

SAE INTERNATIONAL

**STANDARDS IN A RAPIDLY
CHANGING MOBILITY
LANDSCAPE**

**ITU WORKSHOP ON VEHICLE COMMUNICATIONS AND
AUTOMATED DRIVING**

Beijing, China 28-29 July, 2015

SAE International
Gary Schkade



SAE portfolio. Reaching Over 145,000 individuals in over 110 Countries Over 20,000 Volunteers from 51 countries participate on our Standards Committees

PUBLICATIONS

100,000+ collection of technical publications

TECHNICAL STANDARDS

35,000+ aerospace and ground vehicle standards



MEDIA

Magazines, eNewsletters, custom publishing, Tech Briefs Media Group

FOUNDATION

Charitable arm of SAE International, supporting STEM for over 30 years

PROFESSIONAL DEVELOPMENT

400 courses portfolio, webinars; in-house, corporate and self-paced learning

MEMBERSHIP

145,000 members worldwide, multiple-tiered/benefit model

The big picture...



SAE International Global Relationships



**SAE GROUND VEHICLE
STANDARDS**

**COOPERATIVE RESEARCH
PROJECT WORK**

Examples: Cooperative Research Projects and Connected Vehicles

- **Standards and Test Procedures for Plug-in Electric Vehicle safety and Interoperability with Electric Vehicle Supply Equipment**
- **Wireless Charging: J2954: Industry/gov't collaborative effort for the development of minimum performance, interoperability and safety criteria for wireless charging of EVs/PHEVs.**
- **Federal Highway funded project on Dedicated Short Range Communication and performance requirements for V2V communications related to expected NHTSA rulemaking in V2V space.**

SAE GLOBAL GROUND VEHICLE STANDARDS BUSINESS UNIT

**STANDARDS ACTIVITIES IN AUTOMATED VEHICLES/CONNECTED
VEHICLES/INTELLIGENT TRANSPORTATION SYSTEMS**

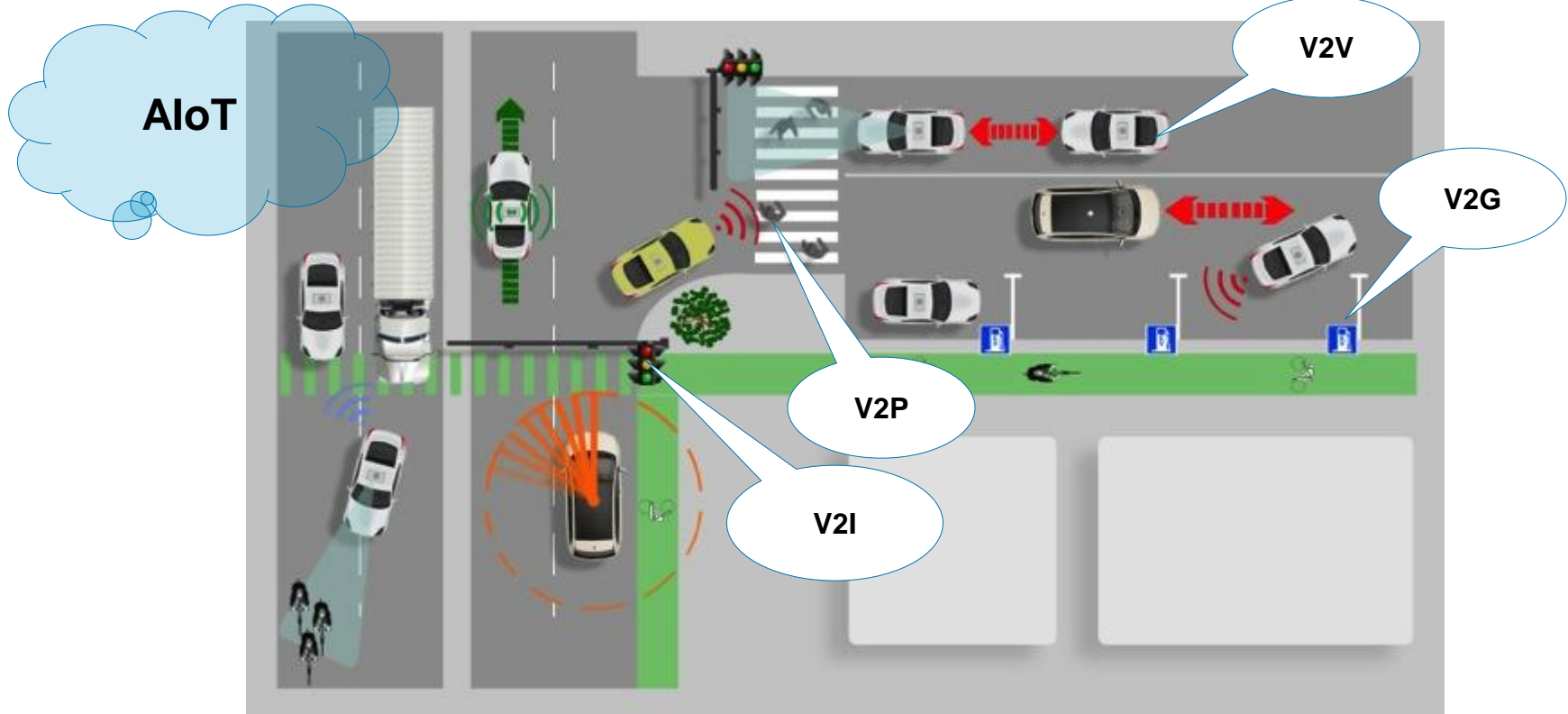
Fundamental Question: Why Connect or Automate? A few anticipated benefits

