



Report ITU-R M.2444-0
(11/2018)

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

M Series
Mobile, radiodetermination, amateur
and related satellite services



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REPORT ITU-R M.2444-0

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

Question ITU-R 205-5/5

(2018)

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.

Scope

This Report provides examples of arrangements for intelligent transport systems (ITS) deployments in certain regions and countries to assist in improving traffic management and safe driving.

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

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.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	5 855 to 5 865	
	See ECC/REC/(08)01	5 865 to 5 875	
Traffic-safety related	Middle part See ECC/DEC/(08)01 and 2008/671/EC	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	
	Upper part	5 905 to 5 915	
See ECC/DEC/(08)01	5 915 to 5 925		

The above regulatory measures from the ECC refer to the ETSI Harmonized Standard EN 302 571³ 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 https://www.etsi.org/deliver/etsi_en/302500_302599/302571

TABLE 2

Frequency usage for evolving ITS Radiocommunication in Region 2

Country	Frequency band	Deployment scenario	Service	Deployment or plan year
United States	5 850-5 925 MHz	Vehicle to Vehicle and Vehicle to/from Infrastructure communications system	Safety-related, mobility and environmental information (Communications)	Model deployment – 2012 ⁴ ; Early Operational Deployments – 2016 ^{5,6} ; Pilot Deployments – 2017 ⁷ ; initial production vehicle deployment – 2017 ⁸ ; planned initiation of large-scale production vehicle deployment – 2021 ⁹
Canada	5 850-5 925 MHz	V2V and V2I communications	Vehicle safety as well as safety of life and property	Deployment started in 2017

2.1 Frequency use in the United States of America

WAVE is one technology being pursued in the United States of America “to improve traveller safety, decrease traffic congestion, facilitate the reduction of air pollution, and help to conserve vital fossil fuels”¹⁰, and as a particular focus in the United States of America, to reduce highway fatalities¹¹. In order to address the need for evolving ITS to provide these public benefits, a number of applications have been developed, with more still under development, to leverage the characteristics of WAVE. These applications include communications among vehicles and other mobile end users, as well as between mobile users and roadside infrastructure.

NOTE – As noted above, there are a number of regulatory proceedings underway in the United States, the results of which could alter the frequency usage for evolving ITS in the United States.

A given WAVE application may use one of several 10 MHz channels on a dynamic assignment basis under the direction of the control channel as shown in the following table. Evolving ITS safety-related applications use dedicated channels for crash-imminent safety-related and high-

⁴ <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/812171-safetypilotmodeldeploydeltestcondrtmrep.pdf>.

⁵ <http://corporatenews.pressroom.toyota.com/releases/toyota-umtri-largest-connected-car-proving-ground.htm>.

⁶ <http://www.aztech.org/projects/connected-vehicles-research.htm>.

⁷ http://www.its.dot.gov/factsheets/JPO_cvPilot.htm.

⁸ <https://media.gm.com/media/us/en/cadillac/news.detail.html/content/Pages/news/us/en/2018/jun/0606-its-cadillac.html>

⁹ <https://www.forbes.com/sites/samabuelsamid/2018/04/16/toyota-launches-aggressive-v2x-communications-roll-out-from-2021/#49e2c6ad146c>

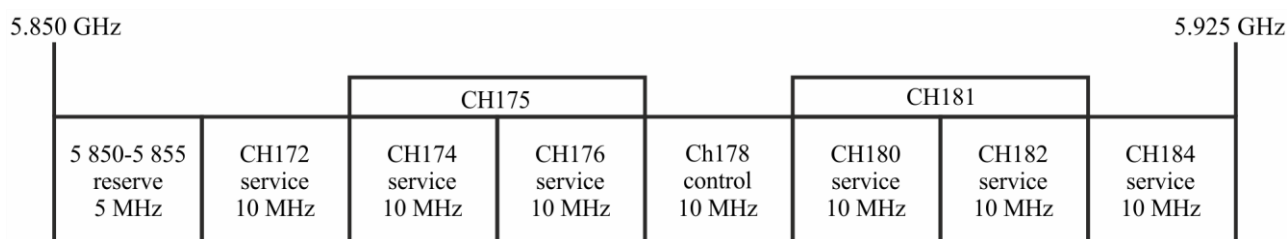
¹⁰ FCC Report and Order, October 1999, ET Docket No. 98-95.

¹¹ Press Release, U.S. Transportation Secretary Mineta Announces Opening of Crash-Preventing “Intelligent Intersection” Test Facility (June 24, 2003) (<http://www.its.dot.gov/press/fhw2003.htm>).

powered public safety-related applications, as well as flexible assignment of other service channels through the control channel mechanism to support the wide range of evolving ITS WAVE applications. Many applications will only partially use a particular assignable channel at a particular time and location, permitting sharing among WAVE applications on individual assignable service channels.

