Roadmap for 5.9 GHz for Vehicle to Everything Communications (V2X) in the Kingdom of Saudi Arabia

October 2022
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1 List of abbreviations and glossary of terms

The definitions included in this document are to assist the reader to understand the range of terms currently in use across the V2X market. These definitions are for information purposes and vary across academic research and jurisdictions.

**3GPP**: Third Generation Partnership Project a global collaboration of standardization partners

**5GAA**: 5G Automotive Association is a global, cross-industry organization of companies from the automotive, technology, and telecommunications industries (ICT), working together to develop end-to-end solutions for future mobility and transportation services.

**DSRC**: Dedicated Short Range Communications is based on the IEEE 802.11p standard providing one-way or two-way short-range to medium-range wireless communication channels specifically designed for automotive use and a corresponding set of protocols and standards.

**C-V2X**: Cellular Vehicle to Everything based on 3GPP standard technologies

**CSMA/CA**: Carrier Sense Multiple Access with Collision Avoidance

**ETC**: Electronic Toll Collection is an automated system to allow electronic payments to be made using V2X technologies

**IMT**: International Mobile Telecommunications is the term used by the International Telecommunications Union to refer to cellular mobile technologies

**IoT**: Internet of Things is a term used collectively to represent devices that connect to the internet via different connectivity platforms

**ITS**: Intelligent Transport Systems is the term used for safety and non-safety-related applications
**ITS-G5**: Intelligent Transport Systems based on the IEEE 802.11p standard for use in the 5.9 GHz band (the G5 part represents the 5.9 GHz band)

**LTE-V2X**: 4G Vehicle to Everything technology is another term used for C-V2X it uses 3GPP standard technologies based on LTE and supports a range of ITS related applications

**OBU**: Onboard unit deployed inside a vehicle

**RSU**: Road-side unit deployed on road-side infrastructure such as gantries, poles and other street furniture

**RTTT**: Road Transport and Traffic Telematics

**TTA**: Telecommunications Technology Association (based in South Korea)

**V2I**: Vehicle to Infrastructure

**V2D**: Vehicle to Device

**V2N**: Vehicle to Network

**V2P**: Vehicle to Pedestrian

**V2V**: Vehicle to Vehicle

**V2X**: Vehicle to Everything
2 Introduction

In March 2021, CITC published its “Spectrum Outlook for Commercial Innovative Use 2021-2023”\(^1\). The spectrum outlook implements our National Spectrum Strategy 2025 and reaffirms our vision to ‘unlock the potential of radiocommunications in Saudi Arabia for a smarter and safer future’. Section 3.9 of the spectrum outlook focused on V2X. The spectrum outlook identified that there has been interest in V2X in the 5.9 GHz band for many years but there has been limited deployment to date.

Vehicle-2-Everything (V2X) is the term used to describe a range of vehicle communication systems. V2X enables information to be exchanged between vehicles or from/to vehicles from road-side infrastructure and pedestrians. It is a vehicular communication system that incorporates specific types of communication such as:

- Vehicle-to-Vehicle (V2V)
- Vehicle-to-Pedestrian (V2P)
- Vehicle-to-Infrastructure (V2I)
- Vehicle-to-Device (V2D)
- Vehicle-to-Network (V2N)

Furthermore, the limited deployment of V2X has been caused by a lack of agreement over a common standard with the Wi-Fi based DSRC/ITS-G5 competing with the 5G-based C-V2X. In the spectrum outlook we committed to consult on this in 2022 with the aim of making spectrum available such that it does not become a constraining factor on the availability of V2X services in KSA. The purpose of this Call for Input is to action our commitment to consult on these issues.

This Call for Input document sets out the key topics and questions on the spectrum bands and authorization approaches that could be adopted to support V2X applications. CITC is seeking input from industry on the different network architectures, technologies and spectrum options and solutions for the deployment V2X in KSA. This will inform CITC decision making, as indicated in the spectrum outlook.

\(^1\) Spectrum Outlook for Commercial innovative Use 2021-2023
3 Technologies and Standards

3.1 Types of V2X Technologies

There are two key ITS technologies that are becoming the dominant protocols for V2X:

1) DSRC/ITS-G5: was the first dedicated V2X technology developed based on IEEE 802.11p standard used in the USA for Dedicated Short Range Communications (DSRC). ITS-G5 was later developed as a European standard by ETSI based on the IEEE 802.11p standard evolutions for use in the 5.9 GHz band. DSRC and ITS-G5 are largely the same technologies, with ITS-G5 being the name of the European variant.

