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**APT REPORT**

**on**

**THE USAGE OF ITS IN APT COUNTRIES**

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**APT REPORT ON THE USAGE OF ITS IN APT COUNTRIES
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1. **Introduction**

Since several decades ago, traffic congestion has been increasing worldwide as a result of increased motorization, urbanization, population growth, and changes in population density. Congestion reduces efficiency of transportation infrastructure and increases travel time, air pollution, and fuel consumption. Interest in Intelligent Transport Systems (ITS) comes from the problems caused by traffic congestion and a synergy of new information technology for simulation, real-time control, and communications networks. Namely, ITS is systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships) [1]



Figure 1. Communication technologies and services for ITS [2]

ITS has been standardized and studied in various organizations. As an international level, ISO TC 204, ITU-R and IEEE are working on developing the standards and recommendations. In

Europe, ETSI TC ITS and CEN TC278 are working as a regional level.

In Asia Pacific region, AWG established a Task Group on ITS (TG ITS) for its study. TG ITS developed a survey questionnaire to collect information on ITS from each APT country The purpose of the questionnaire is to develop an informative report for further study of regional/international ITS harmonization.

The Survey results consist of the responses to the questionnaire received to the TG ITS questionnaire from AWF-9 to AWG-13 from 10 administrations/associated administrations, Afghanistan, Australia, China, Hong Kong, Japan, Korea(Republic of), Singapore, Thailand, Tonga, Vanuatu(Republic of) (in alphabetic order).

This Report identifies the survey results on current and planned usage of ITS technologies, frequency bands, status of service deployment in APT member countries. The results of the survey are summarized and attached in Annex.

Survey consists of the following main question:

* What frequency band(s) is/are used for ITS(e.g. DSRC) in your country/region as of 2010 ?
* What frequency bands are allocated for ITS technology on your frequency allocation table in your country/region?
* Which technologies and/or standards is/are using the frequency band(s) for ITS.

Based on the replies, major deployed ITS systems in APT countries were classified as electronic toll collection, vehicular range radar, and vehicle information & communication. In this report, we described service overview, established standards, frequency plan, and implication in each ITS system.

1. **Major deployed Intelligent Transport Systems in APT countries/regions**
	1. **Electronic Toll Collection (ETC)**
		1. **Overview**

Electronic toll collection allows for the manual in-lane toll collection process to be automated in such a way that drivers do not have to stop and pay cash at a toll booth. ETC systems improve traffic flow at toll plazas, and the level of pollution by reducing fuel consumption. In addition, allowing traffic to pass through the gate without stopping can increase road capacity by three or four times and relieve traffic congestion at the tollgate. It is also expected that ETC systems will reduce the operating costs of toll roads by replacing manual toll collection.

* + 1. **Standards**

Table 1. Standards related to ETC

|  |  |  |
| --- | --- | --- |
| **SDO** | **Standard No.** | **Standard Title** |
| ITU | ITU-R M.1453-2 | Intelligent transport systems – dedicated short range communications at 5.8 GHz |
| ETSI | EN 300 674 | Road Transport and Traffic Telematics (RTTT); Dedicated Short Range Communication (DSRC) transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band |
| TS 102 486 | Test specifications for DSRC transmission equipment |
| TTA | TTAS.KO-06.0025/R1 | Standard of DSRC Radio Communication between Road-side Equipment and On-board Equipment in 5.8 GHz band |
| TTAS.KO-06.0052/R1 | Test specification for DSRC L2 at 5.8GHz |
| TTAS.KO-06.0053/R1 | Test specification for DSRC L7 at 5.8GHz |
| ARIB | STD-T75 | Dedicated Short Range Communication (DSRC) System |

Dedicated Short Range Communication (DSRC) refers to any short-range radiocommunication technology from a roadside infrastructure to a vehicle or a mobile platform [3]. Although DSRC can be applied to various application of ITS (e.g. parking payment, gas (fuel) payment, in-vehicle signing, traffic information, etc), ETC is the most typical one. Table 1 shows the established DSRC standards.

* + 1. **Frequency usage**

The usage status of ETC in APT countries is shown in Table 2. Many APT countries adopted ETC in frequency band of 2.4, 5.8 and 24 GHz. For ETC in some APT countries, DSRC technology and 5.8GHz band has been used.

There are many similar words related to ETC. In Europe, Electronic Fee Collection (EFC) is popularly used. They think that EFC covers ETC, Electronic Parking System (EPS), Electronic Road Pricing (ERP). ERP is usually referred to the electronic toll collection scheme adopted in Singapore for purposes of congestion pricing. To avoid confusion, these terminologies need to be clearly defined.

