



Progress with C-V2X Deployment in India

Dr. Punit Rathod

Qualcomm India Private Limited

WWRF Huddle 2025, September 24, 2025





Agenda

Introduction and Problem Statement

Spectrum and Regulatory
Environment

Standards and Use Cases Going
Forward

Problem Statement



Approximately 1.19M traffic fatalities globally each year

- Leading cause of death for children and young adults aged 5-29 years
- 2/3 are people of working age
- 90% are in low- and middle-income countries
- >50% are vulnerable road users (VRUs)



Global: [World Health Organization Road Traffic Injuries](#)

U.S.: [NHTSA Releases 2022 Traffic Deaths, 2023 Early Estimates](#)

EU: [Preventing road traffic injuries \(who.int\)](#)

India: [road-safety-2023-ind.pdf \(who.int\)](#); [RA Draft.cdr \(morth.gov.in\)](#)

Japan: <https://www.itf-oecd.org/sites/default/files/japan-road-safety.pdf>

China: https://cdn.who.int/media/docs/default-source/country-profiles/road-safety/road-safety-2023-chn.pdf?sfvrsn=eaf5f8fe_3Cdownload=true; [Road traffic mortality in China: analysis of national surveillance data from 2006 to 2016 - The Lancet Public Health](#)

Official Crash Fatality Statistics for India

[RA Draft.cdr \(morth.gov.in\)](https://morth.gov.in) (2023)

- 170,000 road deaths reported per year, and 440,000 injuries reported

Table 4.5: Persons killed in Accidents Classified by the type of impacting vehicles (Crime Vehicles by Victim vehicles) in 2022

Crime Vehicle Victim/Victim Vehicle	1. Bicycles	2. Two Wheelers	3. Auto Rickshaws	4. Cars, Taxis, Vans & LMV	5. Trucks /Lorries	6. Buses	7. Other Non-motorized vehicle (E-rickshaw etc.)	8. Others	9. Total
Pedestrian	81	9,316	1,220	8,030	4,875	2,057	252	6,994	32,825
% Share in total	7.6	19.7	18.6	19.6	14.7	18.8	11.2	26.5	19.5
Bicycles	84	1,248	282	1,138	1,052	349	90	593	4,836
% Share in total	7.9	2.6	4.3	2.8	3.2	3.2	4.0	2.2	2.9
Two-wheelers	281	27,615	2,213	17,020	13,146	4,012	594	10,016	74,897
% Share in total	26.5	58.5	33.7	41.6	39.7	36.6	26.4	37.9	44.5
Auto-Rickshaws	94	656	1,259	1,680	1,492	461	106	848	6,596
% Share in total	8.9	1.4	19.2	4.1	4.5	4.2	4.7	3.2	3.9
Cars, Taxis, Vans & LMVs	173	2,320	484	8,941	5,022	1,561	268	2,271	21,040
% Share in total	16.3	4.9	7.4	21.8	15.2	14.3	11.9	8.6	12.5
Trucks/Lorries	139	1,891	284	1,353	4,943	744	210	1,020	10,584
% Share in total	13.1	4.0	4.3	3.3	14.9	6.8	9.3	3.9	6.3
Buses	73	673	180	407	1,030	1,030	165	446	4,004
% Share in total	6.9	1.4	2.7	1.0	3.1	9.4	7.3	1.7	2.4
Other Non- Motor Vehicles (including e-rickshaw)	42	495	135	561	373	199	226	341	2,372
% Share in total	4.0	1.0	2.1	1.4	1.1	1.8	10.1	1.3	1.4
Others (other motor vehicles, Animals drawn vehicle, cycle rickshaws, hand carts, & other persons)	94	2,957	512	1,804	1,203	541	337	3,889	11,337
% Share in total	8.9	6.3	7.8	4.4	3.6	4.9	15.0	14.7	6.7
Total	1,061	47,171	6,569	40,934	33,136	10,954	2,248	26,418	1,68,491

