

Radio Spectrum and Technical Standards Advisory Committee

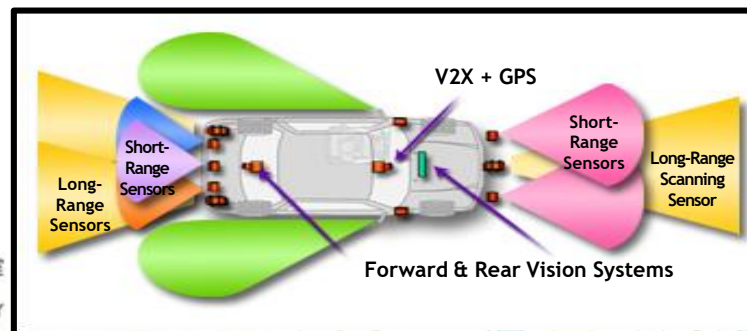
SSAC Paper 7/2020

Brief on Radio Technologies and Standards for Intelligent Transport Systems (ITS) Operating in the 5850 - 5925 MHz Band

Office of the Communications Authority
27 October 2020

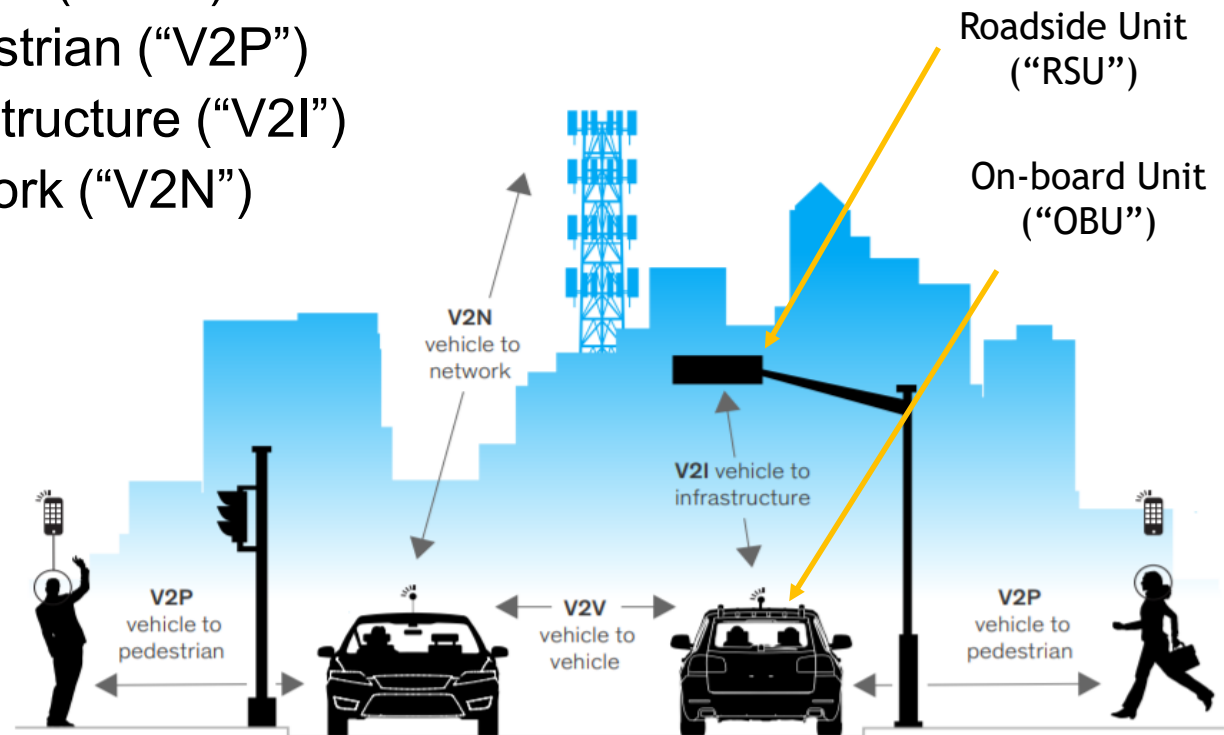
Intelligent Transport Systems

- Intelligent Transport Systems (“ITS”) aim to improve the safety, efficiency, and sustainability of transportation networks, reduce traffic congestion and enhance drivers’ experiences
- Typical ITS applications –
 - traffic safety related and traffic efficiency applications
 - electronic tolling systems
 - automotive radars
 - Vehicle-to-Everything (“V2X”) communications



