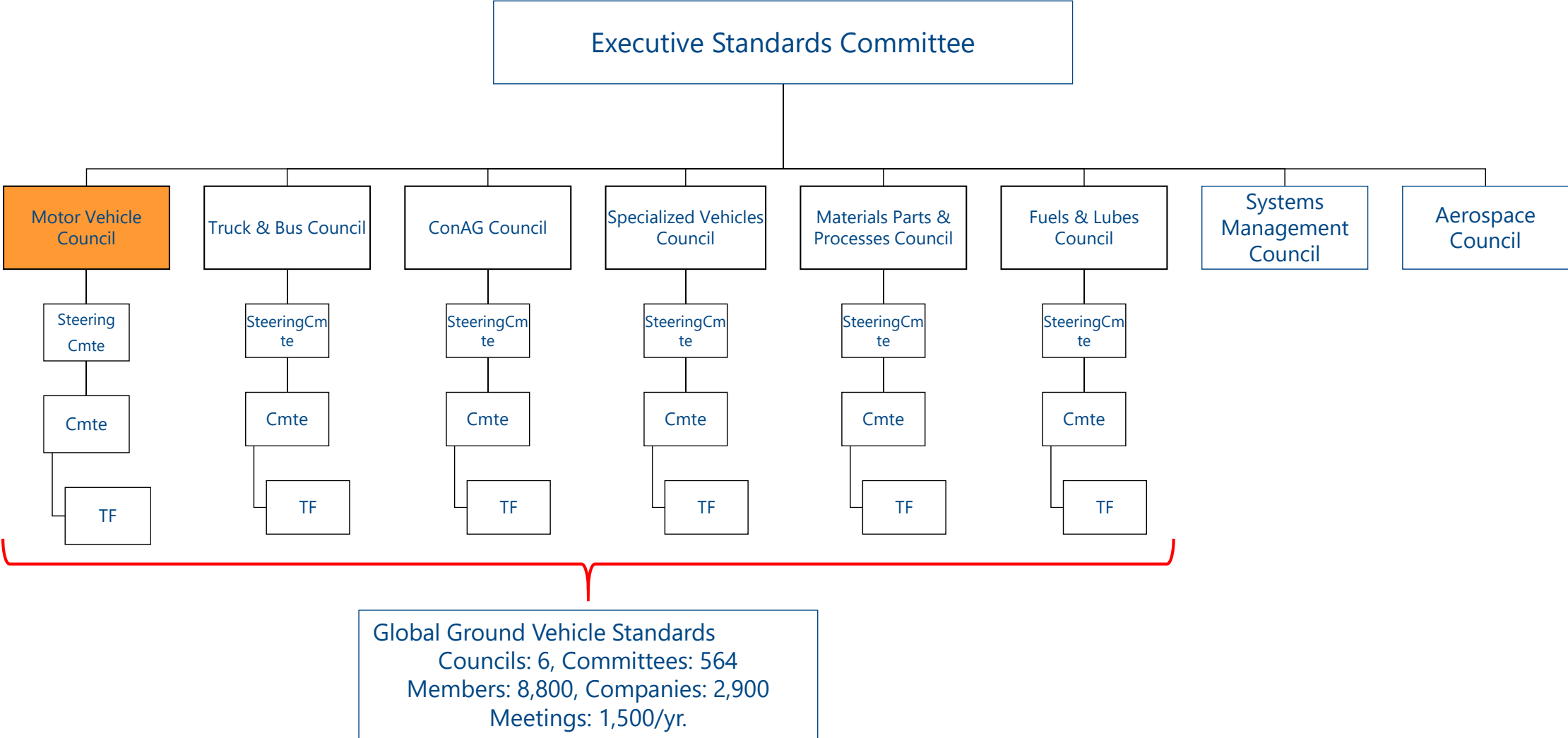# SAE GLOBAL GROUND VEHICLE STANDARDS

JACK POKRZYWA
jack.Pokrzywa@sae.org
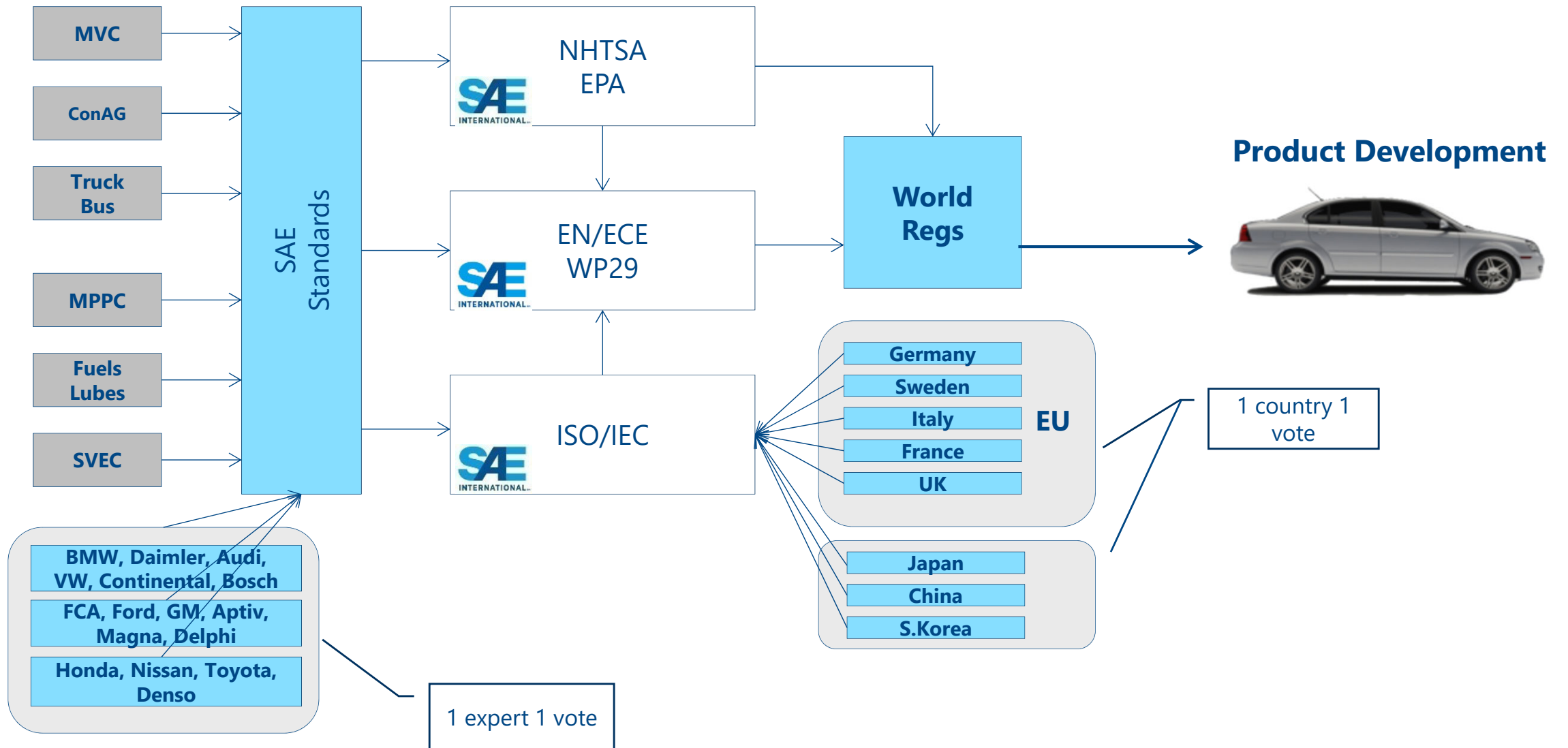
Global industry engagement makes a difference
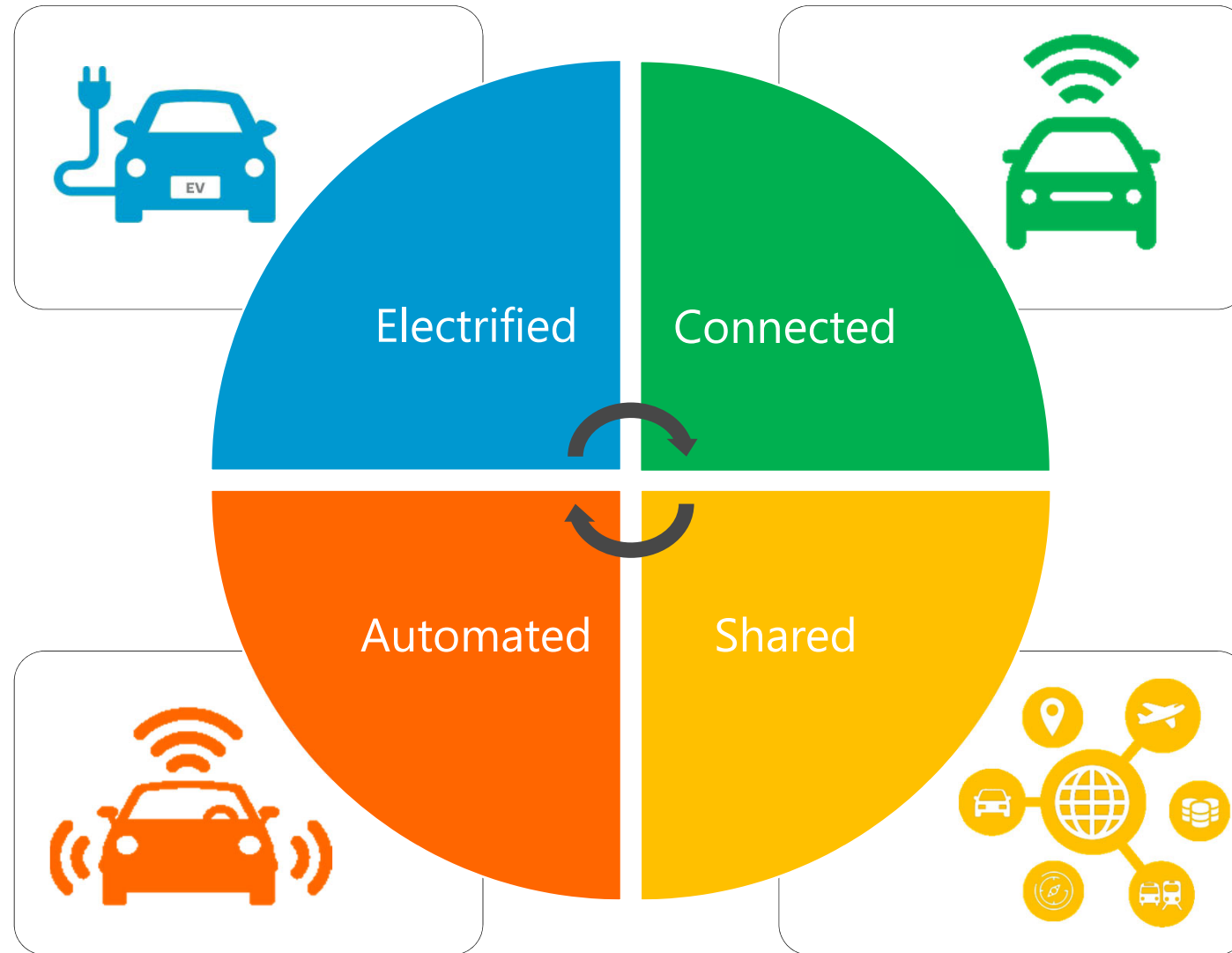
Global Ground Vehicle Standards structure
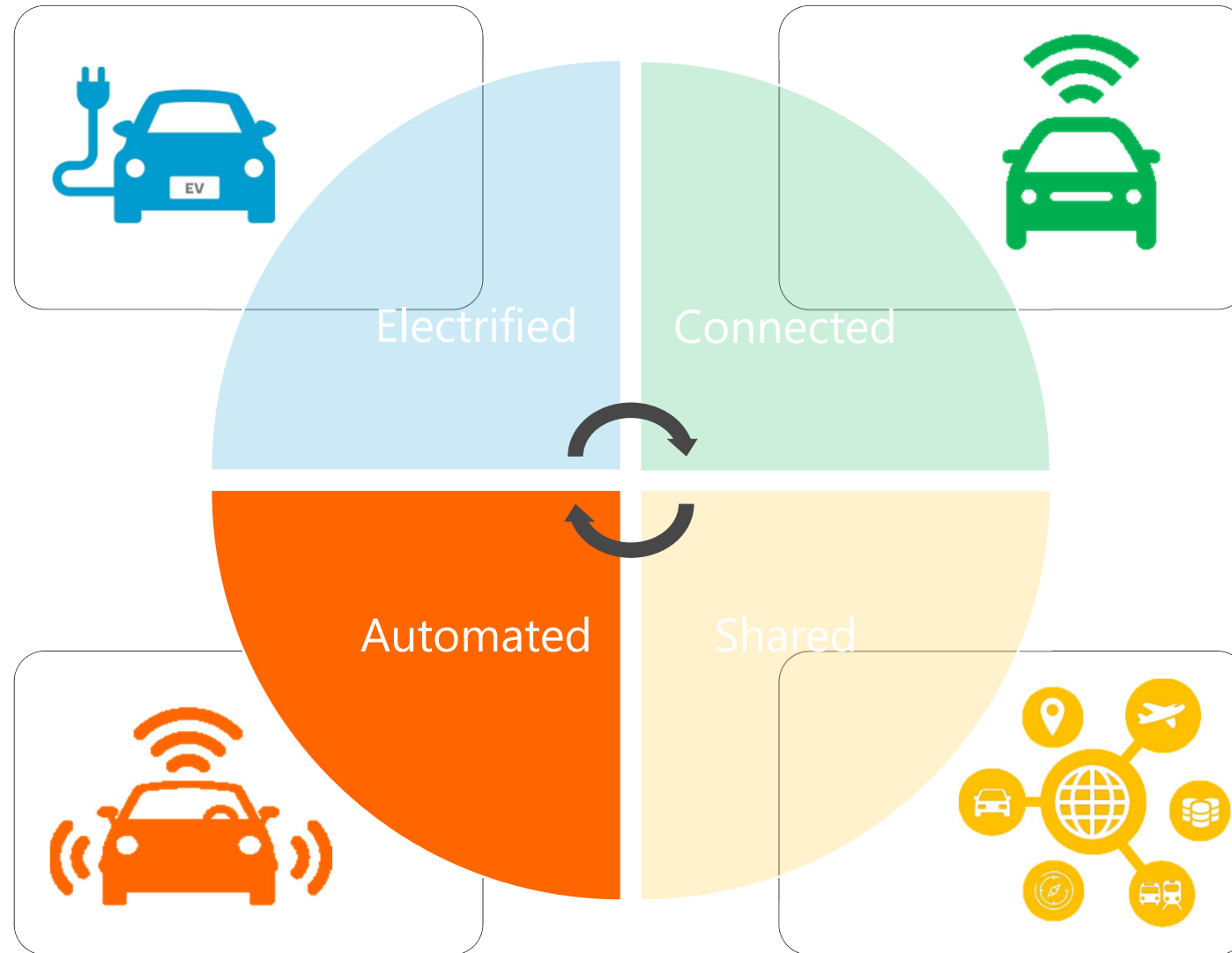
Regulatory and Product Effect of SAE Standards

4 trends in mobility

4 trends in mobility

Electrified

Connected

Automated

Shared

Automated - SAE Automation Standards – J3016™

| Level | Name | Narrative Definition | DDT | | DDT Fallback | ODD |
			Sustained lateral & longitudinal vehicle motion control	OEDR		
Driver performs part or all of the DDT						
0	No Driving Automation	The performance by the **driver** of the entire *DDT*, even when enhanced by *active safety systems*	Driver	Driver	Driver	N/A
1	Driver Assistance	The *sustained* and *ODD*-specific execution by a *driving automation system* of either the *lateral* or the *longitudinal vehicle motion control* subtask of the DDT (but not both simultaneously) with the expectation that the *driver* performs the remainder of the *DDT*.	Driver and System	Driver	Driver	Limited
2	Partial Driving Automation	The *sustained* and *ODD*-specific execution by a *driving automation system* of both the *lateral* and *longitudinal vehicle motion control* subtasks of the *DDT* with the expectation that the *driver* completes the *OEDR* subtask and *supervises* the *driving automation system*.	**System**	Driver	Driver	Limited
ADS ("*System*") performs the entire *DDT* (while engaged)						
3	Conditional Driving Automation	The *sustained* and *ODD*-specific performance by an *ADS* of the entire DDT with the expectation that the *DDT fallback-ready user* is *receptive* to *ADS*-issued *requests to intervene*, as well as to DDT performance-relevant system failures in other *vehicle systems*, and will respond appropriately.	System	**System**	Fallback-ready user (becomes the driver during fallback)	Limited
4	High Driving Automation	The *sustained* and *ODD*-specific performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*.	System	System	**System**	Limited
5	Full Driving Automation	The *sustained* and unconditional (i.e., not *ODD*-specific) performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*.	System	System	System	**Unlimited**

SAE J3016™ principles

8.1 J3016 is not a specification and imposes no requirements.

J3016 provides a logical taxonomy for classifying *driving automation features* (and *ADS-dedicated vehicles*), along with a set of terms and definitions that support the taxonomy and otherwise standardize related concepts, terms and usage in order to facilitate clear communications.

