SAE INTERNATIONAL

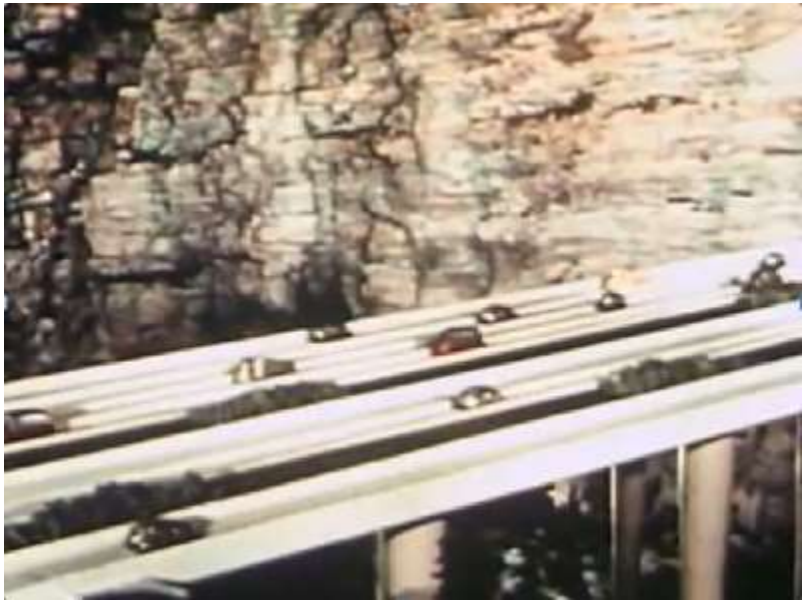
SAE STANDARDS ACTIVITIES FOR THE INTRODUCTION OF CONNECTED/AUTOMATED VEHICLES ON THE ROAD?

AAMVA

March 25, 2015

Bill Gouse
SAE International
Washington DC
wgouse@sae.org
(202) 281-5844

The connected world of tomorrow… from yesteryear



Source: YouTube
http://youtu.be/aIu6DTbYnog
Starts at 14:27

1939 Futurama At New York World Trade Fair Vision for the 1960's Safety with increased speed…

Mission Statement SAE International is a global body of scientists, engineers, and practitioners that advances self-propelled vehicle and system knowledge in a neutral forum for the benefit of society.

Vision SAE International is the leader in connecting and educating engineers while promoting, developing and advancing aerospace, commercial vehicle and automotive engineering.

We reach more individuals than ever in more than 110 countries

145,000

ENGINEERS
EXECUTIVES
EDUCATORS
STUDENTS

SAE technical standards are developed with 20,000 volunteers from 51 countries…

Well established global relationships
Fundamental for collaboration and harmonization