Vehicle-to-Everything

- Specifically, V2X communications includes –
 - Vehicle-to-Vehicle (“V2V”)
 - Vehicle-to-Pedestrian (“V2P”)
 - Vehicle-to-Infrastructure (“V2I”)
 - Vehicle-to-Network (“V2N”)



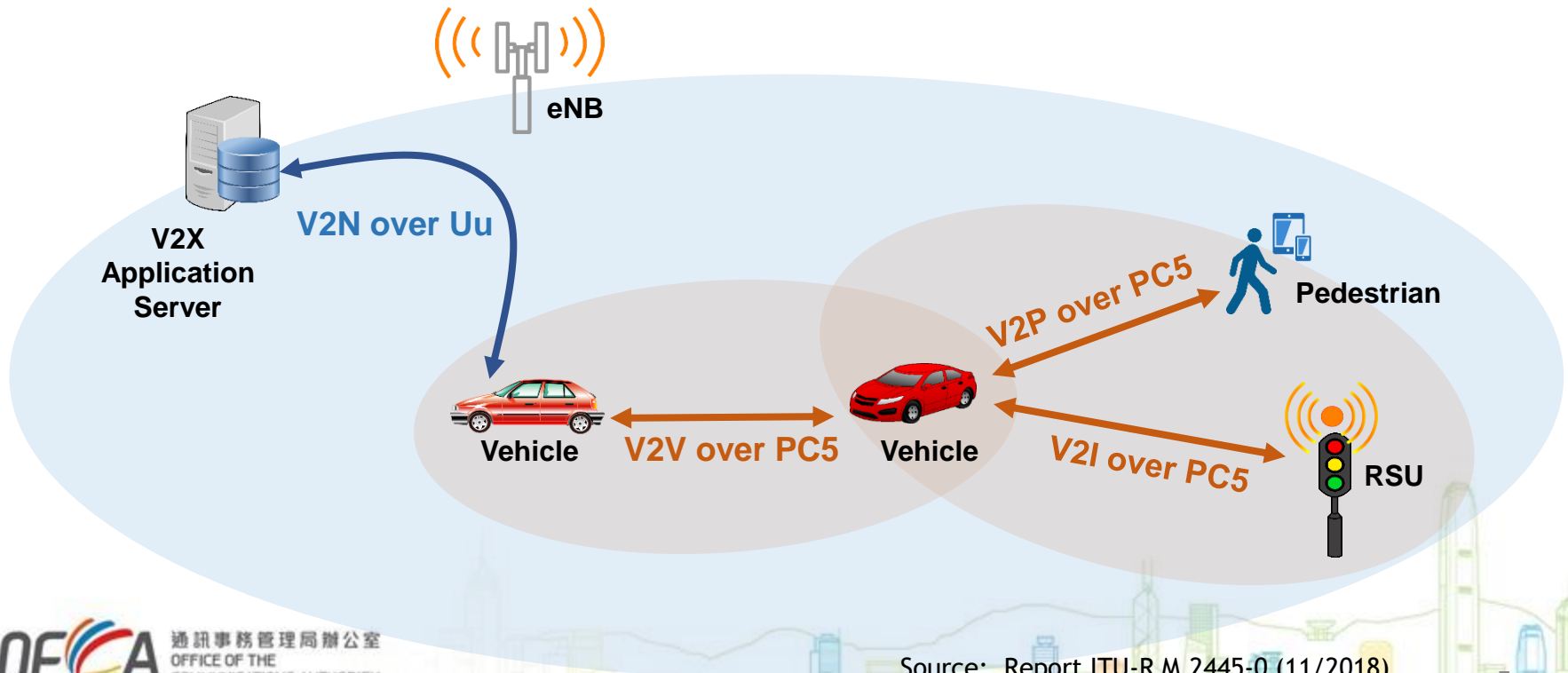
Radio Technologies for V2X

	Dedicated Short Range Communications (“DSRC”)	Cellular V2X (“C-V2X”)
Technology	Wi-Fi based	LTE based *
Release Date	2002	2017
Frequency Band	5850 – 5925 MHz	5855 – 5925 MHz (band 47)

