



CEPT Report 71

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

to study the extension of the Intelligent Transport Systems
(ITS) safety-related band at 5.9 GHz

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0 EXECUTIVE SUMMARY

This Report describes the possibilities for the extension of the Intelligent Transport Systems (ITS) safety-related band at 5.9 GHz. It has been developed in the 2017-2019 timeframe by the European Conference of Postal and Telecommunications Administrations (CEPT) in response to the mandate from the European Commission (EC) to study the extension of the Intelligent Transport Systems (ITS) safety-related band at 5.9 GHz.

In particular, the purpose of this mandate is to study the possibility of:

- extending the upper edge of the EC harmonised safety-related ITS band (5875-5905 MHz) by 20 MHz up to 5925 MHz;
- allowing, in addition to road transport, other means of transport such as Urban Rail¹, using Communication Based Train Control (CBTC), in the EC harmonised safety-related ITS band.

Road ITS does not exclude any kind of ground-based transportation systems, e.g. cars, trucks, bicycles, motor bicycles, tramways, pedestrians, constructions equipment, agricultural equipment, etc.

Additional information with focus on the Urban Rail ITS and Road ITS spectrum sharing solutions is provided in ECC Report 290 [1]. Considerations for non-safety ITS applications operating in 5855-5875 MHz are outside of the scope of this Report and handled in CEPT Report 70 [2] in response to the permanent mandate to CEPT on SRD (7th Update).

This Report is intended as a basis for the amendment of the Commission Decision 2008/671/EC [27] on ITS.

The European Commission is invited to consider the following:

- Road ITS and Urban Rail ITS applications should be part of the same spectrum regulatory framework;
- Urban Rail ITS (such as CBTC) applications in some CEPT countries are currently using frequencies in 5905-5935 MHz and conversely Road ITS applications in some CEPT countries are currently using frequencies in 5875-5905 MHz;
- Technical conditions to be defined by CEPT for RLAN operating above 5935 MHz need to address coexistence with Urban Rail ITS applications below 5935 MHz and Road ITS below 5925 MHz (e.g. out-of-band emission limit requirements and blocking scenario);
- FS applications are widespread above 5925 MHz, and therefore Road ITS applications are not considered in this Report above 5925 MHz unless a proper study is performed;
- Technical solutions already deployed should stay available for maintenance and evolution and the continued rollout of these systems should not be unduly hindered by a change of the spectrum regulatory environment;
- The ITS-G5 control channel is located in 5895-5905 MHz. This does not imply exclusive access to this specific channel for ITS-G5. Other technologies such as LTE V2X should be able to access 5895-5905 MHz on a basis of fair and equal spectrum access and solutions should be found in ETSI;
- The frequency regulation should target technology neutrality, enable early launch of Road ITS products, yet take special care to avoid one technology pre-empt all the spectrum or interfere other technologies ;
- Defining sharing priority between different ITS applications is not against the principle of technology neutrality, prevents segmentation and would provide certainty and a clear frequency regulatory framework to all ITS applications, consistently with the objectives of the EC Mandate on ITS. Road ITS

¹ This type of communication encompasses urban and suburban usages.

and Urban Rail ITS should remain confined to their respective prioritised frequency range only until they implement polite protocols and/or a proper co-channel sharing mechanisms to be defined by ETSI;

- Solutions for the coexistence between Road ITS and Urban Rail ITS applications should not impose the use of a specific Road ITS or Urban Rail ITS technology.

Furthermore, CEPT invites the European Commission to take into due consideration the following proposed improvement of the regulatory framework:

- The restriction to road transportation system should be withdrawn and should encompass all ground-based land transportation systems including Urban Rail (see section 6.1). In addition, it is proposed that a recital in the amended EC Decision 2008/6671/EC for ITS clarifies that UAS/drones communications should be outside the scope of any EC or ECC regulatory deliverables enabling ITS;
- For the purpose of EC and ECC regulatory deliverables enabling ITS, Urban Rail ITS means urban or suburban railway lines segregated from road and pedestrian traffic;
- To harmonise the frequency band 5875-5925 MHz for safety-related ITS applications. In addition, to harmonise the frequency band 5925-5935 MHz for safety-related Urban Rail ITS applications, subject to national coordination with existing FS Networks and/or national studies to determine the sharing conditions;
- The regulatory framework should define priority to Road ITS applications below 5915 MHz and to Urban Rail ITS applications above 5915 MHz, so that protection is afforded to the application having priority;
- In absence of solutions allowing Road ITS applications to protect Urban Rail ITS applications in the frequency range 5915-5925 MHz, on a national basis Road ITS applications limited to vehicle-to-infrastructure (V2I) applications may be permitted and coordinated in 5915-5925 MHz. Vehicle-to-vehicle (V2V) could be permitted when solutions ensuring protection of Urban Rail ITS become available from standardisation in ETSI;
- The precise way how this can be best facilitated for Urban Rail ITS is within the national authorisation process based on national coordination. This can imply the use of individual authorisations for Urban Rail ITS (5915-5935 MHz), Road ITS infrastructure (5915-5925 MHz) and FS (above 5925 MHz);
- The regulatory authority should enable access for Urban Rail ITS (5915-5935 MHz) which would be authorised on a shared basis. The precise implementation of spectrum for Urban Rail ITS should be subject to national circumstances and stakeholder demand for Urban Rail ITS.

Finally, CEPT suggests reviewing the EU framework after no more than 3 years, taking into account the progress made on technology-neutral co-channel sharing mechanisms between ITS applications.

Further investigations are required for the following items:

CEPT invited ETSI to develop sharing and interference mitigation techniques within 3 years, for ensuring co-channel coexistence in the frequency range 5875-5925 MHz between Road ITS and Urban Rail ITS applications and between Road ITS radio technologies, otherwise solutions may need to be defined directly within the regulation, noting that two new work items have been created in ETSI to develop two new Technical Reports. The goal with the two Technical Reports is to specify technical details for road ITS coexistence to be implemented later in a standard (WI reference numbers DTR/ERM-TG37-273 and 274) (see [ECC\(19\)013](#)).

Technical conditions are being defined by CEPT for RLAN operating above 5935 MHz so that the protection of safety-related Urban Rail ITS applications below 5935 MHz and safety-related Road ITS below 5925 MHz (e.g. out-of-band emission limit requirements and blocking scenario) will be addressed.

Depending on requests from administrations, guidance on national coordination may need to be defined by CEPT for Road ITS (V2I) operating in 5915-5925 MHz so that coexistence with Urban Rail ITS applications in 5915-5925 MHz (e.g. maximum received power permitted above urban rail tracks) is ensured.

TABLE OF CONTENTS

0 EXECUTIVE SUMMARY..... 2

1 INTRODUCTION..... 7

2 GENERAL PRINCIPLES AND CONCEPT FOR THE FUTURE REGULATORY APPROACH..... 8

3 ITS TECHNOLOGIES 9

 3.1 Road ITS 9

 3.1.1 ITS-G5 9

 3.1.2 3GPP LTE-V2X..... 10

 3.1.3 Safety-related requirements for Road ITS..... 10

 3.2 Urban Rail ITS 10

 3.2.1 Technologies 11

 3.2.2 Safety-related requirements for Urban Rail ITS 11

**4 ADDITIONAL CONSIDERATIONS ON COEXISTENCE BETWEEN ITS AND OTHER APPLICATIONS
12**

5 COEXISTENCE BETWEEN ITS APPLICATIONS AND TECHNOLOGIES 15

 5.1 Coexistence between Road ITS technologies 15

 5.2 Coexistence between Urban Rail ITS technologies 16

 5.3 Coexistence between Road ITS and Urban Rail ITS 16

 5.3.1 Option 1; Urban Rail ITS having priority in 5905-5925 MHz 18

 5.3.2 Option 2; Urban Rail ITS operating in 5915-5935 MHz and having priority above 5915 MHz
18

6 PROPOSALS FOR FURTHER REGULATION AND STANDARDISATION ON ITS 20

 6.1 Proposals for the EC Decision (and ECC Decision) 20

 6.2 Proposals for ETSI harmonised standard and European profile standard for ITS 21

 6.2.1 Priorities between Road ITS technologies 21

 6.2.2 Priorities between Road ITS and Urban Rail ITS applications 21

7 CONCLUSIONS AND NEED FOR FURTHER INVESTIGATIONS..... 22

ANNEX 1: EXISTING AGREEMENTS, DEPLOYMENTS AND TRIALS IN EUROPE 24

ANNEX 2: CBTC DESCRIPTION AND CHARACTERISTICS..... 31

ANNEX 3: MANDATE TO CEPT 33

ANNEX 4: LIST OF REFERENCES 41

LIST OF ABBREVIATIONS

Abbreviation	Explanation
3GPP	3rd Generation Partnership Project
ACEA	European Automobile Manufacturers' Association
ARIB	Association of Radio Industries and Businesses (Japan)
ASECAP	European Association of Motorway Concessionaries and Toll Operators
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATS	Automatic Train Supervision
CAM	Connected Automated Mobility
CBTC	Communication Based Train Control
CCAM	Cooperative Connected Automated Mobility
CEN DSRC	Dedicated Short-Range Communications as standardised by CEN
CEN-CENELEC	European Committee for Standardisation - European Committee for Electrotechnical Standardisation
CEPT	European Conference of Postal and Telecommunications Administrations
C-ITS	Cooperative Intelligent Transport System
DCC	Decentralised Congestion Control
DENM	Decentralised Environmental Notification Messages
DOT	Department of Transport (USA)
DSRC	Dedicated short range communication as specified in CEN EN 12253, CEN EN 12795, and ETSI EN 300 674
DSSS	Direct Sequence Spread Spectrum
DSSS/TDMA	DSSS/ Time Division Multiple Access
e.i.r.p.	equivalent isotropically radiated power
eNodeB	A logical node responsible for radio transmission/reception in one or more cells to/from the User Equipment.
ETSI	European Telecommunications Standards Institute
FS	Fixed Service
FSS	Fixed-Satellite Service
FWA	Fixed Wireless Access
IMDA	Infocomm Media Development Authority (Singapore)

ITS	Intelligent Transport Systems
ITS-G5	See section 3.1.1
ITU	International Telecommunication Union
JTFIR	ETSI Joint Task Force ITS-RT
LTE	3GPP Long Term Evolution (4G)
LTE-V2X	Cellular V2X
NHTSA	National Highway Traffic Safety Administration in the USA
OBU	On-board Unit
OFDM	Orthogonal Frequency Division Multiplex
OOB	Out-of-Band
PC5	3GPP LTE-V2X PC5 (also known as LTE side-link)
RED	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
RLAN	Radio Local Area Network
RSPG	Radio Spectrum Policy Group
RSU	Roadside Unit
RTTT	Transport and traffic telematics systems for the dedicated use in road environments
SRD	Short Range Device
TD-LTE	Time Division- LTE
TPC	Transmit Power Control
TTA	Telecommunications Technology Association (Korea)
TTT	Transport and traffic telematics
UAS	Unmanned Aircraft Systems
UGTMS	Urban Guided Transport Management and Control/Command Systems
UNIFE	Union of European Railways Industries
V2I	Vehicle to Infrastructure (V2I)
V2V	Vehicle to Vehicle (V2V),
V2X	either vehicle to vehicle (V2V), or vehicle to infrastructure (V2I) and/or infrastructure to vehicle (I2V)
WRC	World Radiocommunications Conference

1 INTRODUCTION

This Report describes the possibilities for the extension of the Intelligent Transport Systems (ITS) safety-related band at 5.9 GHz. It has been developed in the 2017-2019 timeframe by the European Conference of Postal and Telecommunications Administrations (CEPT) in response to the mandate from the European Commission to study the extension of the Intelligent Transport Systems (ITS) safety-related band at 5.9 GHz.