<u>As such, J3016 is a convention based upon reasoned agreement, rather than a technical specification.</u>

SURFACE VEHICLE RECOMMENDED PRACTICE

J3016™

(R) Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles

Issued   2014-01
Revised   2018-06

Superseding J3016 SEP2016

JUN2018
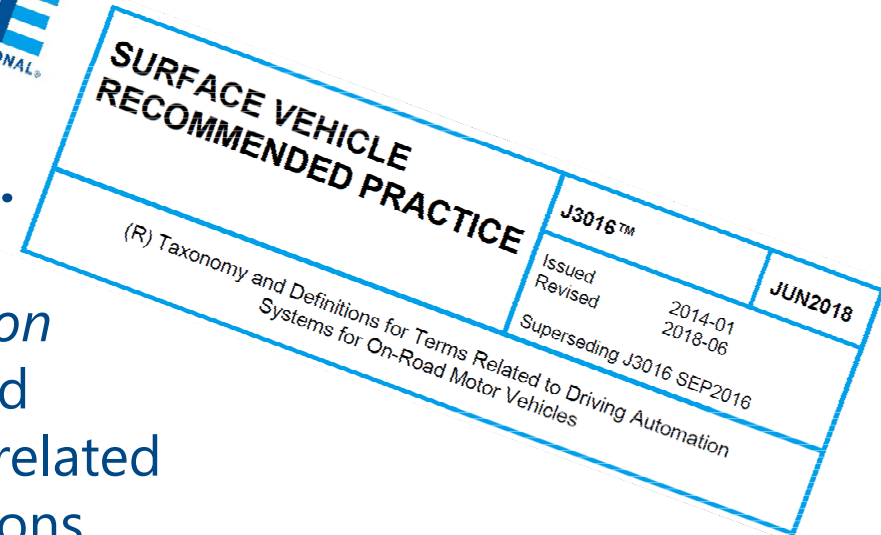
Why level 3?

Time and safety critical conditions (examples)

Accidents   Inclement weather   Work zones

Why level 3?

Operational Design Domain

Road markings

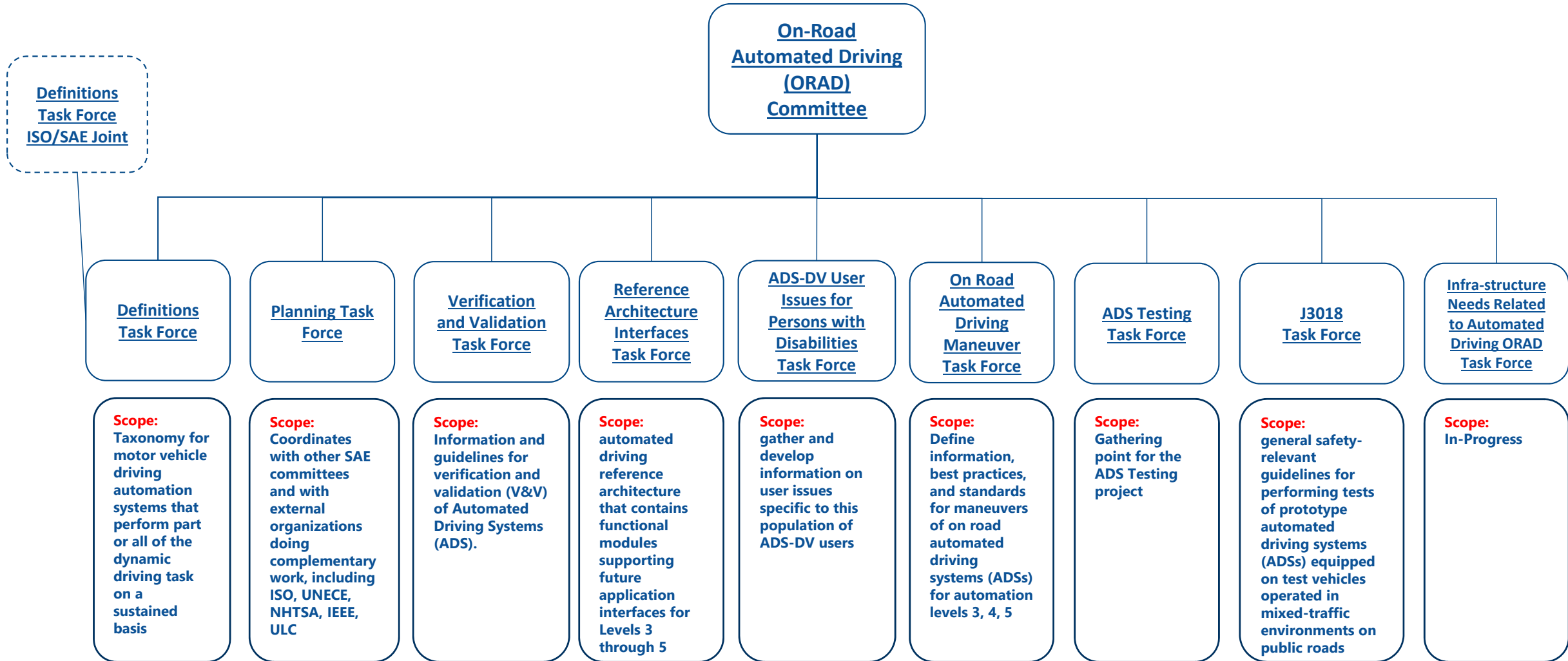Divided expressway

Clear road signs

Automated Levels – consumer version

SAE J3016™ LEVELS OF DRIVING AUTOMATION

	SAE LEVEL 0	SAE LEVEL 1	SAE LEVEL 2	SAE LEVEL 3	SAE LEVEL 4	SAE LEVEL 5
What does the human in the driver's seat have to do?	You **are** driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You **are not** driving when these automated driving features are engaged – even if you are seated in "the driver's seat"		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
	These are driver support features			**These are automated driving features**		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering **OR** brake/acceleration support to the driver	These features provide steering **AND** brake/acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		This feature can drive the vehicle under all conditions
Example Features	• automatic emergency braking • blind spot warning • lane departure warning	• lane centering **OR** • adaptive cruise control	• lane centering **AND** • adaptive cruise control at the same time	• traffic jam chauffeur	• local driverless taxi • pedals/steering wheel may or may not be installed	• same as level 4, but feature can drive everywhere in all conditions

For a more complete description, please download a free copy of SAE J3016: https://www.sae.org/standards/content/j3016_201806/

Automated – where SAE standards are developed

Definitions Task Force ISO/SAE Joint

On-Road Automated Driving (ORAD) Committee

Definitions Task Force	**Planning Task Force**	**Verification and Validation Task Force**	**Reference Architecture Interfaces Task Force**	**ADS-DV User Issues for Persons with Disabilities Task Force**	**On Road Automated Driving Maneuver Task Force**	**ADS Testing Task Force**	**J3018 Task Force**	**Infra-structure Needs Related to Automated Driving ORAD Task Force**
Scope: Taxonomy for motor vehicle driving automation systems that perform part or all of the dynamic driving task on a sustained basis	**Scope: Coordinates with other SAE committees and with external organizations doing complementary work, including ISO, UNECE, NHTSA, IEEE, ULC**	**Scope: Information and guidelines for verification and validation (V&V) of Automated Driving Systems (ADS).**	**Scope: automated driving reference architecture that contains functional modules supporting future application interfaces for Levels 3 through 5**	**Scope: gather and develop information on user issues specific to this population of ADS-DV users**	**Scope: Define information, best practices, and standards for maneuvers of on road automated driving systems (ADSs) for automation levels 3, 4, 5**	**Scope: Gathering point for the ADS Testing project**	**Scope: general safety-relevant guidelines for performing tests of prototype automated driving systems (ADSs) equipped on test vehicles operated in mixed-traffic environments on public roads**	**Scope: In-Progress**