Table 2. Usage status of ETC in APT region

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Country** | **Frequency Band** | **Technology/****Standard** | **Service** | **Deployment or plan Year** |
| Australia | 5,725-5,795 MHz, 5,815-5,875 MHz, 24-24.25 GHz  | - | Electronic tolling | - |
| China | 5,725-5,850 MHz | DSRC | ETC(Electronic Toll Collection) | Enacted in 2003 |
| Hong Kong | 2,400 – 2,4835 MHz | Exemption from Licensing Order | Electronic toll collection services | 1998 |
| Japan | 5,770-5,850 MHz | ETC(Electronic Toll Collection) | Collect highway toll (Communication) | Enacted in 1997 |
| DSRC(Dedicated Short Range Communication) | -Collect highway toll- Provide various information (Communication, Broadcast) | Enacted in 2001(Revised 2007) |
| Korea | 5,795-5,815 MHz | DSRC/TTA Standard(TTAS.KO-06.0025/R1) | ETC(Electronic Toll Collection)BIS(Bus Information System) | 2006(Highpass Tolling)  |
| Singapore | 2,350-2,483.5 MHz  | - | Electronic Road Pricing (ERP) Systems | 1998 |
| Thailand | 5.470-5.850 GHz | Compliance Standard:ETSI EN 300 440-1 or FCC Part 15.247 or FCC Part 15.249 | RFID (e.g. Electronic Toll Collection) | 2008 |

**2.2 Vehicular radar**

**2.2.1 Overview**

Vehicular radar facilitates various functions which increase the driver’s safety and convenience. Exact measurement of distance and relative speed of objects in front, beside, or behind the car allows the realization of systems which improve the driver’s ability to perceive objects during bad optical visibility or objects hidden in the blind spot during parking or changing lanes. Radar technology has proved its ability for automotive applications for several years. Vehicular radar systems are of two categories according to the applications and frequency band

* Automatic Cruise Control 'long-range radar' (usually operating at 76 GHz). This enables a vehicle to maintain a cruising distance from a vehicle in front.
* Anti-collision 'short-range radar' (usually operating at 24 GHz and 79 GHz). This is being developed as part of a system to warn the driver of a pending collision, enabling avoiding action to be taken. In the event where collision is inevitable, the vehicle may prepare itself (for example by applying brakes, pre-tensioning seat belts) to minimize injury to passengers and others.



Figure 2. Vehicular radar [4]

**2.2.2 Standards**

Table 3. Standards related to vehicular radar

|  |  |  |
| --- | --- | --- |
| **SDO** | **Standard No.** | **Standard Title** |
| ITU | ITU-R M.1452-2 | Millimetre wave radiocommunication systems for intelligent transport system applications |
| ARIB | STD-T111 | 79GHz Band High-Resolution Radar |
| ETSI | [TR 101 983](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&qSORT=HIGHVERSION&qINCLUDE_SUB_TB=True&butSimple=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=101+983&qMILESTONE=&qACHIEVED_DAY=&qACHIEVED_MONTH=&qACHIEVED_YEAR=&qREPORT_TYPE=SUMMARY&optDisplay=10&qTB_ID=&includeNonActiveTB=FALSE) | Radio equipment to be used in the 76 GHz to 77 GHz band; System Reference Document for Short-Range Radar to be fitted on road infrastructure  |
| [EN 301 091 parts 1-2](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&qSORT=HIGHVERSION&qINCLUDE_SUB_TB=True&butSimple=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=301+091&qMILESTONE=&qACHIEVED_DAY=&qACHIEVED_MONTH=&qACHIEVED_YEAR=&qREPORT_TYPE=SUMMARY&optDisplay=10&qTB_ID=&includeNonActiveTB=FALSE) | Short Range Devices; Road Transport and Traffic Telematics (RTTT); Radar equipment operating in the 76 GHz to 77 GHz range;  |
| [TR 101 982](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&qSORT=HIGHVERSION&qINCLUDE_SUB_TB=True&butSimple=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=101+982&qMILESTONE=&qACHIEVED_DAY=&qACHIEVED_MONTH=&qACHIEVED_YEAR=&qREPORT_TYPE=SUMMARY&optDisplay=10&qTB_ID=&includeNonActiveTB=FALSE) | Radio equipment to be used in the 24 GHz band; System Reference Document for automotive collision warning Short Range Radar  |
| [EN 302 288 parts 1-2](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&qSORT=HIGHVERSION&qINCLUDE_SUB_TB=True&butSimple=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=302+288&qMILESTONE=&qACHIEVED_DAY=&qACHIEVED_MONTH=&qACHIEVED_YEAR=&qREPORT_TYPE=SUMMARY&optDisplay=10&qTB_ID=&includeNonActiveTB=FALSE) | Short Range Devices; Road Transport and Traffic Telematics (RTTT); Short range radar equipment operating in the 24 GHz range;  |
| [TR 102 263](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&qSORT=HIGHVERSION&qINCLUDE_SUB_TB=True&butSimple=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=102+263&qMILESTONE=&qACHIEVED_DAY=&qACHIEVED_MONTH=&qACHIEVED_YEAR=&qREPORT_TYPE=SUMMARY&optDisplay=10&qTB_ID=&includeNonActiveTB=FALSE) | Road Transport and Traffic Telematics (RTTT); Radio equipment to be used in the 77 GHz to 81 GHz band; System Reference Document for automotive collision warning Short Range Radar  |
| [EN 302 264](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&qSORT=HIGHVERSION&qINCLUDE_SUB_TB=True&butSimple=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=302+264&qMILESTONE=&qACHIEVED_DAY=&qACHIEVED_MONTH=&qACHIEVED_YEAR=&qREPORT_TYPE=SUMMARY&optDisplay=10&qTB_ID=&includeNonActiveTB=FALSE) | Short Range Devices, Road Transport and Traffic Telematics (RTTT); Ultra Wide Band Radar Equipment Operating above 60 GHz  |