Pursuant to Article 4 of the Radio Spectrum Decision 676/2002/EC, 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; such mandates shall set the task to be performed and the timetable thereof.

In its Opinion on Intelligent Transport Systems, the RSPG considers that "*There is no evidence that spectrum availability is currently a constraint on the development of ITS, and there is no immediate need to take regulatory action in this regard.*" However, given the momentum of policy and standardisation development for ITS, RSPG recommends "that the options for ITS to expand to share spectrum for safety-related ITS in the 20 MHz above the existing designation and, for non-safety ITS, in the 20 MHz below, should be kept available for the time being".

So far no need has been identified for the exchange of data and for sharing of information and knowledge between Road ITS and Urban Rail ITS (such as CBTC) communications.

Road ITS does not exclude any kind of ground-based transportation systems, e.g. cars, trucks, bicycles, motor bicycles, tramways, pedestrians, constructions equipment, agricultural equipment, etc.

With regard to Road ITS, the situation outside of Europe is also diverse. A number of countries outside of Europe have issued standards referring to IEEE 802.11 [8]: e.g. Canada in RSS-252 for ITS in 5850-5925 MHz [4], Japan in the ARIB standard for ITS in 755.5-764.5 MHz for V2V and V2I [5] and in 5770-5850 MHz for V2I [48]; South Korea in the TTA standard for Vehicle Communications Systems in 5850-5925 MHz [6]; Singapore for ITS in 5875-5925 MHz [7]. China published a regulation for Intelligent Connected Vehicles in 5905-5925 MHz mandating the use of LTE-V2X [51] in November 2018. In the USA, the DOT and NHTSA have not made any final decision (i.e. decision postponed) on the proposed rulemaking concerning a V2V mandate (on Road ITS) which was in consultation in 2017 [9], however the DOT has launched a further request on how recent developments in communications technologies impact both V2X in general and the DOT's role in encouraging the integration of V2X [49].

More recently, NHTSA has indicated its support for a technology neutral policy approach whereby the market decides whether ITS-G5 (called DSRC in the USA) or LTE-V2X (or both) will be the preferred solution for V2X communications [10].

With regard to Urban Rail ITS, China already dedicated spectrum in 2015 for use of metros in the 1785-1805 MHz range.

2 GENERAL PRINCIPLES AND CONCEPT FOR THE FUTURE REGULATORY APPROACH

In line with the EU principle of technology neutrality in spectrum regulation, the existing Decision 2008/671/EC [27] already allows the use of any technology that falls within the definition of ITS in compliance with the applicable ETSI EN 302 571 [36] (or equivalent).

Technology neutrality in spectrum regulation for Road and Urban Rail ITS (such as CBTC) and its consequences:

- The spectrum regulatory approach should be technology-neutral and should not impose the use of one technology. This does however not preclude the definitions of minimum technical requirements for shared spectrum access;
- Mitigation techniques developed through ETSI standardisation should be accompanied by technical conditions for spectrum access and relevant harmonised standards, in a technology-neutral approach;
- Uncompromised safety-related applications for all users in case of multiple technologies implementation;
- Efficient spectrum use (an overarching principle of Union's Radio Spectrum Policy, also encompassed in the provisions of the Radio Equipment Directive 2014/53/EU). Backward spectrum compatibility implies that all technologies are at least capable to coexist in the same frequency band;
- There should be no segmentation and segregation of the band 5875-5925 MHz. The principle of equal access to shared spectrum should be applied in the spectrum regulation; this does not preclude conditions to take into account specific situations. No specific safety-related ITS technology or use should be excluded from parts of the spectrum in the band 5875-5925 MHz. This means that technologies are allowed to use the spectrum regulation for safety-related ITS in 5875-5925 MHz when they support a sufficiently polite spectrum access and/or interference mitigation which allows sharing of the spectrum in principle.

Further requirements:

- Road ITS and Urban Rail ITS implementations need to be taken into account to avoid deployment issues with the new ITS spectrum regulation. Technical solutions already deployed should stay available for maintenance and evolution. This concerns Road ITS in 5875-5905 MHz as defined under the current regulation as well as existing Urban Rail ITS within 5905-5935 MHz (see Annex 1) provided under national regulatory conditions. The continued rollout of these systems should not be unduly hindered by a change of the spectrum regulatory environment;
- Under a general authorisation regime, once placed into service, it is difficult to envisage modifications to Road ITS devices to fix a potential coexistence issue between Road ITS and Urban Rail ITS;
- It is observed that there is no existing Road ITS implementation above 5905 MHz. In addition, the Urban Rail (CBTC) community favours the frequencies above 5905 MHz due to existing roll-outs as requested in the ETSI TR 103 111 [34];
- Railway lines not segregated from road or pedestrian traffic (such as tramways) shall be considered as part of Road ITS.

3 ITS TECHNOLOGIES

3.1 ROAD ITS

Road ITS communications will enable the exchange of information between vehicles (V2V) and between vehicles and other nodes (roadside infrastructure and pedestrians). This exchange will provide vehicles with a more accurate knowledge of their surrounding environment that can improve traffic safety.

Within the current CEPT framework for ITS traffic-safety applications (ECC Decision (08)01 [22]), in the 5875-5905 MHz range, the spectrum for ITS is divided into channels with a bandwidth of 10 MHz each. The 10 MHz are to be understood as a maximum channel bandwidth, it could also be less than 10 MHz.

ECC Decision (08)01 considered that only one ITS transmitting device uses an ITS frequency channel at any one time using listen before talk, transmitter power reduction and duty cycle restriction. Furthermore, it considered that duty cycle restrictions and specified frequency re-use conditions (e.g. for periodic ITS messages and ITS channel congestion control considerations) are not only beneficial for the compatibility with other systems in the same or adjacent frequency bands but also for the efficient use of the spectrum.

Current radio technologies for Road ITS in the 5.9 GHz band are ITS-G5 and LTE-V2X. LTE-V2X uses in the 5.9 GHz band only the PC5 air interface. ITS-G5 is based on IEEE 802.11/11p [8] specifications while LTE-V2X is based on 3GPP specifications.

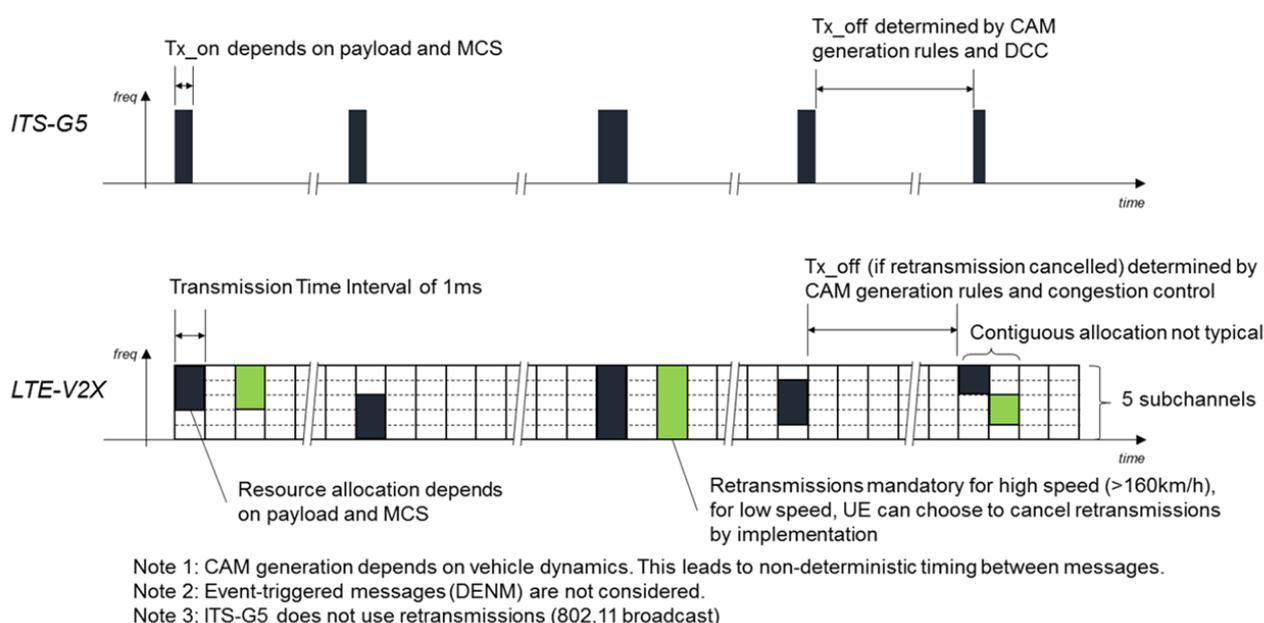


Figure 1: Example of ITS-G5 and LTE-V2X transmit behavior

3.1.1 ITS-G5

ITS-G5 is an ad-hoc network technology based on the IEEE 802.11/11p [8] standard. The PHY and MAC parameters of ITS-G5 are specified in the profile standard ETSI EN 302 663 [38]. It uses EDCA (Enhanced Distributed Channel Access) for channel access prioritisation and DCC as specified in ETSI TS 102 687 [45] to control the channel load. DCC algorithms in ETSI TS 102 687 describe procedures to obey the generic DCC limits that are mandated by the ETSI EN 302 571 and describe the maximum duty cycle limit for a given channel load. Technical details of ITS-G5 can be found in the information from ETSI in document FM(18)135 [37]. Note that IEEE is studying an evolution for IEEE 802.11/11p while maintaining backward compatibility.

In order to limit the congestion, a mandatory decentralised congestion control (DCC) has been specified by ETSI.

The ITS-G5 access layer profile and a set of higher layer specifications were created under the standardisation mandate M/453 by the EC to support the interoperability of co-operative systems for intelligent transport in the European Community.

3.1.2 3GPP LTE-V2X

The Third Generation Partnership Project (3GPP) published in September 2016 specifications in Release 14 for the support of V2X communications ([11] and [12]), which is commonly referred to as LTE-V2X. The specifications include two radio interfaces: the cellular interface supports vehicle-to-network communications in traditional MFCN bands (called Uu), and the PC5 interface supports V2V and V2I communications based on direct LTE sidelink (or device-to-device communication), which was introduced in Release 12 for public safety and enhanced in Release 14 for V2V/V2I communications in 3GPP band 47 (5855-5925 MHz). Note that 3GPP is studying a technology evolution for LTE-V2X based on New Radio (NR) while supporting the interworking with LTE-V2X [28]. Both LTE-V2X and NR-V2X form the Cellular V2X (C-V2X) family. The LTE sidelink includes two modes of operation, mode 1 and mode 2, which were designed with the objective of prolonging the battery lifetime of user equipment for device-to-device communication at the cost of increasing latency. However, connected vehicles require highly reliable and low-latency communications. Because these two modes were not suitable for vehicular applications, Release 14 introduced two new communication modes, mode 3 and mode 4, specifically designed for this use case. Whereas in transmission mode 3 cellular network (eNodeB) controls radio resource scheduling, transmission mode 4 is based on autonomous radio resource selection by vehicles. In other words, mode 4 can operate without cellular network coverage, and is therefore considered as the baseline V2V/V2I mode. Mode 4 includes a distributed scheduling scheme for vehicles to select their radio resources and the support for decentralised congestion control.

Technical details of LTE-V2X such as physical layer, medium-access control protocol and congestion control mechanisms can be found in ECC Report 290 [1].

3GPP has specified a 10 MHz and a 20 MHz air interface for the PC5 air interface in the 5.9 GHz band. However, the relevance of the 20 MHz air interface for Europe has not been expressed.