SAE INTERNATIONAL

Standards Overview

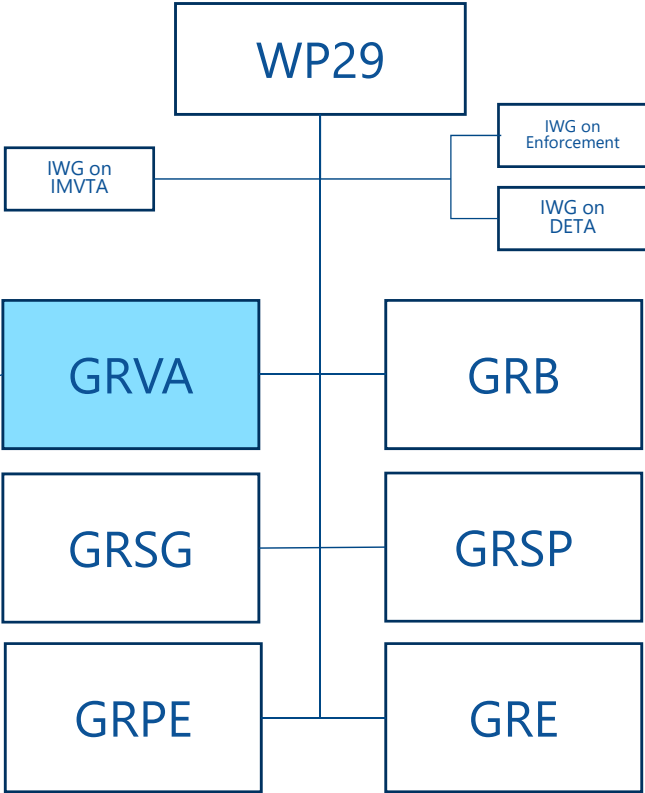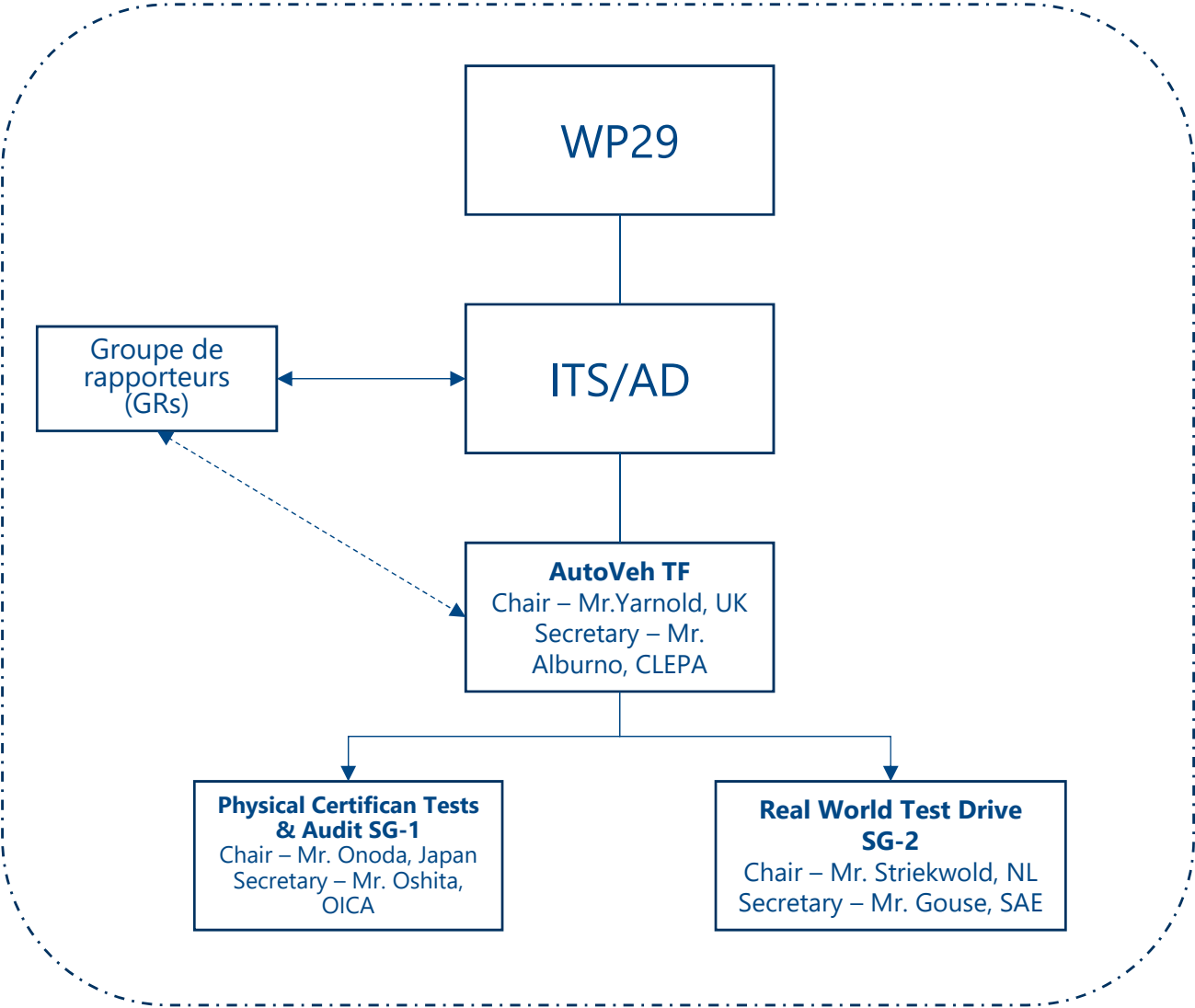| Standard	Description	Status / Timing
J3016™	Recommended Practice: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles Seminal standard for automated driving systems (ADS) that defines key terms and a hierarchy of automation (levels 0-5). Allows industry to speak with a common language about ADS.	Originally published as an information report in 2014. Current Recommended Practice was published in September 2016. A revision was published by June 2018. Associated 1-page infographic expected to be issued soon. Currently being revised jointly with ISO TC204 WG14 to further clarify and refine definitions and specifically deepen the Operational Design Domain (ODD) definition. May be published by end of 2019.
J3018™	Information Report: Guidelines for Safe On-Road Testing of SAE Level 3, 4, and 5 Prototype Automated Driving Systems (ADS) This document provides 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.	Originally Published March 2015. The standard was re-opened in April 2018. Document revision is underway. Updating contents by incorporating lessons-learned and making it compatible with related standards. Publication timing not yet finalized, but potentially by Q2 2019.
J3131	Recommended Practice: Automated Driving Reference Architecture Defines an ADS reference architecture that contains functional modules supporting future application interfaces for Levels 3 through 5 (J3016) with supporting terminology and best practices.	In development. Finalizing draft text prior to starting an ORAD committee ballot. The first document, J3131/1 expected to ballot in early 2019. ORAD experts anticipate follow-on document parts.