2) C-V2X: has been developed as part of the 3GPP family of standards (starting from Release 14) to enable cellular technologies (4G and 5G) to be used for dedicated V2X connectivity.

ITS-G5 and C-V2X are competing technologies, and vehicles which have different technologies installed cannot communicate with each other. There are already vehicles that connect to the public mobile network that would need upgrading to connect to any future private network. The current competitive landscape for V2X connectivity presents CITC with the opportunity to consider, with input from stakeholders, whether there is a need to support a particular approach for connectivity.

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1. What role do you think the two V2X technologies, ITS-G5 and C-V2X, will have in KSA? Which technology should prevail in KSA and why?

2. What current and future application scenarios do you foresee for the V2X technologies listed in section 3.1?

3. How and when do you think V2X technologies will deploy in KSA and to what scale?

4. Should the V2X market be left to decide which technology should prevail (CV2X or ITS G5)?
5. Should a technology neutral approach be taken? Please provide your views on the advantages and disadvantages of adopting a particular approach and use of technology along with any supporting evidence.

6. Are the major import markets for vehicles a significant factor in the consideration of the technology? If so please provide evidence and examples to support your views.

3.2 Technology Coexistence

It is not proven whether peaceful coexistence between C-V2X and ITS-G5 connectivity technologies is possible in the 5.9 GHz band. However, if proven to be possible, this approach would mean that decisions on the adoption of a V2X technology can be made on a country-by-country basis without the establishment of a single international standard. Other parts of the industry (e.g. such as the cellular community) support the development of a single standard. It is important to note that C-V2X can also be deployed over other IMT bands as detailed in 3GPP standards.

7. Is coexistence between the technologies an issue? Please provide any information that supports or prohibits coexistence.

4 Networks for V2X

V2X communication has been technically feasible for a number of years but remains an emerging technology internationally, with mass commercial deployment still not as widespread as was anticipated 10 years ago. CITC wishes to support industry to successfully roll out V2X in KSA. This Call for Input is to learn more from the market on how technology may be deployed, the business models that will support this, the end user customer proposition, how this may change in the future and any barriers that are preventing implementation in KSA.

4.1 Public mobile networks used for V2X – 4G/5G

Specifically enabled vehicles can connect to the public mobile network, if the service is supported by the operator. The vehicle requires an embedded (usually SIM/chip based) cellular modem and the car’s diagnostic data can be transmitted to the manufacturer, or the car can connect to the internet to provide traffic and other relevant data useful to the driver and passengers.
This approach uses the public operators’ spectrum and existing network to deliver coverage to road users but only in the locations where coverage is available, which in some cases may not be the entire road network. Mobile operators could potentially utilize new spectrum bands such as 5.9 GHz and offer a dedicated service solely using this spectrum. In the absence of additional dedicated spectrum for V2X, operators will need to use current IMT allocations as appropriate.

The C-V2X standard is being promoted by 5G Automotive Association (5GAA) along with BMW, Daimler, Ford, Ericsson, Vodafone, Huawei, Intel, Qualcomm, and Samsung. It is also being seen as the connected car technology of choice in China and the United States.

4.2 Private mobile network use

ITS-G5 behaves in a similar way to Wi-Fi (since it is based on the same set of standards as IEEE 802.11) and therefore supports spectrum sharing protocols such as Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). This technology allows failed transmissions to be detected and dealt with and thus permits the use of a license-exempt environment where the infrastructure and vehicle users are able to coexist and share access to a band.

Volkswagen and Renault and the Car-to-Car Communication Consortium is advocating the use of ITS-G5 standard through a license-exempt approach. Supporters of this standard also advocate that it has been more fully tested through several European government-funded projects compared to the C-V2X standard and is a lower-risk solution. However, additional security measures are needed to ensure full protection of the system compared to the inherent security of cellular technologies.

8. What are the advantages and disadvantages to using public networks for V2X?

9. What are the spectrum requirements for implementation of V2X over the public mobile network?

10. If a public network approach is taken will additional spectrum be required for specific V2X operators?

11. What is the current market uptake in KSA for cellular connected cars?

12. What are the advantages or disadvantages to using private networks for V2X?
13. What are the spectrum requirements for implementation of V2X over a private network?