Deeper Dive into India Crash Statistics

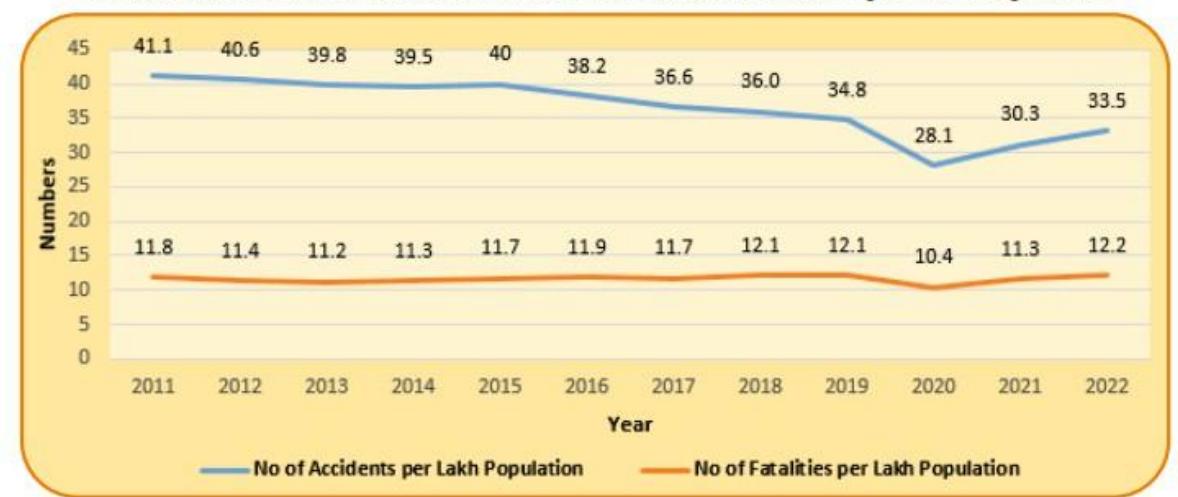
[RA Draft.cdr \(morth.gov.in\)](https://ra.morth.gov.in/) (2023)

- 45% of victims killed were travelling on a power two-wheeler (e.g. motorcycle)
 - Impacting vehicles are PTWs (37%), cars and vans (23%) and lorries (18%)
- 67% of victims are between 18-45 years old
- 6% are under 18

Table 1.7 (a): Decadal trends of Road Accidents, Registered Vehicles and Road Length in India (1970-2020)

Year	Road Accidents ('000)	Road Accident Deaths ('000)	Road Accident Injuries ('000)	Registered Vehicles ('000)	Road Length (000 km)	death rate (no. of accident deaths per 10,000 vehicles)	Vehicle density (no. of vehicles per km of road)
1970	114	15	70	1401	915 [@]	103.5	1.54
1980	153	24	109	4,521	1,485 [#]	53.1	3.04
1990	283	54	244	19,152	1,983	28.2	9.65
2000	391	79	399	48,857	3,316	16.2	14.73
2010	500	135	528	1,27,746	4,582	10.5	27.87

