Moving Together Towards a Mass DSRC Deployment

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Outline

- What is DSRC?
- What can it do?
- Deployment Status
- Challenges & Opportunities
- Toyota’s vision on DSRC

Dedicated Short Range Communication

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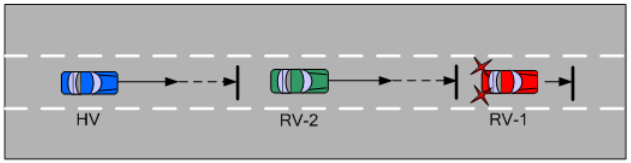
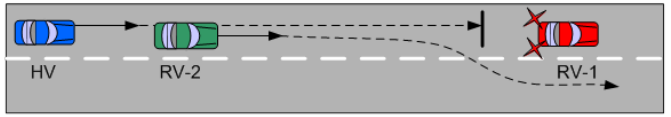
DSRC, a proven, stable and mature technology, helps transform the transportation system

Example V2V Applications

- Different manufacturers
- Communicating on the same channel
- Exchanging standard Basic Safety Messages
- Enables multiple V2V safety applications

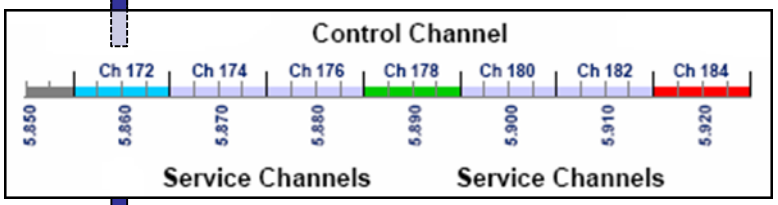


Emergency Electronic Brake Lights (EEBL)

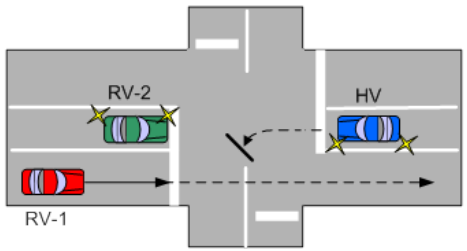


Forward Collision Warning (FCW)

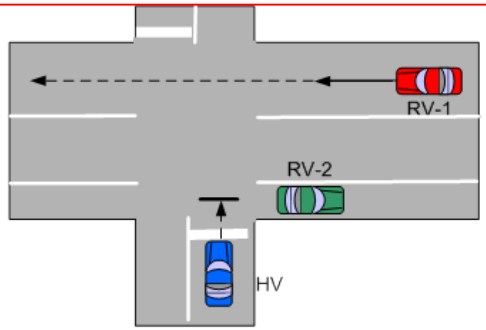
Item
Time
3D Position
Position Accuracy
Speed
Heading
Steering Wheel Angle
Acceleration
Brake Status
Vehicle Size
Event Flags
Path History
Path Prediction
Other optional fields



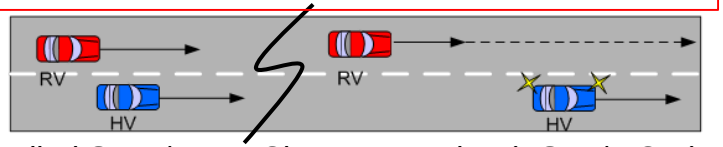
Radar/Camera unlikely to address these two scenarios



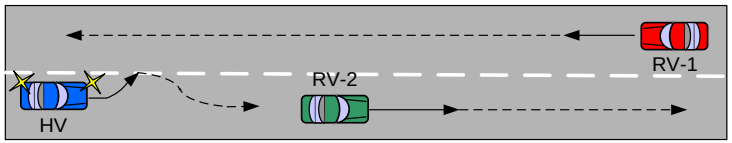
Left Turn Assist (LTA)



Intersection Movement Assist (IMA)



Blind Spot / Lane Change Warning (BSW / LCW)



Do Not Pass Warning (DNPW)