14. Please provide evidence, both national and international, to support either the use of a public or private network approach.

5 Ecosystem Readiness

There is already 3GPP compliant equipment on the market and in use today embedded into many different brands of vehicle supporting most of the existing 4G frequency bands. There are Original Equipment Manufacturers (OEMs) (e.g. Quectel and Sierra Wireless) that have been developing embedded cellular modems for vehicle manufacturers. In turn, car brands such as BMW, Mercedes and Ford, have, for a number of years now, provide a connectivity solution within their vehicles offering a range of connected services. These vehicles connect to the public operators’ network.

In the case of using the 5.9 GHz band for V2X, this is a 3GPP band (B46/47) and OEMs such as Quectel have developed modules (e.g. AG15) which are available on the market and used by some vehicle manufacturers such as Ford and Nissan. In the case of ITS-G5 modules, U-Blox have produced the VERA-P3 series which uses the IEEE 802.11p standard which is also being used by some vehicle manufacturers such as.

15. Consumer choice has an important role to play in increasing V2X implementation. Is the choice of vehicle models capable of V2X going to increase across the market and what will drive this growth?

16. What are the technical barriers for mass adoption of V2X in KSA? When providing input on the barriers, how do you prioritize the need to address these?

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3 https://www.mercedes-benz.com/en/innovation/connected/ (last accessed June 2022)

4 https://www.ford.com/technology/sync/ (last accessed June 2022)


17. How mature are the elements associated with V2X systems (vehicles, infrastructure, networks, etc.) please support your answer with facts and evidence of international practices.

18. Which barriers do you believe require intervention from CITC and what form should that intervention take? What actions should Industry, or other stakeholders, take to address the barriers identified?

6 Spectrum requirements for V2X

5.9 GHz appears to be the spectrum band of choice for implementation of V2X in key markets around the world for both public and private network deployments. It is not, however, the only spectrum band that can be used for providing V2X services, particularly if a public mobile network approach is taken as this would use existing licensed IMT bands. CITC is seeking input on the extent to which other frequency bands may be used to provide V2X services in KSA. These bands include, but are not limited to, IMT bands for applications provided via IMT networks.
Figure 1 summarizes the spectrum allocation and licensing approach for V2X in these countries. A more detailed comparison is provided in Section 8. There is no one consistent approach being taken with regards to spectrum use for V2X internationally. CITC is therefore interested in views as to which approach would be most favorable in supporting the implementation of V2X in KSA, noting:

1) the 5.9 GHz would be used for the purposes of V2X whether used by a public mobile operator or private network operator.

2) the spectrum would likely need to be split into safety ITS and/or non-safety ITS configurations

3) whether the band is technology-neutral or whether a specific technology should be adopted.

19. What spectrum is required to support implementation of V2X in KSA?

20. Would designation of the use of the 5.9 GHz band provide the best outcome for the use of V2X in KSA? Please provide reasons for your preference along with any supporting evidence.

21. If you consider 5.9GHz spectrum to be a favourable approach please indicate how the blocks should be sub-divided taking into account the different approaches identified in Figure 1. What types of services/applications should be used (safety, non-safety) or deployed in each block? Also please elaborate on global deployments and ecosystem readiness for such a division.

22. How much spectrum is needed to support the range of services?

23. What are the timescales required for the release of spectrum? Please provide supporting evidence and future use cases when providing input on the timescales for spectrum.

24. Should there be a designation for safety or non-safety services/applications? Also please elaborate on global deployments and ecosystem readiness for such a division.

25. Please provide your views or any other comments related to spectrum usage of any other band for V2X communications. Please elaborate on global deployments and uptake, along with ecosystem readiness for such bands.

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7 In the graph the use of “L” and “LE” is in reference to Licensed and License Exempt respectively.
7 Regulating V2X

Changes to the current regulatory environment in KSA may be needed to support a successful future for V2X, the key is regulating at the right time. Any reforms undertaken by CITC need to be for the future. This requires stakeholder input and engagement on the future roadmaps for V2X implementation. In order to support V2X implementation CITC wants input from stakeholders as to whether there are any regulatory barriers to implementation. In the absence of any regulatory measures the timing of deployment and adoption of technologies is determined by the market. The role of CITC in enabling the availability of appropriate spectrum has been covered in the previous section. The regulatory environment is more than the availability of spectrum it also includes, but is not limited to, the approach to licensing, eligibility and enabling the importation of equipment, and CITC will align with local authority bodies on its regulatory decisions.

