



Essentials to Beginning V2X at a Public Agency

An Automotive Industry
Partner Perspective

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Agenda

- Flavors of V2X
- Using V2X to address local or regional problems
- Standards, certification “Day 1” vs “Day 2”
- Aftermarket devices
- Step-by-step summary

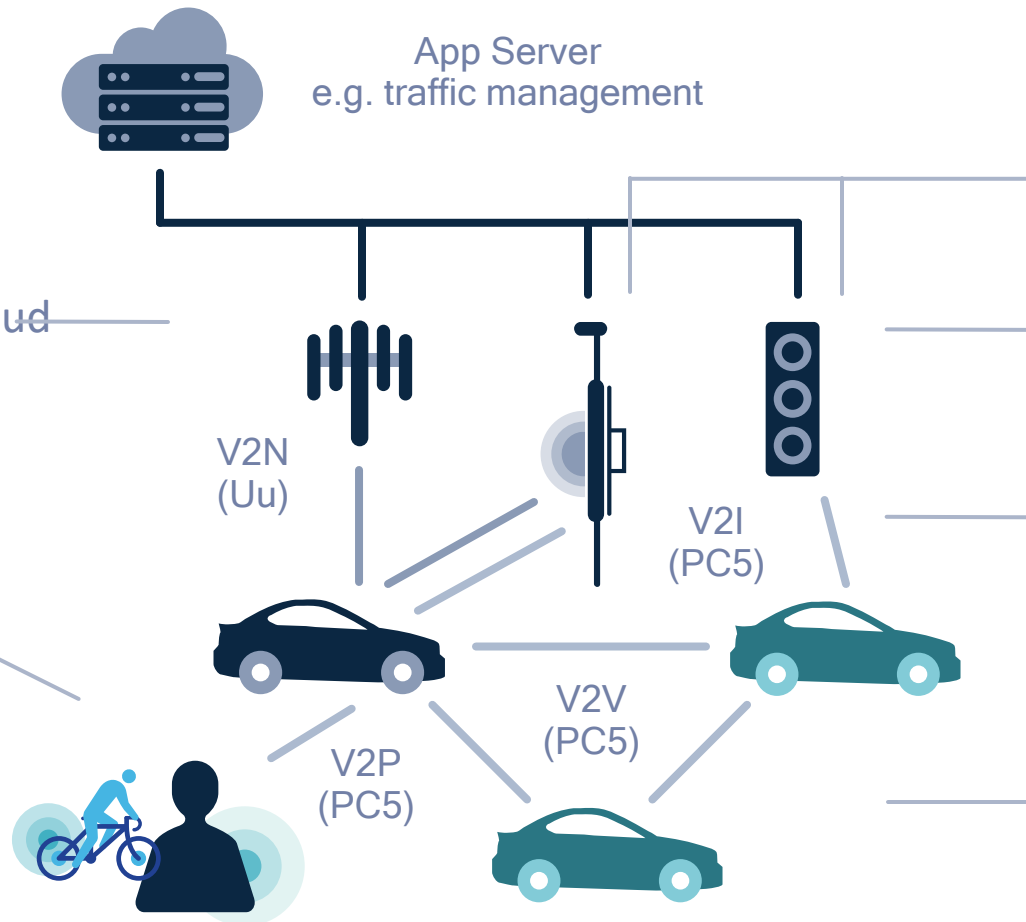
Advanced services further enabled by V2V+V2I+V2P+V2N

Most use cases use a combination of interfaces

V2N provides over-the-top cloud services

V2P enhances safety for vulnerable road-users

— Uu Interface
— PC5 Interface



RSUs combined with eNodeBs or standalone roadside devices

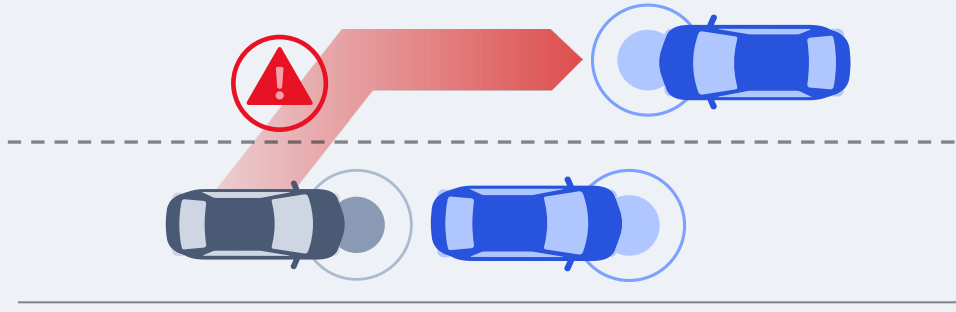
RSUs can connect to network for cloud services