3.1.3 Safety-related requirements for Road ITS

Safety-related road ITS applications require low-latency for vehicle-to-vehicle communications and also for communications with roadside infrastructure. The overall communication channel loading and decentralised communication traffic congestion control must be such to ensure that safety-related messages have a very high predictability to be received by other ITS stations. Future safety-related ITS applications have increased requirements and will support more and more automated driving possibilities, compared with the existing initial driver alert applications in ITS.

3.2 URBAN RAIL ITS

Working assumptions had been defined and set out in the [liaison statement to ETSI](#) from WGFM#87 in February 2017. They are still valid with regard to shared spectrum use. Activities within CEPT had already been started based on the ETSI TR 103 111 on Urban Rail CBTC. ETSI developed ETSI [TR 103 442](#) on the shared use of spectrum between Communication Based Train Control (CBTC) and ITS applications. However, ETSI TR 103 442 can only be considered as an interim report on the way towards spectrum sharing solutions between Road ITS and Urban Rail ITS.

CBTC is a train-to-trackside radiocommunication system, with a potential evolution to train-to-train radiocommunications. Existing CBTC systems normally use 5 MHz channels instead of 10 MHz. Overall, in order to cope with multiple tracks and shunting yards, CBTC requires 20 MHz of contiguous spectrum in the 5.9 GHz band. Additional information about Urban Rail ITS CBTC is provided in Annex 2 and in ECC Report 290 [1].

3.2.1 Technologies

Current radio technologies for CBTC are:

- DSSS/TDMA;
- full or modified IEEE 802.11 [8] technology, OFDM based;
- 3GPP TD-LTE (used in China in the 1785-1805 MHz range, not implemented in Europe yet).

3.2.2 Safety-related requirements for Urban Rail ITS

Urban rail operators need a system to control and manage the traffic on their own network. Urban Rail ITS such as CBTC is a wireless Automatic Train Control (ATC) system, more flexible and cost efficient than traditional ATC. Safety of operation and operational performances (mainly low headway between trains and high number of passengers carried and exchanged along the line) depend on stringent radio-communication requirements; therefore Urban Rail ITS need access to spectrum with conditions ensuring these performances and the required level of safety of operation and needs to be robust against interference.

CBTC provides automatic train control with and without driver. When trains are moving, the wireless system allows communication with a central system. The wireless system is used to transmit traction order or braking order in a safe mode. If trains cannot transmit/receive messages, they will not be authorised to move. The critical aspect of the radio system for Urban Rail (CBTC) implementations is its availability. CBTC therefore includes redundancy in the communications and has low latency requirements.

As per IEEE 1474 [41], CBTC is defined as an automatic train control system utilising:

- high-resolution train location determination, independent of track circuits;
- continuous, high-capacity, bidirectional train-to-wayside data communications;
- train-borne and wayside processors capable of implementing automatic train protection (ATP) functions, as well as optional automatic train operation (ATO) and automatic train supervision (ATS) functions.

The Urban Rail (CBTC) system has to be sufficiently robust, i.e. suitable choice of system parameters in line with the safety-related requirements, especially for use above the ground.

A continuous availability of and accessibility to the radio network is required in order to transmit and receive a Movement Authority, including an emergency brake order, everywhere along the rail tracks. An interference case leading to an interruption of radiocommunication in the context of CBTC will lead to emergency braking and stopping of trains.

Any spectrum harmonisation measure shall ensure a stable frequency regulatory framework from the beginning to Urban Rail, which fulfils the bandwidth requirements, so that the frequency band assigned to Urban Rail remains available during the lifetime of the system in order to avoid service disruption and cost implications of shifting the frequency band.

The protection of already existing CBTC systems is important and it should be considered to make sure that the bandwidth is available for new CBTC systems with priorities (see Annex 1).

4 ADDITIONAL CONSIDERATIONS ON COEXISTENCE BETWEEN ITS AND OTHER APPLICATIONS

Based on ECC Reports 101 [24] and 228 [25], the following items have been examined in ECC Report 290 [1] by taking into account the need for reliable safety-related operation in the 5875-5925 MHz band:

- for LTE-V2X, whether the assumptions and conclusions made in ECC Reports 101 and 228 are valid. This included considerations about TPC, duty cycling and overall transmission activity, coexistence with TTT road tolling;
- for Urban Rail ITS, whether the assumptions and conclusions made in ECC Reports 101 and 228 are valid;
- whether the conclusions of ECC Report 101, stating that between 5875 MHz and 5925 MHz ITS will not suffer from excessive interference resulting from systems/services other than ITS, are also valid for Road ITS based on LTE-V2X (PC5 air interface) and for Urban Rail ITS based on CBTC.

Co-frequency operation between Urban Rail ITS and Fixed Service in 5925-5935 MHz was not assessed in ECC Report 290 as it was considered out of scope. To allow Urban Rail ITS to operate up to 5935 MHz, the adjacent band compatibility between Urban Rail ITS in 5915-5935 MHz and RLAN above 5935 MHz is currently investigated.

Requirements in ETSI EN 302 571 [36], related to coexistence with road tolling below 5815 MHz and Fixed Service above 5925 MHz, are based on ECC Report 228, which supersedes ECC Report 101 on these topics.

Table 1: Summary of the analysis performed in ECC Report 290

Service	Conclusions of ECC Reports 101 and 228		Conclusions on CBTC	Conclusions on LTE-V2X
	ITS as interferer	ITS as victim		
Radio amateur (5830-5850 MHz)	Compatibility is achieved	Compatibility is achieved	Compatibility is achieved above 5875 MHz in both ways	ECC Report 101 remains valid
FSS (5850-6725 MHz)	Compatibility is achieved	Compatibility is achieved in most cases taking into account the limited number of earth stations and real terrain shielding	ECC Report 101 remains valid	ECC Report 101 remains valid, Note 1a
Radiolocation (5725-5850 MHz)	Compatibility is achieved with ITS unwanted power of -55 dBm/MHz, below 5850 MHz	Between 5855-5875 MHz ITS may suffer from interference	For CBTC as interferer, ECC Report 101 remains valid. For CBTC as victim, systems design margin should ensure compatibility above 5875 MHz	ECC Report 101 remains valid, Note 1b

SRD (5725-5875 MHz)	Compatibility is achieved if ITS are operating above 5875 MHz. Mitigation techniques are required in the frequency range 5855-5875 MHz	Mitigation techniques are needed in the frequency range 5855-5875 MHz. LBT may help avoiding interference to ITS	Compatibility is achieved above 5875 MHz in both ways	ECC Report 101 remains valid, Note 1b
FWA (5725-5875 MHz)	Compatibility is achieved if ITS are operating above 5875 MHz. Mitigation techniques are required in the frequency range 5855-5875 MHz	Mitigation techniques are needed in the frequency range 5855-5875 MHz. LBT may help avoiding interference to ITS	Compatibility is achieved above 5875 MHz in both ways	ECC Report 101 remains valid, Note 1b
RTTT, road tolling (5795-5815 MHz)	Compatibility is achieved if ITS unwanted emissions are limited below 5815 MHz: <ul style="list-style-type: none"> • to -65 dBm/MHz without mitigation techniques • to -45 dBm/MHz taking into account the ETSI specifications on ITS (ETSI EN 302 637-2 [19], ETSI EN 302 571 [34]) and the timing requirements according to ECC Report 228 	Interference depends on the antenna beams alignment and is limited to the RTTT communication zone	Compatibility is achieved above 5875 MHz. In case of proximity to the RTTT communication zone, adequate system design is required	Compatibility is achieved under mode A*. Note 2a Under mode B*, compatibility could be achieved if timing requirements (T_{on} & T_{off}) and aggregated spurious emissions do not exceed those of ITS in ECC Report 228 in the interference zone, Note 2b

<p>FS (5925-6425 MHz)</p>	<p>An unwanted emission limit of -40 dBm/MHz is able to avoid harmful interference (I/N = -20 dB) to the Fixed Service or an unwanted emission limit of -30 dBm/MHz may be sufficient to avoid harmful interference to the Fixed Service with mitigation techniques.</p>	<p>ITS within the band 5905-5925 MHz may suffer from interference</p>	<p>When tracks and FS beam are aligned, an unwanted emission limit of -40 dBm/MHz for CBTC should be applied. FS will have limited impact on CBTC operating in the band 5905-5925 MHz taking into account the system margin</p>	<p>ECC Reports 101 and 228 remain valid, Note 1b</p>
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* Modes A and B are specified in ETSI TS 102 792 Table 5.3, which is part of the requirements defined in ETSI EN 302 571.

Note 1a: As per *considering n*) in ECC Decision (08)01, duty cycle restrictions and specified frequency re-use conditions are beneficial for the compatibility with other systems and for the efficient use of the spectrum by cooperative ITS systems.

Note 1b: LTE-V2X systems have to comply with the technical conditions defined in ECC Decision (08)01 and with the requirements given in ETSI EN 302 571 related to unwanted emissions. With regard to the Fixed Service, requirements given in ETSI EN 302 571 are based on ECC Report 228.

Note 2a: On compatibility between LTE-V2X and road tolling in mode A:

- An aggregation of spurious emissions from multiple LTE-V2X vehicles in mode A is considered not to be an issue. In ECC Report 228 it was shown that for spurious emissions of -65 dBm/MHz per ITS device practically no interference zone exists. Therefore contributions of simultaneously transmitting devices from multiple vehicles are assumed to be negligible due to additional propagation losses in comparison with a single dominant device.

Note 2b: On compatibility between LTE-V2X and road tolling in mode B:

- using repeated retransmissions of CAM within a road tolling RSU interference zone can result in lost road toll transactions;
- if CAM retransmissions occur, the average air time of LTE-V2X transmissions within the road tolling RSU interference zone may be longer than the average air time requirements in ECC Report 228 derived for CAM; Compatibility can be achieved if LTE-V2X stations reduce their average air time within the road tolling RSU interference zone in accordance with the timing requirements in ECC Report 228. For a 1 second interval, the air time of the transmissions is the number of used sub-frames times the sub-frame length of 1 ms;
- the requirements regarding timing issues are not yet considered in the current versions of 3GPP LTE-V2X specifications.

It should be noted that LTE-V2X has been studied in this Report based on 3GPP TR 36.786. Furthermore, studies on Smart Tachograph are covered in ECC Report 291 and thus not part of ECC Report 290; and a proposal for harmonisation of the Smart Tachograph in 5795-5815 MHz and of ITS in 5855-5875 MHz is described in CEPT Report 70 [2] in response to the 7th Update for SRD.

5 COEXISTENCE BETWEEN ITS APPLICATIONS AND TECHNOLOGIES

ECC and ETSI worked closely together during the development of the response to the mandate, especially with regard to the various technologies and applications which are under discussion in ETSI, i.e. ITS-G5 vs. LTE-V2X as well as Road ITS vs. Urban Rail ITS. The aim is to define a common framework to share the 5875-5925 MHz band amongst ITS technologies and applications (road and urban rail).

CEPT took into account feedback on the progress of the work developed by ETSI, which aims at providing a technical standard allowing practical implementation of safety-related ITS applications (road, urban rail) in the 5875-5925 MHz band. However, exact technical interference mitigation measures will need to be tested and validated. It is clear that this is not possible within the time frame of the mandate and will require much more time.

CEPT invited ETSI to provide information concerning spectrum sharing by various technologies (LTE-V2X, ITS-G5 and CBTC communications technologies), about commonalities and differences of the spectrum access mechanisms and their capabilities for sharing, and whether this implies that specific actions are necessary to ensure compatibility between them.

There is currently no available specification for sharing solutions between different Road ITS technologies. These are under consideration in ETSI and the work is not finalised yet.

In addition, current Road ITS specifications do not define priority mechanisms for Urban Rail ITS. Harmful interferences to existing CBTC systems would therefore be possible.

