

Report ITU-R M.2444-1

(09/2023)

M Series: Mobile, radiodetermination, amateur
and related satellite services

Examples of arrangements for Intelligent Transport Systems deployments under the mobile service



Foreword

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REPORT ITU-R M.2444-1

**Examples of arrangements for Intelligent Transport Systems
deployments under the mobile service**

(Question ITU-R 205-6/5)

(2018-2023)

Summary

This Report provides examples of arrangements for intelligent transport systems (ITS) deployments in certain regions and countries to assist Administrations in their planning for deployment of ITS within their jurisdictions.

Keywords

Intelligent transport systems (ITS).

Abbreviations

CEPT	European Conference of Postal and Telecommunications Administrations
C-ITS	Cooperative intelligent transport systems
CSMA/CA	Carrier-sense multiple access with collision avoidance
ECC	Electronic Communications Committee of CEPT
EEA	European Economic Area
ETSI	European Telecommunications Standards Institute
ITS	Intelligent transport systems
LTE-V2X	Long-term evolution – V2X
OBE	On-board equipment
OBU	On-board unit
RSE	Roadside equipment
RSU	Roadside unit
RVC	Road-to-vehicle communications
TPC	Transmit power control
V2I	Vehicle-to-infrastructure
V2N	Vehicle-to-network
V2P	Vehicle-to-pedestrian
V2V	Vehicle-to-vehicle
V2X	Vehicle-to-everything
WAVE	Wireless access for the vehicular environment
WSA	WAVE service announcement

Related ITU Recommendations and Reports

Recommendation ITU-R M.1452 – Millimetre wave radiocommunication systems for intelligent transport systems applications.

Recommendation ITU-R M.1453 – Intelligent transport systems – Dedicated short range communications at 5.8 GHz.

Recommendation ITU-R M.1797 – Vocabulary of terms for the land mobile service.

Recommendation ITU-R M.2084 – Radio interface standards of vehicle-to-vehicle and vehicle-to-infrastructure communications for Intelligent Transport System applications.

Recommendation ITU-R M.2120 – Harmonisation of frequency bands for Intelligent Transport Systems in the mobile service.

Report ITU-R M.2228 – Advanced intelligent transport systems radiocommunications.

Report ITU-R M.2445 – Intelligent transport systems usage in ITU Member States.

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1 Examples of arrangements for evolving ITS in Region 1

1.1 Frequency use in CEPT

CEPT designated parts of the 5 855-5 925 MHz band in 2008 for the use by ITS specifically to increase road safety and traffic efficiency based on the existing Mobile Service. The harmonization measure includes the following arrangement:

The frequency band 5 855-5 925 MHz for ITS applications is split into channels with a bandwidth of 10 MHz. The maximum spectral power density for ITS stations should be limited to 23 dBm/MHz e.i.r.p. but the total power should not exceed 33 dBm e.i.r.p. with a Transmit Power Control (TPC) range of 30 dB. The CEPT has designated the lower part of the frequency band for non-traffic safety related ITS applications such as enhancing traffic-efficiency, while the middle of the frequency band is designated and (possibly in the future) upper part is reserved/recommended for traffic-safety related ITS applications such as time critical status information exchange whose aim is to reduce the number of traffic fatalities or accidents using communications between ITS stations (see Table 1 below).

TABLE 1

CEPT channel arrangement for evolving ITS in the band 5 855-5 925 MHz

Application		Frequency range (MHz)	Deployment or plan year
Non-traffic-safety related	Lower part See ECC/REC/(08)01 and 2006/771/EC as amended	5 855 to 5 865	
		5 865 to 5 875	
Traffic-safety related	Upper part See ECC/DEC/(08)01 and (EU) 2020/1426	5 875 to 5 885	Deployment of infrastructure in some member states since 2016 ¹ , deployment of vehicles in 2019 ²
		5 885 to 5 895	
		5 895 to 5 905	
		5 905 to 5 915	
		5 915 to 5 925 ³	

The above regulatory measures from the ECC refer to the ETSI Harmonized Standard EN 302 571⁴ and defines requirements for operation of ITS equipment in 5 855-5 925 MHz, covering the essential requirements of Article 3.2 of the Radio Equipment Directive (2014/53/EU).