V2I allows RSU¹s to monitor traffic, e.g. traffic signals, tolls

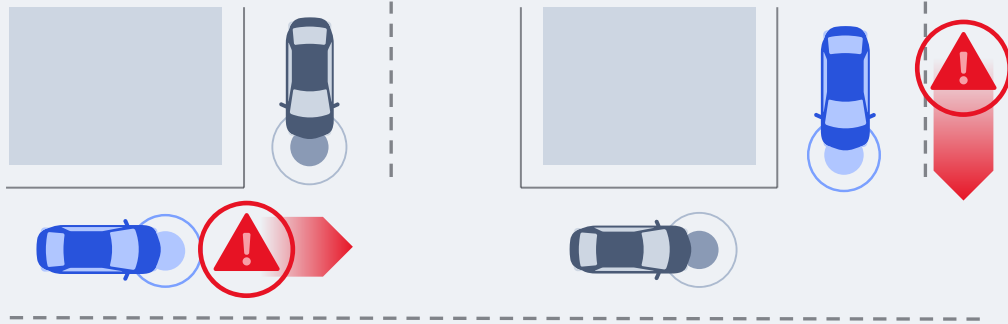
V2V mostly for safety and ADAS services

Vehicle-to-vehicle

Do not pass warning (DNPW)

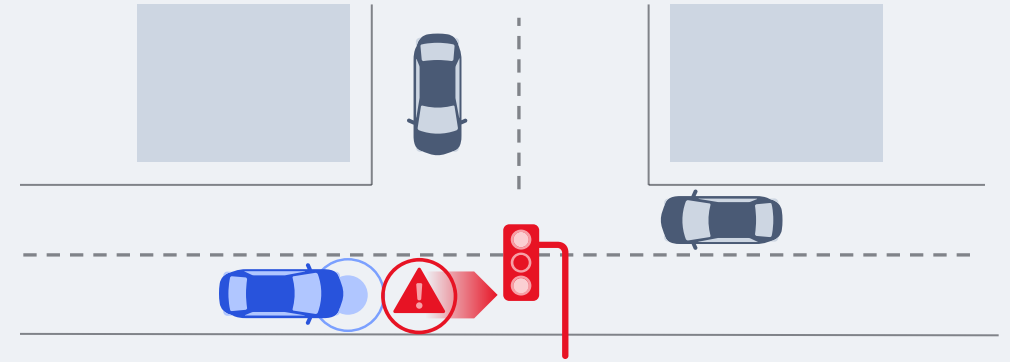


Intersection movement assist (IMA) at a blind intersection

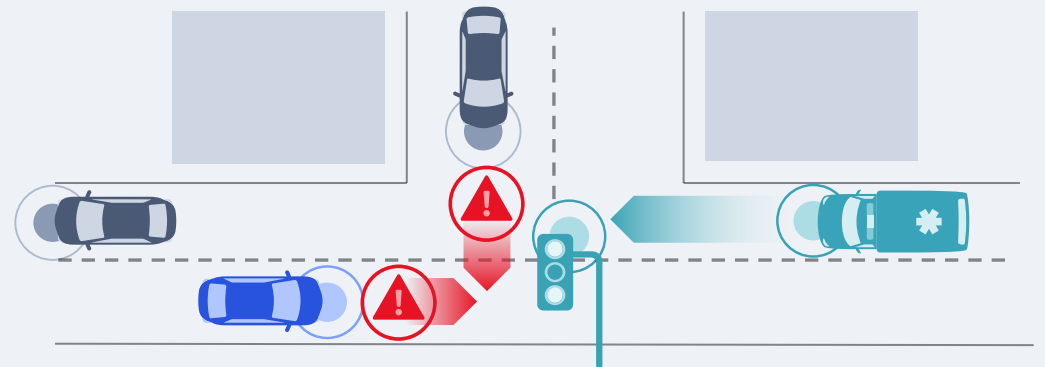


Vehicle-to-infrastructure

Red light violation warning (RLVW)