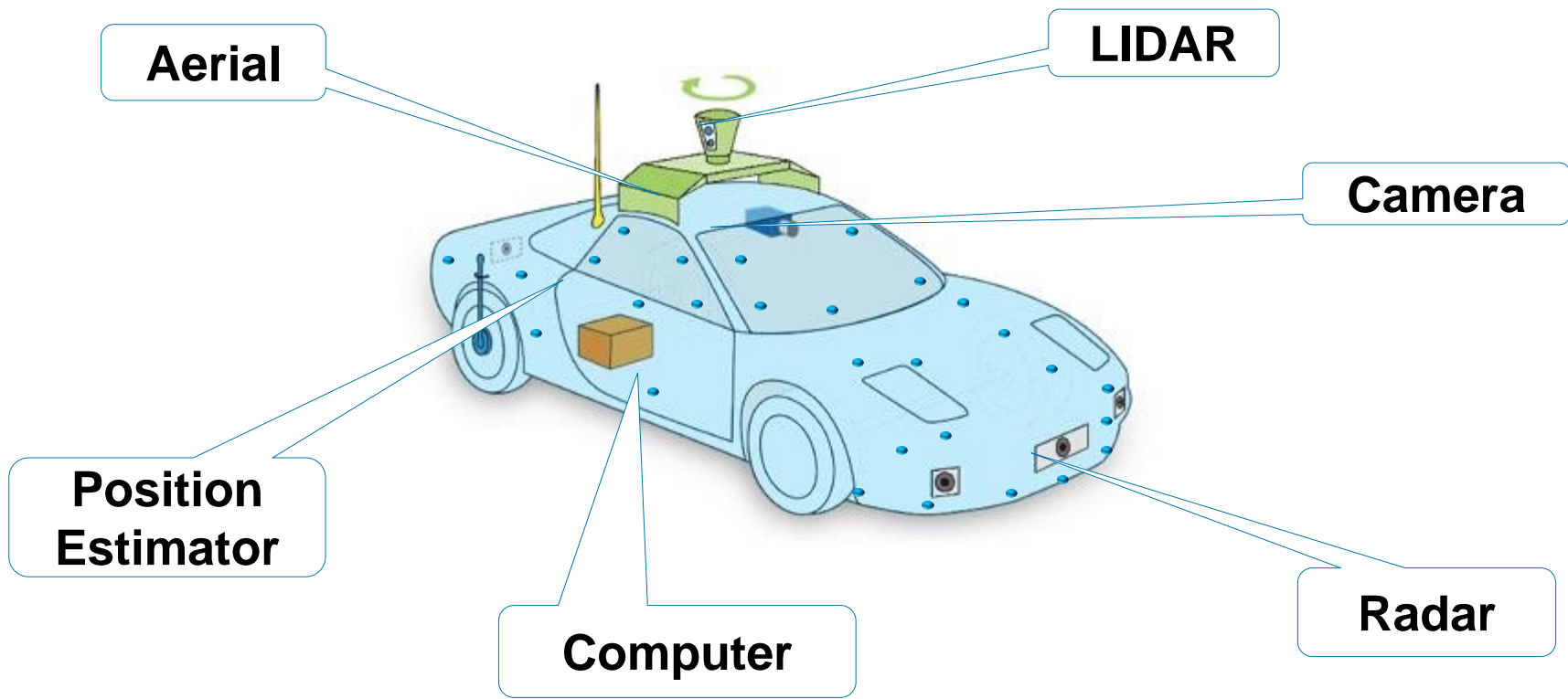
- Reduced fatalities and fewer accidents
- Greater fuel economy and lower emissions
- Reduced traffic congestion, increase existing road capacity
- Improved and new mobility options for aging population and disabled
- Productive time in vehicle