7.1 Frequency Licensing

Different approaches have been taken by regulators on the licensing of the 5.9 GHz band with a mix of licensed and licensed exempt approaches or a combination of the two. CITC would welcome stakeholders’ views on which form of authorization is the most appropriate for access to spectrum for V2X services. The approach to licensing is in some respect determined by the technology that will be used.

The licensing approach for using public mobile networks is straightforward; no licensing is required and use of the frequencies in the vehicles is permitted through the mobile operators’ network and service license. In the case of private mobile networks there are multiple licensing options that can be adopted. These options can be summarised as:

1) A fully licensed option in which an operator would obtain a license to operate a private network and deploy dedicated infrastructure on the road-side.

2) A lightly licensed approach that may only require registration of road-side equipment such as location and power limit.

3) A license-exempt approach for the road-side infrastructure.
In each case the Onboard Units would be license-exempt.

26. What are the regulatory barriers for mass adoption of V2X in KSA? When providing input on the barriers what are your priority actions for addressing these?

27. Please provide views, along with supporting evidence, for the most appropriate option for spectrum authorization of road-side units. Also please elaborate on global deployments and ecosystem readiness and update for both approaches.

28. Should there be a distinction between safety and non-safety service providers in the approach taken to licensing?

7.2 Eligibility

Depending on whether a private network should be deployed, we are interested in stakeholders’ views on what type of users should be eligible to use the spectrum.

Eligibility requirements

29. Should road-side ITS spectrum and the associated network be provided by the private sector or by a government organization? Please elaborate on global deployments and uptake for both approaches.

30. Should there be a distinction between safety and non-safety service providers in the approach taken to eligibility?

31. Should there be eligibility restrictions or minimum qualifications for the issuance of V2X spectrum? If so, what eligibility criteria should be set for access to V2X spectrum? If CITC licenses road-side units (RBUS) what is the optimum duration for spectrum licenses and why?

32. Are there any other issues around eligibility that CITC should consider?
8 International implementation of V2X

This section considers the implementation of V2X in several countries that have already made decisions on the use spectrum in the 5.9 GHz band:

- United States
- European Union
- China
- Japan
- Republic of Korea
- Singapore
- Australia
- GCC

The international context provided in this section is to inform stakeholder responses and to generate discussion on what lessons can be learned from international implementation of V2X in KSA. CITC would welcome stakeholder feedback on implementation internationally both in 5.9 GHz and also in other spectrum bands.

Implementation of the full 5855 – 5925 MHz band varies depending on the region and historic allocations. For example, in the USA the FCC (Federal Communications Commission) assigned 75 MHz from 5850 MHz – 5925 MHz for ITS applications in 1999 with DSRC as the technology of choice but in recent years C-V2X has been introduced. In Europe, 5855 – 5925 MHz has been designated for ITS by the European Commission, whilst this band is technology neutral the market has indicated a preference for ITS-G5. In other countries such as China, Korea, Australia, and Singapore, the 5.9 GHz band has also been designated, or is under consideration, for ITS applications. China has decided to support C-V2X technology. In Japan, the frequency allocation deviates and instead uses a combination of 755.5 – 764.5 MHz and 5770 – 5850 for a mix of safety-related and toll collection applications.

Further details of the regulatory decisions and approaches to implementation are provided for each country below. The international situation presented in this section provides a basis upon
which implementation in KSA could be defined. For ease this section provides a high level snapshot of V2X implementation and the regulatory approach that has been taken.

### 8.1 United States

The FCC designated Dedicated Short-Range Communications (DSRC), over twenty years ago, as the technology standard for providing vehicle related communication services in the 5.9 GHz band, specifically 5850-5925 MHz. In November 2020, the FCC adopted new rules\(^8\) to split the 5.9 GHz band making the lower 45 MHz block (5850-5895 MHz) for unlicensed general (non-automotive) use of spectrum, and the upper 30 MHz (5895-5925 MHz) for enhanced automobile safety using C-V2X technology, reducing the available spectrum for V2X to 30 MHz.