5.1 COEXISTENCE BETWEEN ROAD ITS TECHNOLOGIES

The sharing solutions for ITS-G5 and LTE-V2X in the band 5855-5925 MHz are under study within ETSI; this includes co-channel coexistence. ETSI provided an interim report of their actions to CEPT in section 4 of Annex 2 in document FM(18)135 [37]. In response to questions from ECC, ETSI provided additional information with regard to mitigating adjacent channel interference and multiple channel operation between the different Road ITS radio technologies with use of the Harmonised Standard ETSI EN 302 571 in document FM(19)008 [52].

Two new work items have been created in ETSI to develop two new Technical Reports. The goal with the two Technical Reports is to specify technical details for road ITS coexistence to be implemented later in a standard (WI reference numbers DTR/ERM-TG37-273 and 274) (see [ECC\(19\)013](#)).

The frequency regulation should target technology neutrality, enable early launch of Road ITS products, yet take special care to avoid one technology pre-empt all the spectrum or interfere other technologies.

The following options are under investigation by ETSI:

- a. preferred channels on a temporary basis
- b. detect-and-vacate;
- c. a combination of options a+b above;
- d. geographical sharing/segregation;
- e. channel reservation based on energy signals;
- f. coexistence between Road ITS using reservation messages (where all ITS stations use the ITS-G5 PHY/MAC for this reservation message);
- g. coexistence between Road ITS using header insertion (where all ITS stations transmit ITS-G5 headers);

- h. coexistence between Road ITS using combination of reservation messages and header insertion (combination of the two above);
- i. coexistence amongst heterogeneous MAC layers under a common fairness framework based on congestion control parameters and prioritisation parameters.

The coexistence solution should enable spectrum sharing among Road ITS technologies in a fair and non-discriminatory manner.

The technical feasibility, the impact on the Road ITS specifications as well as the timeframe of the above solutions are yet to be confirmed and are the responsibility of ETSI.

It is proposed to review the ECC and EC Decisions after 3 years, assuming this gives ETSI enough time to complete their work.

5.2 COEXISTENCE BETWEEN URBAN RAIL ITS TECHNOLOGIES

Coexistence between Urban Rail ITS technologies is not an issue since only one technology is usually in operation along a railway line and, if not, the CBTC operator may decide to segregate technologies by using different channels.

The main benefit of a European spectrum harmonisation for Urban Rail ITS is to achieve a bigger market in Europe by using a stable and available European harmonised spectrum regulatory approach. Regional/metropolitan deployment does not necessarily need the harmonisation of frequencies for operational reasons or cross-border/cross-network interoperability specifications in Europe.

5.3 COEXISTENCE BETWEEN ROAD ITS AND URBAN RAIL ITS

The interference risk between Road ITS and Urban Rail ITS is being assessed within ETSI, and coexistence of the two applications requires specific technical measures, in particular when CBTC is operated outside tunnels. ETSI provided an interim reporting of their actions to CEPT in document FM(18)135 [37].

The situation between Road ITS and Urban Rail ITS is seen as different, most importantly in terms of deployment, compared with the situation between Road ITS technologies and needs to be reflected in the ECC Decision and EC Decision.

Urban Rail ITS are currently purely infrastructure-based (all messages are conveyed via the infrastructure, no direct train-to-train communication) while Road ITS in the 5.9 GHz range includes device-to-device communications (either V2V or V2I) where messages are not necessarily conveyed via infrastructure. Planning and deployment rules of Urban Rail ITS infrastructure ensure that all trains are connected to the system, and proper functioning of the trains is dependent upon the reliability of the communication system. Harmful interferences to CBTC systems leading to an interruption of radiocommunication triggers emergency braking and stopping of trains. Last, the meaning of traffic safety amongst those applications is different:

- For Road ITS, the ultimate aim is to reduce the number of traffic fatalities or accidents using communications between ITS stations;
- For Urban Rail ITS, the aim is to automatically control the train movement, enforcing train safety and directing train operations.

Nevertheless, Road ITS and Urban Rail ITS use similar technologies and are recommended to be treated within the same application terminology as safety-related Intelligent Transport Systems (ITS) applications.

Priority between different applications, i.e. different subsets of ITS (Road ITS and Urban Rail ITS in this case), can also be defined in the relevant spectrum regulation: revisions of ECC Decision (08)01 and of EC Decision 2008/671/EC [27]). This would not be against the principle of technology neutrality, but would provide a clear regulatory framework while preserving specificities of the two applications.

At the time of writing, the work is still ongoing within ETSI (JTFIR – Joint Task Force ITS-RT). JTFIR is working on a Technical Report TR 103 580 covering the proposed sharing solutions. In support of its work, ETSI has established a Special Task Force (STF) 553 to intensify investigations. Its work has started in June 2018. Conclusions are expected in 2019. Results of the STF 553 will be included in the ETSI TR 103 580.

Road ITS could use the spectrum prioritised for Urban Rail ITS under the condition that Road ITS devices comply with the specified technical mitigation measures, so that Urban Rail ITS remain free of harmful interference. Urban Rail ITS could use the spectrum prioritised for Road ITS under the condition that Urban Rail devices comply with the specified technical mitigation measures, so that Road ITS remain free of harmful interference. Thus the whole 5875-5925 MHz will be accessible to both applications, once the mitigation measures are specified.

Exact technical interference mitigation measures will need to be tested and validated. It is clear that this is not possible within the time frame of the mandate and will require much more time as ETSI informed CEPT accordingly.

Therefore, it is proposed:

- Road ITS and Urban Rail ITS applications should be part of the same spectrum regulatory framework;
- Urban Rail ITS (such as CBTC) applications in some CEPT countries are currently using frequencies in 5905-5935 MHz and conversely Road ITS applications in some CEPT countries are currently using frequencies in 5875-5905 MHz;
- Technical solutions already deployed should stay available for maintenance and evolution and the continued rollout of these systems should not be unduly hindered by a change of the spectrum regulatory environment;
- Solutions for the coexistence between Road ITS and Urban Rail ITS applications should not impose the use of a specific Road ITS or Urban Rail ITS technology;
- For the purpose of EC and ECC regulatory deliverables enabling ITS, Urban Rail ITS means urban or suburban railway lines segregated from road and pedestrian traffic;
- Tramways, Light Rail and buses are not covered by Urban Rail ITS. As far as they have interaction with road users (cars and pedestrian), tramways, Light Rail and buses should use Road ITS solutions and not Urban Rail ITS ones;
- To harmonise the frequency band 5875-5925 MHz for safety-related ITS applications. In addition, to harmonise the frequency band 5925-5935 MHz for safety-related Urban Rail ITS applications, subject to national coordination with existing FS Networks and/or national studies to determine the sharing conditions;
- The regulatory framework should define priority to Road ITS applications below 5915 MHz and to Urban Rail ITS applications above 5915 MHz, so that protection is afforded to the application having priority;
- In absence of solutions which allow Road ITS applications to protect Urban Rail ITS applications in the frequency range 5915-5925 MHz, Road ITS applications in 5915-5925 MHz could initially be limited to vehicle-to-infrastructure (V2I) applications and coordinated on a national basis. Vehicle-to-vehicle (V2V) could be permitted when solutions ensuring protection of Urban Rail ITS become available from standardisation in ETSI;
- The precise way how this can be best facilitated for Urban Rail ITS is within the national authorisation process based on national coordination. This can imply the use of individual authorisations for Urban Rail ITS (5915-5935 MHz), Road ITS infrastructure (5915-5925 MHz) and FS (above 5925 MHz). The regulatory authority should enable access for Urban Rail ITS (5915-5935 MHz) which would be authorised on a shared basis. The precise implementation of spectrum for Urban Rail ITS should be subject to national circumstances and stakeholder demand for Urban Rail ITS;
- It is proposed to review the ECC Decision (08)01 [22] and EC Decision [27] after 3 years with the aim to assess Road ITS and Urban Rail ITS spectrum sharing, assuming this gives ETSI enough time to complete their work for a technology-neutral co-channel coexistence mechanism between Road ITS and Urban Rail ITS. The initial mandate was limited to the upper frequency edge at 5925 MHz, however CEPT has assessed another scenario with the upper frequency edge at 5935 MHz for Urban Rail ITS, which is the currently recommended scenario. The following sections summarise the advantages and disadvantages of each option. It is important that the preferred Urban Rail ITS spectrum remains the same in the long-term.

Two basic scenarios have been considered with regard to where Urban Rail ITS have priority. Both scenarios fulfil the bandwidth requirements of Urban Rail ITS. Urban Rail ITS vendors and operators have indicated they need a stable frequency regulatory framework from the beginning. The Urban Rail community stated that a continuous 20 MHz of spectrum is required. A potential third option was discussed where Urban Rail ITS have priority in 5905-5915 MHz and 5925-5935 MHz (i.e. a 10 MHz gap in the middle). This option however was not considered acceptable by the Urban Rail community and may have greater impact on existing Urban Rail ITS implementations (see Annex 1).

5.3.1 Option 1; Urban Rail ITS having priority in 5905-5925 MHz

Advantages:

- No need to retrofit existing CBTC systems deployed or under planning in 5905-5925 MHz (See Annex 1);
- No impact on FS links above 5925 MHz.

Disadvantages:

- For co-channel operation, Road ITS devices will need to protect Urban Rail ITS in 5905-5925 MHz (mitigation techniques/measures and/or coordination are needed in order to share the spectrum);
- Only 30 MHz of prioritised spectrum for Road ITS, which might be restrictive for both capacity and coexistence between Road ITS technologies;
- Technical conditions for RLAN need to address coexistence with safety-related Urban Rail ITS applications below 5935 MHz and are also needed for this option due to existing large-scale deployments that will not be retrofitted, therefore (unless legacy systems could be migrated) this option does not enable any relaxation of the constraints for RLAN.

5.3.2 Option 2; Urban Rail ITS operating in 5915-5935 MHz and having priority above 5915 MHz

Advantages:

- 10 MHz of additional spectrum prioritised for Road ITS use immediately in 5905-5915 MHz;
- For co-channel operation, Road ITS devices will only need to protect Urban Rail ITS in 5915-5925 MHz (mitigation techniques/measures and/or coordination are needed in order to share the spectrum);
- Technical conditions for RLAN ensuring protection of safety-related Urban Rail ITS applications below 5935 MHz are the same for this option as compared to the option with Urban Rail ITS having priority in 5905-5925 MHz.

Disadvantages:

- National coordination is necessary with existing FS networks and/or national studies to determine the sharing conditions;
- Urban rail systems may not be able to use 5925-5935 MHz in specific locations where existing fixed links cannot be removed or relocated. Coordination between Urban Rail ITS and FS applications has been successful in several countries where existing Urban Rail deployments use frequencies above 5925 MHz.

CEPT proposes to select this option.

Consequences:

- A national coordination requirement between existing FS authorisations (and potentially some other applications) and safety-related Urban Rail ITS may imply the use of individual authorisations for 5925-5935 MHz;

- Technical conditions are being defined by CEPT for RLAN operating above 5935 MHz so that the protection of safety-related Urban Rail ITS applications below 5935 MHz and safety-related Road ITS below 5925 MHz (e.g. out-of-band emission limit requirements and blocking scenario) is being addressed;
- Depending on requests from administrations, guidance on national coordination may need to be defined by CEPT for Road ITS (V2I) operating in 5915-5925 MHz so that coexistence with Urban Rail ITS applications in 5915-5925 MHz (e.g. maximum received power permitted above urban rail tracks) is ensured;
- An appropriate authorisation regime is needed for coexistence between Road ITS and Urban Rail ITS in 5915-5925 MHz which ensures the protection of Urban Rail ITS.