**2.2.3 Frequency usage**

Today the frequency allocation for vehicular radar application is in a rebuilding phase. Due to technological and commercial constraints the frequency allocation for these safety related applications has been done in the beginning of the last decade in the range of 24 GHz. In Europe e.g. this allocation has been done as an intermediate solution due to the incompatibility with the Radio Astronomy Service, EESS, the Fixed Service and military applications. Therefore the cut-off date of 1st July 2013 has been defined. In July 2011 the EC extends the cut-off date (with modified technical parameter) until 1st January 2018 to allow the car manufacturer a seamless implementation of the 79 GHz technology. The technological evolution during the last years leads to the fact that with a similar effort a higher performance can be reached today [6].

The industries are trying to seek globally or regionally harmonized frequency allocations for new vehicle radar technologies. The following frequency allocagtions are under consideration and the relevant study work is undertaken by ITU-R WP5A/B:

* 76 GHz to 77 GHz Long Range Radar (LRR) > 150 meter
* 77 GHz to 81 GHz Short Range Radar (SRR) < 150 meter (high resolution)

At present, 77.5-78 GHz band is allocated worldwide on a primary basis to the amateur and amateur-satellite services. Therefore, a primary allocation in 77.5 – 78.0 GHz to the Radiolocation Service to cover continuously 77.0 – 81.0 GHz for Short-Range high-Resolution Radar has been discussed. This new agenda will be discussed in WRC-15.

Table 4. Regulation and useful references for vehicular radar in the world

|  |  |  |
| --- | --- | --- |
|  | 76 to 77 GHz | 77 to 81 GHz |
|  | Regulation | Standard | Report/Notes | Regulation | Standard | Report/Notes |
| Europe- ECC | -ERC/REC 70-03  Annex 5-ECC/DEC/(02)01 | ETSI EN 301 091-1 V1.3.3 (2006-11) |  | -ERC/REC 70-03  Annex 5-ECC/DEC/(04)03 | ETSI EN 302 264-1 V1.1.1 (2009-06) | - ECC/REP 056- Partly: CEPT Report 003- CEPT Report 36 &37 |
| - Russia | SFMC Decision No. 07-20-03-001 Annex 7 |  |  |  |  |  |
| EU |  | ETSI EN 301-091-2 V1.3.2 (2006-11) |  | 2004/545/EC | ETSI EN 302 264-2 V1.1.1 (2009-06) |  |
| ITU | Recommendation ITU-R M.1452 |  | Report ITU-R SM.2067 | Recommendation ITU-R M.1452-2 |  |  |
| USA | FCC Part 15/15.253  |  |  |  |  |  |
| Canada | Spectrum Utilization Policies SP-47 GHz | RSS210 |  |  |  |  |
| Mexico | Cofetel usually accepts FCC regulation |  |  |  |  |  |
| Korea, Republic of | Rules on Radio Equipment (Article 29 Paragraph 9)(2013-01-03)” |  |  |  |  |  |
| Gulf States | CITC |  |  |  |  |  |
| China | Technical Specification for Micropower (Short Distance) Radio Equipments, part XIV  |  |  |  |  |  |
| Japan |  | ARIB STD-T48 |  |  | ARIB STD-T111 |  |
| Brazil  | ANATE resolution No.506 |  |  |  |  |  |
| Singapore  | IDA TS SRD |  |  |  |  |  |
| Taiwan | LP002 2005-0324 |  |  |  |  |  |
| Thailand | NTC TS 1011-2549 |  |  |  |  |  |

In APT countries, frequency bands of 22~26.5, 60, 76~77 and 79 GHz has been used. For global harmonization of ITS, APT countries like Australia are considering European activities which use 79 GHz as a permanent band. Also, Hong Kong is considering the plan to open the 77-81 GHz band for automotive radar systems utilizing ultra-wideband technology. In March 2010, the Ministry of Internal Affairs and Communications (MIC) in Japan has started a study group in the Information and Communications Council for the introduction of high-resolution radar in the 77-81 GHz frequency band for national use, and has allocated 78-81 GHz band for high-resolution radar in December 2012.

 [7].