OEM's predict semi autonomous vehicles by mid-decade and fully autonomous vehicles by 2020



From Connected Vehicles: Multiple connections increase system and performance complexity, and create security and privacy issues.





What standards are needed for AV/CV/ITS?

Sensors accuracy and reliability

Data

Positioning **systems** accuracy and reliability

Security

Driver Distraction

Electronic system reliability

HMI

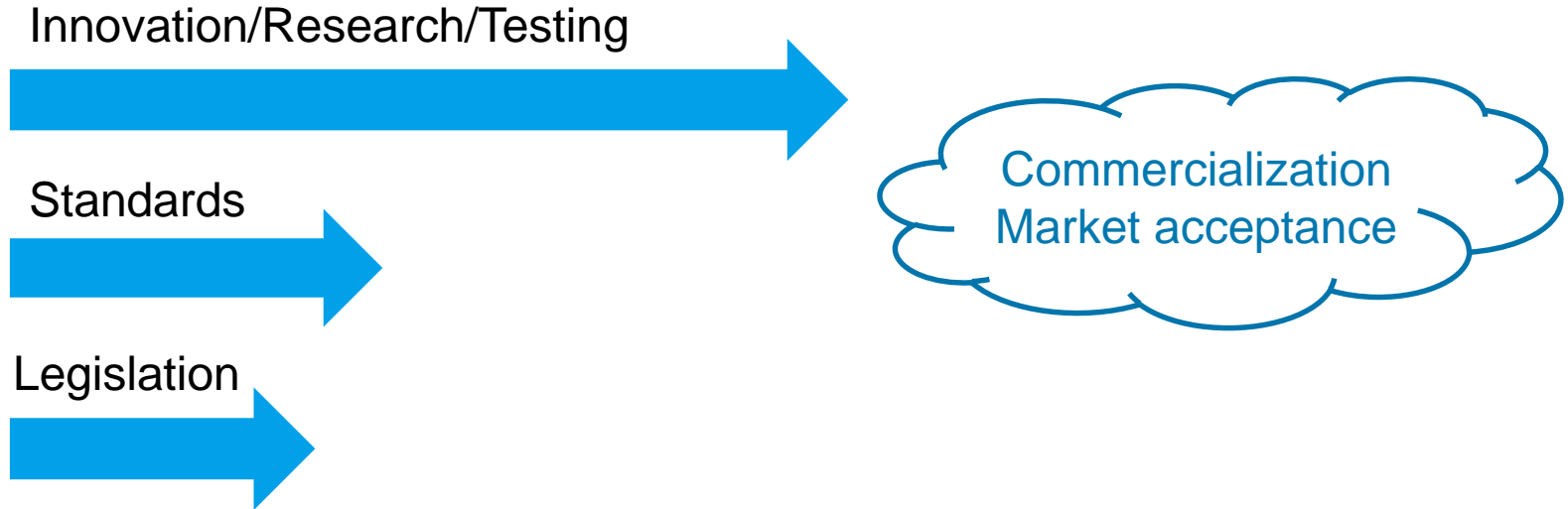
Privacy

Future vehicle vs existing fleets

Entire vehicle system interoperability

Powertrain system interoperability

Automated/Connected Vehicles - Optimal Standard Development path (US)