Example V2I Applications

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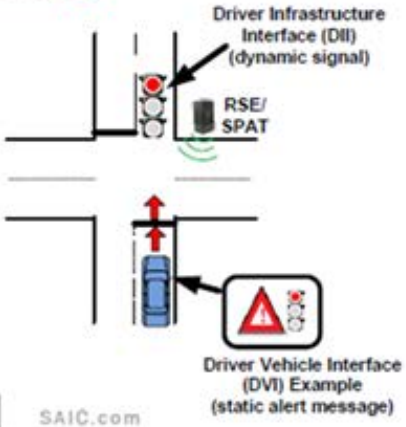
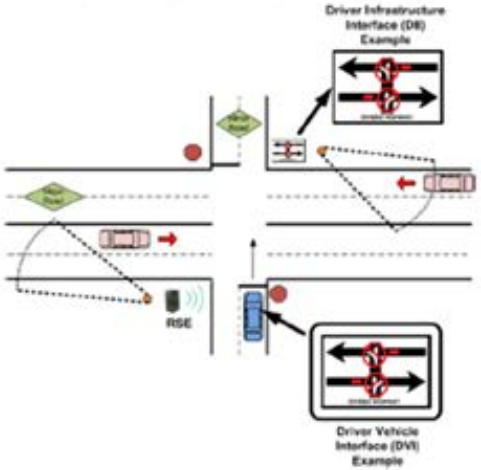
Curve Speed Warning

Smart Roadside

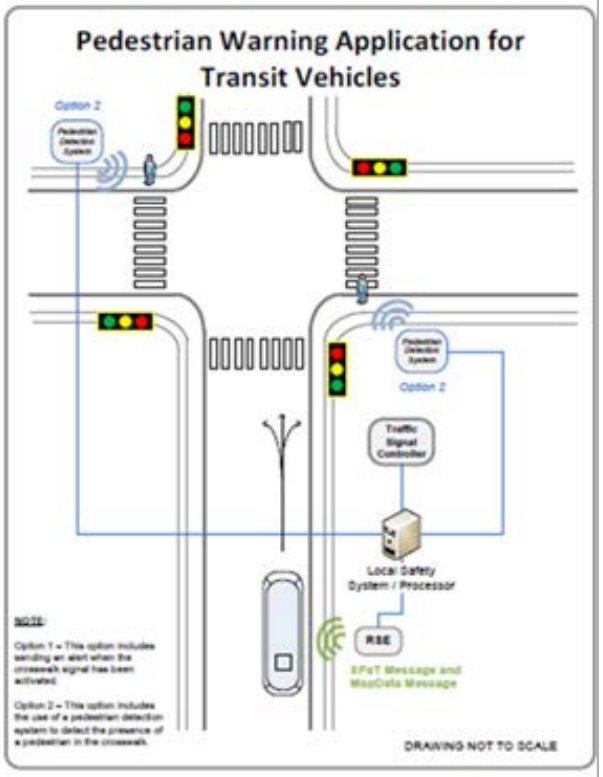
Red Light Violation Warning



Stop Sign Gap Assist



Pedestrian Warning Application for Transit Vehicles



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Source: 2013 Team Fair of TEAM STL

Channel Usage Plan

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US DSRC Spectrum

Seven 10-MHz Channels

5.850 GHz ← → 5.925 GHz

Reserved 5MHz	CH 172 Service (safety only)	CH 174 Safety & Service	CH 176 Safety & Service	CH 178 Control	CH 180 Safety & Service	CH 182 Safety & Service	CH 184 Service (safety only)

Every channel used for safety apps

Ch. 172	BSM safety and small set of V2I safety apps
Ch. 174	I→V safety and mobility, to avoid cross-channel interference to Ch. 172
Ch. 176	VRU safety (PSM) D→V, and download from SCMS (I→V)
Ch. 178	Control channel: WSAs, and low-bandwidth safety (I→V)
Ch. 180	Non-BSM V2V safety (e.g. C-ACC, sensor sharing), and mobility (I→V)
Ch. 182	I→V safety and mobility
Ch. 184	FCC designation for public safety. Ex: Preemption, Emergency Alert