SAE Familiarity

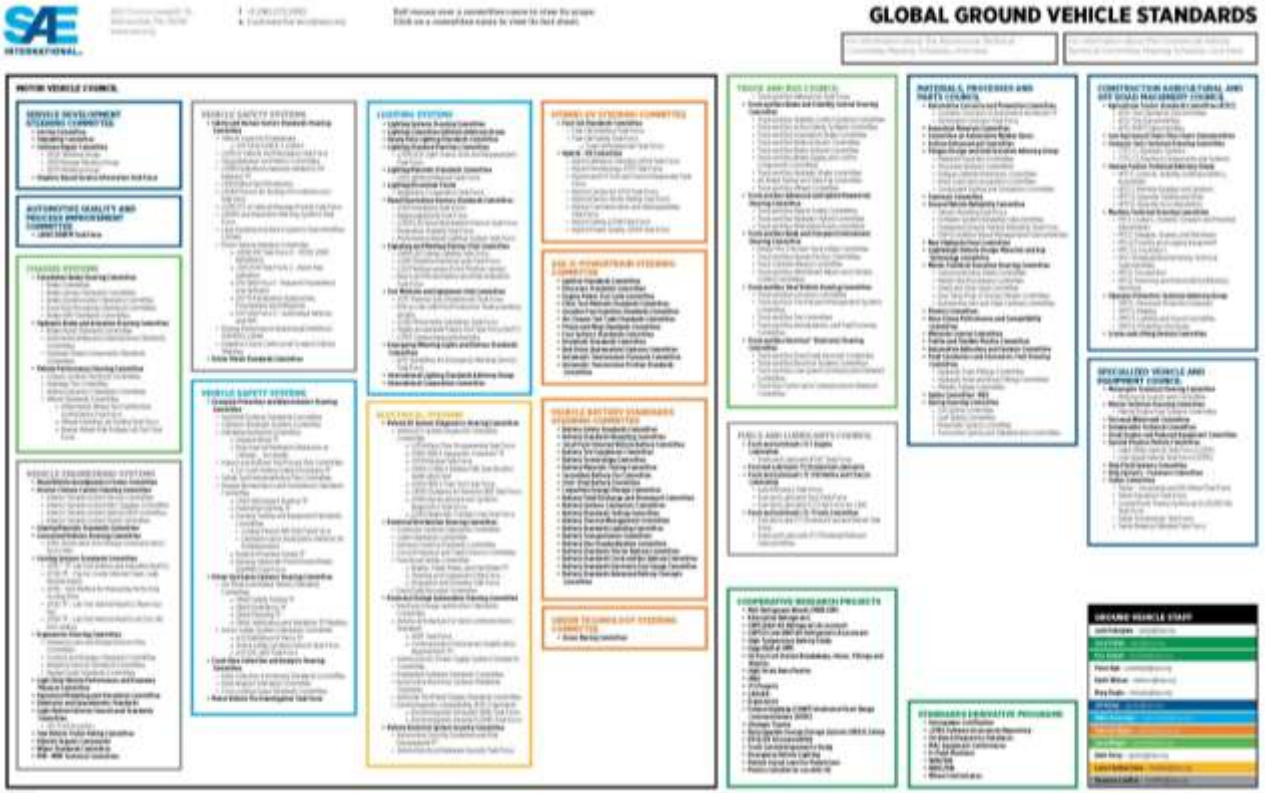
- **Standards Incorporated by Reference**

- **World Manufacturer Identifier / Vehicle Identification Number (WMI/VIN) Program and related standards**

- **World Manufacturers Code / Product Identification Number (WMC/PIN)**

SAE GLOBAL GROUND VEHICLE STANDARDS DEVELOPMENT ACTIVITIES IN VEHICLE CONNECTIVITY

SAE Standards Development



609 committees

8,865 members

2,898 companies

1,423 meetings

Committee meetings are open to all interested parties, but only committee members vote on draft documents.

Individuals participate on committees as technical experts and not as representatives of their organizations

SAE world of vehicle connectivity standards within the functional safety environment of ISO 26262 and SAE J2980

SAE DSRC standards activities in connected vehicle

SAE J2735 – Dedicated Short Range Communications Message Set Dictionary

- Supports interoperability
- Defines standardized message sets
- Defines formats for basic safety message set dictionary

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 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

Source: www.motortrend.com

New DSRC task force for vulnerable road users (pedestrians/cyclists). DSRC pedestrian protection

SAE J2945-X– early start at defining DSRC ‘Vehicle2Pedestrian’ application requirements, channel use and message set and potential test procedures.

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

Source: www.motortrend.com

NHTSA decision on V2V

- On February 3, 2014 DOT Secretary Anthony Foxx announced that the DOT will issue a regulatory proposal to require an onboard DSRC-based V2V communications technology on future cars and light trucks
- On August 18 the USDOT issued an Advanced Notice for Proposed RuleMaking (ANPRM) to begin Implementation of V2V Communications Technology
- NHTSA expected to issue a Notice for Proposed RuleMaking (NPRM) by 2016
- GM announced 2017MY Cadillac CTS will be equipped with V2V communications technology
- US DOT will announce plan for V2V for heavy truck ???
- Guidance for V2I to be issued in 2015