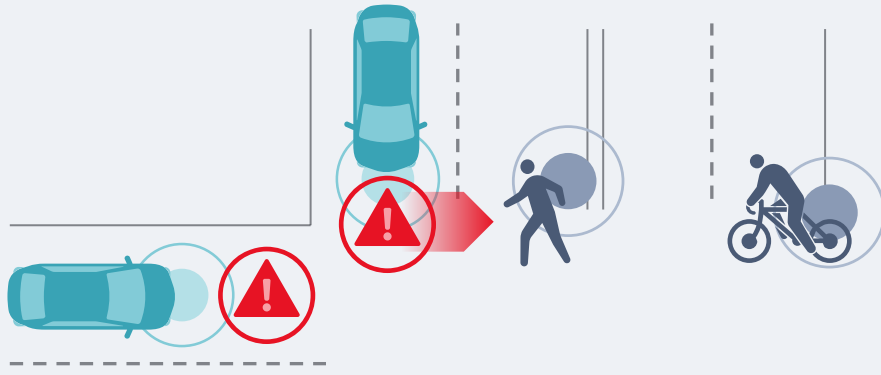


Emergency vehicle pre-emption

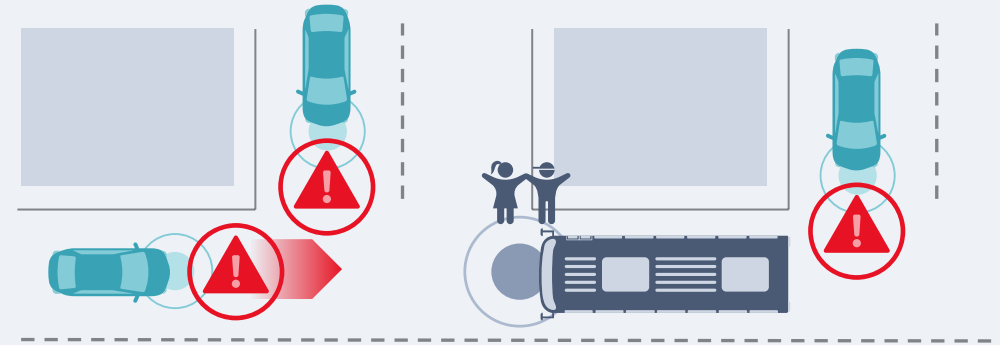


C-V2X use cases can significantly enhance safety

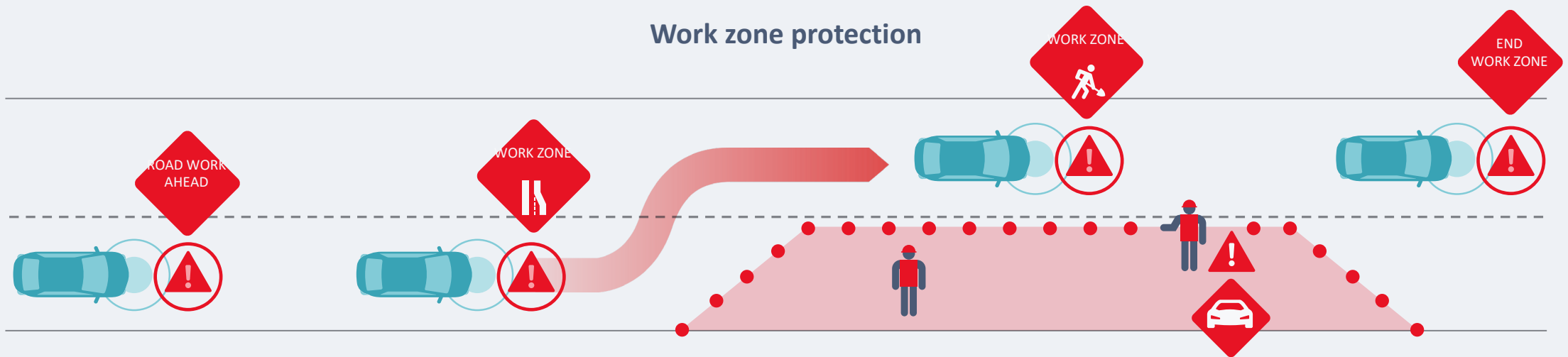
Vulnerable road user (VRU) alerts at a blind intersection



School zone protection



Work zone protection



C-V2X protects vulnerable road users

C-V2X technology is well defined by major industry and standards organizations



Standards covering
C-V2X radio layers



Industry body advocating
adoption of mobility
and transportation



Set of standards and deployment
profiles governing ITS
applications and deployments



