

Figure 2 depicts the channel combinations for channels with 10 MHz and 20 MHz bandwidth. For channels which would overlap with other channels of the same bandwidth different colours are used. Note that all possible carrier frequencies are depicted within 5 855 MHz to 5 925 MHz. Any mix of channel bandwidths is not excluded. To ensure an efficient use of spectrum and to prevent interference between different radio technologies, the combinations of channels with different channel bandwidths should be non-overlapping.

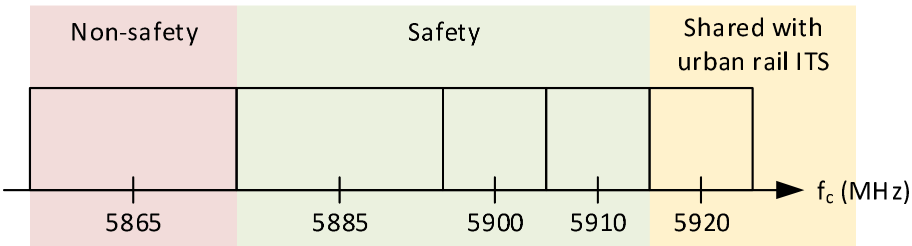

Figure 3: One potential combination of channels with 10 MHz and 20 MHz bandwidth

Figure 3 depicts an example of one potential combination of channels with 10 MHz and 20 MHz bandwidth. In this example in the non-safety ITS spectrum one channel with 20 MHz bandwidth is depicted. In the safety ITS spectrum one channel with 20 MHz bandwidth from 5 875 MHz to 5 895 MHz is depicted, while two channels with 10 MHz bandwidth are maintained with centre frequencies 5 900 MHz and 5 910 MHz.

7.2.2.3 Bandwidth

The supported channel bandwidth should be 10 MHz and 20 MHz.

7.2.2.4 Unwanted emissions

7.2.2.4.1 Spurious emissions

The spurious emissions limits are specified in Table 6. Those limits are aligned with ERC Recommendation 74-01 [i.24]. For the frequency band 5 795 MHz to 5 815 MHz, the limits provided in ETSI TS 102 792 [i.12], Table 5.3, will not be exceeded.

In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 6: Transmitter emission limits

Frequency range	Maximum power (dBm)	Measurement bandwidth
30 MHz ≤ f < 1 000 MHz	-36	100 kHz
1 000 MHz ≤ f < 5 795 MHz	-30	1 MHz
5 795 MHz ≤ f < 5 815 MHz	See ETSI TS 102 792 [i.12]	1 MHz
5 815 MHz ≤ f < 26 GHz	-30	1 MHz

7.2.2.4.2 Out-of-band emission mask

The out-of-band emission mask is the out-of-band emissions on frequencies immediately outside the channel bandwidth, excluding the spurious domain, which is defined in clause 7.2.2.4.1. The transmitter spectrum mask for a channel bandwidth of 20 MHz is given in Table 7.

Table 7: Out-of-band emission limits for channels with 20 MHz bandwidth

Frequency offset to carrier frequency (MHz)	Emission limits e.i.r.p. (dBm)	Measurement bandwidth
±10,0	-16	100 kHz
±11,0	-22	100 kHz
±20,0	-30	100 kHz
±30,0	-40	100 kHz
±40,0	-40	100 kHz

7.2.3 Receiver parameters

Receiver parameters will be consistent to those already defined ETSI EN 302 571 [i.13].

ETSI TR 103 688 [i.23] studies the receiver parameters for road ITS. Based on the findings in ETSI TR 103 688 [i.23] the limits in ETSI EN 302 571 [i.13] are expected to be revised.