Solutions have to be found on a national basis with regard to Urban Rail ITS operating in 5905-5925 MHz and on-going projects in 5905-5925 MHz (see ANNEX 1).

6 PROPOSALS FOR FURTHER REGULATION AND STANDARDISATION ON ITS

6.1 PROPOSALS FOR THE EC DECISION (AND ECC DECISION)

Considering that the 5.9 GHz band is to be used by different ITS traffic safety applications (road and urban rail) and by different technologies, and observing the principle of technology neutrality, it is proposed:

- To revise the definition in Article 2(1) of ITS that shall be broadened to encompass all ground-based land transportation systems, including Urban Rail;
- Any restriction to 'road' needs to be avoided and should be deleted. A wider scope should also include applications such as off-road transportation vehicles, e.g. used in agriculture or at construction sites. Off-road applications are considered as applications which typically have a lower number of transportation vehicles in the market, hence there is no spectrum compatibility concern;
- All spectrum compatibility studies so far were conducted on the basis of ground-based ITS stations. ITS applications operating on-board vessels or flying drones, i.e. UAS (Unmanned Aircraft Systems), were not considered yet. Further investigations may be required for such use cases, also noting that communication solutions for drones currently under discussions in CEPT may lead to a demand for harmonisation. It is proposed that a recital in the amended EC Decision 2008/671/EC for ITS clarifies that UAS/drones communications are outside of the ITS spectrum regulatory approach;
- To distinguish between Urban Rail ITS and Road ITS in the regulation, while keeping them in the same regulatory framework, otherwise it would be a sign to keep the separation on a permanent basis which is against the strategy of fostering sharing and improved spectrum utilisation;
- To define priority for Urban Rail ITS above 5915 MHz and priority for Road ITS below 5915 MHz;
- To review the regulation after 3 years at the latest, taking into account the progress made on technology-neutral co-channel sharing mechanisms between ITS applications.

CEPT invited ETSI to develop sharing and interference mitigation techniques within a reasonable time-frame (no more than 3 years), for ensuring co-channel coexistence in the frequency range 5875-5925 MHz between Road ITS and Urban Rail ITS applications and between Road ITS radio technologies. The review is intended to complete the work (specification, testing and validation) within ETSI on the required mitigation measures and to give time for its implementation in the field.

Minimum technical requirements (without any change for Road ITS in 5875-5905 MHz):

- the frequency band 5875-5925 MHz is designated for all safety-related ITS applications (Road ITS and Urban Rail ITS);
- the frequency band 5925-5935 MHz is designated for safety-related Urban Rail ITS applications;
- define priority to Road ITS applications below 5915 MHz and to Urban Rail ITS applications above 5915 MHz, so that protection is afforded to the application having priority;
- the spectrum for all ITS applications is divided into channels with a maximum bandwidth of 10 MHz each;
- the maximum spectral power density for all ITS stations should be limited to 23 dBm/MHz e.i.r.p.;
- the total transmit power for all ITS stations shall not exceed 33 dBm e.i.r.p. with a Transmit Power Control (TPC) range of 30 dB;
- Road ITS and Urban Rail ITS should remain confined to their respective prioritised frequency range only until they implement polite protocols and/or a proper co-channel sharing mechanisms to be defined by ETSI.

In absence of solutions allowing Road ITS applications to protect Urban Rail ITS applications in the frequency range 5915-5925 MHz, on a national basis Road ITS applications limited to vehicle-to-infrastructure (V2I) applications may be permitted and coordinated in 5915-5925 MHz. Vehicle-to-vehicle (V2V) could be permitted when solutions ensuring protection of Urban Rail ITS become available from standardisation in ETSI.

As a consequence, Road ITS may have the possibility to use the frequency range 5915-5925 MHz in geographical areas, where Urban Rail ITS does not use these frequencies.

6.2 PROPOSALS FOR ETSI HARMONISED STANDARD AND EUROPEAN PROFILE STANDARD FOR ITS

This includes consideration of intertwining and working together of ETSI standards and the need to ensure coherence between the regulatory framework set out in the EC and ECC Decisions.

At the 48th ECC Plenary meeting in July 2018, concluded that priority between different applications, i.e. different subsets of ITS (Road ITS and Urban Rail ITS in this case), can also be defined in the relevant spectrum regulation (revision of ECC Decision (08)01). This would not be against the principle of technology neutrality, but would provide clear regulatory framework. However, a prioritisation or band segmentation with regard to different technologies (ITS-G5 and LTE-V2X) should be avoided as far as possible, taking into account the need to ensure coexistence, reliable safety-related operation, and efficient use of spectrum. Technology neutrality is to be considered as a basic principle.

6.2.1 Priorities between Road ITS technologies

The frequency regulation should target technology neutrality, enable early launch of Road ITS products, yet take special care to avoid one technology pre-empt all the spectrum or interfere other technologies until ETSI agrees on a proper co-channel sharing mechanism compatible with early launched technologies.

6.2.2 Priorities between Road ITS and Urban Rail ITS applications

The situation between Road ITS and Urban Rail ITS is seen as different compared with the situation between Road ITS technologies.

Priority between Road ITS and Urban Rail ITS can be defined in the relevant spectrum regulation (revision of ECC Decision (08)01 and EC Decision 2008/671/EC). This would not be against the principle of technology neutrality, but would provide clear regulatory framework. The main considerations are:

- Urban Rail ITS is more infrastructure-based while Road ITS in the 5.9 GHz range has a focus on vehicle-to-vehicle communications;
- Current and planned Urban Rail ITS require certainty that operation can continue undisturbed;
- Harmful Interference to Urban Rail ITS leading to an interruption of radiocommunication will lead to emergency braking and stopping of trains;
- Markets of Urban Rail ITS and Road ITS are distinct. Therefore market forces are not adequate substitutes to regulation;
- Where a Road ITS infrastructure is deployed and then an urban rail ITS deployment in the same location is considered at a later stage, the priority in 5915-5925 MHz should not imply a requirement to remove road ITS infrastructure. The availability of suitable sharing mechanisms in the future would help to resolve such a problem (see also section 6.1).

7 CONCLUSIONS AND NEED FOR FURTHER INVESTIGATIONS

This Report is intended as a basis for the amendment of the Commission Decision 2008/671/EC [27] on ITS.

The European Commission is invited to consider the following:

- Road ITS and Urban Rail ITS applications should be part of the same spectrum regulatory framework;
- Urban Rail ITS (such as CBTC) applications in some CEPT countries are currently using frequencies in 5905-5935 MHz and conversely Road ITS applications in some CEPT countries are currently using frequencies in 5875-5905 MHz;
- Technical conditions to be defined by CEPT for RLAN operating above 5935 MHz need to address coexistence with Urban Rail ITS applications below 5935 MHz and Road ITS below 5925 MHz (e.g. out-of-band emission limit requirements and blocking scenario);
- FS applications are widespread above 5925 MHz, and therefore Road ITS applications are not considered in this Report above 5925 MHz unless a proper study is performed;
- Technical solutions already deployed should stay available for maintenance and evolution and the continued rollout of these systems should not be unduly hindered by a change of the spectrum regulatory environment;
- The ITS-G5 control channel is located in 5895-5905 MHz. This does not imply exclusive access to this specific channel for ITS-G5. Other technologies such as LTE V2X should be able to access 5895-5905 MHz on a basis of fair and equal spectrum access and solutions should be found in ETSI;
- The frequency regulation should target technology neutrality, enable early launch of Road ITS products, yet take special care to avoid one technology pre-empt all the spectrum or interfere other technologies ;
- Defining sharing priority between different ITS applications is not against the principle of technology neutrality, prevents segmentation and would provide certainty and a clear frequency regulatory framework to all ITS applications, consistently with the objectives of the EC Mandate on ITS. Road ITS and Urban Rail ITS should remain confined to their respective prioritised frequency range only until they implement polite protocols and/or a proper co-channel sharing mechanisms to be defined by ETSI;
- Solutions for the coexistence between Road ITS and Urban Rail ITS applications should not impose the use of a specific Road ITS or Urban Rail ITS technology.

Furthermore, CEPT invites the European Commission to take into due consideration the following proposed improvement of the regulatory framework:

- The restriction to road transportation system should be withdrawn and should encompass all ground-based land transportation systems including Urban Rail (see section 6.1). In addition, it is proposed that a recital in the amended EC Decision 2008/6671/EC for ITS clarifies that UAS/drones communications should be outside the scope of any EC or ECC regulatory deliverables enabling ITS;
- For the purpose of EC and ECC regulatory deliverables enabling ITS, Urban Rail ITS means urban or suburban railway lines segregated from road and pedestrian traffic;
- To harmonise the frequency band 5875-5925 MHz for safety-related ITS applications. In addition, to harmonise the frequency band 5925-5935 MHz for safety-related Urban Rail ITS applications, subject to national coordination with existing FS Networks and/or national studies to determine the sharing conditions;
- The regulatory framework should define priority to Road ITS applications below 5915 MHz and to Urban Rail ITS applications above 5915 MHz, so that protection is afforded to the application having priority;
 - In absence of solutions allowing Road ITS applications to protect Urban Rail ITS applications in the frequency range 5915-5925 MHz, on a national basis Road ITS applications limited to vehicle-to-infrastructure (V2I) applications may be permitted and coordinated in 5915-5925 MHz. Vehicle-to-vehicle (V2V) could be permitted when solutions ensuring protection of Urban Rail ITS become available from standardisation in ETSI;

- The precise way how this can be best facilitated for Urban Rail ITS is within the national authorisation process based on national coordination. This can imply the use of individual authorisations for Urban Rail ITS (5915-5935 MHz), Road ITS infrastructure (5915-5925 MHz) and FS (above 5925 MHz);
- The regulatory authority should enable access for Urban Rail ITS (5915-5935 MHz) which would be authorised on a shared basis. The precise implementation of spectrum for Urban Rail ITS should be subject to national circumstances and stakeholder demand for Urban Rail ITS.

Finally, CEPT suggests reviewing the EU framework after no more than 3 years, taking into account the progress made on technology-neutral co-channel sharing mechanisms between ITS applications.

Further investigations are required for the following items:

CEPT invited ETSI to develop sharing and interference mitigation techniques within 3 years, for ensuring co-channel coexistence in the frequency range 5875-5925 MHz between Road ITS and Urban Rail ITS applications and between Road ITS radio technologies, otherwise solutions may need to be defined directly within the regulation.

Technical conditions are being defined by CEPT for RLAN operating above 5935 MHz so that the protection of safety-related Urban Rail ITS applications below 5935 MHz and safety-related Road ITS below 5925 MHz (e.g. out-of-band emission limit requirements and blocking scenario) will be addressed.

Depending on requests from administrations, guidance on national coordination may need to be defined by CEPT for Road ITS (V2I) operating in 5915-5925 MHz so that coexistence with Urban Rail ITS applications in 5915-5925 MHz (e.g. maximum received power permitted above urban rail tracks) is ensured

ANNEX 1: EXISTING AGREEMENTS, DEPLOYMENTS AND TRIALS IN EUROPE

A1.1 ROAD ITS

ITS devices used by pedestrians, e.g. integrated into smartphones, have not been studied. The overall number and density of ITS messages may deviate from the assumptions made in studies for vehicles.

A1.1.1 C-Roads Platform

The C-Roads Platform has 17 Member States and 84 associated Member States (Croatia, Greece, Ireland, Israel, Switzerland, Russia, Australia and New Zealand). The aim of the C-Roads Platform is linking all C-ITS deployments and to develop, share and publish common technical specifications (including the common communication profiles), planning intensive cross-testing to verify interoperability in the EU (also using ETSI plug-tests) and develop system tests based on the common communication profiles by focusing on hybrid communication mix, which is a combination of ETSI ITS-G5 and operational cellular network. The ultimate goal is interoperability of all C-ITS communications; it should be technically possible that all vehicles can communicate to each other.