Automated/Connected Vehicles - Current Standards Development path (US)

Innovation/Research/Testing



Standards



Legislation



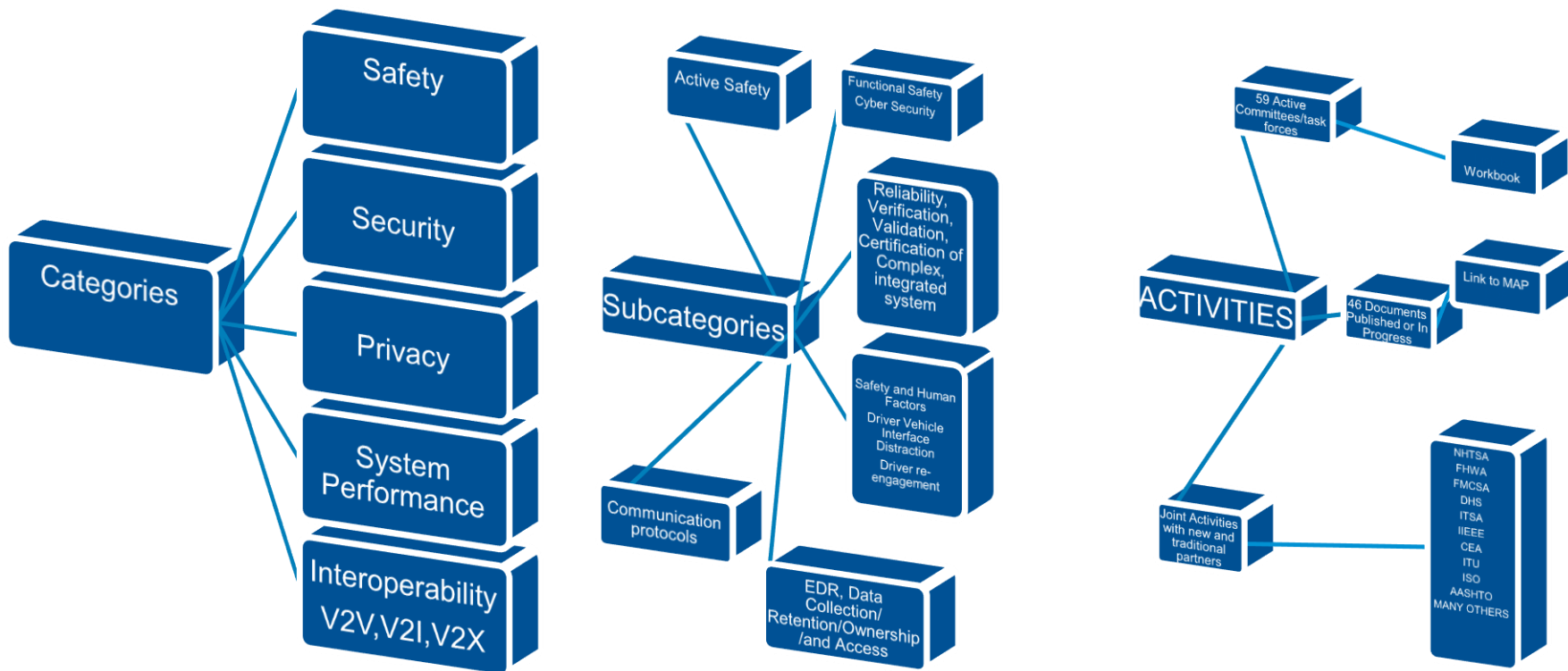
SAE and Connected/Automated Vehicle Technology