Table 5. Usage status of vehicular radar in APT region

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Country** | **Frequency Band** | **Technology/****Standard** | **Service** | **Deployment or plan Year** |
| Australia | 22–26.5 GHz |  | Ultra-wideband short-range vehicle radar (UWB SRR) systems for collision avoidance | - |
| 76–77 GHz |  | Long-range vehicle radar (intelligent cruise control) |  |
| China | 76-77 GHz | Radar | Vehicular range radar | Enacted in 2005 |
| 24.25-26.65 GHz | Radar | Vehicular range radar | Enacted in 2012 |
| Hong Kong | 76 – 77 GHz | Exemption from Licensing Order | Vehicular radar systems | 2005 |
| Japan | 22-29 GHz | Quasi-millimeter, Millimeter wave system | Detect obstacles (Sensor) | Enacted in 2010 |
| 60.5 GHz/76.5 GHz | Enacted in 1997 |
| 78-81 GHz | Enacted in 2012 |
| Korea | 76-77 GHz | Radar | Vehicular collision avoidance radar | 2008 |
| 24.25-26.65 GHz | Radar | Vehicular collision avoidance radar | 2012 |
| Singapore | 76-77 GHz | FCC Part 15 – 15.253 (c) or EN 301 091  | Short Range radar systems such as automatic cruise control and collision warning systems for vehicle | 2001 |
| Thailand | 5.725-5.875 GHz | - | Radar Application  | Regulation adopted in 2007 |
| 24.05 – 24.25 GHz | - | Radar Application  | Regulation adopted in 2007 |
| 76-81 GHz | - | Radar Application  | Regulation adopted in 2007 |
| 76-77 GHz | Compliance Standard: FCC Part 15.253 or EN 301 091-1 | Vehicle Radar Application | Regulation adopted in 2006 |

**2.3 Vehicle Information & Communication (including V2V, V2I, I2V)**

**2.3.1 Overview**

Since 1994, Vehicle Information and Communication System (VICS) was used in Japan for delivering traffic and travel information to road vehicle drivers.

Nowadays, to extend beyond the existing ITS applications and to achieve traffic safety and reduce the environmental impact by the transportation sector, vehicle-to-vehicle (V2V), vehicle-to-infrastructure (I2V), infrastructure-to-vehicle (I2V) communications are studied. According to this progress, ITU-R WP5A has developed report on advanced ITS radiocommunications [8]. In the report, traditional ITS and advanced ITS are classified by its technical characteristics as shown in table 6. Wireless Access in Vehicular Environments (WAVE) and Continuous Access for Land Mobiles (CALM) technologies could be inclusive in advanced ITS category.

Table 6. Technical characteristic of Advanced ITS

|  |  |  |
| --- | --- | --- |
| Items | Traditional ITS (DSRC) | Advanced ITS (WAVE, CALM, etc) |
| Vehicular networking | V2I | V2I, V2V, V2N |
| Radio performance | Radio coverage : Max. 100 mData rate : ~ 4 MbpsPacket size : ~100 bytes | Radio coverage : Max. 1 000 mData rate : Max. 27 Mbps Packet size : Max. 2 kbytesLatency : within 100 msec |



Figure 3. Vehicle information & Communication (V2V, V2I, I2V)