Standards Overview

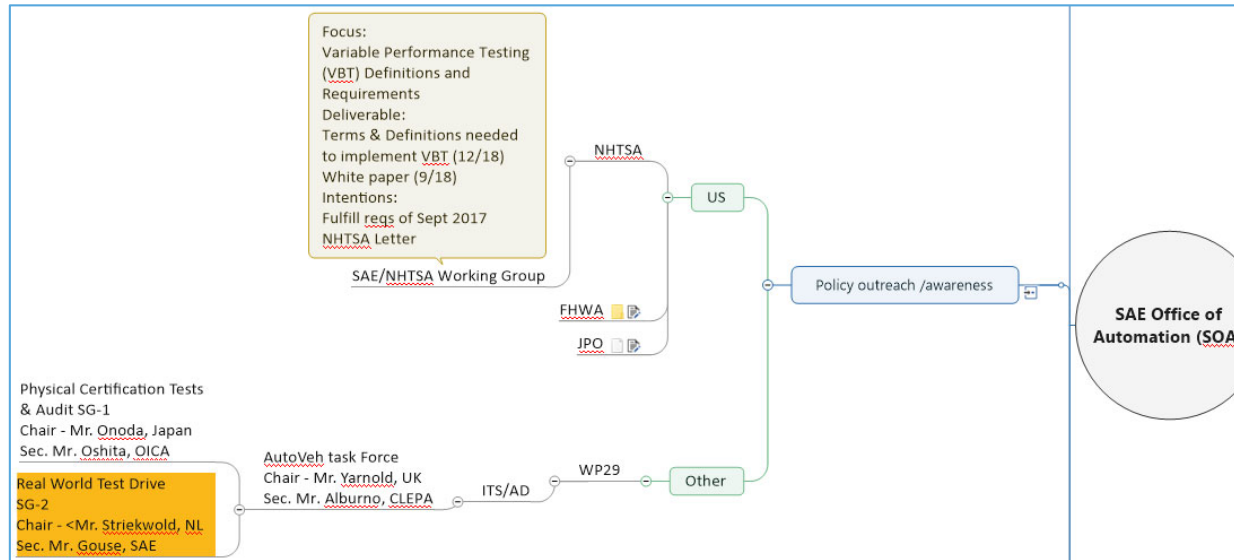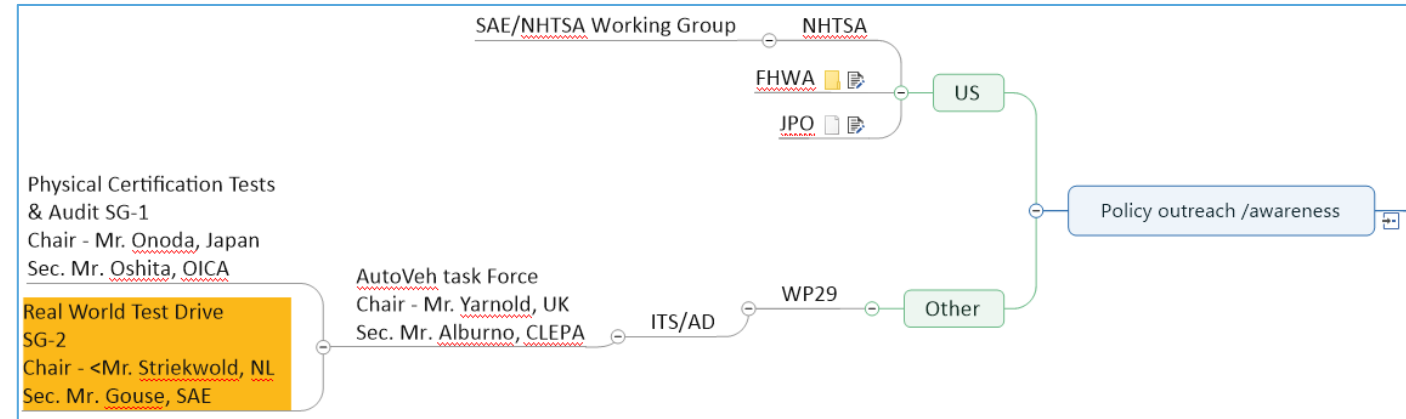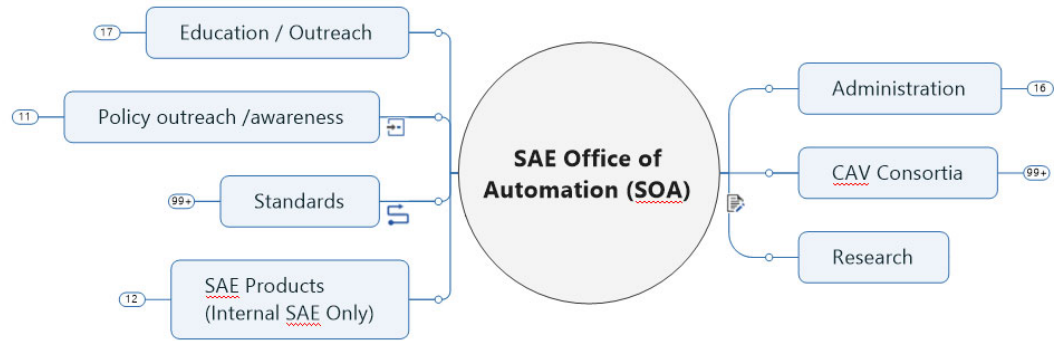| Standard	Description	Status / Timing
J3092	Information Report: Dynamic Test Procedures for Verification and Validation of Automated Driving Systems	In development. Completing literature review of activities for more than 20 entities across the world working on automated vehicles. Task Force intends for an eventual V&V Recommended Practice, but is currently is pursuing an Information Report.
J3171	Information Report: ADS-DV User Issues for Persons with Disabilities It is expected that level 4 and 5 Automated Driving System - dedicated vehicles (ADS-DVs) will eventually enable persons to travel at will who are otherwise unable to obtain a driver's license for a conventional vehicle, namely, persons with visual, physical, and/or cognitive impairments.	In development. The information report is being developed through literature review (including regulatory requirements, research papers and policy statements) and interviews with advocacy groups, government agencies, and researchers. Publication timing not yet finalized, but potentially by mid-2019.
J3164	Taxonomy and Definitions for Terms Related to Automated Driving System Behaviors and Maneuvers for On-Road Motor Vehicles Focused on behaviors and maneuvers for ADS for automation levels 3 through 5.	In development. Begun in January 2018. The task force will seek to codify the behaviors and maneuvers for ADS levels 3-5. Reviewing NHTSA documents regarding human drivers and research from California PATH and University of Waterloo. ORAD Committee feels that Variable Performance Testing for ADS activities outside of the SAE standards committee structure will feed this task force to develop more robust SAE standards. Likely stemming from a common approach to developing testing scenarios will arise.

Non-ORAD Automation Standards

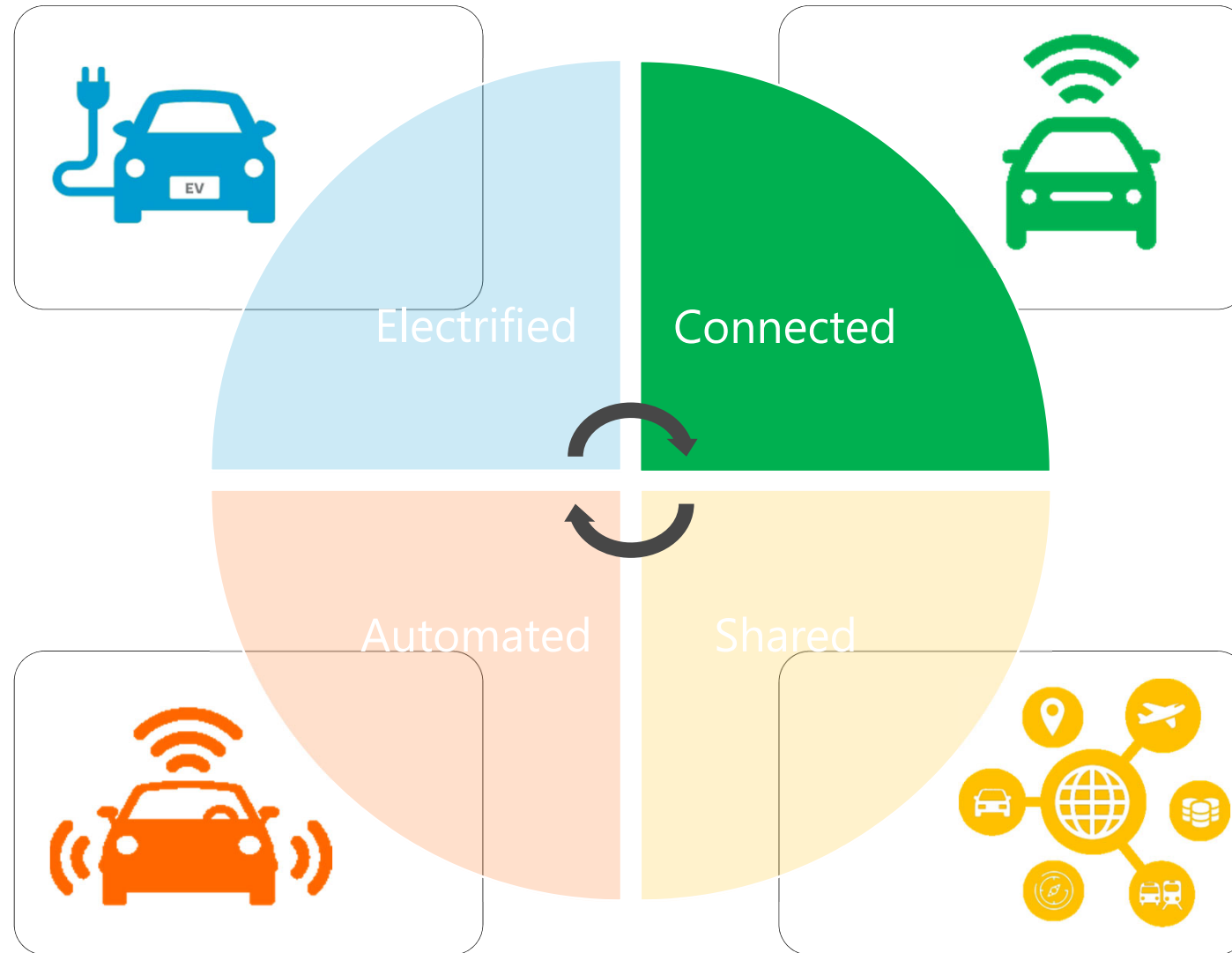| Committee	Overview
Driving Automation Systems	This Technical Committee is responsible for all safety & human factors issues concerning driving automation systems and how these new technologies will impact the driving experience. This includes any vehicle that involves human operation, either in-vehicle or remotely located, transitioning into or out of Level 1 driving automation and above, and/or based on any interaction of human road users with driving automation systems. J3114- Human Factors Definitions for Automated Driving and Related Research Topics (Dec 2016)
ADS Logger Task Force	The Event Data Recorder Committee established this Task Force to detail ADS data elements and definitions that can be gathered in crash or near-crash events in ADS. These additional data elements may be those useful for accident reconstruction involving an ADS-equipped vehicle or allowing determination of whether further analysis into the ADS system performance or non-ADS system performance is needed.
ADS Lamps Task Force	Signaling and Marking Devices Standards Committee established this Task Force to develop test procedures, performance requirements, and design guidelines for autonomous vehicle lighting (J3134).
Driving Skills Committee	Drafting J3300 AV Safety Operator endorsement for test drivers (safety operators) on proving grounds as a complement to the four skill levels defined in the foundational license.