Figure 2: C-Roads Platform – Partner Member States’ Authorities

The C-Roads Platform is co-financed by the European Union and aims at the following implementation strategy:

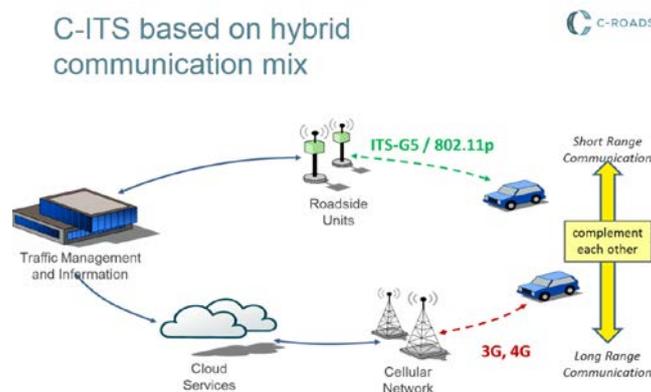


Figure 3: Communication mix as specified within the scope of C-Roads

A position paper was published in 2017 [31]. Road authorities should not be forced to equip the roadside with two or more competing technologies (ITS-G5, LTE-V2X, or potential future technologies) serving the same use cases or providing the same content to road users. Furthermore, C-Roads Member States are committed to the “backwards compatibility” criteria in the technological evolution: new C-ITS equipment beyond Day-1 needs to support and safeguard already deployed C-ITS services. Additionally, the evolution of cellular communication standards towards 5G is expected to bring further improvements to long range cellular communication (e.g. coverage improvements and signalling efficiency), providing benefits to the hybrid communication approach and complementing short range connectivity. Road authorities need to have the choice how to provide connectivity via a hybrid communication approach, including all suitable communication networks to vehicles also in the future (see figure above). The C-Roads Member State authorities work in close cooperation with ASECAP, the Car-2-Car Consortium and ACEA.

C-ROADS has published Release 1.3 of the Roadside ITS-G5 System Profile [39] Release 1.4 is published in December 2019. The profile contains all Day-1 applications and is aligned with the basic system profile of the Car-to-Car Communication Consortium. The security mechanism is prepared, while central elements are prepared by the EC, and the operational link to the industry has been established. A hybrid communication profile (ITS-G5 and existing 3G/4G cellular networks) is expected by mid-2019.

Several C-ROADS pilot deployments are already operational [50]. C-ROADS Pilots are first steps to larger roll-outs and installed for continued operation in larger corridors or nationwide roll-outs. They are not radio equipment tests, but use commercially available radio equipment to introduce C-ITS services to early. First C-ITS services for a subset of Day-1 use case are operational. Full-scale Day-1 services are considered operative in 2019. For the 5.9 GHz range, these services are based on ITS-G5 technology. Tenders for Day-1 have been started or are in preparation in several C-ROADS member states (e.g. [43] and [44]). Some members also include services beyond Day-1 such as Automated Driving Support [43]. By 2019, 6000 km of safety-critical road sections will be covered by short-range C-ITS services.

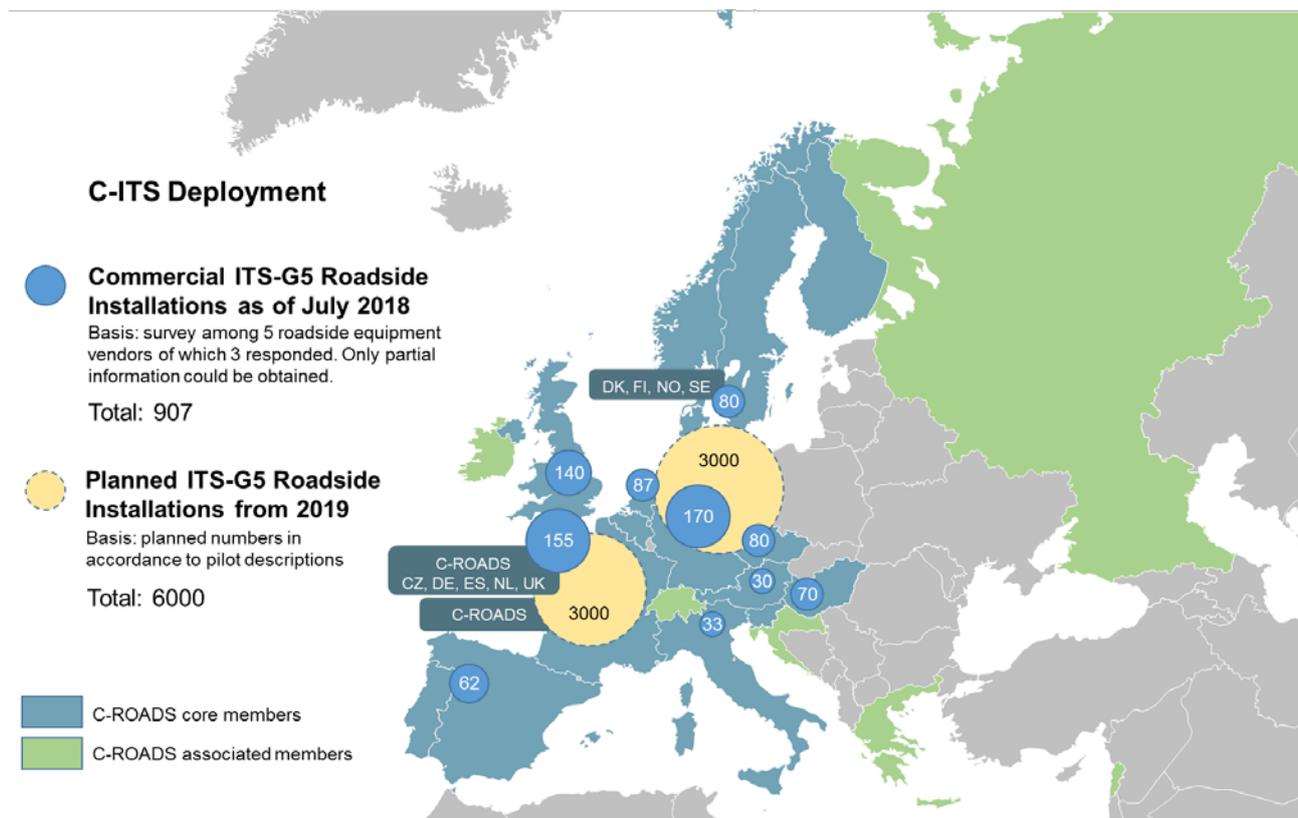


Figure 4: C-ITS Deployment in Europe in C-ROADS and national deployments [46]

A1.1.2 Platooning (example of a new Road ITS application)

In the wake of the successful European Truck Platooning Challenge [13], several pilots and research projects have been initiated with the aim of bringing multibrand truck platooning to the European roads. All European truck OEM are part of the EU project ENSEMBLE [14], which aims at bringing a pan-European truck platooning system to the market. ENSEMBLE will also serve as the foundation for the upcoming legislation on platooning as announced in the third mobility package published in May 2018 [15].

Pilots are currently carried out in Sweden [16], Germany [17], and UK [18]. Platooning increases safety and efficiency and it is the first connected and automated driving application that will see the day of light in Europe. These projects and pilots are using ITS-G5 for wireless communicating between the trucks on a 10 MHz frequency channel (e.g. 5.875-5.885 GHz). Platooning puts up concurrent requirements on reliability and delay. If one 10 MHz channel (e.g. 5.895-5.905 GHz) has to carry all position messages triggered by vehicle dynamics (a.k.a. Cooperative Awareness Message, CAM [19]) and event-triggered hazard notifications (a.k.a. Decentralised Environmental Notification Message, DENM, [20]), the channel may quickly be overloaded locally. Therefore, it is planned to use another frequency channel for the platooning application. Platooning deployment for commercial use is expected in 2020 [29].

A1.2 URBAN RAIL ITS, CBTC

A1.2.1 Urban rail sector position

Numerous UITP and UNIFE members (operators and manufacturers) have agreed in 2015 on a [Position Paper UITP UNIFE CBTC Frequency Bandwidth](#) targeting protected frequency channels for CBTC systems in the 5.9 MHz spectrum even if the channels are shared with Road ITS. The related initiative coordinated by UITP since 2010 is called "Spectrum User Group" – SUG, also referred to as "the CBTC community".

Twenty-one companies signed the Position Paper:

- Operators or contracting authorities: BKV – Budapest; DPP – Prague; FGC – Barcelona; Keolis – International; London Underground (LUL) – London; MTR – International; RATP – International; RET – Rotterdam; Société du Grand Paris – Paris; Sporveien – Oslo; Stasy – Athens; STIB/MIVB – Brussels; TMB – Barcelona; Transdev – International; UTP – French public transport operators; VDV – German public transport Association (more than 600 members);
- Manufacturers: Alstom; Bombardier; Siemens.

Other UITP members have confirmed their support to the Spectrum User Group initiative, e.g.:

- ATAC – Rome; MM – Madrid; SNCF – France; SRWT – Belgium; Wiener Linien – Austria
- THALES (although they currently operate in the 2,4 GHz band) ; Hitachi-STS

Most of all these have signed in 2011 and in 2016 a 5-year long Memorandum of Understanding supporting the Spectrum User Group initiative.

The current CBTC systems run over a digital networked radio system by means of antennas or leaky feeder cable for the bi-directional communication between the track equipment and the trains.

Some existing CBTC systems use inductive loop and 2.4 GHz ISM band for wireless communications. The original two-wire inductive loop system was prone to vandalism and, in newer versions, the control signal is transmitted inside the running rails at radio frequency using IEEE 802.11 (Wi-Fi) access points. In the UK, London underground and Docklands Light Railway use this system (see Table 2a). Whereas these lines used track-based loop technology for control, command and positional information, the sub-surface lines use radio technology to continually communicate with the trains together with sleeper mounted transponders (RFID tags) to give train position information. The radio employs free space transmission, even in tunnels, using the 2.4 GHz band.