Intelligent Transportation Systems: Ancillary Activities

- **Mapping all SAE Connected/Automated/ITS Vehicle standards activities across all SAE sectors:**
 - Expected portal launch date: August 2015
- **Expanding alliances with non-traditional Standards Partners:**
 - Federal Highway - International Standards harmonization project
 - American Association of State Highway and Transportation Officials (AASHTO)-Infrastructure
 - Transportation Research Board (2014 /5 Autonomous Vehicle Symposium- Ann Arbor)
 - State and Local DOTs (automated vehicle testing on public roads)
 - Consumer Electronics Association (CEA). MEMA, SEMA: EMC and consumer device interference
 - Technology Maintenance Council (TMC) commercial vehicle and fleet maintenance/Platooning – new TMC committee on fleet platooning (CACC incorporating DSRC)
- **International Telecommunications Union (ITU)**
 - Geospatial Transportation Mapping Association (GTMA): Digital Asset Management and base maps

RESULTING SAE CROSS COUNCIL CONNECTED MOBILITY STANDARDS MATRIX

Categories, Subcategories And Activities



Top AV/CV/ITS Standards Activities within SAE International Over 59 Active Committees/More than 46 Standards Published or in Progress

STANDARDS COMMITTEES:

- Dedicated Short Range Communication
- Vehicle Active Safety
- Truck and Bus Active Safety
- Functional Safety
- Truck and Bus Functional Safety
- On Road Automated Vehicles
- Truck and Bus Automated Commercial Vehicle
- Vehicle Electrical System Security (CyberSecurity)
- Truck and Bus CyberSecurity

Top AV/CV/ITS Standards Activities within SAE International Over 59 Active Committees/More than 46 Standards Published or in Progress

STANDARDS COMMITTEES:

- Automotive Electronic Systems Reliability
- Vehicle Architecture For Data Communications
- Vehicle Event Data Recorder
- Truck and Bus Event Data Recorder
- Safety and Human Factors incorporating Driver Vehicle Interface in Automated/Connected/ITS Vehicles.
- Adaptive Beam Lighting
- Truck and Bus Driver Distraction

- J2980 Functional Safety: Companion to ISO26262 for Automotive ASIL classifications
- J3018 Safe Testing of Highly Automated Vehicles on Public Roads:
- J3016 Terms and Definitions: Levels of Automated Driving Systems: Being globally harmonized and adopted in ISO
- J2735: Dedicated Short Range Communication Message Sets: Updated to include message sets needed for Signal Phase and Timing (traffic signaling) SPaT Map.
- J2353: Data Dictionary for Advanced Traveller Information Systems (ATIS)
- J2540/2: ITIS Phrase Lists (International Traveler Information Systems)
- J3061 WIP CyberSecurity in Balloting Stage expected publication 3rd qtr. 2015
- J3101 Requirements for Hardware-Protected Security for Ground Vehicle Applications (WIP)

- J2395 ITS –In-Vehicle Message Priority
- J2808 Road/Lane Departure Warning Systems: Information for the Human Interface (WIP)
- J3083 Reliability Prediction for Automotive Electronics(WIP)
- J2988 Guidelines for Speech Input and Audible Output in a Driver Vehicle Interface (WIP)
- J2944 Operational Definitions of Driving Performance Measures and Statistics
- J3063* Active Safety Terms and Definitions
- J3088 Active Safety System Sensors
- J3087: Automatic Emergency Braking (AEB) underway for Crash Imminent Braking based on CAMP (Collision Avoidance Metrics Partnership) project

Connected Vehicles Communication and Message Standards: Dedicated Short Range Communication (DSRC) Protocol

A system of real time wireless communication (Wi-Fi) using Dedicated Short Range Communication (DSRC) in the 5.9GHz band between:

- Vehicle to Vehicle (V2V)
- Vehicle to Infrastructure (V2I)



- Messages transmitted 10 times/sec (300m range)
- Basic Safety Message: vehicle position, speed, heading, acceleration, size, brake system status, etc.
- Privacy is protected (vehicle VIN and location is NOT recorded or tracked)

SAE DSRC Standards activities in Connected Vehicle: Supports expected National Highway Traffic Safety Administration expected V2V rulemaking