2 Examples of arrangements for evolving Intelligent Transport Systems (ITS) in Region 2

Table 2 shows the frequency usage in 5.9 GHz in Region 2.

¹ <https://www.c-roads.eu/platform.html>

² <https://www.volkswagenag.com/en/news/2017/06/pwlan.html#>

³ Within EEA, access by road ITS to the frequency range 5 915-5 925 MHz shall be limited applications involving infrastructure-to-vehicle (I2V) connectivity only.

⁴ https://www.etsi.org/deliver/etsi_en/302500_302599/302571

TABLE 2

Frequency usage for evolving ITS Radiocommunication in Region 2

Country	Frequency band (MHz)	Deployment scenario	Service	Deployment or plan year
United States of America	5 895-5 925	V2V and V2I communications	Safety-related, mobility and environmental information	Model deployment – 2012-13 ⁵ ; Pilot and Initial Deployments – beginning in 2015 ^{6-7, 8, 9, 10}
Canada	5 895-5 925	V2V and V2I communications	Vehicle safety as well as safety of life and property	Currently limited deployments. Revised policy decision issued in December 2022 to allow only C-V2X-based ITS in this band. Deployments expected following the publication of the revised technical equipment standard.
Brazil	5 855-5 925	V2V and V2I communications	Vehicle communications, including traffic and vehicle safety applications	Regulation approved in 2020

2.1 Frequency use in the United States of America

In 2020 the United States spectrum regulator repurposed 45 MHz of the lower 5.9 GHz band to allow for the expansion of unlicensed operations, while preserving 30 MHz in the upper 5.9 GHz for ITS operations.

The U.S. 2020 decision also required ITS at 5 895-5 925 MHz to use 3GPP Cellular Vehicle-to-Everything (C-V2X) specifications. The 2020 decision permitted existing ITS deployments in the U.S. to remain in the 5 850-5 895 MHz band until July 2022. Thereafter, ITS in that range may only operate in 5 895-5 925 MHz.

⁵ https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/technical_fact_sheet-model_deployment.pdf

⁶ https://www.its.dot.gov/factsheets/pdf/JPO_CVPilot.pdf

⁷ <https://theacvpilot.com/>

⁸ https://www.its.dot.gov/press/2018/wydot_trafficmang.htm

⁹ <https://transportationops.org/spatchallenge>

¹⁰ These initial deployments in the U.S. were based on prior regulations (using 5 850-5 925 MHz and WAVE lower layer technology); however, current deployments are transitioning to, and future deployments will incorporate, the new spectrum (5 895-5 925 MHz) and lower-layer technology (C-V2X).

2.2 Frequency use in Canada

In December 2022, the Canadian regulator revised its spectrum utilization policy¹¹ to now allow licence-exempt radio local area network (RLAN) operations in the frequency band 5 850-5 895 MHz, while allowing ITS operations to continue to operate in the frequency band 5 895-5 925 MHz. ITS operations deployed in the frequency band 5 850-5 895 MHz prior to April 2023 may continue to operate, but on a no-protection, no-interference basis.

To provide the ITS community the certainty required to quickly and efficiently develop and deploy ITS applications using the latest technologies, Canada also mandated the use of 3GPP-based C-V2X technology for all ITS applications in the 5 895-5 925 MHz range. As of April 2023, only equipment employing C-V2X technology will be certified to operate in the 5 895-5 925 MHz range. Equipment using other technologies, such as Dedicated Short Range Communications, that were deployed prior to this date, may continue to operate on a no-protection, no-interference basis.

2.3 Frequency use in Brazil

Brazil considers important the emergence of vehicle connectivity solutions to mobile communications networks in urban, rural and highway environments, for sending and receiving data and information to aid in driving traffic, traffic conditions and preventive maintenance of the vehicle.