Global DSRC Standards Development
Collaboration is key with all parties and related organizations

Signed Cooperative agreement with ETSI in April, 2014

- Initial joint work item covers ITS technology
- SAE DSRC Committee and ETSI ITS Working Group 1 (WG1)
- Allows participation in each others Technical Committees, but no voting rights
- Permits joint review and comment on current and new standards

Developing relationship with International Telecommunications Union (ITU)

Informal dialogue with ISO TC204 Committee

- ISO 19091 Harmonization (Signal Request Message/Signal Priority Message)

Discussions with IEEE

- Summary of needs presented to IEEE 1609 workgroup

SAE ITS Standards Development and DSRC

- SAE under 5 year contract with FHWA for ITS standards development
- Work performed by SAE SMEs working in concert with the SAE DSRC Technical Standards Committee
- Key Deliverables
  - SAE J3067, Candidate Improvements to Dedicated Short Range Communications (DSRC) Message Set Dictionary [SAE J2735] Using Systems Engineering Methods, published in August, 2014
  - Specifies dialogs, messages, and the data frames and data elements that make up the messages specifically for use by applications intended to utilize the 5.9 GHz Dedicated Short Range Communications for Wireless Access in Vehicular Environments, communications systems.
  - Next Step – develop J2945.x tracks
  - Future Work – Next Revision of SAE J2735 (NextGen), Dedicated Short Range Communications (DSRC) Message Set Dictionary™

2015: Rapid Standardization to Support Rulemaking is Major Force for work in the SAE DSRC Committee

Europe: European Norm (EN) 453 mandates standardization

- First release 2013
- Issues in ‘mitigation’ / interference with 5.8 GHz tolling

North America: Impending Notice of Public Rulemaking (NPRM)

- NPRM in 2016, potential mandate 1 – 2 years afterward, wide scale deployment
- IEEE and SAE issued letters to expedite and complete by end of 2015
  - IEEE 1609.2 (security), 1609.3 (networking)
  - SAE J2735 (message sets), 2945.1 (minimum performance, including congestion control)

Some convergence: ETSI ITS TC WG1 and SAE DSRC TC:

- Cooperative Adaptive Cruise Control/Platooning
- Vulnerable Road Users

Other Committee Interests

- V2P Vulnerable Road Users
- ISO 19091 Harmonization: Signal Request / Signal Priority Messages
- Eventual Inclusion of J3067 Information Report (FHWA Contract)

Commercial Vehicles: Truck and Bus Committee Activities in Connected Vehicles

***J3081: Recommended Practice for Heavy Vehicle Operator Controls Prioritization and Conflict Resolution*: Work In Progress at ballot stage**

- **Growing desire for implementation of advanced vehicle control technologies in Commercial Vehicles represents operator input challenges.**
- **Shift from Traditional Mechanical Control Systems to Electronic Control Systems to reduce vehicle emissions and improve vehicle safety.**
  - "Drive-by-wire"
    - Examples: automatic traction control, automated mechanical transmissions, adaptive cruise control and hybrid systems technology.

Communication Link Message Prioritization

- Essential to avoid conflicting messages being received simultaneously.
- Intelligent control strategy to be used within the system to assure safe operation regardless of data link

J3081 provides specific recommendations to avoid potential conflicts between operator control inputs vs. advanced system control inputs.

Commercial Vehicles: Truck and Bus Committee Activities in Connected Vehicles:

New activity: Platooning

- **Objectives:**
  - Cost reductions from improved fuel economy.
  - Lack of trained drivers
  - Crash avoidance through Advanced Electronic System Control Systems
- **Human Machine Interface/Driver Vehicle Interface Challenges:**
  - Driver re-engagement and situational awareness issues.