SAE J2735 – Dedicated Short Range Communications Message Set Dictionary

- Supports interoperability
- Defines standardized message sets
- Defines formats for basic safety message set dictionary
- Incorporates Signal Phase and Timing message sets (SPaT)

SAE J2945 (WIP) – Dedicated Short Range Communications Minimum Performance

- Specifies minimum communication performance requirements
- Defines message transmission rate, channel usage, optional data usage in various situations

Examples of In Vehicle Driver Alerts

- Forward Collision Warning
- Emergency Electronic Brake Light
- Intersection Movement Assist
- Blind Spot Warning
- Lane Change Warning
- Do Not Pass Warning
- Right Turn in Front
- Signal Phase and Timing
- Curve Speed Warning



New DSRC Work in Progress for Vulnerable Road Users (Pedestrians/Cyclists/Disabled).

SAE J2945-9

To include Pedestrian Safety Messages (PSM) to support interoperability among various types of handheld devices, vehicles, and vehicle-pedestrian applications.



SAE Intelligent Transportation Systems (ITS) Standards Development and DSRC

SAE under 5 year contract with FHWA for ITS standards development

- Work performed by SAE contractors working in concert with the SAE DSRC Technical Standards Committee

New Work in Progress: J2945/6 for vehicle platooning using DSRC and Cooperative Adaptive Cruise Control Technology

Developing Joint Standards activities with other strategic stakeholders and non-traditional partners:

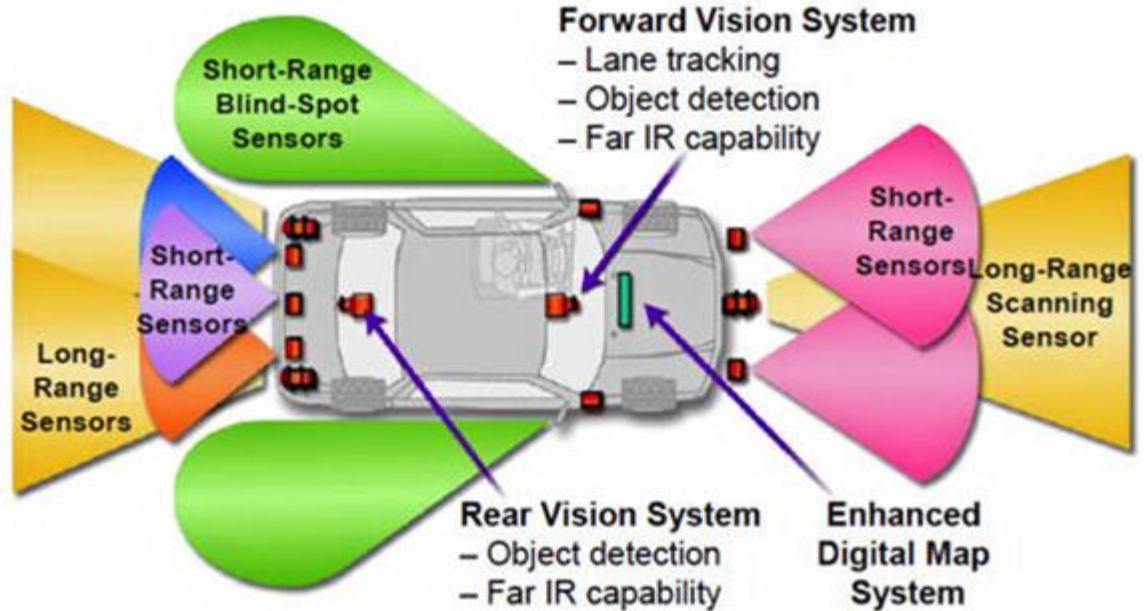
- New project with Infrastructure on uniform pavement markings for optimizing machine vision systems for active safety technology: Lane Departure Warnings (LDW) and Lane Keeping Assistance Systems (LKA)

SAE International’s Functional Safety Committee completed a new, recommended practice intended to provide a global, harmonized approach for determining Automotive Safety Integrity Level (ASIL) classifications for vehicle level hazards and is consistent with guidelines provided in ISO 26262.

Reviews factors to be taken into account for determining the exposure, severity and controllability for a given hazard.