Chart 1.10A: Trend in the number of Accidents and Fatalities per lakh Population

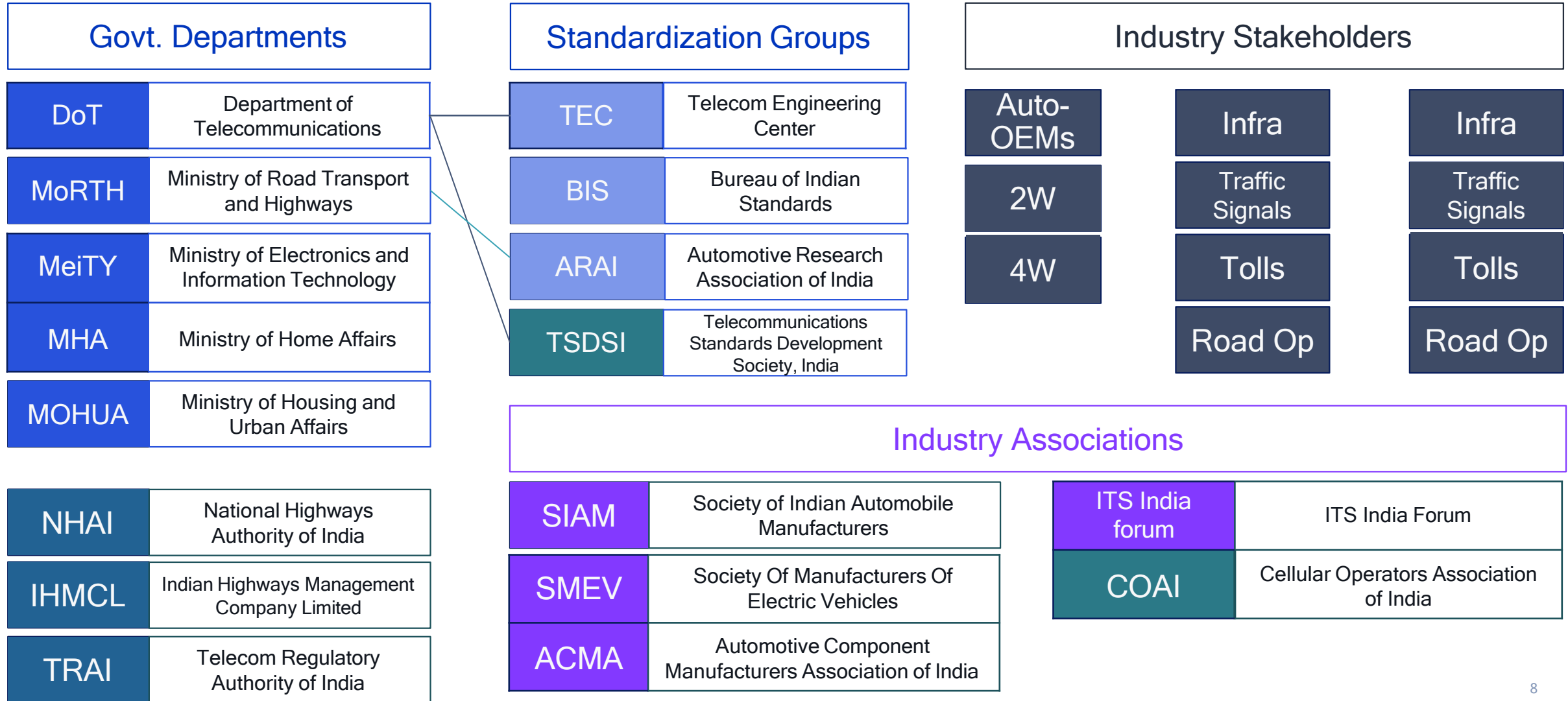


Spectrum and Regulatory Environment



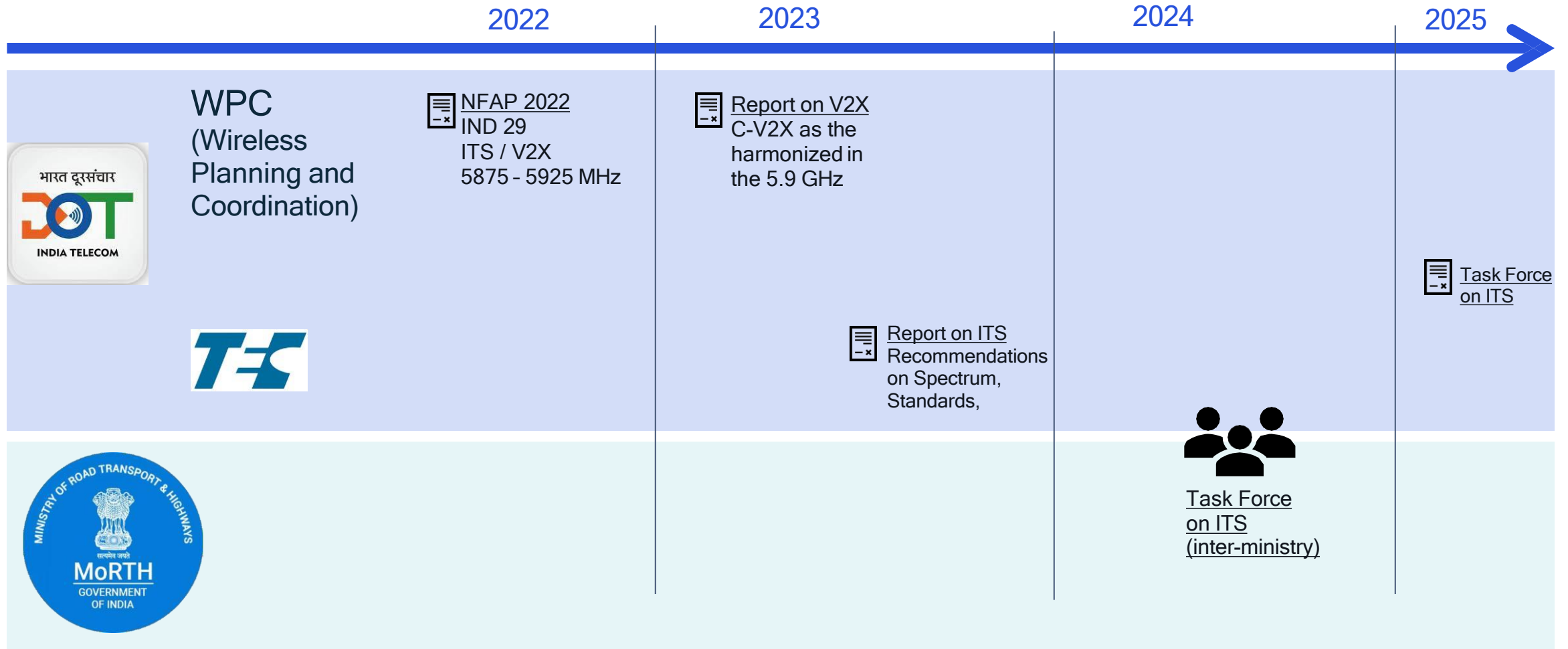
India Automotive Stakeholder Map

Not-exhaustive



India C-V2X Progress

Journey so far within different departments and committees



TEC Report (TEC 31218:2003) on “The Technologies and standards for Intelligent Transport Systems”

Recommendations

1. Spectrum related aspects:

- Recommends developing spectrum rules / gazette notifications in 5 875-5 925 MHz
- Follow global best-practices e.g., licensed-exempt spectrum

7.2 Standards related aspects:

- Develop TEC Specifications related to testing and certification for OBU and RSU.
- Adopt 3GPP C-V2X for harmonized ecosystem
- For non-access layer need to converge on common ITS stack (e.g., ETSI).

7.3 General recommendations to enable implementation of V2X:

- Inter-ministerial coordination required
- Consider V2X communication in Bharat NCAP

7.4 Recommendations related to security implementation in V2X

- Recommends the following for cybersecurity and functional safety: ISO/SAE 21434 and UN Regulation no. 155 (R155)
- Need for PKI to authenticate the source of messages and ensure trustworthiness between communication parties.