The FCC decision to reduce the spectrum available to ITS was not without controversy with the Intelligent Transportation Society of America and the Association of State Highway and Transportation Officials petitioning the court of appeal to review the FCCs decision\(^9\). In 2021 the FCC began\(^10\) the transition away from DSRC, which is incompatible with C-V2X.

DSRC has been available in the US for many years, but with limited deployments since the early 2000s\(^11\). There are some limited C-V2X deployments in the US\(^12\) but the technology implementation in vehicles is still early and these deployments are part of specific projects within certain states in the US, supported by telecommunications vendors and certain vehicle manufacturers. It is

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\(^8\) FCC New release “FCC Modernizes 5.9 GHz Band for Wi-Fi and Auto Safety”, 18 November 2020 (last accessed June 2022)


\(^10\) FCC Factsheet Modernising the 5.9 GHz band, October 2020 (last accessed June 2022)

\(^11\) DSRC? It’s become a faith-based thing, ITS International March 2021 (last accessed June 2022)

\(^12\) Vehicular connectivity: C-V2C & 5G A 5G Americas White paper, September 2021 (last accessed June 2022)
expected that C-V2X will continue to gather pace as more vehicles manufacturers adopt the technology.

8.2 European Union

![Figure 3: Summary of the approach taken to spectrum allocation for V2X in the EU](image)

In Europe, the approach to allocating spectrum in the 5.9 GHz band for V2X is slightly different to the USA and other countries around the world (as indicated in figure 1). The frequencies have been divided into four separate blocks:

- A 20 MHz block which covers non-safety-related ITS from 5855 - 5875 MHz which can be shared with other services, notably short-range devices
- A prioritized middle 40 MHz block which covers safety-related ITS from 5875 - 5915 MHz. This prioritization means that no harmful interference can be caused and protects with priority access to the spectrum, and
- A 10 MHz block at the top end of the range which covers use for rail from 5915 MHz.
- The last 10 MHz block (5925 – 5935 MHz) has been reserved for those European countries that wish to implement safety-related rail ITS. However, in most European countries, this block falls into the lower part of a larger block in the 5925 – 6425 MHz range which has been identified for indoor low power Wi-Fi use

Spectrum use for this band is on a technology-neutral basis, which is common within Europe. The frequency designations for Europe have been ratified by CEPT in both ECC Recommendation (08)0113 and ECC Decision (08)0114, which were approved in March 2020.

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13 ECC recommendation (08)01, Use of the band 5855-5875 MHz for Intelligent Transport Systems (ITS), July 2015, [last accessed June 2022]

ITS-G5 has been deployed in parts of Europe, part of a co-financed project\textsuperscript{15} with the EC’s Connecting Europe Facility. It includes a range of pilots for deploying ITS infrastructure along a number of highways in several countries within Europe. However, some of the pilots, for example in Slovenia, used 4G for the connectivity platform to vehicles confirming the technology neutral approach being adopted in Europe.

8.3 China

![Figure 4: Summary of the approach taken to spectrum allocation for V2X in China](image)

The Bureau of Radio Regulation (BRR) within the Ministry of Industry and Information Technology (MIIT) identified the 5.9 GHz band for V2X communications in 2018\textsuperscript{16}. Specifically, the frequency range 5905 – 5925 MHz was designated for safety-related road-ITS. The spectrum has been divided into two 10 MHz blocks with the lower block used for V2V communications and the upper 10 MHz block for V2I communications.

The decision was also made to use C-V2X technology (LTE-V2X) as the direct communications method between road-side units and onboard units within vehicles. This was considered the only option for ITS-related safety applications due to the close alignment of the technology features with the safety requirements given the use of cellular technology for the communications provision, it was decided that RSUs (Road-side Units) would be authorized using a license, whereas authorization of the OBUs (Onboard Units) are exempt from licensing, in a similar way to traditional mobile networks.

\textsuperscript{15} Annual pilot overview report 2020, C-Roads, June 2021 (Last accessed June 2022)

\textsuperscript{16} China’s MIIT publishes regulations for direct communication of Internet of Vehicles, 16 November 2018 (last accessed June 2022)
Mass scale deployments of C-V2X are expected by 2025 in China\textsuperscript{17} when half of vehicles produced have C-V2X installed and a large proportion of the planned road-side infrastructure will have been deployed in 90 cities across the country.