Interleaved V2V and V2I limits interference

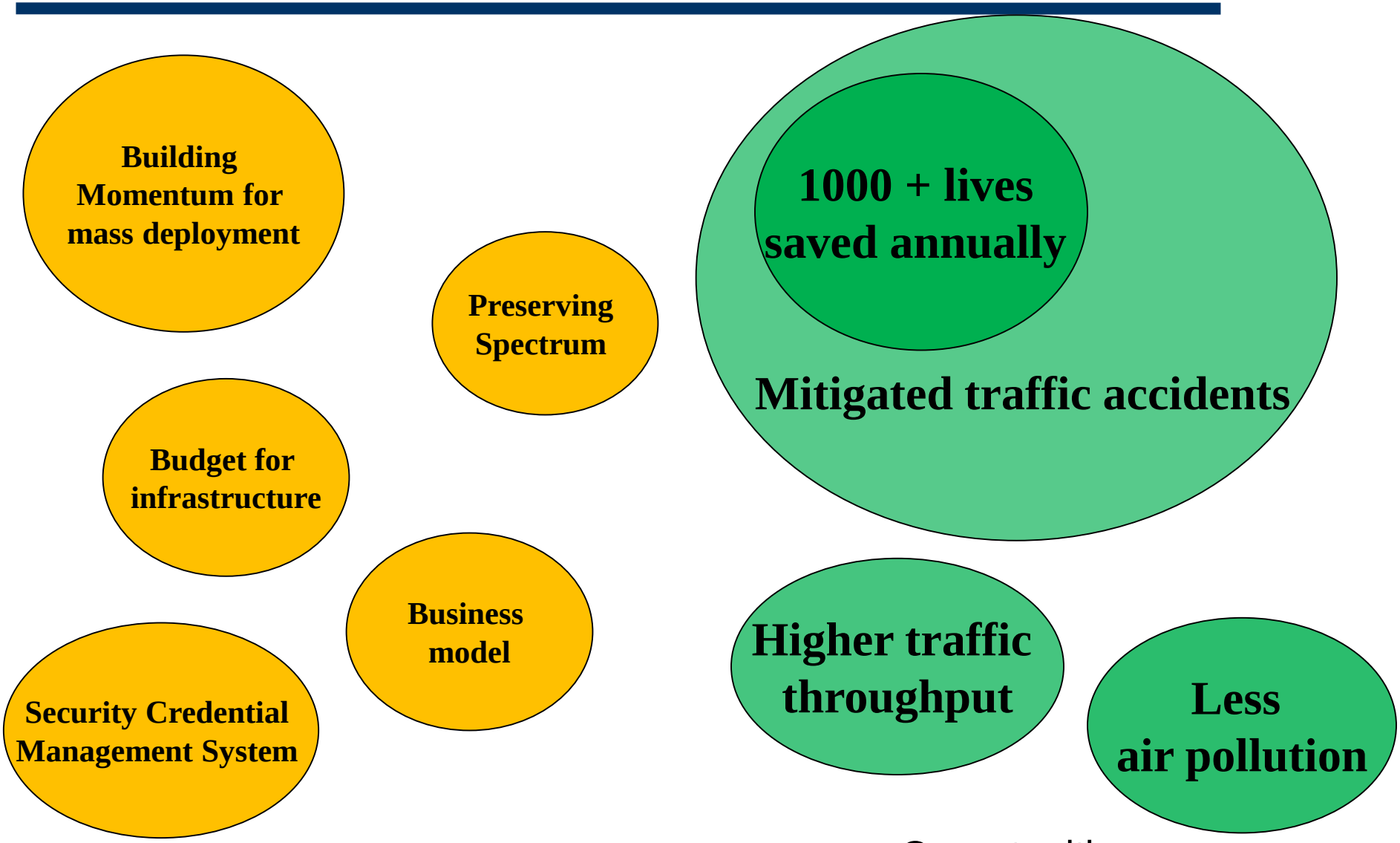
BSM = Basic Safety Message VRU = Vulnerable Road User PSM = Personal Safety Message
WSA = WAVE Service Advertisement C-ACC = Cooperative Adaptive Cruise Control
SCMS: Security Confidential Management System

***SAE J2945/0**

DSRC Deployment

- Toyota and Lexus
  - Japan: started 2015, more than100,000 cars equipped
  - US: starting 2021, across most of its lineup by mid-2020s
- GM
  - US: started March 2017 with Cadillac CTS
  - Recently announced: High volume Cadillac models by 2023
- VW announced deployment in EU starting 2019
  - Entire VW group (VW, Audi, …)
  - EU Car2Car Communications Consortium, representing 16 automakers, sets broad deployment target for 2019
- Government-industry collaboration propels numerous deployment projects
  - CV Pilot Deployments, Smart City, Pool Fund Study, SPaT Challenge etc.