**2.3.2 Standards**

Table 7. Standards related to vehicle information & communication

|  |  |  |
| --- | --- | --- |
| **SDO** | **Standard No.** | **Standard Title** |
| ITU | ITU-R M.1890 | Intelligent transport systems - Guidelines and objectives |
| ETSI | [TR 102 638](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&butExpertSearch=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=102+638&qTB_ID=&qINCLUDE_SUB_TB=True&includeNonActiveTB=FALSE&qWKI_REFERENCE=&qTITLE=&qSCOPE=&qCURRENT_STATE_CODE=&qSTOP_FLG=N&qSTART_CURRENT_STATUS_CODE=&qEND_CURRENT_STATUS_CODE=&qFROM_MIL_DAY=&qFROM_MIL_MONTH=&qFROM_MIL_YEAR=&qTO_MIL_DAY=&qTO_MIL_MONTH=&qTO_MIL_YEAR=&qOPERATOR_TS=&qRAPTR_NAME=&qRAPTR_ORGANISATION=&qKEYWORD_BOOLEAN=OR&qKEYWORD=&qPROJECT_BOOLEAN=OR&qPROJECT_CODE=&includeSubProjectCode=FALSE&qSTF_List=&qDIRECTIVE=&qMandate_List=&qSORT=HIGHVERSION&qREPORT_TYPE=SUMMARY&optDisplay=10&titleType=all) | Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Definitions |
| [TS 102 637 series](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&butExpertSearch=++Search++&qETSI_STANDARD_TYPE=%27TS%27&qETSI_NUMBER=102+637&qTB_ID=&qINCLUDE_SUB_TB=True&includeNonActiveTB=FALSE&qWKI_REFERENCE=&qTITLE=&qSCOPE=&qCURRENT_STATE_CODE=&qSTOP_FLG=N&qSTART_CURRENT_STATUS_CODE=&qEND_CURRENT_STATUS_CODE=&qFROM_MIL_DAY=&qFROM_MIL_MONTH=&qFROM_MIL_YEAR=&qTO_MIL_DAY=&qTO_MIL_MONTH=&qTO_MIL_YEAR=&qOPERATOR_TS=&qRAPTR_NAME=&qRAPTR_ORGANISATION=&qKEYWORD_BOOLEAN=OR&qKEYWORD=&qPROJECT_BOOLEAN=OR&qPROJECT_CODE=&includeSubProjectCode=FALSE&qSTF_List=&qDIRECTIVE=&qMandate_List=&qSORT=HIGHVERSION&qREPORT_TYPE=SUMMARY&optDisplay=10&titleType=all) | Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications |
| [EN 302 665](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&butExpertSearch=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=302+665&qTB_ID=&qINCLUDE_SUB_TB=True&includeNonActiveTB=FALSE&qWKI_REFERENCE=&qTITLE=&qSCOPE=&qCURRENT_STATE_CODE=&qSTOP_FLG=N&qSTART_CURRENT_STATUS_CODE=&qEND_CURRENT_STATUS_CODE=&qFROM_MIL_DAY=&qFROM_MIL_MONTH=&qFROM_MIL_YEAR=&qTO_MIL_DAY=&qTO_MIL_MONTH=&qTO_MIL_YEAR=&qOPERATOR_TS=&qRAPTR_NAME=&qRAPTR_ORGANISATION=&qKEYWORD_BOOLEAN=OR&qKEYWORD=&qPROJECT_BOOLEAN=OR&qPROJECT_CODE=&includeSubProjectCode=FALSE&qSTF_List=&qDIRECTIVE=&qMandate_List=&qSORT=HIGHVERSION&qREPORT_TYPE=SUMMARY&optDisplay=10&titleType=all) | Intelligent Transport Systems (ITS); Communications Architecture |
| [TS 102 636 series](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&butExpertSearch=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=102+636&qTB_ID=&qINCLUDE_SUB_TB=True&includeNonActiveTB=FALSE&qWKI_REFERENCE=&qTITLE=&qSCOPE=&qCURRENT_STATE_CODE=&qSTOP_FLG=N&qSTART_CURRENT_STATUS_CODE=&qEND_CURRENT_STATUS_CODE=&qFROM_MIL_DAY=&qFROM_MIL_MONTH=&qFROM_MIL_YEAR=&qTO_MIL_DAY=&qTO_MIL_MONTH=&qTO_MIL_YEAR=&qOPERATOR_TS=&qRAPTR_NAME=&qRAPTR_ORGANISATION=&qKEYWORD_BOOLEAN=OR&qKEYWORD=&qPROJECT_BOOLEAN=OR&qPROJECT_CODE=&includeSubProjectCode=FALSE&qSTF_List=&qDIRECTIVE=&qMandate_List=&qSORT=HIGHVERSION&qREPORT_TYPE=SUMMARY&optDisplay=10&titleType=all) | Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; |
| [ES 202 663](http://webapp.etsi.org/WorkProgram/Frame_WorkItemList.asp?SearchPage=TRUE&butExpertSearch=++Search++&qETSI_STANDARD_TYPE=&qETSI_NUMBER=202+663+&qTB_ID=&qINCLUDE_SUB_TB=True&includeNonActiveTB=FALSE&qWKI_REFERENCE=&qTITLE=&qSCOPE=&qCURRENT_STATE_CODE=&qSTOP_FLG=N&qSTART_CURRENT_STATUS_CODE=&qEND_CURRENT_STATUS_CODE=&qFROM_MIL_DAY=&qFROM_MIL_MONTH=&qFROM_MIL_YEAR=&qTO_MIL_DAY=&qTO_MIL_MONTH=&qTO_MIL_YEAR=&qOPERATOR_TS=&qRAPTR_NAME=&qRAPTR_ORGANISATION=&qKEYWORD_BOOLEAN=OR&qKEYWORD=&qPROJECT_BOOLEAN=OR&qPROJECT_CODE=&includeSubProjectCode=FALSE&qSTF_List=&qDIRECTIVE=&qMandate_List=&qSORT=HIGHVERSION&qREPORT_TYPE=SUMMARY&optDisplay=10&titleType=all) | Intelligent Transport Systems (ITS); European profile standard for the physical and medium access control layer of Intelligent Transport Systems operating in the 5 GHz frequency band |
| IEEE | IEEE Std 802.11p-2010 | Wireless Access for the Vehicular Environment |
| IEEE 1609 | Family of Standards for Wireless Access in Vehicular Environments (WAVE) |
| - IEEE Std 1609.1-2006 - Trial Use Standard for WAVE - Resource Manager |
| - IEEE Std 1609.2 -2006- Trial Use Standard for WAVE - Security Services for Applications and Management Messages |
| - IEEE Std 1609.3 -2010 - Standard for WAVE - Networking Services |
| - IEEE Std 1609.4 -2010- Standard for WAVE - Multi-Channel Operations |
| - IEEE Std 1609.11-2010 Over-the-Air Electronic Payment Data Exchange Protocol for ITS |
| TTA | TTAS.KO-06.0175 | Vehicle-to-Vehicle Communication System Stage1: Requirements |
| TTAS.KO-06.0193 | Vehicle-to-Vehicle Communication SystemStage2: Architecture |
| TTAS.KO-06.0216 | Vehicle-to-Vehicle Communication System Stage3 : PHY/MAC |
| TTAS.KO-06.0234 | Vehicle-to-Vehicle Communication System State 3 : Networking |
| TTAK.KO-06.0242 | Vehicle-to-Vehicle Communication System Stage3 : Application Protocol Interface |
| ARIB | STD-T109 | 700 MHz Band Intelligent Transport Systems |

**2.3.3. Frequency usage**

Among APT countries, Japan is studying 700MHz in addition to 5.8GHz band for V2V communication to transmit safety information. Also, Korea is studying to allocate optimum frequency band for V2V, V2I communication, and performed field test for V2V, V2I communication in experimental frequency band (5.835~5.855 GHz).