The requirements for ITS communications in Brazil are included in the regulation governing the technical requirements for conformity assessment of restricted radiation radiocommunication equipment, which includes systems for data communication between vehicles and between vehicles and road infrastructure. The characteristics for use of ITS in Brazil are based on the standard ETSI EN 302 571, covering the use of radiocommunications equipment operating in the frequency band 5 855-5 925 MHz, divided into blocks of 10 MHz. Channel aggregation can be performed, for example combining consecutive 10 MHz channels to make a 20 MHz channel.

TABLE 3
Band plan for ITS in Brazil

Channel number	Frequency range (MHz)
1	5 855-5 865
2	5 865-5 875
3	5 875-5 885
4	5 885-5 895
5	5 895-5 905
6	5 905-5 915
7	5 915-5 925

For vehicle-to-vehicle and vehicle-to-infrastructure communications using the 5.9 GHz frequency band, the maximum e.i.r.p. is 23 dBm (200 mW). For high power communications of vehicle-to-infrastructure, a maximum e.i.r.p. of 26 dBm (400 mW) is permitted. Channels 5 to 7 are limited to traffic and vehicle safety applications.

¹¹ Decision on the Technical and Policy Framework for Radio Local Area Network Devices in the 5 850-5 895 MHz band and for Intelligent Transportation Systems in the 5 895-5 925 MHz band.

3 Examples of arrangements for evolving Intelligent Transport Systems (ITS) in Region 3

Some Region 3 countries identified the bands 755.5-764.5 MHz, 5 770-5 850 MHz and/or 5 855-5 925 MHz for the use by ITS applications as shown in Table 4.

TABLE 4

Frequency usage on evolving ITS Radiocommunication in Asia-Pacific

Country	Frequency band (MHz)	Deployment scenario	Application	Status
Japan	5 770-5 850	V2I communication	Safety related information	Enacted in 2001 (revised 2008)
	755.5-764.5	V2V/V2I communication		Enacted in 2011 (revised 2013); deployed in 2015
Korea	5 855-5 925	V2V/V2I communication	Vehicle safety related C-ITS	Enacted in 2016
China	5 905-5 925	V2V/V2I /V2P communication	V2X communication	Enacted in 2018
Singapore	5 855-5 925	V2V/V2I communication	Traffic/Safety/Non-safety Related Information	Enacted in 2017
Australia	5 855-5 925	V2V/V2I communication	Traffic/Safety/Non-safety related information	Enacted in 2017

Those include the following arrangements.

3.1 Frequency use in Japan

3.1.1 Band 5 770-5 850 MHz in Japan

The frequency band 5 770-5 850 MHz for ITS applications (refer to Recommendation ITU-R M.1453) is split into channels with a carrier frequency spacing of 5 MHz.

The maximum transmission power for roadside equipment (RSE) should be less than 44.7 dBm e.i.r.p. The maximum transmission power for on-board equipment (OBE) should be less than 20 dBm e.i.r.p.

Table 5 shows channel arrangement of ITS applications using DSRC at 5.8 GHz band in Japan.

TABLE 5

Channel arrangement for ITS applications at 5 770-5 850 MHz band in Japan

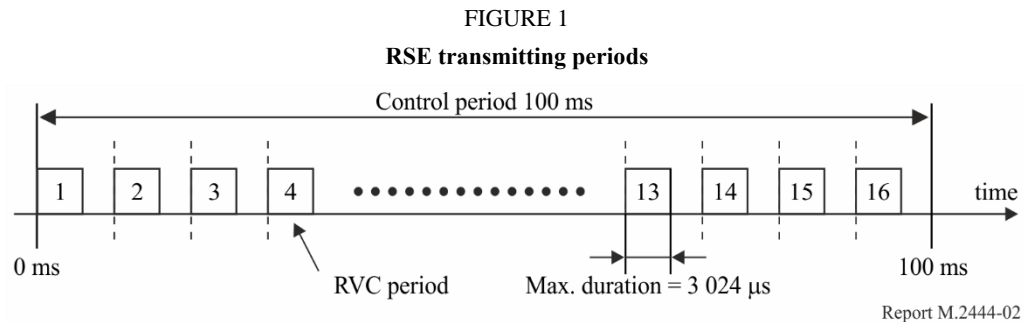
	Carrier frequency (MHz)
Road side equipment channel	5 775
	5 780
	5 785
	5 790
	5 795
	5 800
	5 805
On-board equipment channel	5 815
	5 820
	5 825
	5 830
	5 835
	5 840
	5 845

3.1.2 760 MHz band in Japan for V2X (ITS Connect)

In Japan, the frequency band 755.5-764.5 MHz is assigned for ITS Connect.