Challenges and Opportunities



Our Commitment to DSRC

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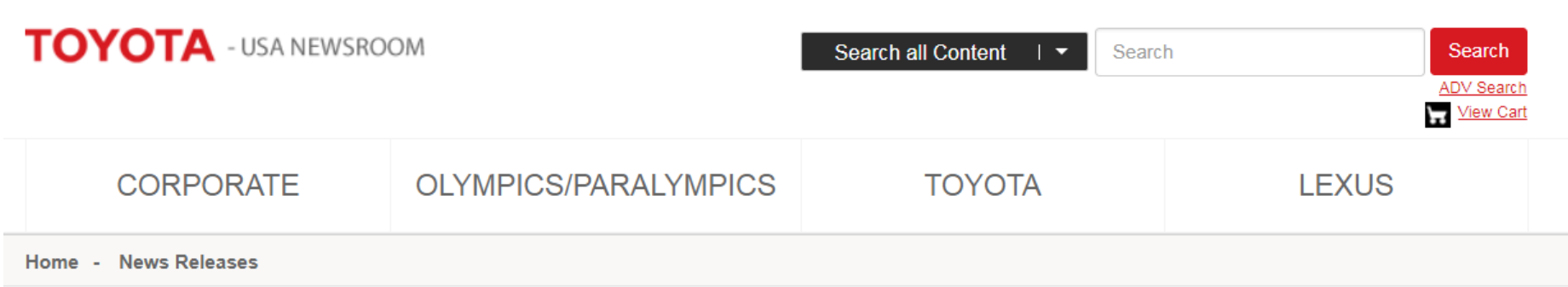

- ✓ Most of the lineups will be equipped by mid-2020s
- ✓ Increased road safety and efficiency
- ✓ Accelerates adoption of V2X capability
- ✓ Encourage all automakers to adopt 5.9GHz DSRC

Toyota's Experience in Japan

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V2I
Vehicle-to-Infrastructure Communication

Right-turn Collision Caution

Alerts the driver to potentially unseen oncoming vehicles and pedestrians to prevent collisions.

* This system is equivalent to "Left-turn Assist" in countries that drive on the right.

Red Light Caution

Notifies the driver of the signal ahead to avoid running a red light.

Signal Change Advisory

Provides a signal change timer to help smooth starting.

V2V
Vehicle-to-Vehicle Communication

Communicating Radar Cruise Control

Integrates Radar Cruise Control and V2V information from the vehicle ahead to help follow it smoothly.

Emergency Vehicle Notification

Informs the driver of the emergency vehicle nearby to aid swift location.

Crossing Collision Prevention

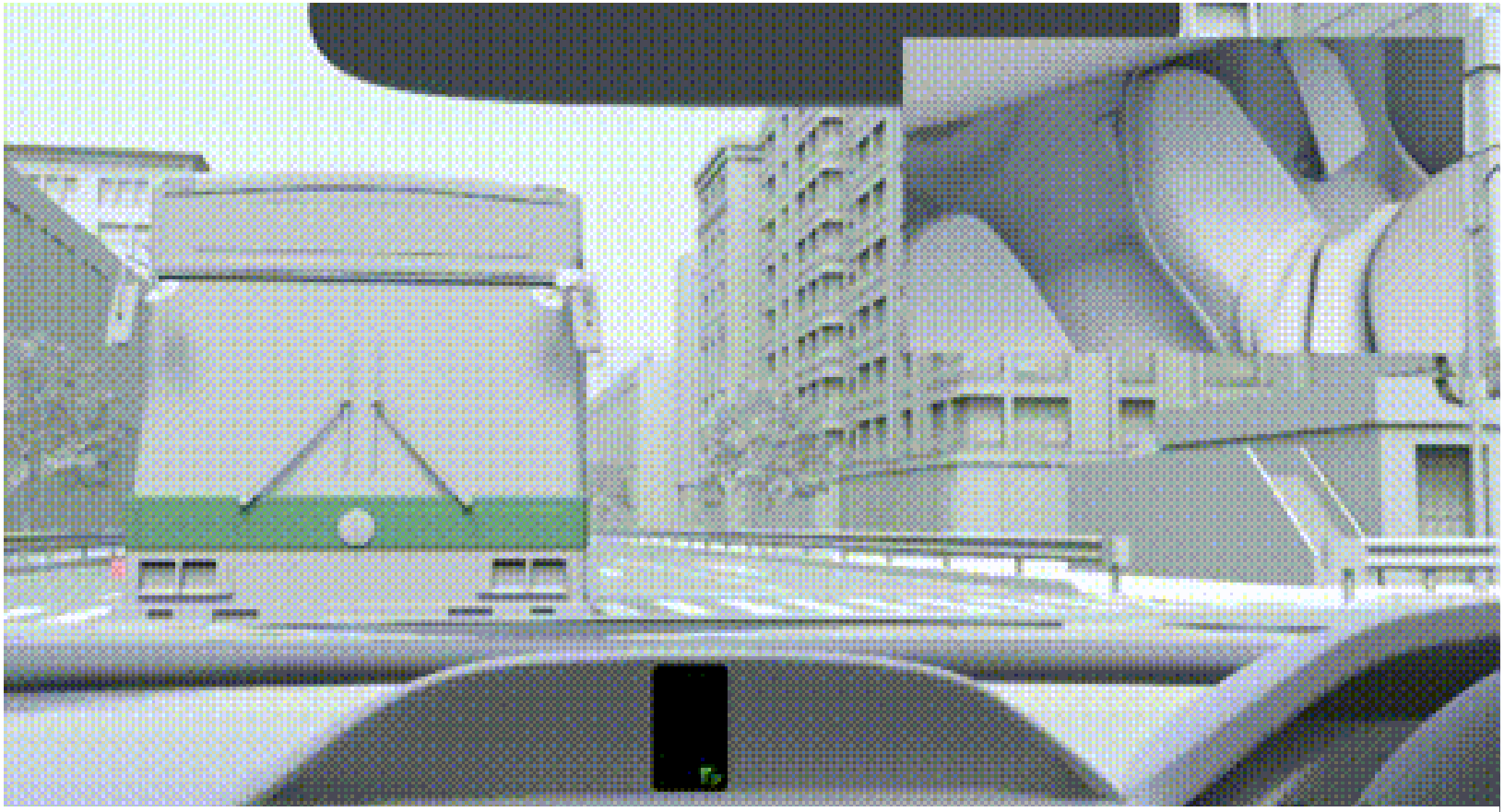
Alerts the driver to potentially unseen intersecting vehicles from the left or right to prevent collisions.