A1.2.2 Deployment of CBTC systems

Table 2a: Use of CBTC systems in 2.4 GHz bands

Lines already deployed or under construction								
Country	City	Situation	Opening to Public	Band	Trips per day	Full length (km)	Portion of the line outside (m)	% of outdoor part
UK	London Jubilee	Already in operation	2011	2400-2483 MHz	5,000,000 Trips a day across whole network	402 for whole network	220,000 for whole network	55 for whole network
UK	London Northern	Already in operation	2015	2400-2483 MHz				
UK	London Docklands Light Railway	Already in operation	2007	2400-2483 MHz				
UK	London Metropolitan	Already in operation	2018	2400-2483 MHz				
UK	London Hammersmith and City	Already in operation	2018	2400-2483 MHz				
UK	London Circle	Already in operation	2018	2400-2483 MHz				
UK	London District	Already in operation	2018	2400-2483 MHz				

Table 2b: Use of CBTC systems in 5.9 GHz bands

Lines already deployed or under construction								
Country	City	Situation	Opening to Public	Band	Trips per day	Full length (km)	Portion of the line outside (m)	% of outdoor part
France	Paris L1	Already in operation	2011	5915-5935 MHz	750.000	18.000	920m (in 2 places)	6%
France	Paris L3	Already in operation	2010	5915-5935 MHz	350.000	13.000	0	0%
France	Paris L5	Already in operation	2013	5915-5935 MHz	450.000	16.000	3200	20%
France	Paris L9	Already in operation	2015	5915-5935 MHz	550.000	21.000	0	0%
Spain	Malaga L1	Already in operation	-	5905-5925 MHz		9.400	1500	16%
Spain	Malaga L2	Already in operation	-	5905-5925 MHz		5.300	5300	100%
France	Paris L4	Contract awarded	Planned 2020	5915-5935 MHz	780.000	13.000	Only depot	
France	Rennes LB	Roll-out	Planned 2020	5872,5-5927,5 MHz		13.700	2330 + depot	17%
France	Lyon line B	Roll-out	Planned 2020	5905-5925 MHz		8.700	1000	11%
France	Lyon line D	Roll-out	Planned 2020	5905-5925 MHz		13.600	1000	7%
France	Lille LM1 (refurbishment of existing lines)	Roll-out	Planned 2020	5915-5935 MHz		13.900	4200	30%
Belgium	Brussels L1*	Contract awarded	Planned 2021	5905-5925 MHz	220.000	47.500	5700	12%
Belgium	Brussels L5*	Contract awarded	Planned 2021	5905-5925 MHz				
Belgium	Brussels L2**	Contract awarded	Planned 2021	5905-5925 MHz	180.000	32.500	2900	9%
Belgium	Brussels L6**	Contract awarded	Planned 2021	5905-5925 MHz				
France	Paris L11	Contract awarded	Planned 2022	5915-5935 MHz	300.000	8.000	0	0%
Denmark	Copenhagen S-bane (6 phases)	First phase in operation – Roll out in several phases	Last phase planned 2022	5925-5975 MHz				
Austria	Vienna (resignalling project)	Contract awarded	Opening planned 2024 (start with test)	Under discussion with regulator		8.000	1600	20%

Lines already deployed or under construction								
			run in 2020)					
France	Marseilles L1	Contract awarded	Planned 2023					
France	Marseilles L2	Contract awarded	Planned 2023					
France	Paris L6	Contract awarded	Planned 2023	5915-5935 MHz	600.000	13.000	6100	47%
France	Lyon line D	Roll-out	Planned 2023	5905-5925 MHz				
France	Paris L14 (Orly-Pleyel)	Contract awarded	Planned 2024	5915-5935 MHz	1.100.000			
France	Paris NExTEO EOLE	Contract awarded	Planned between 2021 and 2023	5905-5925 MHz		27.600	9.000	33%
France	Grand Paris line 15	Contract awarded Q3 2018	Planned between 2024 to 2030	5905-5925 MHz		77.000	Only depot	0%
France	Grand Paris line 16	Contract awarded Q3 2018	Planned between 2024 to 2030 1st area in 2024 for Olympic Games	5905-5925 MHz		29.000	Only depot	0%
*L1 and L5 in Brussels have a common part **L2 and L6 in Brussels have a common part								

Table 3: Future projects waiting for regulator authorisation for a frequency band and needing urgent decision

Projects waiting for regulator authorisation for a frequency band and needing urgent decision						
Country	City	<u>Situation</u>	<u>Opening to Public</u>	<u>Full length (km)</u>	<u>Portion of the line outside (m)</u>	<u>% of outdoor part</u>
Germany	Frankfurt Airport	Contract awarded	Planned 2023			
France	Paris line 10	To be awarded Q3 2018	Planned 2024	20.000	-	0%
France	Toulouse	Project	Planned 2024			
France	Paris line 12	To be awarded Q1 2019	Planned 2026	17.000	-	0%
Germany	Hamburg line U5	Project	First part planned 2028	26.000	1.000	4%
France	Paris NExTEO B	To be awarded	Planned between 2024 and 2029	80.000	44.000	55%
France	Paris NExTEO D	To be awarded	Planned between 2024 and 2029	24.500	17.000	69%
France	Paris line 17	Contract awarded	Planned between 2024 to 2030	20.000	6.000	30%
France	Paris line 18	Tender to launch in 2019	Planned between 2025 to 2030	35.000	13.000	37%
France	Paris line 3	To be awarded 2025	Planned 2029	13.000	-	0%
France	Paris line 8	To be awarded 2025	Planned 2029	25.000	4.100	16%
Belgium	Brussels Line 3	Extension of awarded contract	Planned 2030	20.000	-	0%
France	Paris line 9	To be awarded 2027	Planned 2031	21.000	-	0%
Germany	Cologne Innenstadt tunnel	Pre-Project (Note 1)	First part planned between 2035 to 2040	6.000	-	0%
Germany	Berlin Line 5 & 8	Pre-Project	First part planned 2026	41.000	7100	17%

Note 1: The project is in a very early planning phase and therefore does not require any urgent decisions

ANNEX 2: CBTC DESCRIPTION AND CHARACTERISTICS

As per CEN-CENELEC Guide 26 [44], a Urban Rail system is a public transport system permanently guided at least by one rail, intended for the operation of local, urban and suburban passenger services with self-propelled vehicles and operated either segregated or not from general road and pedestrian traffic.

Mass transport metro lines which are operated at a high level of performance with short intervals between successive trains are now using Communications-Based Train Control systems, in short CBTC. CBTC systems have been deployed for more than 15 years in several European countries under national exclusive agreements in the upper 5 GHz range.

CBTC systems typically allow running trains only 90 seconds (or less) apart ("headway" 90 s or less) with total safety for the passengers and the staff. The headway depends upon: the train "dwell time" (time spent by the train at every station for passengers to leave and board trains); the distance between stations; and the profile of the line as well as the possible acceleration, maximum speed and deceleration of the train.

CBTC is providing automatic train control with and without driver. To drive automatically a train, a Data Communication System (DCS) is needed. When trains are moving the wireless system allows communication with a central system. The wireless system is used to transmit traction orders or braking orders in a safe mode. If trains cannot transmit messages, they will not be authorised to move.

The main spectrum requirements for Urban Rail systems cover the needs for:

- fundamental time-critical and safety-relevant applications with very low latency;
- non-safety-relevant applications, extending the applicability of the communications equipment towards railway traffic management tasks and other applications.

Non-safety-related Urban Rail ITS applications include Internet access, passenger information systems, Urban Rail maintenance applications, video, audio and telecommand/telemetry applications. Both types of applications might indirectly enhance the urban rail traffic safety and system operation. All these functionalities are described in the ETSI system reference documents [1]. Non safety-related CBTC applications are in 5855 to 5875 MHz.

CBTC is defined as a continuous, automatic train control system utilising:

- high-resolution train location determination, independent of track circuits;
- continuous, high-capacity, bidirectional train-to-wayside data communications;
- train-borne and wayside processors capable of implementing automatic train protection (ATP) functions, as well as optional automatic train operation (ATO) and automatic train supervision (ATS) functions.

Since it is related to mass transport, CBTC has critical requirements which are classified at the highest Safety Integrity Level (SIL4). This level is equivalent to the highest one in aeronautics and nuclear plants, and exceeds the current classification of the automotive industry (ASIL-A to D). This level implies enforcing formal methods for specifications, development, and validation of hardware and software parts, then of the whole systems. CBTC system ensures safety operation for a complete metro line based on, EN 50126 [32], EN 50128 [33] and EN 50129 [34] demonstration.

Proper functioning of CBTC and therefore efficiency of the transport system and the safety of passengers are based on highly reliable communication links between wayside and on-board CBTC. External interference on the frequency band used by CBTC can cause repeated disturbances reducing the public transport capacity.

Safe train protection involves a number of operational functions; noticeably the emergency braking that must be anticipated to guarantee the safety of standing passengers: indeed emergency braking from 80 km/h to a full stop will occur if one-way latency time is greater than 1 second. Emergency braking causes huge

discomfort and may even lead to injury to metro passengers. There is no seat belt in metro systems. For this reason, CBTC's radio must provide a low latency or delay, even under a significant load of the radio. It is of course very important for the train to be sure that the message received is valid, that is to say up to date.

CBTC applications must stay fully independent from the communication system. Therefore no constraints should come from the communication system regarding repartition of data in messages, recurrences of these messages, etc.

The technical harmonisation of spectrum for Urban Rail would be beneficial from the pan-European market harmonisation perspective. Some existing Urban Rail CBTC roll-outs use different frequency ranges including 2.4 GHz. The approach is to include Urban Rail systems 'under the umbrella' of the 5.9 GHz ITS regulation which is already harmonised in Europe. This approach is considered to have the benefit of being available at an acceptable time-to-market throughout Europe.

The safe operation of CBTC systems requires a redundancy of the communication (see section 8.2.1 of ETSI TR 103 111 [35]). This redundancy must be continuous in space and permanent in time. To ensure redundancy a single train contains 2 radio transmitters, both transmitting in parallel the same data towards two different trackside radio equipment on 2 different channels. On the other side, each trackside transmitter has most of the time multiple trains to communicate with, from a nominal value of 4 trains in operational lines up to typically a dozen trains in dense areas such as multiple-platform stations, multiple tracks in parallel, branches and train yards/depots.

ANNEX 3: MANDATE TO CEPT



EUROPEAN COMMISSION

Communications Networks Content & Technology Directorate-General

Electronic Communications Networks & Services

Spectrum

Brussels, 18 October 2017

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PUBLIC DOCUMENT

RADIO SPECTRUM COMMITTEE

Working Document

Subject: Mandate to CEPT to study the extension of the Intelligent Transport Systems (ITS) safety-related band at 5.9 GHz

Opinion of the RSC

pursuant to Advisory Procedure under Article 4 of Regulation 182/2011/EU and Article 4.2 of Radio Spectrum Decision 676/2002/EC

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1. PURPOSE

The underlying objective of this Mandate is to provide the Commission with the necessary information to consider the amendment of Commission Decision 2008/671/EC, of 5 August 2008, on the harmonised use of radio spectrum in the 5 875-5 905 MHz frequency band for safety-related applications of Intelligent Transport Systems (ITS).

In particular, the purpose of this mandate is to study the possibility of:

- Extending the upper edge of the EC harmonised safety-related ITS band (5 875-5 905 MHz) by 20 MHz up to 5 925 MHz.
- In addition to road transport, allowing other means of transport such as Urban Rail¹ (using Communication Based Train Control, (CBTC)) in the EC harmonised safety-related ITS band.

2. EU POLICY CONTEXT

Mobility has an important role in modern day society and substantially impacts our lives and the EU economy. Among the top challenges are road safety (over 26 000 people died on European roads in 2015²), the environmental impact (road transport is the main responsible for Nitrogen Oxides (NOx) emissions in the EU)³, economic concerns (every day, congested roads are a huge cost to the EU economy), and the global competitive position of the EU automotive and rail industry.

In line with the Declaration of Amsterdam, endorsed by Transport Ministers in April 2016⁴, the Commission has announced in the 2017 work programme⁵ its intention to work in an integrated way on mobility, connectivity and the future of the automotive industry.

In order to cater for vehicle connectivity in terms of access to spectrum for safety-related ITS applications, the European Commission adopted Decision 2008/671/EC, which has facilitated standardisation and development of equipment. Recent developments described below have led the Commission to consider an amendment of Decision 2008/671/EC.

¹ This type of communication encompasses urban and suburban usages which shall be taken into due consideration when conducting relevant studies.

² https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/pdf/observatory/trends_figures.pdf

³ <https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-air-pollutants-8/transport-emissions-of-air-pollutants-4>

⁴ <https://www.regjeringen.no/contentassets/ba7ab6e2a0e14e39baa77f5b76f59d14/2016-04-08-declaration-of-amsterdam---final1400661.pdf>

⁵ https://ec.europa.eu/commission/work-programme-2017_en

In its Opinion on Intelligent Transport Systems⁶, the RSPG considers that *"There is no evidence that spectrum availability is currently a constraint on the development of ITS, and there is no immediate need to take regulatory action in this regard. However, given the momentum of policy and standardization development for ITS we recommend that the options for ITS to expand to share spectrum for safety-related ITS in the 20 MHz above the existing designation and, for non-safety ITS, in the 20 MHz below, should be kept available for the time being"*.