8.4 Japan

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\textsuperscript{*} 755.5 - 764.5 MHz for ITS Connect (IEEE 802.11p) Regime-TBD

\textsuperscript{**} (IEEE 802.11p) LE OBU- L(RSU)

Figure 5: Summary of the approach taken to spectrum allocation for V2X in Japan

The Japanese Ministry of Information and Communications’ Frequency Action Plan prioritizes ITS enhancements to allocations in the 5.8 GHz band but does not identify specific technologies. The action plan states that as global trends for new V2X technologies emerge these will be considered. Japan has allocated two quite distinct bands for V2X communications both of which do not align with the other countries considered in this section.

- A single 9 MHz block has been designated in the 755.5 – 764.5 MHz range used for ITS Connect\textsuperscript{18} which is a commercial service dedicated for V2V, V2I and I2I safety features. The 755.5 – 764.5 MHz band is available on an exclusive basis for RSUs and on a license-exempt basis for OBUs.

\textsuperscript{17} China paves way to enhanced safety with C-V2X. ITS International, Sept 2021 [last accessed June 2022]

\textsuperscript{18} Toyota. Background of the “ITS Connet” [last accessed June 2022]
• The 5770 – 5850 MHz block has been designated for Electronic Toll Collection (ETC/ETC 2.0)\(^9\) (noting this is an ARIB STD-T75 based system). This is an 80 MHz portion which is in the lower adjacent block below the ‘normal’ 5.9 GHz allocation. The 5770 – 5850 MHz band used for toll collection has seven FDD channel combinations to support the service.

DSRC has been available in Japan for some time and Japanese vehicle manufacturers have incorporated the technology as part of the Electronic Toll Collection service. There were trials\(^{20}\) conducted by some vehicle manufacturers, such as Nissan, using C-V2X in 2018, to validate the benefits of the technology. However, other manufacturers such as Honda and Toyota have opted for DSRC.

### 8.5 Republic of Korea (ROK)

![Figure 6: Summary of the approach taken to spectrum allocation for V2X in the Republic of Korea](image-url)

In 2016 the Ministry of Science and ICT (MSIT) assigned the 5855 – 5925 MHz band for Cooperative ITS (C-ITS) specifically for V2V and V2I communications. This designation was aimed at improving road safety with targets of ‘zero accidents in 30 years’\(^{21}\) which formed part of an ITS masterplan. In the initial stages of deployment, IEEE 802.11p was used for the C-ITS pilot project however a decision has subsequently been made not to specify the radio technology to be operated in this spectrum. In turn, developments of the standards are ongoing by the TTA\(^{22}\), with the goal to support

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\(^{20}\) Connected Vehicles DSRC vs. C-V2X (in perspective to Japan), Linkedin, January 2020 (last accessed June 2022)

\(^{21}\) C-ITS pilot project, Korea Expressway Corporation web site, (last accessed June 2022)

\(^{22}\) Telecommunications Technology Association of Korea
various radio technologies (i.e. technology neutral) for ITS applications, including both IEEE 802.11p and C-V2X. The authorization approach for the band has not yet been confirmed by the regulator.

In Seoul the city authority and transport department have funded the deployment of a C-ITS network across the city\textsuperscript{23}. This supports the installation of V2X technology onboard 2000 public buses which will be able to alert drivers of traffic incidents, weather information and collision avoidance.

8.6 Singapore

![Figure 7: Summary of the approach taken to spectrum allocation for V2X in Singapore](image)

The approach taken in Singapore by the IMDA reflects the general trend of allocating the entire 5.9 GHz band for ITS with a slight difference, that is more aligned to Europe. The lower 20 MHz block 5855 – 5875 MHz is designated an ISM band/private channel, so ITS services that could be deployed can share with short range devices. The other 50 MHz of spectrum, 5875 - 5925 MHz is designated to a mix of ITS-related channels for both public and private use, providing the ability to support different V2X services. IMDA also indicates the OBU\'s mounted within the vehicles can operate on a license-exempt basis. However, the RSUs\textsuperscript{24} and other non-vehicular installations would require a license to operate in the frequency band.