Standards to support
interoperability among roadside
units (RSU)



NEMA TS 10 standard for agencies
procuring and deploying RSUs



Standard for wireless access in vehicular
environments (WAVE)
IEEE 1609.2 - security services
IEEE 1609.3 - networking services



C-V2X testing and certification



OmniAir provides 3rd party testing and certification through global network of test labs

Ensure certified devices conform to industry standards and meet minimal interoperability and performance requirements

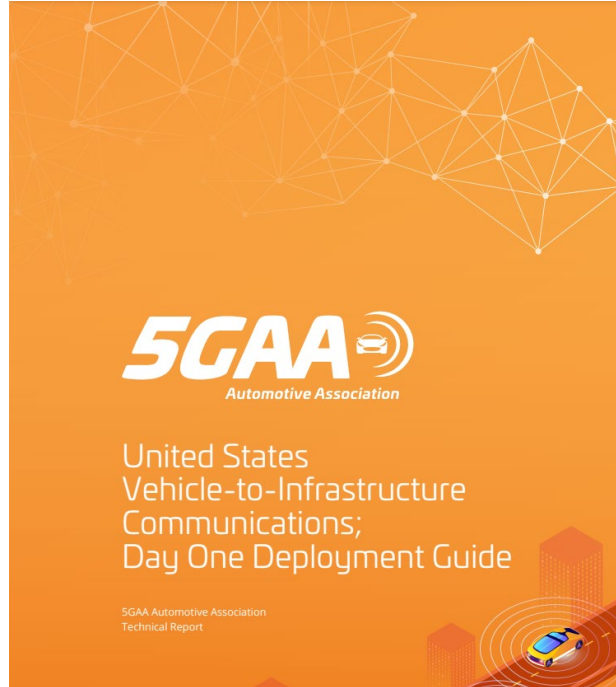
Services

V2X
application
testing

Device and module
certification for RSUs and
OBUs

Plugfest events
to promote
C-V2X readiness

5GAA U.S. V2I communications Day 1 Deployment Guide: Industry-Initiated Multi Stakeholder Profile to Simplify US Day 1 C-V2X PC5 at 5.9 GHz



<https://5gaa.org/content/uploads/2023/10/5gaa-wi-usdploy-231667-technical-report-guidance-day-1.pdf>

Motivation and Goals

Initial Motivation: Automotive OEMs and their suppliers observe that V2I services and messages are not uniform. Guidebook conceived within 5GAA to be a specification for hospitable infrastructure to be interoperable with OEM definition of Day One at 5.9 GHz.

Transformed Motivation: After productive dialog with IOOs and other associations, definition included additional Day One messages, still promoting certainty and interoperability.

Goal: Profile for uniform V2X roadside unit deployment in a concise and accessible format to include:

- Pointers to existing and anticipated references and standardization efforts
- Definition of limited, but important, set of existing messages, minimum performance requirements, and certification (and SCMS) criteria that must be supported for expedited Day One deployments
- Profile of SAE J3161 rules so that OEMs and IOO have a common understanding on optimal use one 20 MHz C-V2X radio in Channel 183

What is Day One? Three (Interoperable) Perspectives

IOO: Limited Use Fleet Vehicle (*LUFV*) – These messages are expected to be supported by vehicles that are within the purview or authority of individual IOO agencies as opposed to mass produced passenger vehicles. The messages in this category necessarily include all MUPV messages.

OEM: Mass Use Production Vehicle (*MUPV*) – These messages are expected to be supported broadly across automotive OEM passenger vehicles. Given this, it is anticipated that a broad set of IOOs across the country will likewise provide support for these messages.