* 3GPP has issued ITS standard for LTE and that for 5G is in the pipeline

C-V2X Communications Interfaces

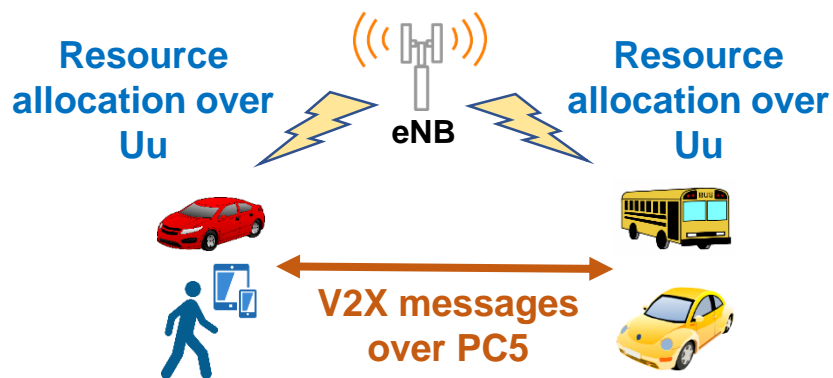
- 3GPP defined two interfaces for C-V2X –
 - Uu** (existing interface) – for communications between base stations (eNB) and UE
 - PC5** (new interface) – for **direct communications** among V2X devices