\textsuperscript{23} Seoul City transforms transport system by deploying V2X systems powered by Autotalks, March 2022 (last access June 2022)

\textsuperscript{24} The RSUs can be used as part of a wide area private network
At present, there are no new commercial ITS deployments in Singapore but there are trials at Nanyang Technological University, Singapore using the campus as a testbed to explore hybrid DSRC and C-V2X communication software and applications as part of wider connected smart mobility project. The Singapore Land Transport Authority recently upgraded their Electronic Road Pricing technology to a new DSRC system that now provides real-time road traffic information.

8.7 Australia

In Australia the full 5855-5925 MHz is available for ITS applications with the band divided into seven 10 MHz channels. The band is divided into four categories:

- the lowest 20 MHz block, 5855 – 5875 MHz, is assigned for non-safety-related ITS
- the middle 20 MHz block 5875 – 5895 MHz is assigned for safety-related ITS,
- there is a 10 MHz block, 5895 – 5905 MHz assigned as a control channel, and
- the upper most 20 MHz block, 5905 – 5925 MHz is reserved for future applications.

The ACMA requires ITS stations to comply with ETSI Standard EN 302 571 and published a Class Licence in 2017, which allows transmissions of ITS stations as follows (as extracted from the Class Licence):

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26 Eutelsat to participate in Singapore National V2X Project Telematics Wire, Sept 2020, (last accessed June 2022)

28 ETSI EN 302 571 Intelligent Transport Systems (ITS). Radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band: Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU (last access June 2022)
Operate within the range of frequencies, greater than 5855 MHz and not greater than 5925 MHz
Maximum EIRP not to exceed 23 dBm/MHz
ITS station to comply with ETSI Standard EN 302 571, with some minor modifications

It was initially proposed that operation was restricted to road/transport authorities as the main users and license holders, but this has not been implemented. Therefore, the bands are available for commercial use.

At present, the Australian government\(^{27}\) has supported a range of trials nationally to test different safety-related and autonomous vehicle applications, through various grant schemes via the different states, the telecommunications companies and vehicle manufacturers. Cellular-V2X testing\(^{28}\) commenced in 2018 on private roads that moved to public roads in 2019 with a focus on road safety.

8.8 GCC countries

In GCC countries, the UAE and Qatar have been exploring the applications and benefits of V2X technology in addition to conducting trials. Specifically, in Dubai, the Roads and Transport Authority recently developed an Intelligent Transport System that supported a range of modern features including artificial intelligence, big data, IoT and a range of communications technologies. In addition, the UAE have been trialing fully autonomous vehicles using C-V2X with support from the telecommunications industry, vehicle manufacturers and other technology players. The trial was funded via a government accelerator programme, with a consortium led by Am jan X and Etisalat.

In January 2021, Qatar set out its ITS Communications strategy\(^ {29}\) identifying the drivers, benefits, stakeholders and implementation plan for deploying ITS in Qatar. This comprehensive strategy

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\(^{28}\) Australia starts first on road-tests of cellular C2X technology in Victoria, TTI, 27 June 2019 (last accessed June 2022)

\(^{29}\) Intelligent Transportation Systems Telecommunications Strategy, January 2021 (last accessed June 2022)
identifies the spectrum and connectivity options available for deploying ITS. There are numerous options including public and private cellular networks, that will useful for coverage outside of the cities.

33. Please provide your views or any other comments related to spectrum usage of the 5.9 GHz band for V2X communications internationally and any lessons that can be learned from this to inform the future direction for KSA.

9 Invitation for V2X Trials

CITC notes that there has been an interest in V2X technology to use the 5 GHz band for many years but still there are limited deployments to date as the technology continues to be developed.

That drives uncertainty for CITC with regards to how much spectrum should be allocated for such use and when that allocation should be adopted.

In this context, CITC is opening all relevant spectrum bands for V2X trials and demonstrations in the Kingdom.

CITC would be pleased to invite interested parties including manufacturers, telecommunication services providers, startups and V2X solution providers to participate in this initiative. Whoever is interested in conducting a V2X trial is requested to respond to this consultation in order to facilitate the trial process and necessary approvals.

CITC believes the trial alongside both the international development, and harmonized standards will expedite allocating the spectrum and will help CITC to take the appropriate decisions.
10 Next Steps

CITC aims to use the responses from this consultation to help enable V2X technologies in the Kingdom of Saudi Arabia by implementing the right spectrum strategy and regulations for V2X.