On the other hand, Europe plans to use of the 5.855~5.925 GHz frequency band for cooperative ITS according to the ECC decision in 2008, and the U.S. use the frequency band 5.850~5.925 GHz for the WAVE providing ITS applications with specific channels for safety. For interoperability and global harmonization, some APT countries are (e.g. Australia, Singapore) also considering these band for cooperative ITS systems.

Regards these activities, in Australia, the investigation has carefully examined the constraints created by existing and future service coordination requirements. These include, for example, the fixed-satellite service concerns over the unknown compounding effects of aggregated roadside and onboard units which could constructively interfere with the FSS, and/or raise the overall noise floor within which the FSS operates. Moreover, the need to protect intelligent transport systems may severely limit the deployment of future FSS earth stations in the band 5,850-5,925 MHz. While studies have indicated these impacts will be minimal, mitigation and appropriate licensing strategies are under consideration.

Table 8. Usage status of vehicle information & communication in APT countries

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Country** | **Frequency Band** | **Technology/****Standard** | **Service** | **Deployment or plan Year** |
| Japan | 76-90 MHz(FM multiplex broadcasting) | VICS(Vehicle Information and Communications System) | Traffic information | Enacted in 1994 |
| 2,499.7 MHz(Radio beacon) |
| 5,770-5,850 MHz | Vehicle-to-Vehicle communications system | Safety information(Communications) | Guidelines for field experiment in 2007 |
| 700 MHz band | Enacted in 2011 |
| Korea | TBD | (TTAS.KO-06.0175,06- 0913,06- 0216,06- 0234,06- 242) | Vehicle to vehicle and vehicle to Infrastructurecommunication | FieldExperiment |

1. **Summary**

Intelligent transport systems attract many people’s interest because it could improve the safety of road traffic, ensure smoother traffic, reduce environmental burdens, and stimulate regional economic activity, etc. From the survey results, major deployed ITS systems in APT countries were classified as electronic toll collection, vehicular radar, and vehicle information & communication. As the importance of car safety is increasing, cooperative system is widely considered for international deployment. Especially in Europe, frequency band 5.855~5.925 GHz was assigned for cooperative systems and many development project was performed. Regards these activities, APT countries should study the optimal frequency spectrum for cooperative systems and try to reach regional/international harmonization of spectrum arrangements.

**Reference**

[1] ETSI EN 302 665 V1.1.0, “Intelligent Transport Systems (ITS); Communications Architecture”

[2] <http://www.etsi.org/website/Technologies/IntelligentTransportSystems.aspx>

[3] ITU-R M.1453-2, “Intelligent transport systems – dedicated short range communications at 5.8 GHz”

[4] AWF-9/INP-52, “79GHz Short-Range High-Resolution Radar”, by Japan

[5] AWG-10/INP-63, “79GHz Short-Range High-Resolution Radar”, by Japan

[6] AWG-11/INP-09, “World Wide Status in the Regulation of Automotive Radar Applications in the 76 MHz to 81 GHz Range", by Robert Bosch (SEA) Pte. Ltd., Singapore

[7] ITU-R Recommendation M.1452-2

[8] ITU-R Report M.2228, “Advanced Intelligent Transport Systems (ITS) radiocommunications”

**ANNEX**

**- Questionnaire and Responses**

1. **Questionnaire**

AWG Questionnaire sent out on May 2010 is shown below.

***Question 1*:** What frequency band(s) is/are used for ITS(e.g. DSRC) in your country/region as of 2010 ?

***Question 2:*** What frequency bands are allocated for ITS technology on your frequency allocation table in your country/region?

***Question 3:*** Which technologies and/or standards is/are using the frequency band(s) mentioned in Question 1.

***Question 4:*** If above question 1,2 were answered, would you provide the summary of technologies and/or standards used in the frequency band(s) mentioned in Question 1,2.

***Question 5:*** If above question 1,2,3 were answered, would you provide the summarized current status of service deployment used in the frequency band(s) mentioned in Question 1,2.

**Answer template:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

***Question 6:*** In addition to the answers above, would you provide the future plan for the designation of ITS frequency band(s)

1. **Administrations that submitted responses to APT up to the opening of AWG-13**
2. Afghanistan
3. Australia
4. China
5. Hong Kong
6. Japan
7. Korea
8. Singapore
9. Tonga
10. Vanuatu
11. Thailand
12. **Responses**
13. **Afghanistan**

Q1~Q5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
| N/A | N/A | N/A | N/A |  |

Q6) Our authority is going to forecast designation of ITS frequency bands in our NFAT in the future.