In line with equation (5.3.1) in [i.23] and taking into account the noise contribution increases linear with the higher channel bandwidth, the receiver sensitivity P_{Sens} can be assumed as:

$$P_{Sens} = \left\lfloor 10 \log_{10}\left(2^{\frac{\bar{R}_{\text{eff Tx}}}{4}\frac{1}{[MBit/s]}} - 1\right) - 83{,}8\,dB + 10\log_{10}\left(\frac{BW[\text{MHz}]}{10\text{MHz}}\right)\right\rfloor$$

where $\bar{R}_{\text{eff Tx}}$ denotes the effective data rate in Mbit/s and BW is the channel bandwidth in MHz and $\lfloor\cdot\rfloor$ denotes the flooring operation.

For channels with 20 MHz bandwidth this results in:

$$P_{Sens} = \left\lfloor 10 \log_{10}\left(2^{\frac{\bar{R}_{\text{eff Tx}}}{4}\frac{1}{[MBit/s]}} - 1\right) - 80{,}8\,dB\right\rfloor$$

The Adjacent Channel Rejection (ACR) and the Alternate Adjacent Channel Rejection (AACR) are usually independent of the channel bandwidth, therefore the limits in equations (6.3.3) and (6.3.6) from [i.23] can be directly used:

$$ACR_{req} = \left\lfloor -10 \log_{10}\left(2^{\frac{\bar{R}_{\text{eff Tx}}}{4}\frac{1}{[MBit/s]}} - 1\right) + 15{,}8\right\rfloor dB$$

$$AACR_{req} = \left\lfloor -10 \log_{10}\left(2^{\frac{\bar{R}_{\text{eff Tx}}}{4}\frac{1}{[MBit/s]}} - 1\right) + 31{,}3\right\rfloor dB$$

7.2.4 Channel access parameters

For channel access parameters it is recommended to reuse the parameters in [i.18] and [i.19].

7.3 Information on relevant standard(s)

ETSI EN 302 571 [i.13] is the current version of the harmonised standard covering radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band. Once the channelization has been updated to support wider channels, ETSI EN 302 571 [i.13] will be revised to include wider channel bandwidths.

8 Radio spectrum request and justification

The main purpose of the present document is to present consideration for ITS use in the frequency band 5 855 MHz to 5 925 MHz with channels with 20 MHz bandwidth. There is no request for additional radio spectrum.

9 Regulations

9.1 Current regulations

9.1.1 International Allocations

The ITU (Region 1) frequency allocation 5 850 MHz to 5 925 MHz is allocated to FIXED, FIXED SATELLITE (Earth-to-space) and MOBILE [i.14]. See Figure 4.

5 850-5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.150

Figure 4: Region 1 allocation of 5 850 MHz to 5 925 MHz from ITU Radio Regulations [i.14] table for the frequency range 5 570 MHz to 7 700 MHz

9.1.2 European Allocations

The European Common Allocation for 5 850 MHz to 5 925 MHz is allocated to FIXED, FIXED SATELLITE (EARTH-TO-SPACE) and MOBILE. See Figure 5.

5850 MHz - 5925 MHz

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RR Region 1 Allocation and RR footnotes applicable to CEPT	*European Common Allocation and ECA Footnotes*	*ECC/ERC harmonisation measure*	*Applications*	*Standard*	*Notes*
FIXED FIXED-SATELLITE (EARTH-TO-SPACE) MOBILE 5.150	FIXED FIXED-SATELLITE (EARTH-TO-SPACE) MOBILE 5.150	ECC/REC/(06)04	BFWA	EN 302 502	Within the band 5725-5875 MHz
		ECC/DEC/(15)03	DA2GC	EN 303 316 EN 303 339	Within the band 5855-5875 MHz
			FSS Earth stations	EN 301 443	Priority for civil networks
			ISM		Within the band 5725-5875 MHz
		ECC/DEC/(08)01 ECC/REC/(08)01	ITS	EN 302 571 EN 302 636 EN 302 637	Within the bands 5875-5935 MHz and 5855-5875 MHz. Traffic safety applications within the band 5875-5935 MHz
		ECC/REC/(17)03	MBR	EN 303 276	Within 5852-5872 MHz and 5880-5900 MHz
		ERC/REC 70-03	Non-specific SRDs	EN 300 440	Within the band 5725-5875 MHz
		ERC/REC 70-03	Radiodetermination applications	EN 302 372	Within the band 4500-7000 MHz for TLPR application
		ERC/REC 70-03	WIA	EN 303 258	Within the band 5725-5875