WP 29 Automated Vehicle Activities

SAE Office Of Automation

4 trends in mobility

Electrified

Connected

Automated

Shared

Connected – where SAE standards are developed

V2X Communications Steering Committee

DSRC Technical Committee	C-V2X Technical Committee	Advanced Applications Technical Committee	Security Technical Committee	Cross-Cutting Technical Committee	Infrastructure Applications Technical Committee	Traffic Signal Applications Technical Committee	Vehicular Applications Technical Committee	Tolling Applications Technical Committee
Scope: DSRC Radio access-specific items	**Scope:** C-V2X Radio access-specific items	**Scope:** Lower layer-unknown applications that may require new communication technologies	**Scope:** Over the air security	**Scope:** Common to multiple applications or communication technologies	**Scope:** Infrastructure applications that do not require traffic signal data	**Scope:** Infrastructure applications that require traffic signal data or interface	**Scope:** Vehicle communication needs	**Scope:** Applications for tolling and financial transactions

Connected - SAE DSRC Standards

- Supports interoperability
- Defines standardized message sets
- Defines formats for basic safety message set dictionary
- Being revised to meet new needs/applications

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

Published

J2735 Message Set Dictionary
- Basic Safety Message (BSM)
- MapData (Map) message
- Signal Phase and Timing (SPaT)
- Personal Safety Message (for pedestrian and other vulnerable road users)
- Traveler Information Message (TIM)

J2945/0 Systems Engineering Process Guidance for J2945/x Documents and Common Design Concepts
- System engineering example
- Communication protocol
- Channel use
- V2X message/application priority

Published

| J2945/1 On-Board System Requirements for V2V Safety Communications | J2945/9 VRU (V2P) Safety Message Minimum Performance Requirements | J2945/2 Performance Requirements for V2V Safety Awareness | J2945/3 Requirements for V2I Weather Applications | J2945/4 V2I Road Safety (title TBD) Applications | J2945/5 Message Security | J2945/6 CACC/ Platooning Performance Requirements |

Published

Published

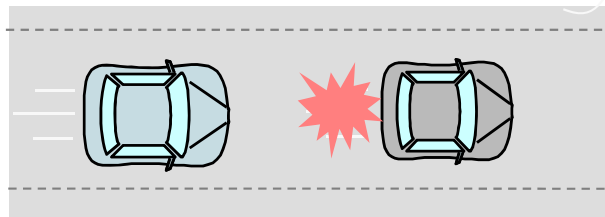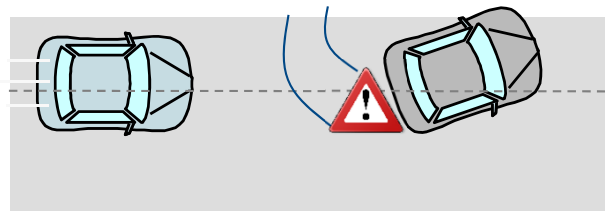| J2945/10 Map/SPaT Related | J2945/11 Signal Preemption Related | J2945/12 Traffic Probe Use and Operation |

SAE INTERNATIONAL

J2945/1"On-Board System Requirements for V2V Safety Communications"
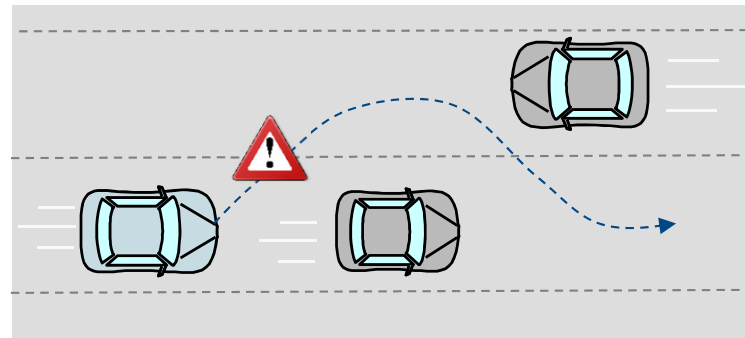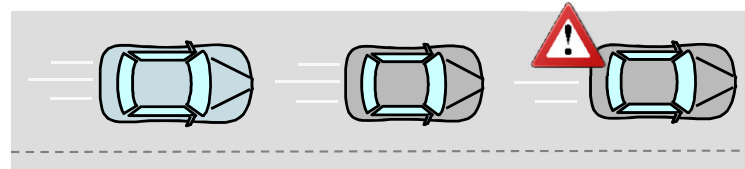