New Activity: Dedicated Short Range Communication DSRC:

- **Objectives:**
  - Similar to Passenger Vehicles. Commercial Vehicle establishing mirror committee
  - Advanced technologies i.e. Lane Keeping Assistance require V2V DSRC to be in place for Commercial Vehicles:

Current NHTSA V2V efforts primarily focused on passenger vehicles and light trucks. Decision on Commercial expected end 2014

Commercial Vehicles: Truck and Bus Committee Activities in Connected Vehicles: Active Safety. Both Documents approved at Level 1 Ballot

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

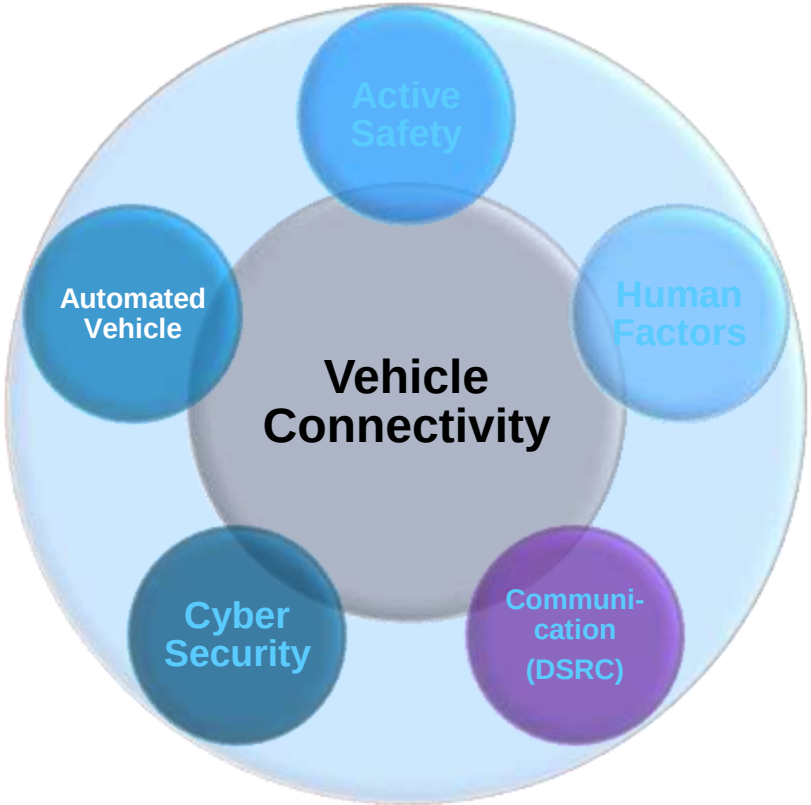
J3029 Forward Collision Avoidance and Mitigation (FCAM) System Vehicle Test Procedure