* Available on LS only

Right Turn Collision Caution (in Japan)

Equivalent to left turn assist in US

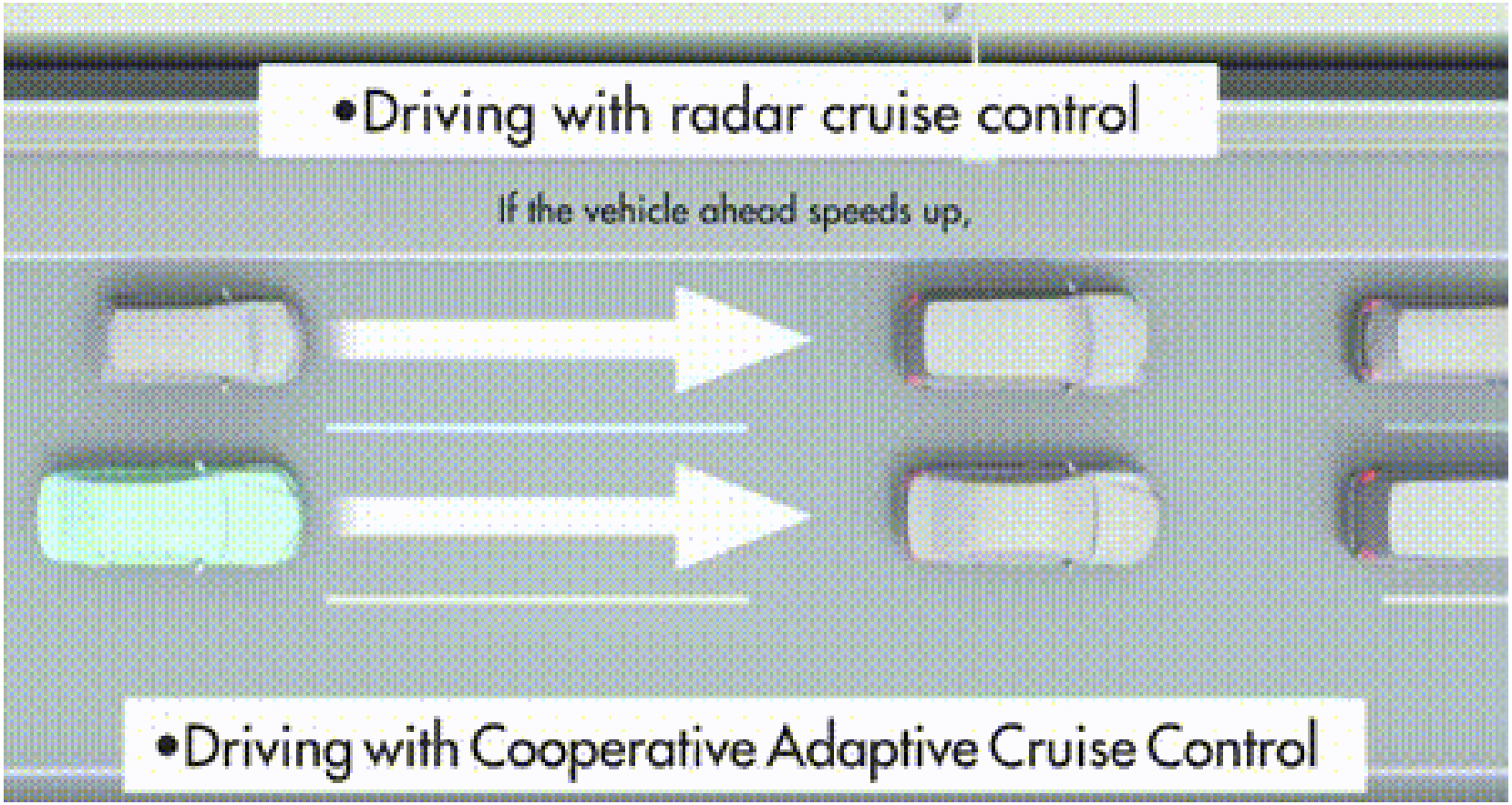
Driver's view inside the vehicle



Animation for illustration purpose only, Actual design may differ

From Alerts to Automation

- V2X provides warnings to drivers, and in the future will be used for higher levels of automation