Automated Vehicles – Sensing Systems

Sensor quality / reliability & HMI are critical to the successful deployment of automated vehicles - SAE Functional Safety, Safety and Human Factors & Active Safety Committees are focused on these areas



J3018 Safe Testing of Highly Automated Vehicles on Public Roads: SAE's On Road Automated Vehicle Committee (ORAV)

Guidelines for the safe conduct of on-road tests of vehicles equipped with prototype conditional, high, and full (levels 3-5) *automated driving systems (ADSs)*, as defined by SAE J3016.

Published May 2015



With the goal of providing common terminology for automated driving, SAE International's new standard J3016 delivers:

- Harmonized classification system and supporting definitions that:
- Identify six levels of driving automation from “no automation” to “full automation”.
- Base definitions and levels on functional aspects of technology.
- Describe categorical distinctions for a step-wise progression through the levels.
- Are consistent with current industry practice.
- Eliminate confusion and are useful across numerous disciplines (engineering, legal, media, and public discourse).
- Educate a wider community by clarifying for each level what role (if any) drivers have in performing the dynamic driving task while a driving automation system is engaged.

Summary of SAE International's J3016 Levels of Driving Automation for On-Road Vehicles

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitors the driving environment						
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the dynamic driving task with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	System	Human driver	Some driving modes
4	High Automation	the <i>driving mode</i> -specific performance by an automated driving system of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes

ORAV: New Activities in On Road Autonomous Vehicles Standards Committee

2015 Panel/Committee Session at Transportation Research Board Autonomous Vehicle Symposium July 21-23 2015; UMTRI's New Mobility Transformation Center

Validation and Verification Task Force

Reference Architecture and Interfaces based on TARDEC AMAS (Autonomous Mobility Applique Systems) for fully automated truck platoons and convoys.

The SAE Vehicle Electrical System Security Committee, formed in 2011, is responsible for developing and maintaining Recommended Practices and Information Reports in the area of vehicle electrical systems' security. The committee's scope is on-board vehicle electrical systems that affect vehicle control or otherwise act contrary to the occupants' interests if the systems are manipulated by an attacker.



The goals of the 56 members committee are:

- To identify and recommend strategies and techniques related to preventing and detecting adversarial breaches, and
- Mitigating undesirable effects if a breach is achieved.

Vehicle Cybersecurity: SAE J3061 Cybersecurity Guidebook for Cyber-Physical Automotive Systems



SAE J3061 “Cybersecurity Guidebook for Cyber-Physical Automotive Systems”

Estimated publish time: 1qtr 2015

Scope of SAE J3061

- Consistent with Process Framework for ISO 26262 Functional Safety Standard
- Contains automotive cybersecurity framework and processes
- Evaluates Threat Analysis and Risk Assessment (TARA) methods
- Simple approach to allow effective implementation across the automotive industry
- Contains elements of existing industry security standards
- Definitions, Acronyms, and sample templates provided

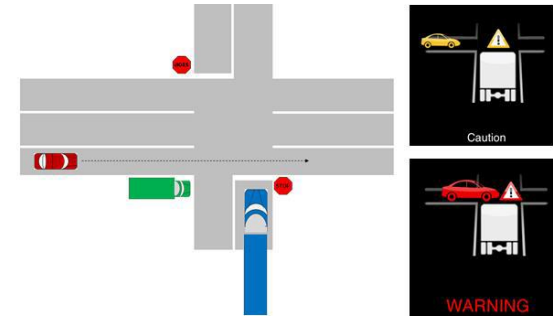
J3101 “Requirements for Hardware-Protected Security for Ground Vehicle Applications”

Scope:

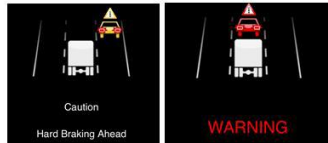
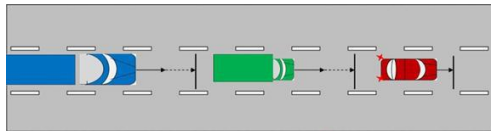
This Recommended Practice establishes a set of high level guiding principles for cyber security as it relates to automotive cyber-physical systems as well as establishes a framework lifecycle process for the incorporation of cyber-security in automotive systems. Additionally, this document provides information on some common tools and methodologies used when designing and validating cyber-physical automotive systems.