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

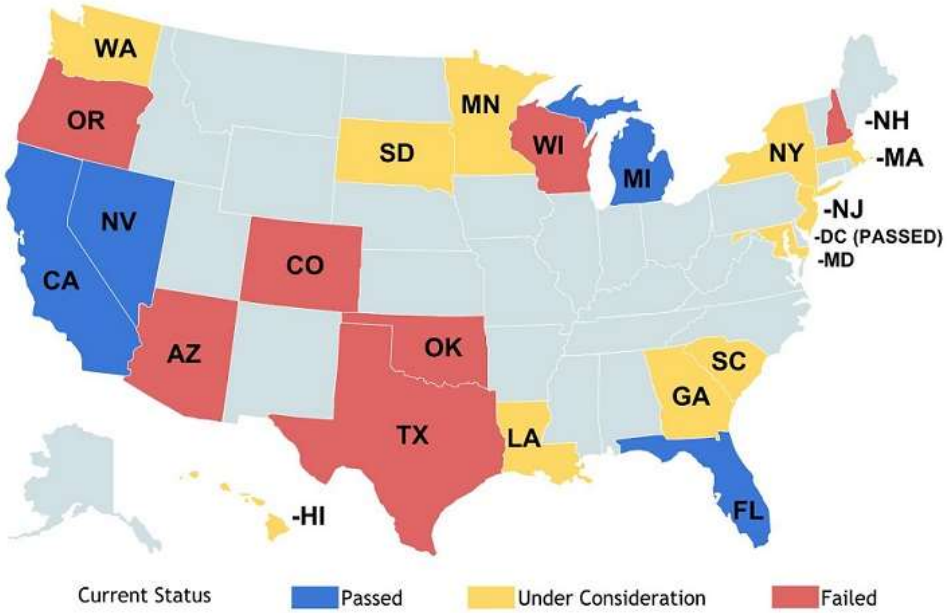
HMI/DVI considerations similar to J3045

Phase 2: Companion Standard for Performance Specifications

SAE world of vehicle connectivity standards within the functional safety environment



Currently a small number of states approve the use of autonomous vehicles for development purposes, many states still to go….