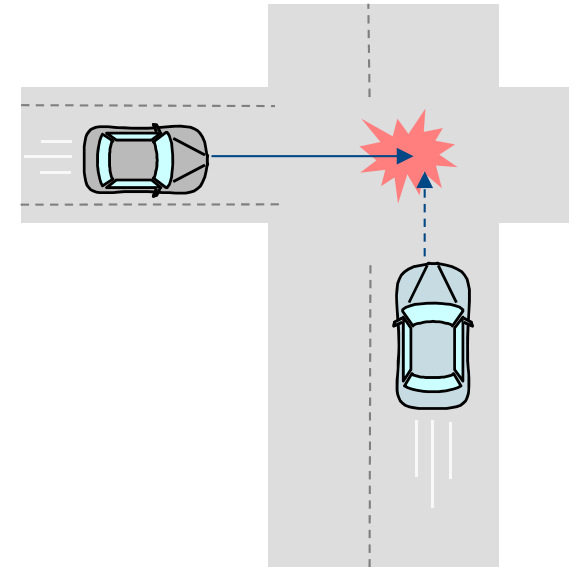Blind Sport Warning

Forward Collision
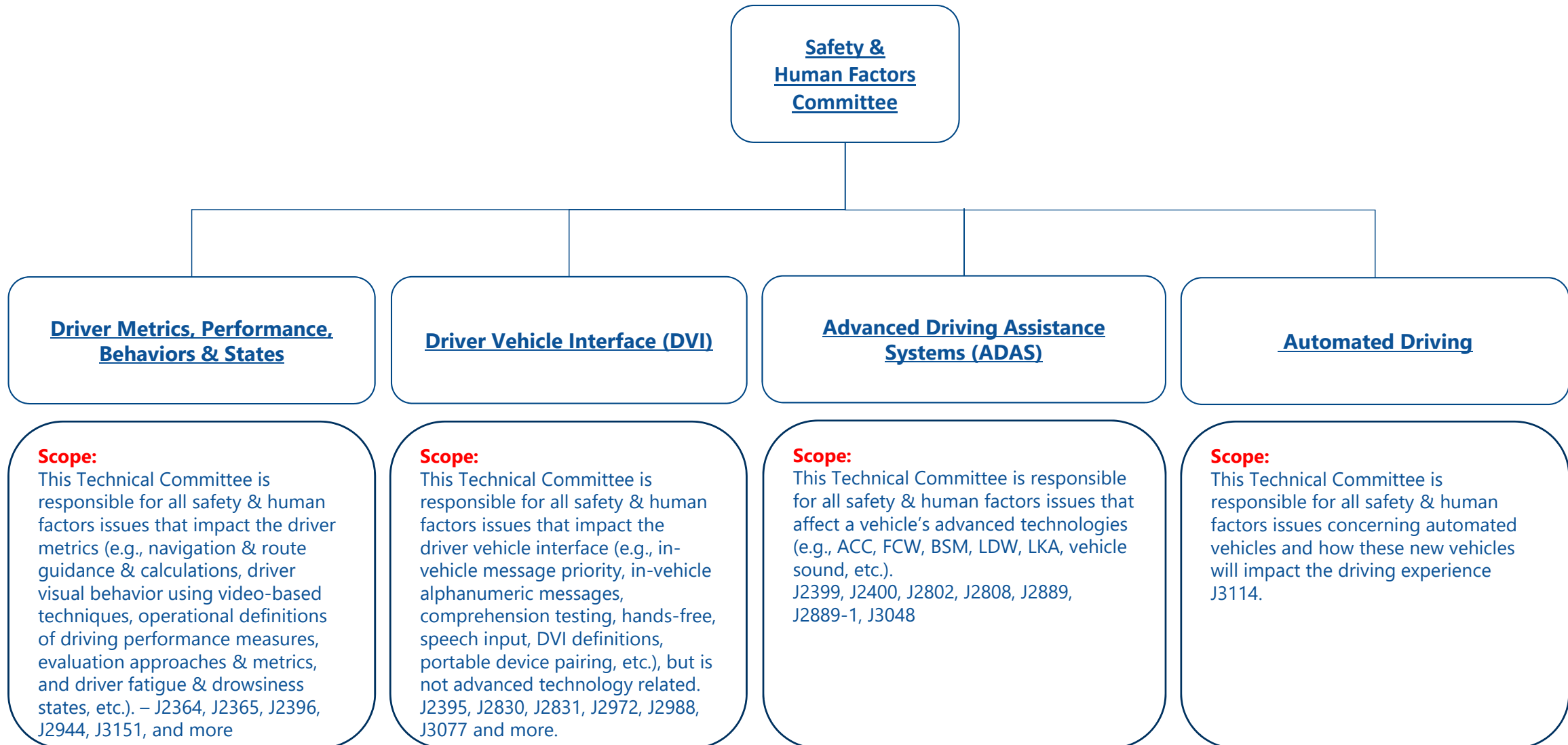Warning

Control Loss
Warning

Do Not Pass Warning

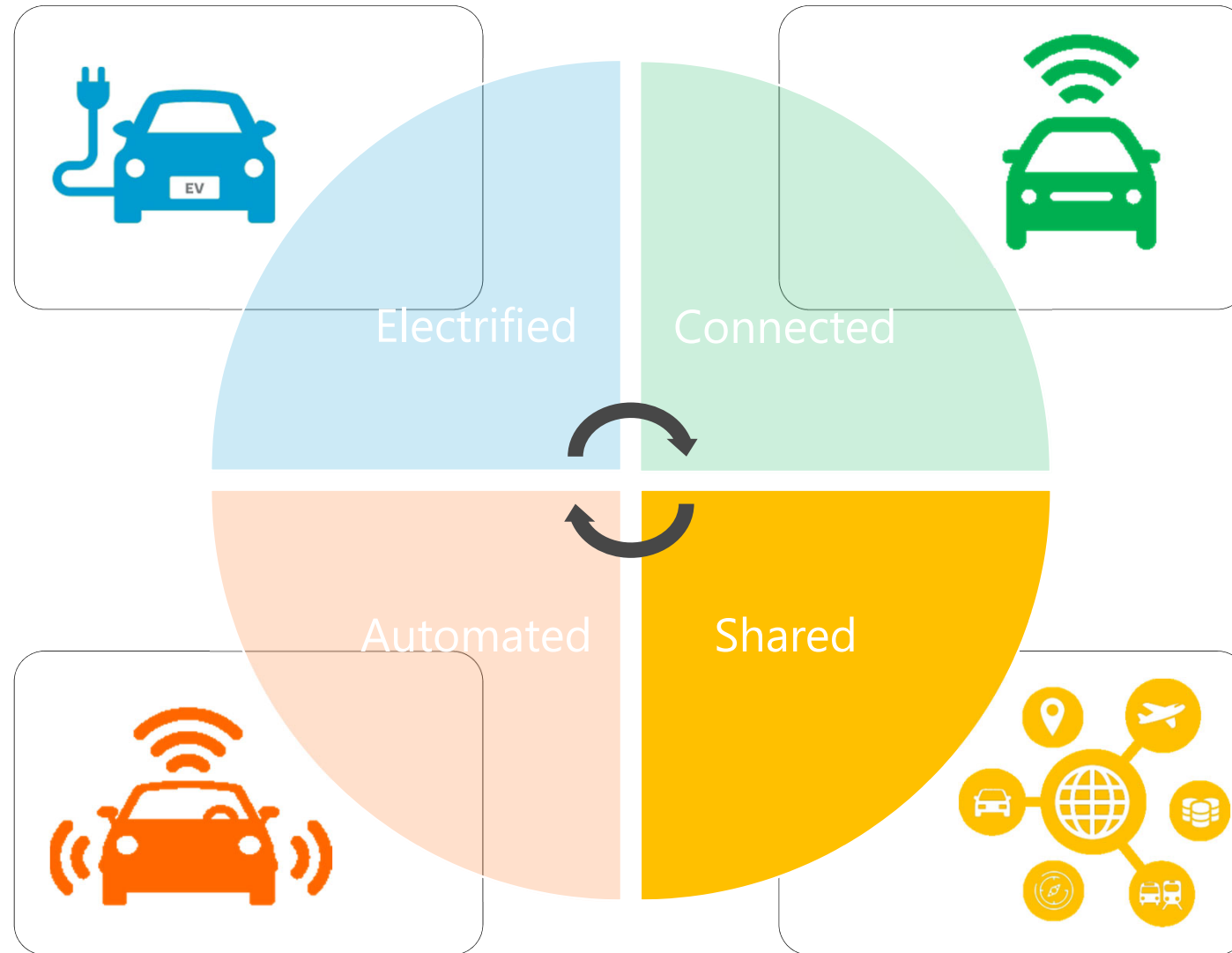Electronic Emergency
Brake Lights

Intersection
Movement Assist

- 1st edition of on-board system requirements standard for V2V safety communications

- Support interoperability and data integrity

- Largely referenced by USDOT's V2V safety system NPRM

Human Factors – where SAE standards are developed

Safety & Human Factors Committee

Driver Metrics, Performance, Behaviors & States

Scope:
This Technical Committee is responsible for all safety & human factors issues that impact the driver metrics (e.g., navigation & route guidance & calculations, driver visual behavior using video-based techniques, operational definitions of driving performance measures, evaluation approaches & metrics, and driver fatigue & drowsiness states, etc.). – J2364, J2365, J2396, J2944, J3151, and more

Driver Vehicle Interface (DVI)

Scope:
This Technical Committee is responsible for all safety & human factors issues that impact the driver vehicle interface (e.g., in-vehicle message priority, in-vehicle alphanumeric messages, comprehension testing, hands-free, speech input, DVI definitions, portable device pairing, etc.), but is not advanced technology related. J2395, J2830, J2831, J2972, J2988, J3077 and more.

Advanced Driving Assistance Systems (ADAS)

Scope:
This Technical Committee is responsible for all safety & human factors issues that affect a vehicle's advanced technologies (e.g., ACC, FCW, BSM, LDW, LKA, vehicle sound, etc.).
J2399, J2400, J2802, J2808, J2889, J2889-1, J3048

Automated Driving

Scope:
This Technical Committee is responsible for all safety & human factors issues concerning automated vehicles and how these new vehicles will impact the driving experience J3114.

SAE INTERNATIONAL

4 trends in mobility

Electrified

Connected

Automated

Shared

What is Shared Mobility?

Shared mobility is the **shared** use of a vehicle, motorcycle, scooter, bicycle, or other travel mode. **Shared mobility** provides users with short-term access to one of these modes of travel as they are needed.