Heavy Truck Commercial Vehicle Active Safety Standards Activities

- V2V and V2I Applications for Heavy Truck
- Forward Collision Warning (FCW)
- Blind Spot/Lane Change Warning (BSW/LCW)
- Intersection Movement Assist (IMA)
- Emergency Electronic Brake Lights (EEBL)
- V2I – Curve Speed Warning (CSW)
- V2I – Bridge Height Inform (BHI)



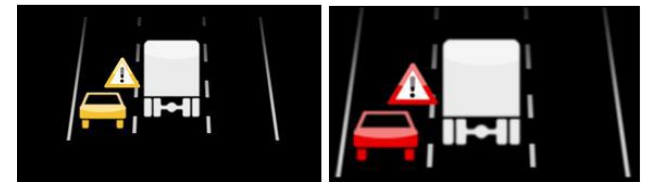
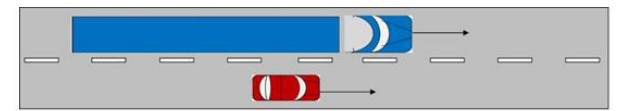
Intersection Movement Assist (IMA)



Emergency Electronic Brake Lights (EEBL)



Forward Collision Warning (FCW)



Blind Spot/Lane Change Warning (BSW/LCW)

Commercial Vehicles: Truck and Bus Committee Activities in Connected Vehicles: Active Safety.

J3045 Lane Departure Warning Test Procedure

Establishes a uniform, powered vehicle test procedure for lane departure warning systems used in highway commercial vehicles greater than 10,000 lbs.

Human Machines Interface (HMI)/Driver Vehicle Interface (DVI) challenges:

All warning systems (audio, visual and haptic) are being further researched:

- DVI design principles: Interfaces must be effective without increasing distraction

Phase 2: Companion Standard on Performance specifications

J3029 Forward Collision Avoidance and Mitigation (FCAM) System Vehicle Test Procedure

Establishes uniform powered vehicle test procedure for forward collision avoidance and mitigation systems used in highway commercial vehicles and coaches greater than 10,000 lbs.

HMI/DVI considerations similar to J3045

Phase 2: Companion Standard for Performance Specifications

SAE and Connected/Automated Vehicle Technology

Intelligent Transportation Systems: On-Going Challenges

- **Human Factors: Driver Vehicle Interface: Challenges in automation and automated driving systems**
 - Distraction
 - Re-engagement
 - Cognitive overload
- **System status: Integrated Vehicle Health Management Systems**
- **Functional Safety: Electronic Control Systems: Safety, Security, Reliability**
- **CyberSecurity**
- **Driver Education and Training**
- **Public acceptance**
- **Common Terminology and Taxonomy**
- **Liability Issues**
- **Policy Issues**
- **Funding (Infrastructure needs for Cooperative Intelligent Transportation Systems)**

SAE and Connected/Automated Vehicle Technology

Intelligent Transportation Systems: Challenges

- **Legacy Vehicles and Mixed fleets on common roadways**
- **Data: Ownership and Privacy Issues**
- **Data Access: Aftermarket and Right to Repair**
- **Funding (Infrastructure needs for Cooperative Intelligent Transportation Systems)**

SAE and Connected/Automated Vehicle Technology

Intelligent Transportation Systems: New Areas in development

- **Digital mapping not only for precise positioning of vehicles on the road, but potential for mapping and maintenance of the state and local highway assets**
- **V2I: Infrastructure approach needs to be sustainable over the long term vs. short term upgrades to existing networks**
- **Progressive integration using Vehicle Probe Data**
- **Uniform Roadway markings for machine reading to optimize integrated ADAS systems such as lane keeping assistance, lane departure warnings.**

CONTACT INFORMATION

FOR ADDITIONAL INFORMATION ON COMMITTEE ACTIVITIES OR STANDARDS CONTACT:

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THANK YOU!