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| **Radiocommunication Study Groups** |  |
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| **4 June 2018** |
| **English only** |
| Annex 33 to Working Party 5A Chairman’s Report | |
| Working document towards a preliminary draft new  Report ITU-R M.[ITS\_ARR] | |
| Examples of Arrangements for Intelligent Transport Systems deployments under the mobile service | |

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.].

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# 1 Examples of arrangements for evolving intelligent transportation systems (ITS) in Region 1

## 1.1 Arrangements for evolving ITS 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](http://www.erodocdb.dk/Docs/doc98/official/pdf/REC0801.PDF) | 5 855 to 5 865 |  |
| 5 865 to 5 875 |
| Traffic-safety related | Middle part  See [ECC/DEC/(08)01](http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC0801.PDF) and [2008/671/EC](http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008D0671&from=en) | 5 875 to 5 885 | Deployment of infrastructure in some member states since 2016[[1]](#footnote-1), deployment of vehicles in 2019[[2]](#footnote-2) |
| 5 885 to 5 895 |
| 5 895 to 5 905 |
| Upper part  See [ECC/DEC/(08)01](http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC0801.PDF) | 5 905 to 5 915 |  |
| 5 915 to 5 925 |

The above regulatory measures from the ECC refer to the ETSI Harmonized Standard EN 302 571[[3]](#footnote-3) 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).

## 1.2 Arrangement for evolving ITS in XXX

XXX identified …

# 2 Examples of arrangements for evolving intelligent transportation systems (ITS) in Region 2

## 2.1 Arrangement for evolving ITS in the United States

WAVE is one technology being pursued in the United States “to improve traveler safety, decrease traffic congestion, facilitate the reduction of air pollution, and help to conserve vital fossil fuels”[[4]](#footnote-4), and as a particular focus in the United States, to reduce highway fatalities[[5]](#footnote-5). In order to address the need for advanced 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. Table 2 shows the frequency usage in the 5.9 GHz in the US.

Table 2

Frequency Usage for evolving ITS Radiocommunication in Region 2

| Country | Frequency band | Technology/ System | 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[[6]](#footnote-6); Early Operational Deployments - 2016[[7]](#footnote-7),[[8]](#footnote-8); Pilot Deployments – 2017[[9]](#footnote-9) |

Note: as noted above, there are a number of regulatory proceedings underway in the U.S., the results of which could alter the frequency usage for advanced 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. Advanced ITS safety-related applications use dedicated channels for crash-imminent safety-related and high-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 advanced 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

Current Band Plan for WAVE in the United States[[10]](#footnote-10)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 5.850 GHz |  |  | |  |  | | 5.925 GHz |
|  | | CH175 | |  | CH181 | |  |
| 5 850-5 855  reserve 5 MHz | CH172  service 10 MHz | CH174  service 10 MHz | CH176  service 10 MHz | CH178  control 10 MHz | CH180  service 10 MHz | CH182  service 10 MHz | CH184  service 10 MHz |

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

# 3 Examples of arrangements for evolving intelligent transportation 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 3.

Table 3

Frequency usage on Advanced ITS Radiocommunication in Asia-Pacific

| Country | frequency band | Technology | Application | Status |
| --- | --- | --- | --- | --- |
| Japan | 5 770-5 850 MHz | V2V/V2I communication | Safety related information | Guidelines for field experiment in 2007 (revised 2013) |
| 755.5-764.5 MHz band | Enacted in 2011 (revised 2013) |
| Korea | 5 855-5 925 MHz | V2V/V2I communication | Vehicle Safety Related  C-ITS | Enacted in 2016 |
| China | 5 905-5 925 MHz | LTE based V2X | V2X communication | Field  Experiment in 2017 |
| Singapore | 5 855-5 925 MHz | V2V/V2I | Traffic/Safety Related Information | Enacted in 2017 |
| Australia | 5 855‑5 925 MHz |  |  |  |

Those harmonization measures 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 ITU-R M.1453-2, 2005) 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 4 shows channel arrangement of ITS applications using DSRC at 5.8 GHz band in Japan.

Table 4

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 RSU and OBE share one RF channel. Time slot is divided into Vehicle to Vehicle (V2V) communication periods and I2V communication periods, then RSU and OBE can share the frequency without mutual interference. Figure 9 shows the sharing mechanism. The RSUs and OBEs carry out communications normally in a cycle of 100 ms. In the Figure 9, the RSU can use gray period. If the RSU does not use all 3024 us, OBE can use the time for V2V communication.

FIGURE 2

RSU transmitting periods



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 7 radio frequency channel with 10 MHz channel bandwidth as shown in Table 5. In channel operation, control channel uses 5 895-5 905 MHz radio cannel and the other 6 radio channel can be used for service channel. Also, the each RF channel has 20 dBm in radio transmit power level.

TABLE 5

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 6 below.

TABLE 6

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 kilometres of the Murchison Radioastronomy Observatory located at latitude 26º 42’ 15” south, longitude 116º 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*](https://www.legislation.gov.au/Details/F2018L00026).

# 4 Examples of other arrangements for intelligent transportation systems (ITS)

*[If considered necessary.]*

1. <https://www.c-roads.eu/platform.html>. [↑](#footnote-ref-1)
2. [https://www.volkswagenag.com/en/news/2017/06/pwlan.html#](https://www.volkswagenag.com/en/news/2017/06/pwlan.html). [↑](#footnote-ref-2)
3. <http://www.etsi.org/deliver/etsi_en/302500_302599/302571/02.00.00_20/en_302571v020000a.pdf>. [↑](#footnote-ref-3)
4. FCC Report and Order, October 1999, ET Docket No. 98-95. [↑](#footnote-ref-4)
5. 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>). [↑](#footnote-ref-5)
6. <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/812171-safetypilotmodeldeploydeltestcondrtmrep.pdf>. [↑](#footnote-ref-6)
7. <http://corporatenews.pressroom.toyota.com/releases/toyota-umtri-largest-connected-car-proving-ground.htm>. [↑](#footnote-ref-7)
8. <http://www.aztech.org/projects/connected-vehicles-research.htm>. [↑](#footnote-ref-8)
9. <http://www.its.dot.gov/factsheets/JPO_cvPilot.htm>. [↑](#footnote-ref-9)
10. FCC 03-324 REPORT AND ORDER, December 2003, ET Docket No. 98-95. [↑](#footnote-ref-10)