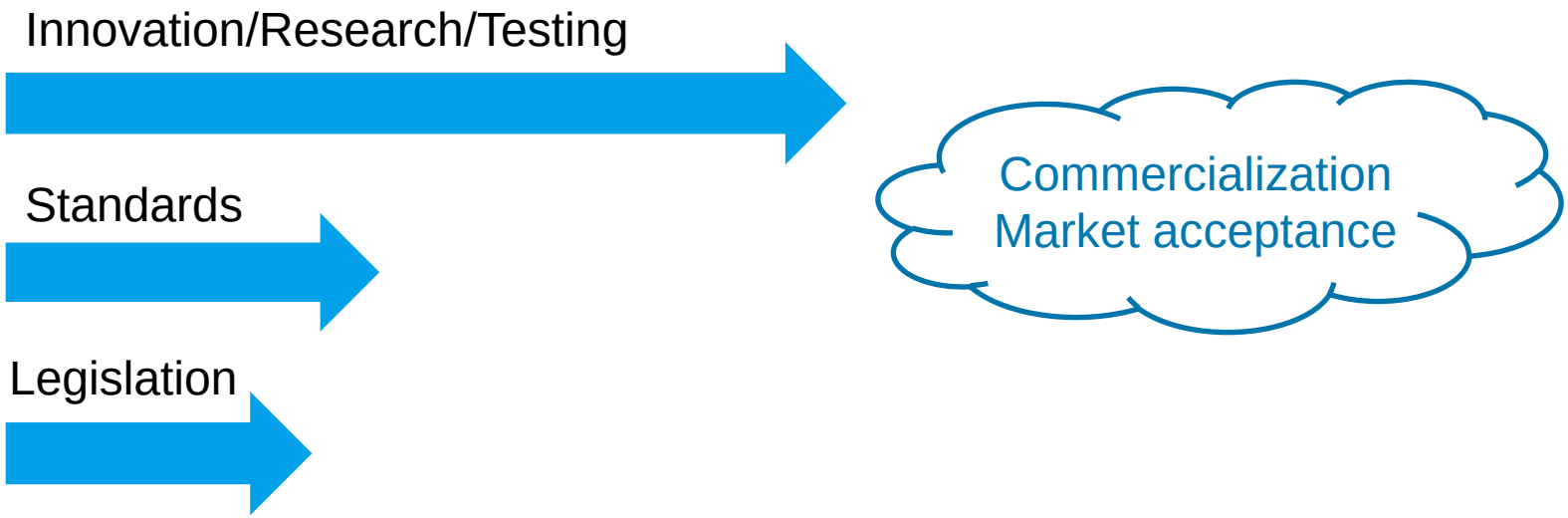


Source: cyberlaw.stanford.edu

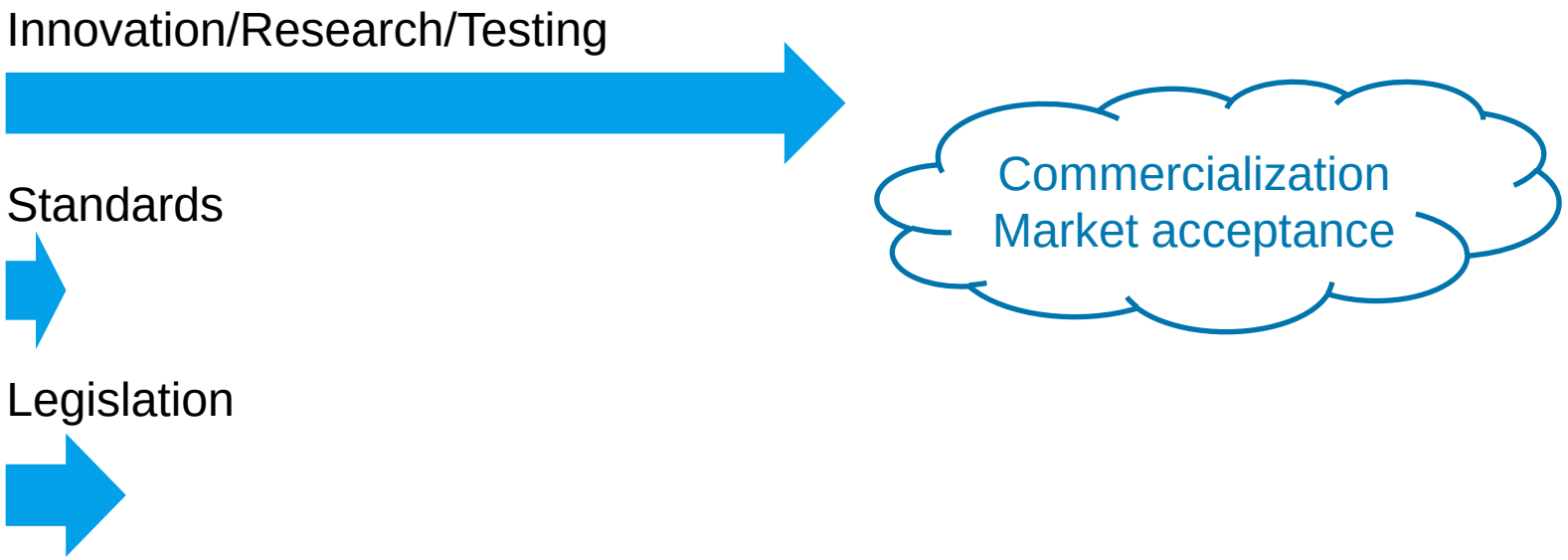
Automated vehicles – US policy

- **Speed of technological advancements outpacing government's ability to regulate**
- As initial step, NHTSA released Policy Statement of Automated Vehicle Development on May 31, 2013
- NHTSA Policy addresses the following:
  - An explanation of the many areas of vehicle innovation and types of automation that offer significant potential for enormous reductions in highway crashes and deaths
  - A summary of the research NHTSA has planned or has begun to help ensure that all safety issues related to vehicle automation are explored and addressed
  - Recommendations to states that have authorized operation of self-driving vehicles, for test purposes, on how best to ensure safe operation as these new concepts are being tested on highways

Automated vehicles - optimal path (US)



Automated vehicles - current path (US)



Autonomous Vehicles

SAE On-Road Automated Vehicle Standards Committee

- **Kick Off: ORAV Committee**
  - September 27, 2011
- **J3016: Taxonomy and Definitions**
  - Published on January 16, 2014
- **J3018: Safety Testing Guidelines**
  - Guidelines for operation of automated prototype vehicles
  - Issued March 2015
- **Additional Task Forces**
  - Planning & Coordination
  - Verification & Validation
  - Interoperability

SAE J3016 Taxonomy and Definitions for terms related to on-road motor vehicle Automated Driving Systems (ADS)

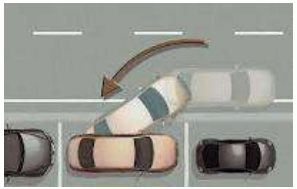
With the goal of providing common terminology for automated driving, SAE International's new standard J3016 delivers a harmonized classification system and supporting definitions that:

- 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 Levels of Driving Automation for On-Road Vehicles - SAE J3016

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 *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the *driving mode*-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 *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the *driving mode*-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 *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	Conditional Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	High Automation	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	Full Automation	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

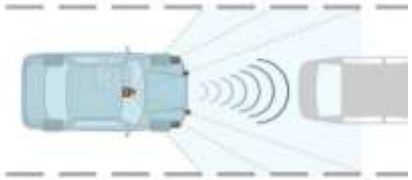
Autonomous Vehicles – Levels of Autonomy



Self Parking Car

Parallel Park Assist

(currently available)



Cadillac Super Cruise

Steers and Brakes Vehicle in Highway Driving

(forecast 2015)

Onboard hardware and software plans route and controls vehicle

(Forecast 2020-2030)

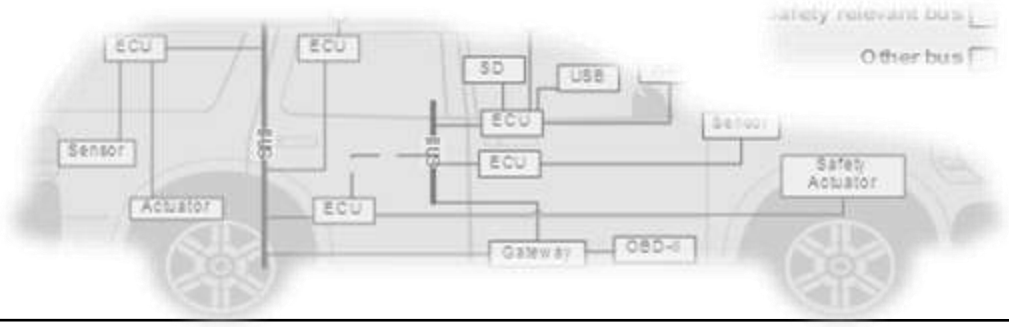
Levels of Autonomy

Function-specific Automation Level 1	Combined Function Automation Level 2	Limited Self-Driving Automation Level 3	Full Self-Driving Automation Level 4
Stability control Brake Assist	Adaptive Cruise Control Lane Centering	Driver's occasional control (Google car)	Driver indicates where to go, car drives there

SAE world of vehicle connectivity standards within the functional safety environment

In step with technology trends – Cyber security

- Automotive systems are also rapidly becoming more connected, both to each other and to the outside world. Examples include:
  - Bluetooth
  - Cellular Communications
  - Wireless Tire Pressure Monitoring System
  - Connected vehicle systems
- Taken together, these trends are increasing both the exposure and potential consequences of cyber-based attacks
- The cyber security threats are produced by underground and hacker communities that adapt quickly and collaborate
- Global industries must follow a very effective process to counteract cyber security threats to minimize detrimental result on product safety



SAE Cybersecurity standards

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 member 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.

SAE J3061 – Cybersecurity

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

Estimated publish time: Summer 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

SAE JXXXX **“Best Practices for Cyber Physical Automotive Systems”**

Estimated publish time: Late 2015/2016

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.

Commercial Vehicles: Truck and Bus Committee Activities in Connected Vehicles: CyberSecurity*

Launching new Committee to examine current Cyber Threats in the Commercial Vehicle Sector: Mirror of Passenger Car Committee

- **Higher value target: Cargo**
- **Currently happening outside US:**
  - sending up drones to interfere with GPS signaling, jamming phones.
  - Entire fleets being hacked.
- **Telematics provide access points**
- **Commercial Vehicles are prone to the same cyber threats as passenger vehicles.**
- **Aftermarket solutions could unintentionally make vehicles more susceptible to cyber threats.**
- **Whole fleets compromised not just one stand alone vehicle.**
- **Substantial physical dangers compared to passenger vehicles**

Next Steps:

- **Comprehensive evaluation of unique Cyber-related risks for commercial vehicle vs. passenger vehicle.**
- **Identify and engage all stakeholders including policy makers.**
- **Design solutions to minimize/eliminate risks.**

**Information from: 2014 SAE International ComVec Technical Expert Panel Discussion: Cybersecurity for Commercial Vehicles – Part 1 of 2.*

CyberSecurity for Commercial Vehicles, Part 2 of 2.