More automated driving systems…

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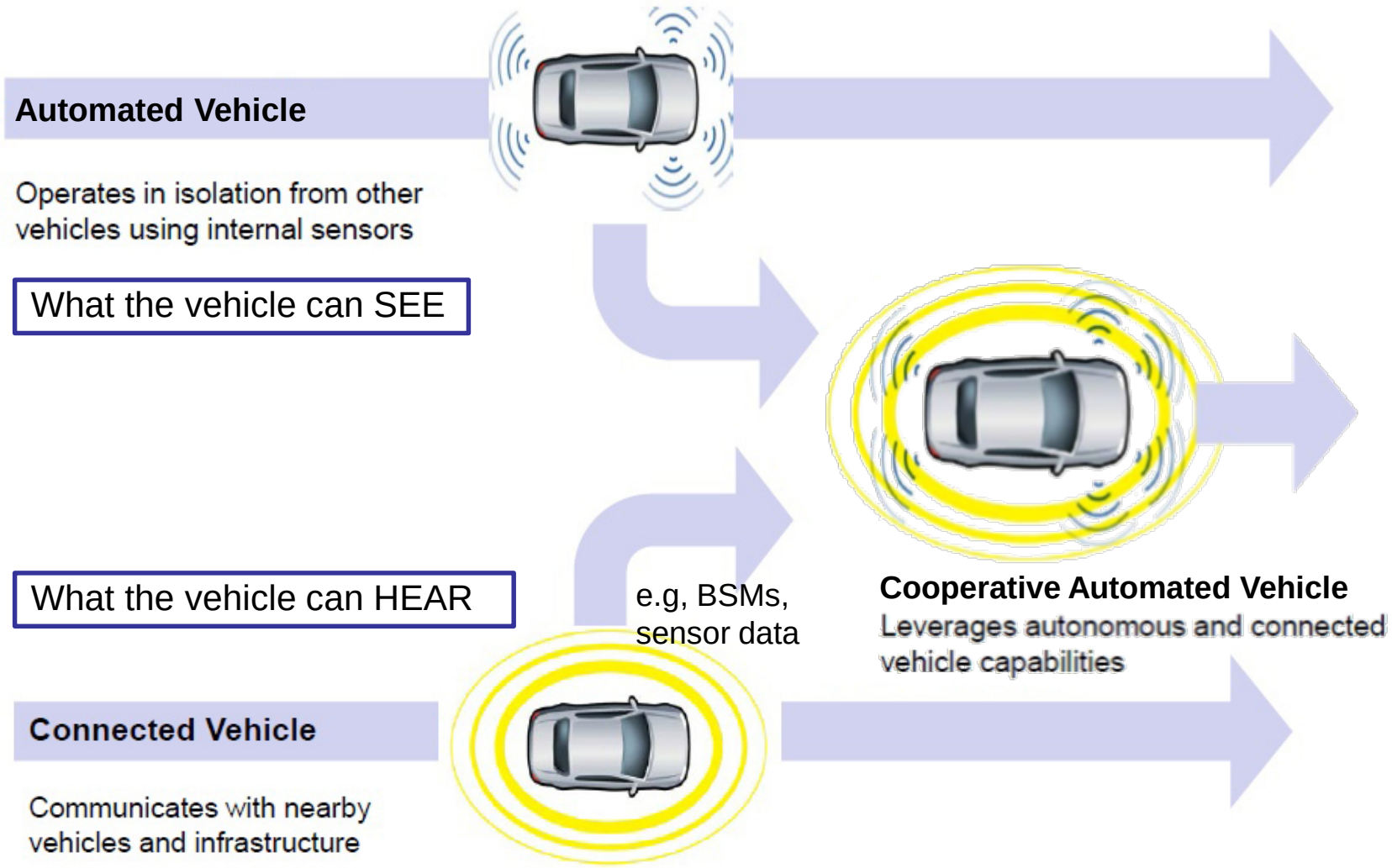
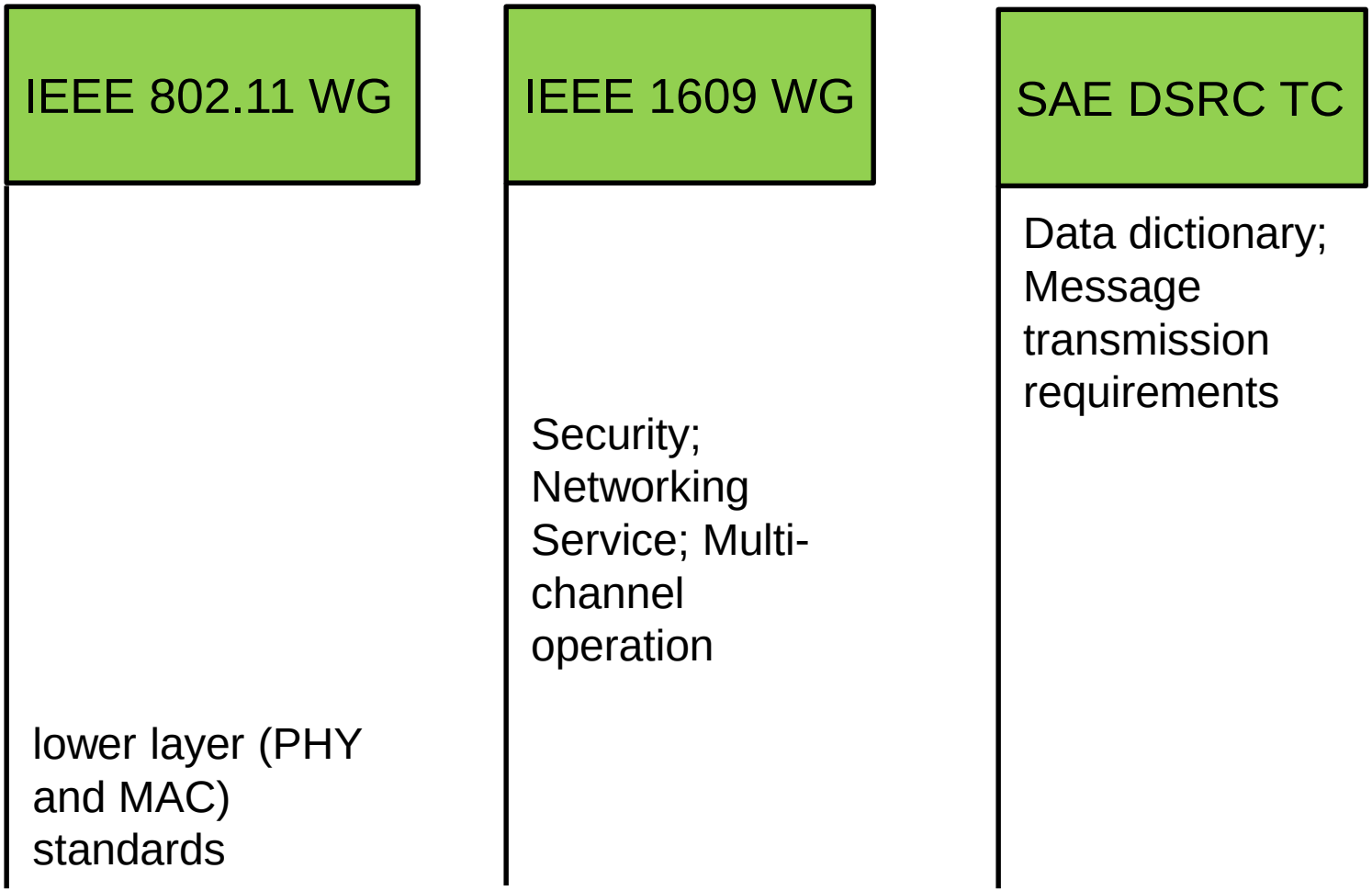
A version of test vehicle