ITS in the Automotive industry

The automotive industry is making substantial progress in view of EU-wide deployment of ITS in 2019. ITS will contribute to connected and driverless vehicles, notably for safety-related applications. The Commission notes the appreciation of continued EU support expressed by EATA, the European Automotive Telecom Alliance at the round table co-chaired by Vice President Andrus Ansip and Commissioner Günther Oettinger at the Mobile World Conference on 27 February 2017 and the progress made at the latest round-table of 15 September 2017⁷. Furthermore, an MoU⁸ on cooperation in the field of connected and autonomous driving solutions has been signed between EATA and the 5G Automotive Association (5GAA). Also an MoU⁹ between C-Roads¹⁰ and the Car2Car Communication Consortium (C2C-CC) has been signed at the ITS Europe Congress preparing the deployment of initial cooperative ITS services across Europe by 2019.

One of the recent developments in the ITS scenario is the standardisation of an LTE-based V2X (vehicle to everything) technology¹¹ which could underpin the path to 5G connectivity for the automotive/road transport "vertical" sector. This technology however will be commercially available later than the existing IEEE 802.11p "G5" Wi-Fi based ITS technology¹². Various initiatives are on-going in Europe towards implementation in vehicles of the G5 technology which has been subject of European R&D¹³ since several years. However, stakeholders appear quite divided as regards the

⁶ https://circabc.europa.eu/sd/a/b30590d7-5190-480b-b1d1-def24719e061/RSPG17-008-Final_opinion_ITS.pdf

⁷ <https://ec.europa.eu/digital-single-market/en/node/88557>

⁸ https://www.eurofiber.nl/assets/uploads/2017/02/EATA_5GAA_MOU_final-for-signature-20170227.pdf

⁹ <https://www.c-roads.eu/platform/about/news/News/entry/show/c-its-cooperation-between-c2c-cc-and-c-roads-platform-1.html>

¹⁰ <https://www.c-roads.eu/platform.html>

¹¹ 3GPP Release 14 (direct communication interface, PC5).

¹² In line with the C-ITS Strategy COM(2016) 766, the ITS Directive 2010/40/EU and subject to investments in 16 EU Member States to implement C-ITS based on the principles of the "C-ROADS" platform.

¹³ <https://ec.europa.eu/transport/sites/transport/files/themes/its/doc/c-its-platform-final-report-january-2016.pdf>

choice among the above technologies as was demonstrated at the recent workshop held by the Commission on 5 September 2017¹⁴.

ITS projects in the EU

EU Member States in the C-Roads project are deploying C-ITS based on the ETSI ITS-G5 technology as of 2017 for road infrastructure¹⁵. A total of 350 million EUR are earmarked in 16¹⁶ Member States to implement C-ITS based on the principles of the “C-Roads position on the usage of the 5.9 GHz band” and on the Release 1 of the ETSI ITS-G5 System Profile¹⁷ while new CEF initiatives¹⁸ are in addition to ETSI ITS-G5 and existing long-range cellular communication also studying LTE-V2X technology.

In line with the EU principle of technology neutrality in spectrum regulation, the existing Decision 2008/671/EC already allows the use of any technology that falls within the definition of ITS in compliance with the applicable harmonised standard (EN 302 571 published in the OJEU on 9 June 2017¹⁹).

Thus the 5.9 GHz band offers spectrum for V2V(I) in a technology neutral way and licence-exempt use of this band is recommended by CEPT taking into account coexistence with other co-primary radio communication services. Based on current technology development and the applicable harmonised standard, a G5-only vehicle and an LTE-only vehicle do not communicate with each other.

Outside the scope of this mandate, Industry should actively engage in European Standardisation Organisations and with Member State authorities in order to identify the best way forward to achieve interoperability between various systems in this band.

Further work leading to coexistence and efficient spectrum use of safety-related car-to-car/infrastructure operation in the designated 5.9 GHz band (e.g. through shared use) should be undertaken in ETSI and CEPT, as appropriate.

¹⁴ <https://ec.europa.eu/digital-single-market/en/news/workshop-short-range-vehicular-communications-59-ghz-band>

¹⁵ For details on ITS-G5 deployment per country, see https://www.c-roads.eu/fileadmin/user_upload/media/Dokumente/c-roads-flyer_2.pdf

¹⁶ Austria, Belgium, Czech Republic, France, Germany, The Netherlands, Slovenia, United Kingdom, Denmark, Finland, Hungary, Italy, Norway, Portugal, Spain and Sweden.

¹⁷ www.c-roads.eu

¹⁸ e.g. the CONCORDA project that was selected in a recent CEF-Transport evaluation and is currently in the contract signature phase.

¹⁹ http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2017.180.01.0005.01.ENG&toc=OJ:C:2017:180:TOC

ITS in the urban rail sector

Urban Rail (such as metros, trams, light trains) consists of public transport systems permanently guided by at least one rail, intended for the operation of local, urban and suburban passenger services segregated or not from general road and pedestrian traffic. Some of those systems (in particular metros and suburban rail lines) increasingly use Communication Based Train Control (CBTC)²⁰, often also for Unattended (driverless) Train Operations (UTO). The operational characteristics of this application qualify it for using spectrum in the frequency range between 5 and 6 GHz. Today, a variety of proprietary Urban Rail systems exist in various frequency bands and some are already in operation in a part of the 5 905-5 925 MHz band, sometimes reserved by national administrations for such a radio application. In support of more harmonisation, the UITP (Union Internationale des Transports Publicques) has worked within ETSI to adopt a Technical Report (ETSI TR 103 111), the System Reference Document (SRDoc) on: *"Spectrum requirements for Urban Rail Systems in the 5.9 GHz range"*²¹.

Considerations on a possible prioritization²² between the various ITS applications are taking place in various fora including in ETSI and CEPT: for example, as an initial proposal, the road ITS may have priority in the 5875-5905 MHz band over urban rail ITS, while urban rail may have priority in the 5 905-5 925 MHz band over road ITS. In this regard, it is important to study the coexistence of urban rail applications and in particular CBTC with ITS solutions for safety-related road ITS (LTE-V2X and IEEE 802.11p "ETSI ITS-G5") in the 5.9 GHz band. Mitigation techniques developed through ETSI standardisation should be accompanied by technical conditions for spectrum access and relevant harmonised standards, in a technology neutral approach.

Decision 2008/671/EC on ITS specifies in Article 2(1): *"Intelligent Transport Systems' mean a range of systems and services, based on Information and Communications technologies, including processing, control, positioning, communication and electronics, that are applied to a road transportation system;"*.

Therefore, besides expanding the frequency band for safety-related ITS, it would be necessary to amend this legal definition in order to include safety-related rail applications in the ITS category. This is supported by the aforementioned Opinion of the RSPG, which set outs that it *"is also important to take into account the developments in ITS technologies [...] and the introduction of Communication Based Train Control (CBTC) within the ITS designation. We recognise the risk that this could constrain other potential future uses of this spectrum (e.g. RLAN) and recommend that this risk is kept under review"*.

Considering that the 5.9 GHz band is likely to be used by different technologies for safety-related transport systems (for road and rail such as ETSI ITS-G5, LTE-V2X and technologies for CBTC) each having its own merit, and observing the EU spectrum policy principle of technology neutrality, the Commission services take the

²⁰ In addition to current operational CBTC lines, a large number of projects have been already recorded on operators' side for operational CBTC service (see <http://www.urbanrail.net/eu/euromet.htm>).

²¹ http://www.etsi.org/deliver/etsi_tr/103100_103199/103111/01.01.01_60/tr_103111v010101p.pdf

²² Prioritization does not imply spectrum fragmentation (exclusivity) and is technology neutral.

view that there are sufficient grounds to study the possibility of expanding the 5 875- 5 905 MHz band by 20 MHz upwards and pending the results and subsequent discussions in the RSC to amend Article 2(1) of Decision 2008/671/EC in order to expand the definition of safety-related ITS beyond road transportation based on the result of studies in response to this EC mandate.

3. JUSTIFICATION

Taking into account the RSPG Opinion, the evolving work of ETSI and the wider cooperation among stakeholders, the EU regulatory framework on the harmonised use of radio spectrum for safety-related applications of Intelligent Transport Systems (Commission Decision 2008/671/EC) should be reviewed in order to cope with multiple technologies and increased traffic management requirements.

It is important to note that the potential spectrum expansion is not intended to support segmentation and segregation between technologies and applications within the same band and thus to compensate for any cases of inefficient spectrum use. Technology neutrality and efficient spectrum use are important regulatory principles. They, together with uncompromised safety and the introduction in the longer-term of 5G for the further development of CCAM, are the four principles to be followed at EU level.

Pursuant to Article 4(2) of the Radio Spectrum Decision²³ 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.

4. TASK ORDER AND SCHEDULE

To support the policy objectives presented above, CEPT is mandated to carry out the following technical tasks:

Task 1 Study the possibility to extend the 5 875-5 905 MHz frequency band to the range 5 875-5 925 MHz for use by safety-related road and rail²⁴ ITS systems under harmonised technical conditions including *sharing* conditions. In this context, study measures which allow coexistence of LTE-V2X and Urban Rail ITS (such as technologies for CBTC already in operation in the 5 905-5 925 MHz frequency band) with existing ETSI ITS-G5²⁵ within the 5 875-5 925 MHz frequency band.

²³ 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

²⁴ This type of application encompasses urban and suburban usages which shall be taken into due consideration when conducting relevant studies.

²⁵ See also foot note 12. There are investments based on ETSI ITS G5 in 16 EU Member States under the C Roads platform.

Task 2 In relation to Task 1, assess the suitability of the existing harmonised technical conditions applicable to the 5 875-5 905 MHz frequency band for use by Urban Rail ITS (such as technologies for CBTC); amend these conditions, if necessary, so as to develop consistent technical, including *sharing*, conditions for the whole 5 875-5 925 MHz frequency band. This should not result in segmentation and segregation of the band. The principle of equal access to shared spectrum shall be applied taking into account the need to avoid harmful interference and the need for reliable safety-related operation in the whole band.

Under tasks 1 and 2, the work will need to verify under which conditions ITS for Urban Rail can share the band with ITS for road transportation so as to facilitate the reliable safety-related operation of ETSI ITS-G5, LTE-V2X and technologies for CBTC in the whole band. CEPT should work in cooperation with ETSI, as appropriate.

In the work carried out under the Mandate, the general and specific policy objectives of the Radio Spectrum Policy Programme (RSPP) such as effective and efficient spectrum use and support for specific Union policies take utmost account of the applicable EU law and support the principles of service and technological neutrality, non-discrimination and proportionality insofar as technically possible.

CEPT should provide deliverables under this Mandate according to the following schedule:

Delivery date	Deliverable	Subject
March 2018	Interim Report from CEPT to the Commission	Description of work undertaken and interim results.
November 2018	Draft Report from CEPT to the Commission	Description of work undertaken and provisional results.
March 2019	Final Report from CEPT to the Commission, taking into account the outcome of the public consultation.	Description of work undertaken and final results.

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 timely applying the results of this mandate in the EU, pursuant to Article 4 of the Radio Spectrum Decision, taking into account that initial ITS deployment is foreseen for 2019.

ANNEX 4: LIST OF REFERENCES

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- [24] ECC Report 101: “Compatibility studies in the band 5855-5925 MHz between Intelligent Transport Systems (ITS) and other systems”
- [25] ECC Report 228: “Compatibility studies between Intelligent Transport Systems (ITS) in the band 5855-5925 MHz and other systems in adjacent bands”
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