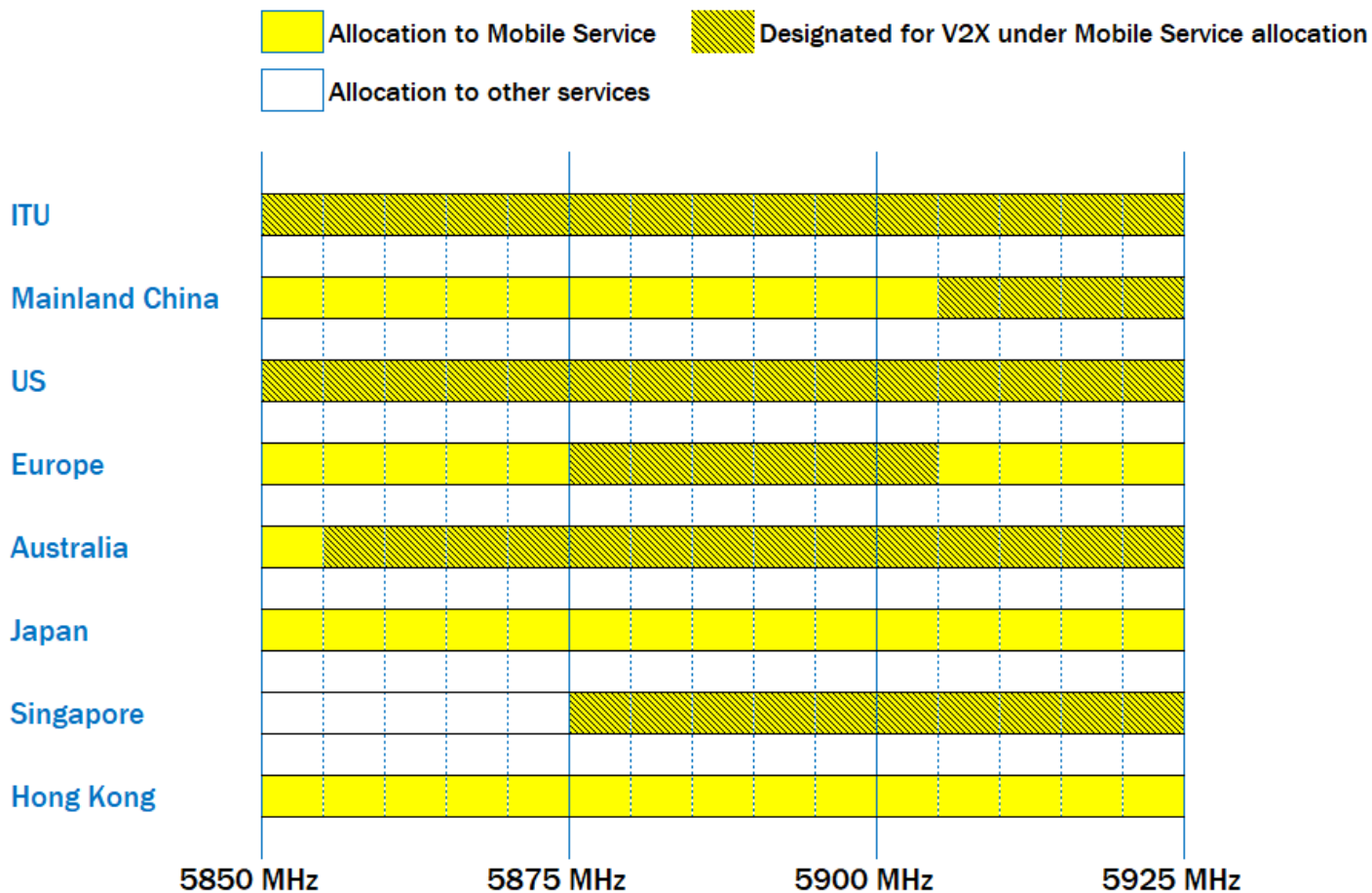
C-V2X Communications Modes

Two modes of resource allocation under C-V2X

- **Mode 3:** eNB schedules resource allocation where all users will have to subscribe to a particular mobile network that manages V2X radio resources, i.e. using Uu and PC5
- **Mode 4:** UE autonomous resource selection without the need to bundle with any mobile network, i.e. using PC5 only



Spectrum Allocation for V2X in Leading Economies



Related Discussion in SSAC Meeting

- The 22nd SSAC meeting as held on 14 January 2020 discussed the proposed additional primary allocation of the 5850 – 5925 MHz band (“5.9 GHz band”) to mobile service to align with the decision of the World Radiocommunication Conference 2019
- The Communications Authority (“CA”) has considered the matter taking into account the comments offered by SSAC members and approved the aforesaid allocation, among others, to take effect on 1 January 2021



Overseas V2X Regulatory Requirements

Economies	Standard		Licensing Requirements	
	Current	Latest Development	OBU	RSU
Mainland China	C-V2X	Standard development on C-V2X	No	Yes
US	DSRC	Proposal to introduce C-V2X	No	Yes
European Union	Technology neutral	Rejected the proposal to adopt DSRC	No	No
Australia	Technology neutral	Trial on C-V2X	Class licence	Class licence
Japan	DSRC	Trial on C-V2X	No	No
Singapore	DSRC	Trial on C-V2X	No	Yes

Recent Development on C-V2X (1)

- Mainland China
 - C-V2X standard development was initiated in June 2018
- US
 - In December 2019, FCC^[1] proposed to re-allocate –
 - ▶ 5850 – 5895 MHz (45 MHz) to Wi-Fi
 - ▶ 5895 – 5905 MHz (10 MHz) to either DSRC or C-V2X
 - ▶ 5905 – 5925 MHz (20 MHz) to C-V2X
 - FCC has yet to make known of its decision
- European Union
 - In July 2019, the EU Council rejected the proposal to adopt DSRC on the ground that it violated EU's principle of technology neutrality in spectrum regulation
 - There is no further information by EU in this regard yet

Recent Development on C-V2X (2)

- Australia
 - Started C-V2X trial in August 2020 involving some 500 vehicles in an area of 300 km²
- Japan
 - C-V2X trial conducted in December 2018
 - Study to use the 5.9 GHz band for ITS is ongoing
- Singapore
 - Planning for the C-V2X testbed and trials

Some economies having adopted DSRC initially are now considering C-V2X

3GPP Technical Specifications

- **3GPP** has developed technical specifications for LTE-based **C-V2X** starting from **Release 14** –

Specification ^[2]	Covered areas in 3GPP LTE-V2X
TS 23.285	Architecture enhancements for V2X services
TS 36.101	RF characteristics & performance requirements of RSU and OBU as UE
TS 36.521-1	Conformance testing of RSU and OBU as UE

- **3GPP** is also developing **5G NR-based C-V2X** in **Release 16** –

Specification ^[2]	Covered areas in 3GPP NR-V2X
TS 23.287	Architecture enhancements for 5G systems to support V2X services

[2] 3GPP specifications are available at <https://www.3gpp.org/specifications/specification-numbering>.

Conformity Assessment Standards

- Standards for ITS equipment operating in the 5.9 GHz band

Europe

- **Harmonised European standard EN 302 571 “Intelligent Transport Systems (ITS); Radiocommunications equipment operating in the 5855 MHz to 5925 MHz frequency band”^[3]**

US

- **Draft 47 CFR Part 90 Subpart M^[4] for RSU**
- **Draft 47 CFR Part 95 Subpart L^[5] for OBU**

[3] Available at <https://www.etsi.org/standards-search>

[4] Draft Code of Federal Regulations (USA); Title 47 Telecommunication; Chapter 1 FCC, Part 90 Private Land Mobile Radio Services, Subpart M (available at <https://docs.fcc.gov/public/attachments/FCC-19-129A1.pdf>)

[5] Draft Code of Federal Regulations (USA); Title 47 Telecommunication; Chapter 1 FCC, Part 95 Personal Radio Services, Subpart L (available at <https://docs.fcc.gov/public/attachments/FCC-19-129A1.pdf>)