Figure 5: ERC Report 25 [i.26] extract for 5 850 MHz to 5 925 MHz

9.1.3 European Regulation

The Commission Implementing Decision (EU) 2020/1426 [i.15] harmonizes the conditions for the availability and efficient use of frequency band 5 875 MHz to 5 935 MHz for safety-related applications of Intelligent Transport Systems (ITS). The frequency arrangement, as of the Annex in [i.17], "*is based on block sizes of 10 MHz starting at the lower edge of the band, at 5 875 MHz. In the 5 875-5 925 MHz band, road ITS applications shall use channels within the boundaries of each 10 MHz block. Channel bandwidth may be less than 10 MHz.*"

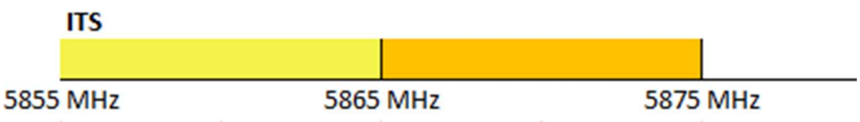
The band 5 855 MHz to 5 875 MHz is harmonized as part of the Short-Range Devices (SRDs) Regulation EC Decision 2019/1345 [i.16], which is an amendment to Decision 2006/771/EC. Here, the two channels with 10 MHz bandwidth have been identified as ITS non-safety bands.

The frequency arrangement for ITS applications in 5,9 GHz is based on a channel block size of 10 MHz. In 5 855 MHz to 5925 MHz, road ITS applications are mandated by European regulation to use channels within the boundaries of each 10 MHz block (channel bandwidth may be lower than 10 MHz) and in 5 915 MHz to 5 935 MHz, the maximum channel bandwidth is 10 MHz for Urban Rail ITS applications.

ECC Recommendation (08)01 [i.11] addresses frequency usage for non-safety applications of ITS in the band 5 855 MHz to 5 875 MHz. Annex 1 of [i.11] contains the following:

"The frequency arrangement is based on a block size of 10 MHz starting at the lower edge of the band, at 5855 MHz.

For ITS:

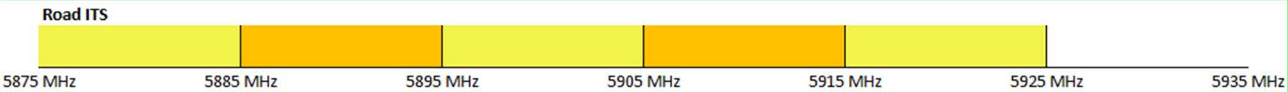


In 5855-5875 MHz, ITS applications shall use channels within the boundaries of each 10 MHz block. Channel bandwidth may be lower than 10 MHz."

ECC Decision (08)01 [i.10] addresses frequency designation within the band 5 875 MHz to 5 935 MHz for the harmonized implementation of safety-related ITS. Annex 1 of [i.10] contains the following:

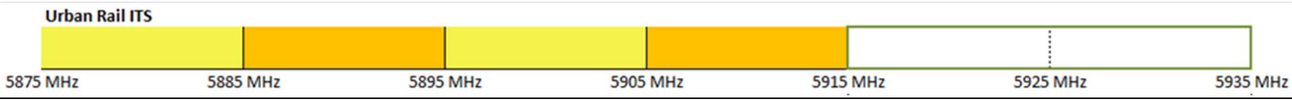
"The frequency arrangement is based on a block size of 10 MHz starting at the lower edge of the band, at 5875 MHz.