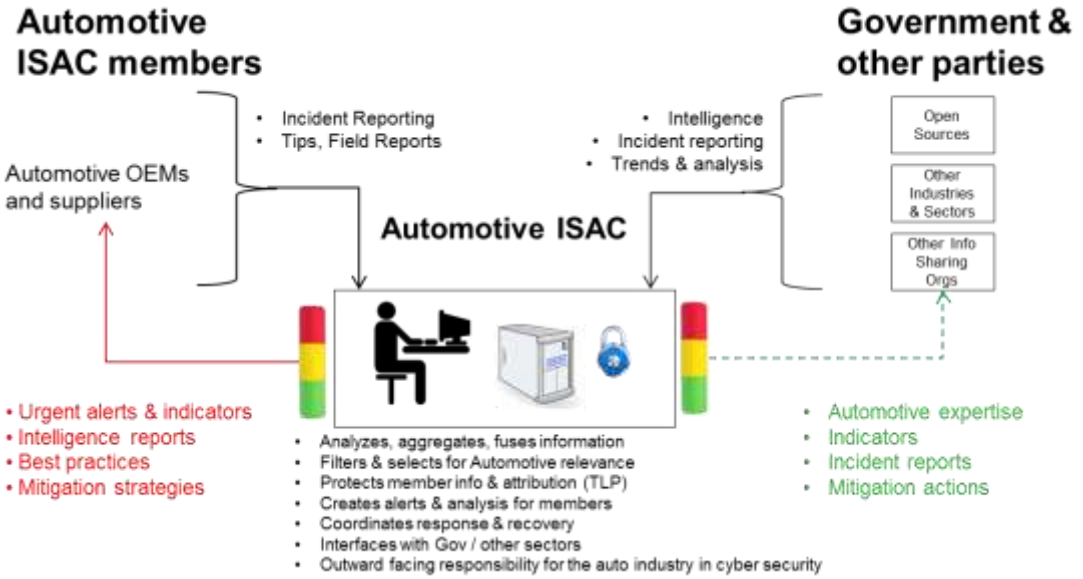
Oral presentation by Andre Weimerskirch, University of Michigan and Kevin Harnett, DOT/Volpe Center

Information Sharing & Analysis Centers (ISAC's)

Forewarned is to be Forearmed

Automotive ISAC (Auto-ISAC)

- Currently in Development Stage
- Consortium being formed by the Global Automakers & Alliance of Automobile Manufacturers
- SAE supporting
- Will be known as “Auto-ISAC”
- Scheduled to be online 4Q2015



In summary - key session questions

1. Are the main cornerstones for roll out fixed or do we need additional efforts.

The European standards must be harmonized with the rest of the world.

In summary - key session questions

2. What are the open topics? When is a revision of the current standards needed?

In the US, the SAE DSCR committee is currently working on the revision of J2735 "Dedicated Short Range Communication (DSRC) Message Set Dictionary".

At the same time, work is being initiated on SAE J2945 "Dedicated Short Range Communication (DSRC) Minimum Performance Requirements".

In summary - key session questions

3. Do we need local, regional, national or global standards?

Answer:

The granularity of standards depends on application and if a harmonized approach is followed, there is potential for a system of various standards (local, regional, national, global) as long as they are harmonized and do not impede innovation or product safety and performance.

In summary - key session questions

4. Will standards follow technological development or vice versa

Answer:

This depends…..

In some cases there will be need for regulation so that standards can be developed, in others standards will be developed parallel to innovation, and yet in others, regulations will be produced after standards.

Overall the standards process for automated vehicles needs to be accelerated

THANK YOU