1. **Australia**

Q1)

5 725-5 795 MHz, 5 815-5 875 MHz and 24-24.25 GHz are used for electronic tolling in Australia. The use of these bands is authorised on a no interference/no protection basis under the Radiocommunications (Low Interference Potential Devices) Class License

22–26.5 GHz is used for ultra-wideband short-range vehicle radar (UWB SRR) systems for collision avoidance. There are a number of restrictions on the use of this band for short-range vehicle radar systems including power density limits, adherence to ETSI 302-288-1, and restrictions from exclusion zones around radioastronomy sites. Details can be found in the Radiocommunications (Low Interference Potential Devices) Class License. UWB SRR for collision avoidance is seen as an interim solution only and this technology is expected to be replaced by 77–81 GHz radars as Europe will only allow installation of 24 GHz automotive radars until June 2013.

76–77 GHz is currently used for long-range vehicle radar (intelligent cruise control) in Australia. The use of these bands is authorised under the Radiocommunications (Low Interference Potential Devices) Class License.

Q2)

Intelligent transport systems are considered a mobile service. However, no frequency bands are allocated specifically for intelligent transport systems in the Australian frequency allocation table. Intelligent transport systems technology is currently authorised primarily via the Radiocommunications (Low Interference Potential Devices) Class License.

Q3) N/A

Q4) N/A

Q5) N/A

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
| 5 725-5 795 MHz, 5 815-5 875 MHz, 24-24.25 GHz  |  | electronic tolling |  | Radiocommunications (Low Interference Potential Devices) Class License |
| 22–26.5 GHz |  | ultra-wideband short-range vehicle radar (UWB SRR) systems for collision avoidance |  |
| 76–77 GHz |  | long-range vehicle radar (intelligent cruise control) |  |

Q6)
The 5 850-5 925 MHz band is currently being investigated with a view to facilitating the introduction of intelligent transport systems in Australia. The investigation has carefully examined the constraints created by existing and future service coordination requirements. These include, for example, the fixed-satellite service concerns over the unknown compounding effects of aggregated roadside and onboard units which could constructively interfere with the FSS, and/or raise the overall noise floor within which the FSS operates. Moreover, the need to protect intelligent transport systems may severely limit the deployment of future FSS earth stations in the band 5 850-5 925 MHz. While studies have indicated these impacts will be minimal, mitigation and appropriate licensing strategies are under consideration

1. **China**

Q1~Q5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
| 5725-5850 | DSRC (1) | ETC(Electronic Toll Collection) | Enacted in 2003 | Planed several frequency points in this band for DSRC |
| 76000-77000 | Radar (2) | Vehicular range radar | Enacted in 2005 |  |

Q6) N/A

(1) DSRC

|  |  |  |
| --- | --- | --- |
|  | Active | passive |
| frequency | Downlink(GHz) | Uplink(GHz) | Downlink(GHz) | Sub-carrier frequency of uplink(MHz) |
| 5.8355.845 | 5.795 5.805  | 5.7975, 5.8025, 5.8075, 5.8125 | 1.5, 2.0 |
| transmit power | ＜300mW | ＜2W |
| occupied frequency bandwidth | ＜4MHz | ＜8MHz |
| frequency tolerance | 20ppm |
| power limit of spurious emission | ＜24dBm |
| modulation type | ASK |

(2) Radar

frequency range: 76-77GHz

power limit of maximum EIRP: 55dBm

1. **Hong Kong**

Q1~Q5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
| 2.4 – 2.4835 GHz | Telecommunications (Telecommunications Apparatus) Exemption from Licensing Order | Electronic toll collection services | 1998 |  |
| 76 – 77 GHz | Vehicular radar systems | 2005 |  |

Q6) We are considering to open the 77- 81 GHz band for automotive radar systems utilizing ultra-wideband technology.

1. **Japan**

Q1~Q5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
| 76-90(FM multiplex broadcasting) | VICS(Vehicle Information and Communications System) | Traffic information | Enacted in 1994 |  |
| 2500(Radio beacon) |
| 5800 | ETC(Electronic Toll Collection) | Collect highway toll (Communication) | Enacted in 1997 |  |
| DSRC(Dedicated Short Range Communication) | -Collect highway toll- Provide various information (Communication, Broadcast) | Enacted in 2001(Revised 2007) |  |
| 24000/26000 | Sub-millimeter, Millimeter wave system | Detect obstacles (Sensor) | Enacted in 2010 |  |
| 60000/76000 | Enacted in 1997 |  |
| 79000 | Under consideration |  |
| 5800 | Vehicle-to-Vehicle communications system | Safety information(Communications) | Guidelines for field experiment in 2007 |  |
| 700 | Guidelines for field Experiment in 2009 |  |

Q6) N/A

1. **Korea**

Q1~Q5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
| 5,795-5,815 | DSRC1)/TTA Standard(TTAS.KO-06.0025/R1)2) | ETC(Electronic Toll Collection) | 2006(Highpass Tolling)  | - |
| 5,835-5,855 | Provide various information (Communication, Broadcast) | Not decided |  |
| 76,000-77,000 | Radar/ work in progress | Vehicular collision avoidance radar | 2008 | - |

1. DSRC: Dedicated Short Range Communication
2. TTA Standard(TTAS.KO-06.0025/R1, DSRC Radio Communication between Road-side Equipment and On-board Equipment in 5.8 GHz band)

: This standard specifies physical layer, data link layer and application layer of Dedicated Short Range Communication (DSRC) at 5.8GHz for Transport Information and Control System (TICS) services.