For Road ITS:



In 5875-5925 MHz, Road ITS applications shall use channels within the boundaries of each 10 MHz block. Channel bandwidth may be lower than 10 MHz.

For Urban Rail ITS:



In 5875-5915 MHz, Urban Rail ITS applications shall use channels within the boundaries of each 10 MHz block. Channel bandwidth may be lower than 10 MHz.

In 5915-5935 MHz, the maximum channel bandwidth is 10 MHz for Urban Rail ITS applications. The dotted line shows the preferred harmonised frequency arrangement but, at national level, some rollouts may use a channel centred at 5925 MHz."

9.2 Proposed regulation and justification

It is proposed to allow a more flexible frequency arrangement within the ITS non-safety and safety bands, respectively. For the ITS non-safety band support of channel bandwidth 20 MHz is proposed. For the ITS safety band, to support advanced use cases which require a channel with 20 MHz bandwidth, support of channels with 10 and 20 MHz bandwidth is proposed since those bandwidths are supported by the current ITS technologies, as described in clause 5. For this, the frequency arrangement would need to be adapted in the regulation. In line with the current regulation, for all channels the channel bandwidth may be narrower than the maximum bandwidth.

Annex A:
Physical layer parameters

A.1 ITS-G5 based on IEEE 802.11

ETSI EN 302 663 [i.2] describes the ITS-G5 access layer specification.

For channels with 20 MHz bandwidth, it is assumed that the same access layer parameterization and mechanisms are used such as the medium access control procedure (as elaborated in informative clause B.4 of ETSI EN 302 663 [i.2]).

Clause 4.2 in ETSI EN 302 663 [i.2] contains physical layer receiver requirements which are only applicable to 10 MHz frequency channels. For channels with 20 MHz bandwidth the receiver parameters as indicated in clause 7.2.3 are to be used.

A.2 LTE-V2X (release 14)

ETSI EN 303 613 [i.22] describes the release 14 LTE-V2X access layer specification.

For channels with 20 MHz bandwidth, it is assumed that the same access layer parameterization and mechanisms are used, excepted for the following ones.

Table A.1: General LTE-V2X information elements

Item	LTE-V2X information element	Default/initial value	Comment
5	sl-bandwidth	n100 for 20 MHz channel	Indicates the carrier bandwidth. See ETSI TS 136 331 [i.37]. n50 for 10 MHz channel. n100 for 20 MHz channel.

Table A.2: LTE-V2X information elements for transmission pool

Item	LTE-V2X information element	Default/initial value	Comment
4	numSubchannel	10	Indicates the number of Physical Resource Blocks (PRBs) of each sub-channel in the corresponding resource pool.

Table A.3: LTE-V2X information elements for reception pool

Item	LTE-V2X information element	Default/initial value	Comment
4	numSubchannel	10	Indicates the number of Physical Resource Blocks (PRBs) of each sub-channel in the corresponding resource pool.

For channels with 20 MHz bandwidth the receiver parameters as indicated in clause 7.2.3 are to be used.

Annex B: Change History

Date	Version	Information about changes
10/2021	0.0.1	Created the structure of the SRdoc based on ETSI EG 201 788 V2.1.1 (2009-08).
01/2022	0.0.2	Added first technical details, presentation of the technology and current regulations.
03/2022	0.0.3	Added operating frequencies and receiver parameters. Transmit mask added. Reorganization of content within the present document.
04/2022	0.0.4	Add clean-up by ***editHelp!*** and address comments by ***editHelp!***.
06/2022	0.0.5	Inclusion of latest agreed input documents from the drafting sessions. Reduce the request to only include 20 MHz channels. Market information added. Clause 7.1 providing detailed technical description added and Annex with physical layer parameters.
09/2022	0.0.6	Addressing comments from ETSI Technical Officer. Added not the scope. Update of clauses 5 and 6.
11/2022	0.0.7	Statements by ETSI Members added to Clause 4.1 as a result of remote consensus.

History

Document history		
V1.1.1	January 2023	Publication