India spectrum rules (under consideration)

Following 3GPP C-V2X specifications

- Transmit Power

Device type	Maximum conducted Output Power	Maximum Effective Radiated Power Limits
OBU		4W (36 dBm)
RSU	200mW (23 dBm) in spread of 20 MHz or higher	4W (36 dBm)

- Out-of-band Emission

Offset frequency from the end of the occupied frequency bandwidth	Reference value (average power)	Resolution bandwidth
$\pm 0\text{-}1$ MHz	-16 dBm	100 kHz
$\pm 1\text{-}5$ MHz	-13 dBm	1 MHz
$\pm 5\text{-}30$ MHz	-16 dBm	1 MHz
± 30 MHz and beyond	-28 dBm	1 MHz

Standards and Use Cases Going Forward



Choice Between Two Stacks

Need for one pan-India Stack - For C-V2X to be effective, all participants need to talk a common language (OEMs and roadside)

ETSI TC ITS Stack

- Message set defined by ETSI Common Dictionary (TS 103 894-2)
- Security Services (TS 103 097) is a profile of IEEE 1609.2 family
- PKI – Root of trust: Certificate Trust List (CTL) based on single signer. More vulnerable to compromise; signer rollover is inherently fragile and creates risk of lockout
- 10 MHz (Release 1) vs 20 MHz (Release 2)
 - 10 and 20 MHz not interoperable
 - 10 MHz limits message traffic
- Interoperability conformance assessment: Results from handful of plugtests

SAE/IEEE WAVE Stack

- Different Message set defined by V2X Communications Message Set Dictionary
- Nearly equivalent with ETSI
- PKI – Root of trust: CTL has multiple signers and quorum of valid signature. Robust against malicious compromise or with old certificates in the field
- 20 + 10 MHz
 - V2V: SAE J3161/1 On-Board System Requirements for LTE-V2X V2V Safety Communications
 - V2I: SAE J3161 LTE Vehicle-to-Everything (LTE-V2X) Deployment Profiles and Radio Parameters for Single Radio Channel Multi-Service Coexistence
 - Additional 10 MHz: SAE J3161/2 LTE Vehicle-to-Everything (LTE-V2X) Deployment Profiles and Radio Parameters for PC5 Interface in 10 MHz Channel 180
- Interoperability conformance assessment: OmniAir Consortium has robust interoperability certificate program

Use Cases / Implementation Challenges

Bangalore Green Corridor Pilot

- 10-intersection corridor at 800+ meter spacing (with 4 RSU-equipped intersections)
 - 800+ meter spacing
 - Strong fading environment (sidelink and GNSS occlusions)
- Equipment
 - Danlaw OBU in Mahindra surrogate ambulance
 - Danlaw RSU / Arcadis/CDAC Traffic Signal Controller
- WAVE stack @ 20 MHz
- Applications
 - Emergency Vehicle Preemption
 - Red Light Violation Warning
- Practical considerations and issues
 - No RTK/RTMS: Lane level GNSS position difficult
 - NavIC (India GNSS constellation) is a resource
 - Poor C-V2X coverage for all approaches
 - Lack of standard RSU to traffic signal controller interfaces
 - No unified SCMS
 - No consensus on stack
- VRU problem statement difficult to address
 - Lack of cameras to deploy SDSM/Cooperative Perception

Thank you

Nothing in these materials is an offer to sell any of the components or devices referenced herein.

© Qualcomm Technologies, Inc. and/or its affiliated companies. All Rights Reserved.

Qualcomm and Snapdragon are trademarks or registered trademarks of Qualcomm Incorporated.
Other products and brand names may be trademarks or registered trademarks of their respective owners.

References in this presentation to “Qualcomm” may mean Qualcomm Incorporated, Qualcomm Technologies, Inc., and/or other subsidiaries or business units within the Qualcomm corporate structure, as applicable. Qualcomm Incorporated includes our licensing business, QTL, and the vast majority of our patent portfolio. Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated, operates, along with its subsidiaries, substantially all of our engineering, research and development functions, and substantially all of our products and services businesses, including our QCT semiconductor business.

Snapdragon and Qualcomm branded products are products of Qualcomm Technologies, Inc. and/or its subsidiaries. Qualcomm patented technologies are licensed by Qualcomm Incorporated.

Follow us on: [in](#) [X](#) [@](#) [v](#) [f](#)

For more information, visit us at [qualcomm.com](https://www.qualcomm.com) C [qualcomm.com/blog](https://www.qualcomm.com/blog)