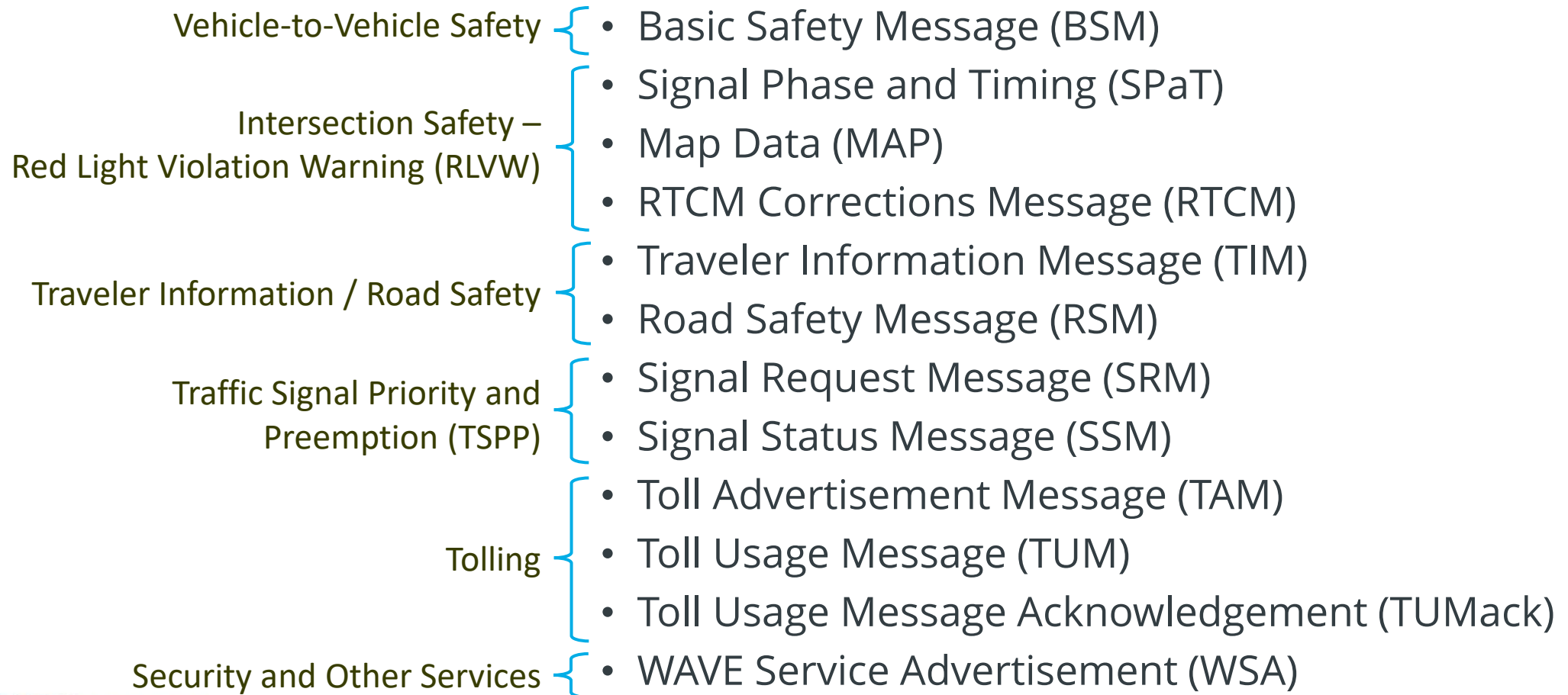
Special (e.g., Managed Lane, Tolling) Facility / IOO Collaborator: Limited Use Mixed Vehicle (*LUMV*) – These messages are likely to happen on day one or shortly thereafter but under bounded circumstances and potentially supported by only a subset of automotive OEM or IOO agency vehicles.

Day One *LUFV* (IOO) message support might occur before Day One *MUPV* (OEM) message support

It is essential for Day One MUPV messages to be broadcast in accordance with the guidebook to establish an interoperable V2I ecosystem that warrants automotive OEM and customer investment in C-V2X PC5 deployments.

Day One Messages

- For Day One, 12 messages have been identified, some of which are intended to be deployed or supported as a set:



ASD: Definitions and Attributes (SAE J3315 Work in Progress)



Ultralight

100 I2V use cases for early Day 1
(mainly at intersections)

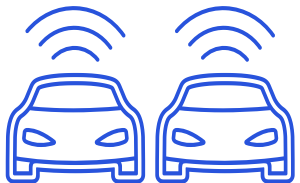
- Range: ~ 4 sec TTI
- Position accuracy: road level
- Timeline: “as soon as possible”



Light

For most pre-emption and priority use cases

- Range: ~ 4 sec TTI
- Position accuracy: lane level
- Timeline: “as soon as possible”



Full

V2V interacting with OEM factory fit
vehicles

- Longer timeline



C-V2X OBU easily installable in most vehicles



Can alert through another device
(e.g., smartphone)