Safety-related applications which are not pre-assigned to the dedicated channels typically use the control channel to transmit very short, infrequent messages, or else use WAVE Service Announcements (WSA) on the control channel to indicate a service channel upon which to communicate, if those messages are less dependent upon having very low latency. Lower priority messages typically use WSAs on the control channel to be assigned to a service channel which is not fully occupied by safety-related communications at that location at that time. This flexible designation of application messages to different service channels in various locations facilitates spectral efficiency and reduces interference among WAVE applications.

FIGURE 1



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NOTE – This band plan may need to be revised if regulatory changes occur as a result of ongoing regulatory proceedings in the United States of America.

2.2 Frequency use in Canada

The frequency band 5 850-5 925 MHz is used by ITS for Dedicated Short Range Communications (DSRC) systems consisting of short-range, wireless links to transfer data between vehicles and roadside units, other vehicles or portable units. DSRC deployments began in 2017 after Canada published a Spectrum Advisory Bulletin¹² advising it was allowing the introduction of vehicle-mounted DSRC devices in the frequency band 5 850-5 925 MHz and therefore would be displacing fixed service assignments in that frequency range. Table 2 shows the use of the band and status of deployment in Canada. Table 3 shows ITS channels used by vehicle mounted devices (on-board units).

¹² ISED Spectrum Advisory Bulletin SAB-001-17, Displacement of Existing Fixed Service Assignments in the Frequency Band 5 850-5 925 MHz, February 2017.

TABLE 3
ITS channel assignment in Canada

Channel number	Service	Frequency (MHz)
170	Reserved	5 850-5 855
172 ⁽¹⁾	Service channel	5 855-5 865
174	Service channel	5 865-5 875
175	Service channel	5 865-5 885
176	Service channel	5 875-5 885
178	Control channel	5 885-5 895
180	Service channel	5 895-5 905
181	Service channel	5 895-5 915
182	Service channel	5 905-5 915
184 ⁽¹⁾	Service channel	5 915-5 925

⁽¹⁾ Channels 172 and 184 are designated for safety applications involving safety of life and property.

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	Deployment scenario	Application	Status
Japan	5 770-5 850 MHz	V2I communication	Safety related information	Enacted in 2001 (revised 2008)
	755.5-764.5 MHz	V2V/V2I communication		Enacted in 2011 (revised 2013); deployed in 2015
Korea	5 855-5 925 MHz	V2V/V2I communication	Vehicle Safety Related C-ITS	Enacted in 2016
China	5 905-5 925 MHz	V2V/V2I /V2P communication	V2X communication	Enacted in 2018
Singapore	5 855-5 925 MHz	V2V/V2I communication	Traffic/Safety/Non-safety Related Information	Enacted in 2017
Australia	5 855-5 925 MHz	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.1453-2) 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

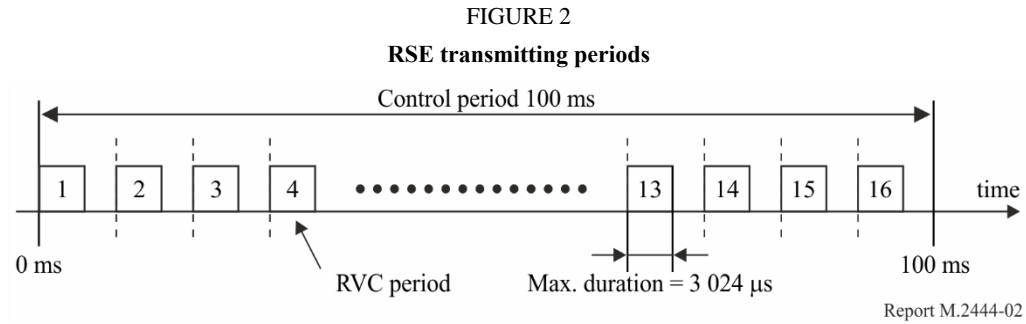
	Carrier frequency (MHz)
Road Side Equipment Channel	5 775
	5 780
	5 785
	5 790
	5 795
	5 800
	5 805
On-Board Equipment Channel	5 815
	5 820
	5 825
	5 830
	5 835
	5 840
	5 845

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

In Japan, 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 2 shows the sharing mechanism. The RSEs and OBEs carry out communications normally in a cycle of 100 ms. In Fig. 2, the RSE can use gray period. If the RSE does not use all 3024 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 channel 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, the 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 below.

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 & 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.