Cooperative Automation for Greater Benefits



Our Approach to DSRC Deployment (1)

- Consensus: rely on specifications and protocols standardized with industry consensus



Our Approach to DSRC Deployment (1)

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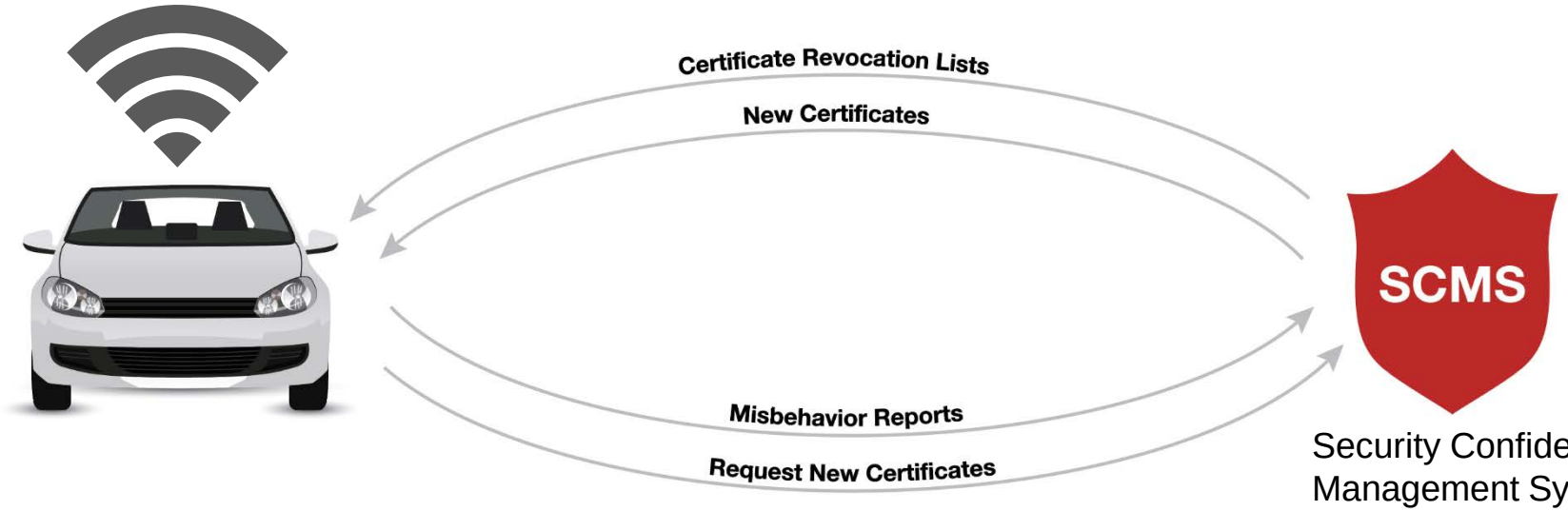
We emphasize privacy and security

- ✓ **No personal identifiable information sent**
- ✓ **Authentication protects data integrity, validates transmission authority**
- ✓ **Encryption keeps data secret**



Our Approach to DSRC Deployment (2)

- Support
  - Preservation of 5.9GHz ITS spectrum
  - Voluntary deployment now
  - Eventual mandate of V2V technology

Our Approach to DSRC Deployment (3)

- Collaboration:
  - Toyota Motor North America is a member of OmniAir
  - Helps insure interoperability between OBU and infrastructure, and among OBUs
  - Embracing work with different stakeholders

Our Approach to DSRC Deployment (3)

- Encourage:
  - Automakers to introduce DSRC to their vehicles
  - Road operators to install DSRC infrastructures
  - Car/fleet owners to install after market devices to existing vehicles

Moving Forward

"We believe that greater DSRC adoption by all automakers will not only help drivers get to their destinations more safely and efficiently, but also help lay the foundation for future connected and automated driving systems"

- James Lentz,
Chief Executive Officer

Toyota Motor North America

Thank you

Contact for more information:
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