Low cost for emerging mass market



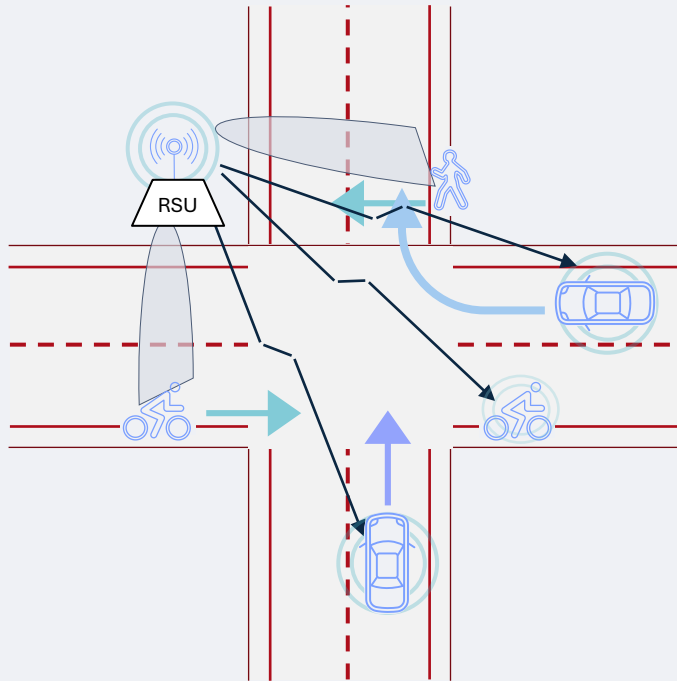
No vehicle-bus integration required



Variations of device flavors for different use
cases (e.g., internal vs. external GNSS
antennas for positioning)

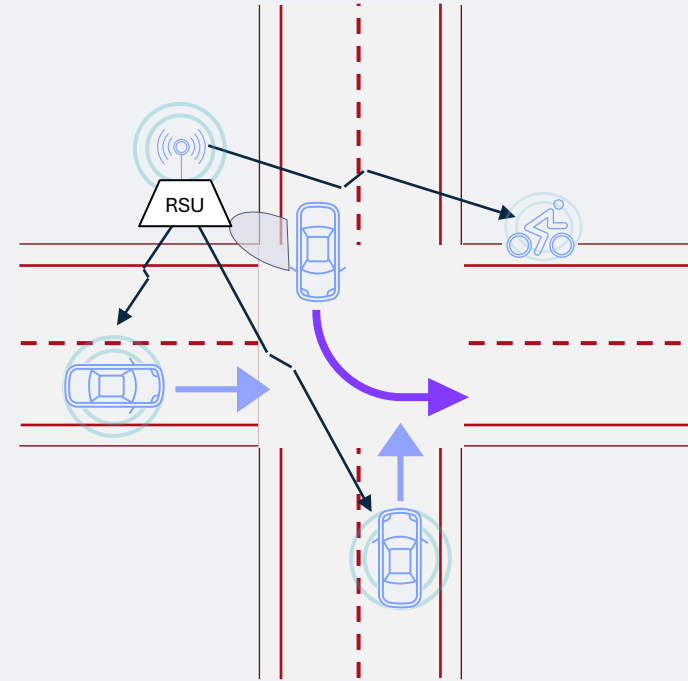
Illustration of sharing infrastructure-sensed objects at or near intersections

VRU Case



Detect non-connected VRUs
Disseminate to connected road
users

Low Market Penetration Case



Detect non-connected vehicles
Disseminate to connected road
users

RSU Sensor Data Sharing



Step-by-Step Summary

Advice from a C-V2X Technology Partner

1. Define the problem statement(s)
2. Work with experts. Hire them, contract them. There are many out there.
3. Along with your experts, open your (finite) toolbox and select the right tool. For V2X, choose direct, network or a combination.
4. For 5.9 GHz C-V2X Direct, ensure that:
 - ...applications and messages are interoperable. You will need standardized messages that work for OEMs (5GAA is a start. OmniAir is essential. Connect the West and fledgling SCMS Manager are working with OmniAir and vehicle OEMs and to take it across the finish line.)
 - ...messages always come with certificates and security services.
 - ... interoperability and performance are written into your contracts and program plan
5. Along with your experts, open your (finite) toolbox and select the right tool. For V2X, choose direct, network or a combination.
6. Plan OBU solutions, and remember, it starts with aftermarket devices on public and/or commercial fleets

Thank you

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