Q6) It is not decided yet.

1. **Singapore**

Q1~Q5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
| 2.35-2.4835 GHz  | - | Electronic Road Pricing (ERP) Systems | 1998 | - |
| 5.725-5.850 GHz | FCC Part 15 – 15.209, 15.247, 15.407 | Short Range Devices | 2001 | ≤ 100 mW (e.i.r.p) |
| 76-77 GHz | FCC Part 15 – 15.253 (c) or EN 301 091  | Short Range radar systems such as automatic cruise control and collision warning systems for vehicle | 2001 | ≤ 37 dBm (e.r.p) when vehicle is in motion;≤ 23.5 dBm (e.r.p) when vehicle is stationary; |

Q6)

****

1. **Tonga**

Q1~Q5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
| N/A | N/A | N/A | N/A |  |

Q6) There is no future plan yet for designation of ITS in our table of frequency allocation.

1. **Vanuatu (Republic of)**

Q1~Q5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/****Standard****(Q3, Q4)** | **Designated Service****(Q5)** | **Deployment or plan****Year (Q5)** | **Other****Comment** |
| 2.4 - 2.4835 GHz | Technology neutral | Unrestricted  | 2010 | General user /Class licence band |
| 5.15 - 5.25 GHz | Technology neutral | Wireless LAN  | 2010 | General user /Class licence band |
| 5.25 - 5.35 GHz | Technology neutral | Wireless LAN  | 2010 | General user /Class licence band |
| 5.47 - 5.725 GHz | Technology neutral | Wireless LAN  | 2010 | General user /Class licence band |
| 5.725 - 5.875 GHz | Technology neutral | Unrestricted  | 2010 | General user /Class licence band |
| 5.725 - 5.875 GHz | Technology neutral | RTTT  | Not yet | General user /Class licence band |
| 24 - 24.25 GHz | Technology neutral | unrestricted  | Not yet | General user /Class licence band |
| 76 – 77 GHz | Technology neutral | RTTT  | Not yet | General user /Class licence band |

Q6)

122 – 123 GHz, 244 – 246 GHz

1. **Thailand**

Q1~Q5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency Band(MHz)****(Q1, Q2)** | **Technology/** **Standard****(Q3, Q4)** | **Service****(Q5)** | **Deployment or plan****Year(Q5)** | **Other****Comment** |
| 5.725-5.875 GHz |  | Radar Application  | Regulation adopted in 2007 | License exempted when Tx. Power < 10 mW |
| 24.05 – 24.25 GHz |  | Radar Application | Regulation adopted in 2007 | License exempted when Tx. Power < 10 mW |
| 76-81 GHz |  | Radar Application | Regulation adopted in 2007 | License exempted when Tx. Power < 10 mW |
| 76-77 GHz | Compliance Standard: FCC Part 15.253 or EN 301 091-1 | Vehicle Radar Application` | Regulation adopted in 2006 | License exempted when Tx. Power < 10 W but type approval is required. |
| < 135 kHz | Compliance Standard: ETSI EN 300 330-1 | RFID | Regulation adopted in 2008 | License exempted when Tx. Power < 150 mW. License required when Tx. Power is 150 mW - 7.5 W. |
| 920 – 925 MHz | Compliance Standard: FCC Part 15.247 or FCC Part 15.249 orETSI EN 302 208-1 | RFID (e.g. vehicle registration and inspection) | Regulation adopted in 2008 | When Tx. Power < 0.5 W, license exempted on possess, use, export, and establishment of radiocom station, but license required on make, import, and trading.When Tx. Power is 0.5 – 4 W, license required. |
| 2.4 – 2.5 GHz | Compliance Standard:ETSI EN 300 440-1 or FCC Part 15.247 or FCC Part 15.249 | RFID  | Regulation adopted in 2008 | License exempted when Tx. Power < 100 mW  |
| 5.470-5.850 GHz | Compliance Standard:ETSI EN 300 440-1 or FCC Part 15.247 or FCC Part 15.249 | RFID (e.g. Electronic Toll Collection) | Regulation adopted in 2008 | License exempted when Tx. Power < 1.0 W  |
| 300 – 500 MHz |  | Radiocommunication Equipment (any application) | Regulation adopted in 2007 | License exempted when Tx. Power < 10 mW  |

Q6)

In the 24.00 – 24.25 GHzband**,** radar applicationwith Tx. Power < 100 mW isbeing considered

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