Background

Rapidly advancing technology	Congestion & Travel time	Increasing traveler expectations
Environmental concerns	Demographic changes	Limited Resources

https://www.sae.org/shared-mobility

SAE Shared And Digital Mobility Standards Committee

First Mile — Shared Mobility — Last Mile
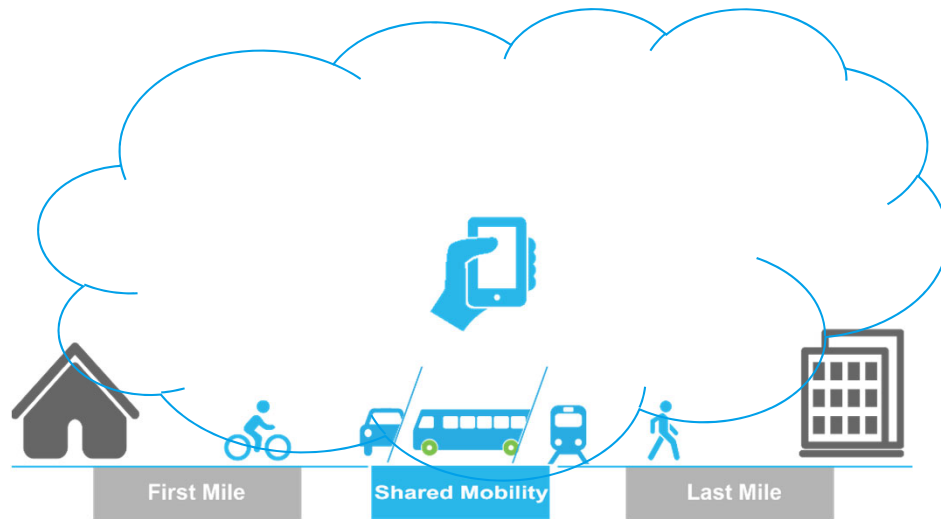
SAE Shared and Digital Mobility Committee embarked on the task of standardizing terms and definitions related to shared mobility.
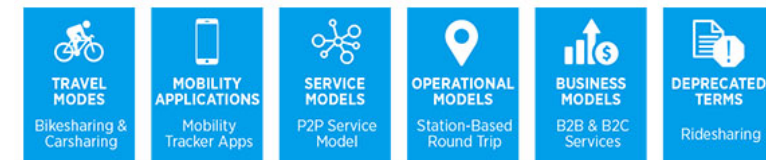
MILESTONES

- Established in September 2017
- First technical report:

  J3163 – Taxonomy and Definitions for Terms Related to Shared Mobility and Enabling Technologies.

It covers six categories of terms related to shared mobility:

- TRAVEL MODES — Bikesharing & Carsharing
- MOBILITY APPLICATIONS — Mobility Tracker Apps
- SERVICE MODELS — P2P Service Model
- OPERATIONAL MODELS — Station-Based Round Trip
- BUSINESS MODELS — B2B & B2C Services
- DEPRECATED TERMS — Ridesharing

Published

-
  - Symbols and signage for shared mobility
  - Data format for data sharing
  - Household travel surveys
  - Exploring intersect with core GV technologies
  - Revision in second half of 2019

SAE Micro-Mobility Devices Committee

New!

Electric Kick Scooter

Electric Skateboard

(Half) Segways

Electric Self-Balancing Unicycles

Emerging and innovative mobility vehicles and devices, sometimes referred to as micro-mobility, are proliferating in cities around the world.

These technologies have the potential to expand mobility options for a variety of people. Some of these technologies fall outside traditional definitions, standards, and regulations.

This committee will initially focus on low-speed personal mobility devices and the technology and systems that support them that are not normally subject to the United States Federal Motor Vehicle Safety Standards or similar regulations. These may be device-propelled or have propulsion assistance.
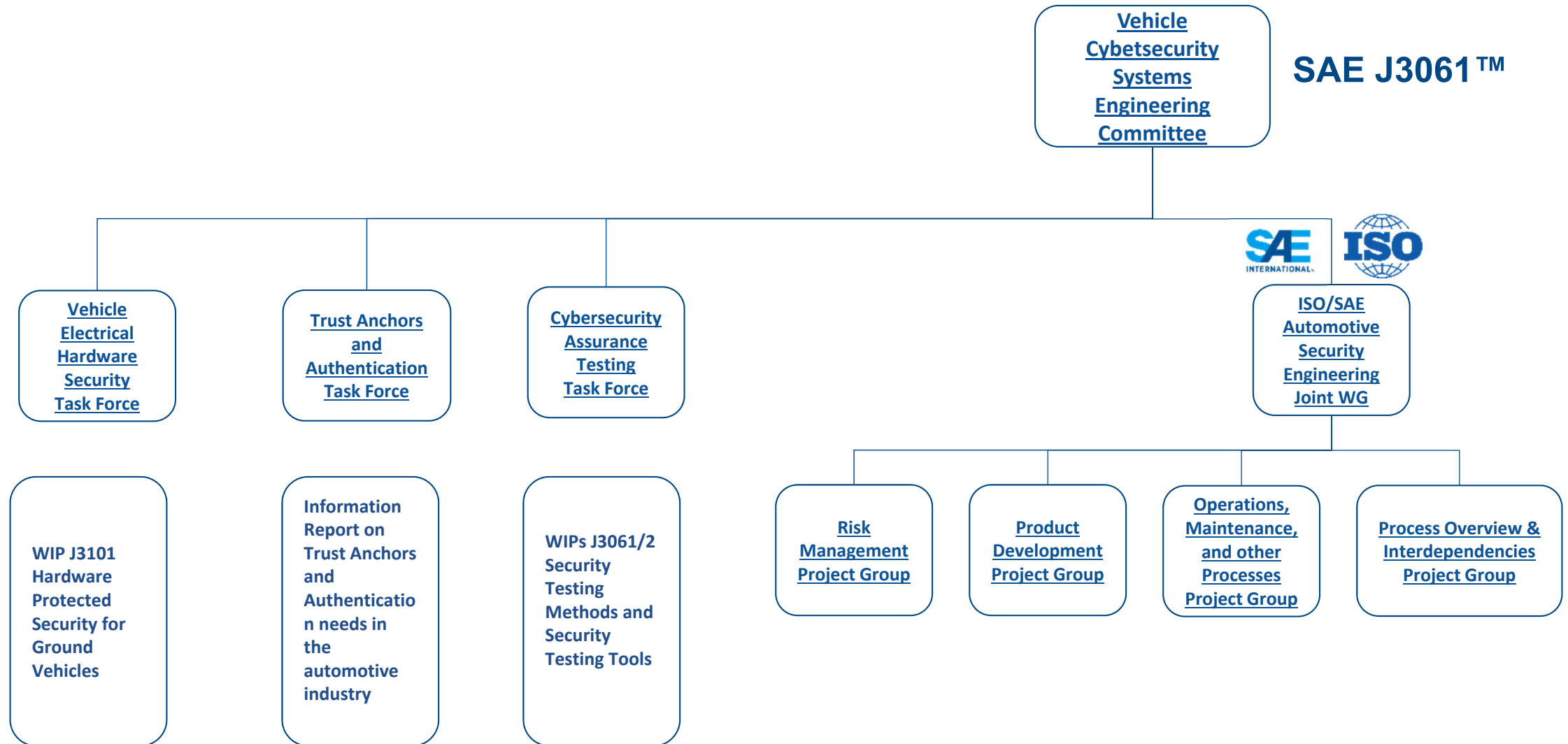
Initial standards:

1. Taxonomy of Micromobility Devices
2. J3171 ADS-DV User Issues for Persons with Disabilities

5th trend in mobility - cybersecurity

Electrified   Connected

Automated   Shared

Cybersecurity – where SAE standards are developed

Vehicle Cybetsecurity Systems Engineering Committee

SAE J3061™

Vehicle Electrical Hardware Security Task Force

Trust Anchors and Authentication Task Force

Cybersecurity Assurance Testing Task Force

ISO/SAE Automotive Security Engineering Joint WG

WIP J3101 Hardware Protected Security for Ground Vehicles

Information Report on Trust Anchors and Authenticatio n needs in the automotive industry

WIPs J3061/2 Security Testing Methods and Security Testing Tools

Risk Management Project Group

Product Development Project Group

Operations, Maintenance, and other Processes Project Group

Process Overview & Interdependencies Project Group

SAE Standards on a Global Platform

Joint development of SAE/ISO standards

Road Vehicle & Intelligent Transportation Systems (ITS)

SAE Standards on a Global Platform

SAE is providing Secretariat function

To ISO TC204 Intelligent Transport System

SAE Standards on a Global Platform

Questions?

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