Comparison between EN 302 571 and Draft 47 CFR Parts 90M and 95L (1)

■ EN 302 571 vs. Draft 47 CFR Parts 90M and 95L –

	EN 302 571	Draft 47 CFR Parts 90M and 95L
Current Status	V2.1.1 published in Feb 2017	Published on 6 Feb 2020; final rules or further proposed rules are yet to be seen
Technology Adopted	Technology neutral	<ul style="list-style-type: none"> • IEEE 802.11p-2010 for DSRC • 3GPP Rel-14 for C-V2X (LTE-based)
Operating Bands	<ul style="list-style-type: none"> • ITS non-safety applications: 5855 – 5875 MHz • ITS road safety applications: 5875 – 5905 MHz • Future ITS applications: 5905 – 5925 MHz 	<ul style="list-style-type: none"> • DSRC or C-V2X : 5895 – 5905 MHz • C-V2X : 5905 – 5925 MHz

Comparison between EN 302 571 and Draft 47 CFR Parts 90M and 95L (2)

■ EN 302 571 vs. Draft 47 CFR Parts 90M and 95L –

	EN 302 571	Draft 47 CFR Parts 90M and 95L
Maximum Output Power	33 dBm (EIRP), does not distinguish between RSU & OBU	<u>RSU</u> (for DSRC & C-V2X) <ul style="list-style-type: none"> • 20 dBm (conducted) • 33 dBm (EIRP) <u>OBU</u> <ul style="list-style-type: none"> • 1.0 mW (conducted), for DSRC • 20 dBm (conducted), for C-V2X • 23 dBm (EIRP), for C-V2X
Channel Bandwidth	10 MHz	<ul style="list-style-type: none"> • DSRC : 10 MHz • C-V2X : 10 MHz or 20 MHz

LTE-Based C-V2X Trials in Hong Kong

Trial Location	Hong Kong Science Park ^[6]	Hong Kong International Airport	Shatin District
Key participants	<ul style="list-style-type: none"> • A local mobile network operator • ASTRI 	<ul style="list-style-type: none"> • A local mobile network operator • Hong Kong Airport Authority • ASTRI 	<ul style="list-style-type: none"> • Transport Department (“TD”) • ASTRI
Frequency band	5850 - 5860 MHz	5905 - 5925 MHz	5905 - 5925 MHz
Trial period	June 2017	2 nd half of 2019	2021
Status	Completed	Completed	Installation in progress

[6] Report of the trial is available at https://www.ofca.gov.hk/filemanager/ofca/en/content_669/tr201804_01.pdf

Current Status

- DSRC has been introduced to the market for some two decades but there is no significant mass market deployment anywhere
- C-V2X has recently been gaining momentum as noticed from the development in the Mainland, Europe and the US
- For the time being, there is no known in-built OBU offered by motor traders or manufacturers for the mass market
- ITS trial by TD in Shatin district to be conducted in 2021

Way Forward

- The Office of the Communications Authority (“OFCA”) will continue to liaise with TD with a view to facilitating its plan for the introduction of ITS into Hong Kong. In this regard,
 - ▶ The CA has decided to allocate the 5.9 GHz band to mobile service on a primary basis to enable the development of ITS in Hong Kong
 - ▶ OFCA will liaise with motor traders and monitor for the development of OBU with a view to timely proposing the applicable ITS standards to be adopted in Hong Kong
 - ▶ After TD completes its trial in 2021 and the picture for introducing ITS into Hong Kong becomes clear, OFCA will make a recommendation to the CA on the licensing regime for RSU and OBU in due course

Views/Comments Sought

- Members and stakeholders including TD and motor traders are invited to offer views/comments on the relevant matters



Acronym List

3GPP	Third Generation Partnership Project
ASTRI	Hong Kong Applied Science and Technology Research Institute Company Limited
C-V2X	Cellular Vehicle-to-Everything
CFR	Code of Federal Regulations
DSRC	Dedicated Short Range Communications
eNB	E-UTRAN Node B / Evolved Node B
EU	European Union
FCC	Federal Communications Commission
IEEE	Institute of Electrical and Electronics Engineers

ITS	Intelligent Transport Systems
LTE	Long Term Evolution
NR	New Radio
OBU	On-board Unit
RSU	Roadside Unit
TD	Transport Department
UE	User Equipment
V2I	Vehicle-to-Infrastructure
V2N	Vehicle-to-Network
V2P	Vehicle-to-Pedestrian
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Everything

Thank You