The maximum transmission power for roadside equipment (RSE) should be less than 10 mW/MHz. The maximum transmission power for on-board equipment (OBE) should be less than 10 mW/MHz.

All RSE and OBE share one RF channel. Time slot is divided into Vehicle to Vehicle (V2V) communication periods and I2V communication periods, then RSE and OBE can share the frequency without mutual interference. Figure 1 shows the sharing mechanism. The RSEs and OBEs carry out communications normally in a cycle of 100 ms. In the Figure, the RSE can use gray period. If the RSE does not use all 3 024 μ s, OBE can use the time for V2V communication.



In order to avoid collision between OBE to OBE, CSMA/CA protocol is used.

3.2 Frequency use in Korea

V2X communication technology has been developed for vehicle safety and Cooperative ITS applications.

In the Republic of Korea, the frequency band is 5 855-5 925 MHz for C-ITS (V2V and V2I communications) and can use seven radio frequency channels with 10 MHz channel bandwidth as shown in Table 6. In channel operation, control channel uses 5 895-5 905 MHz radio channel, and the other six radio channel can be used for service channel. Also, each RF channel has 20 dBm in radio transmit power level.

TABLE 6
Radio channel assignment for ITS in Korea

Channel number	Frequency band (MHz)	Channel usage
1	5 855-5 865	Service channel
2	5 865-5 875	Service channel
3	5 875-5 885	Service channel
4	5 885-5 895	Service channel
5	5 895-5 905	Control channel
6	5 905-5 915	Service channel
7	5 915-5 925	Service channel

3.3 Frequency use in Singapore

The frequency band 5 855-5 925 MHz for ITS applications is split into channels with a bandwidth of 10 MHz per channel. The ITS service channelling arrangements and the RF transmit power could be found in Table 7.

TABLE 7
Singapore ITS service channel allocation

	Channel type	Frequency range (MHz)
Non-Safety related	Service channel	5 855 to 5 865
	Service channel	5 865 to 5 875
Traffic/Safety related	Service channel	5 875 to 5 885
	Control channel	5 885 to 5 895
	Service channel	5 895 to 5 905
	Service channel	5 905 to 5 915
	Service channel	5 915 to 5 925

Typical RF power limit of up to 33 dBm e.i.r.p. for traffic/safety related channels and 20 dBm e.i.r.p. for non-safety related channels.

3.4 Frequency use in Australia

The frequency band 5 855-5 925 MHz has been made available for use by ITS systems. Individual licensing is not required. However, the following conditions are to be met:

- a) the ITS station must be operated:
 - i) on a frequency, or within a range of frequencies, greater than 5 855 MHz and not greater than 5 925 MHz; and
 - ii) at a radiated power that does not exceed a maximum e.i.r.p. of 23 dBm/MHz;
- b) the ITS station must not be operated within 70 km of the Murchison Radioastronomy Observatory located at latitude 26° 42' 15" south, longitude 116° 39' 32" east;
- c) the ITS station must comply with ETSI Standard EN 302 571; and
- d) other conditions concerned with general public exposure to electromagnetic radiation as defined in the Radiocommunications (Intelligent Transport Systems) Class Licence 2017.

3.5 Frequency use in China

In 2018, the Chinese administration released the frequency planning for Internet of Vehicles (Intelligent and Connected Vehicle), the band of 5 905-5 925 MHz (20 MHz) has been made available as one channel for direct link communication (V2V, V2I, and V2P) for LTE-V2X based technologies. This spectrum planning provides technical conditions for LTE-V2X equipment. The frequency and station licensing are required for road side unit (RSU) implementation, but the Chinese administration shall exempt on board unit (OBU) and ITS portable radio equipment from frequency and station licensing. In addition, this regulation also provides interference coordination conditions to protect incumbent services in the same band and adjacent spectrum bands.
