FIRST REVISION OF J3016 – UPDATE ON TASK FORCE ACTIVITIES

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(SAE On-Road Automated Vehicle Standards Committee)
Revision history of original version of J3016

- Full ORAV review August 2012
- Survey ballot DEC2012 (closed 04JAN2013) – passed
- 1st formal ballot FEB2013 – passed unanimously with comments
- 2nd formal ballot NOV2013 – passed unanimously with minor comments
- Published 11JAN2014

Primary source/reference documents for J3016:JAN2014

- BASf (Tom Gasser, et al.)
- NHTSA draft definitions (presented at January, 2013, SAE G-I Meeting)

Motivation for revisions to J3016

- BASf/VDA/OICA harmonization with J3016 taxonomy and supporting definitions for WP29 discussions
- Application and adaptation of J3016 levels and definitions in AdaptlVe and CAMP AVR projects
- Information and ideas gleaned from other sources (conferences, meetings, academic exchanges, etc.)
<table>
<thead>
<tr>
<th>SAE level</th>
<th>Name</th>
<th>Narrative Definition</th>
<th>Execution of Steering and Acceleration/Deceleration</th>
<th>Monitoring of Driving Environment</th>
<th>Fallback Performance of Dynamic Driving Task</th>
<th>System Capability (Driving Modes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Human driver monitors the driving environment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>No Automation</td>
<td>the full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems</td>
<td>Human driver</td>
<td>Human driver</td>
<td>Human driver</td>
<td>n/a</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance</td>
<td>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</td>
<td>Human driver and system</td>
<td>Human driver</td>
<td>Human driver</td>
<td>Some driving modes</td>
</tr>
<tr>
<td>2</td>
<td>Partial Automation</td>
<td>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</td>
<td>System</td>
<td>Human driver</td>
<td>Human driver</td>
<td>Some driving modes</td>
</tr>
<tr>
<td></td>
<td><strong>Automated driving system (&quot;system&quot;) monitors the driving environment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Conditional Automation</td>
<td>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</td>
<td>System</td>
<td>System</td>
<td>Human driver</td>
<td>Some driving modes</td>
</tr>
<tr>
<td>4</td>
<td>High Automation</td>
<td>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</td>
<td>System</td>
<td>System</td>
<td>System</td>
<td>Some driving modes</td>
</tr>
<tr>
<td>5</td>
<td>Full Automation</td>
<td>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</td>
<td>System</td>
<td>System</td>
<td>System</td>
<td>All driving modes</td>
</tr>
</tbody>
</table>
Characteristics of the DDT, fallback operation, and operational design domain determine the level of each driving automation system application.

Does the driving automation feature:

Perform sustained control of lateral or longitudinal vehicle motion, but rely on the driver to perform the remainder of DDT?

Perform both sustained longitudinal and sustained lateral vehicle motion control, but rely on the driver to complete OEDR?

Perform complete DDT during normal operation, but rely on the human user to perform DDT fallback?

Perform complete DDT and DDT fallback within a limited operational design domain, without need for intervention by a human user?

Perform complete DDT and DDT fallback in all on-road conditions, without need for intervention by a human user?

Blue text indicates new terms to be defined in revised J3016
Maintain

- The 6 levels, including names and numbers
- The functional differentiators for the levels (clarification and/or augmentation, only)
- Table 1 framework and step-wise logic (wording changes, only)

Revisions include

- Clarify and rationalize taxonomical differentiator(s) for lower levels
- Clarify scope of taxonomy (to what it does and does not apply)
- Modify existing, and add new, supporting terms and definitions
- Add more rationale, examples, and explanatory text throughout
The SAE J3016 taxonomy classifies those driving automation features that serve to automate part or all of the DDT on a sustained basis, and thus fundamentally alter the driver’s role.

- **DRAFT definition of sustained (operation):** “Performance of part or all of the DDT between and across external events, including responding to external events and continuing performance of the DDT in the absence of external events.”

- External events are defined as situations in the driving environment that necessitate a response

- Driving automation that is not sustained does not qualify as driving automation and is not classifiable (other than at level 0) under the J3016 taxonomy.
  - Systems that provide momentary intervention (e.g., ABS, ESC, AEB, etc.) do not perform any part of the DDT on a sustained basis.
  - Conventional cruise control does not provide sustained operation because it does not respond to external events.
Modify existing, and add new, supporting terms and definitions

New supporting terms and definitions:

- driving automation system (vs. ADS)
- (driving automation system) feature or application
- DDT fallback
- (human) user
  a. driver/operator
    o (conventional) driver
    o remote driver/operator (teleoperator)
  b. passenger
  c. DDT fallback-ready user
  d. dispatcher
- monitor
  a. monitor the driver
  b. monitor the driving environment
  c. monitor vehicle performance
  d. monitor driving automation system performance
- object and event detection and response (OEDR)
- operational design domain (ODD)
- supervise
- sustained
- usage specification
- (user) receptivity
**Example**: DRAFT definition of “monitor driving automation system performance”

The driver activities, performed while using a level 1 or 2 driving automation system, that accomplish evaluation of the driving automation system performance with respect to the driving environment, including response preparation, but excluding any actual response.

Example 1: A conventional driver verifies that an active ACC system is following a preceding vehicle correctly in a curve.

Example 2: A remote operator activating a level 2 automated parking feature monitors the pathway of the vehicle to ensure that it is free of pedestrians or other obstacles.

Note 1: The term “monitor the driving automation system performance” should not be used in lieu of “supervise,” which includes both monitoring and responding, and therefore is more comprehensive.

Note 2: Recognizing driving automation system-issued alerts is not a form of monitoring driving automation system performance, but rather a form of receptivity.

Note 3: At higher levels of automation (levels 3-5), the ADS self-monitors its performance, but this is not considered “monitoring of driving automation system performance,” as the definition would otherwise be circular.
AdaptlVe (Automated driving applications and technologies for Intelligent Vehicles)

- €25 million project running January 1, 2014 - June 30, 2017
- Co-funded by the European Commission as part of the Seventh Framework Programme with €14.3 million supported by the European Council for Automotive R&D, EUCAR
- 29 partners from 8 countries – France, Germany, Greece, Italy, Spain, Sweden, The Netherlands, United Kingdom; including 11 original equipment manufacturers, 4 suppliers, 11 research institutes and universities, and 3 small/medium enterprises
- Objectives include human factors issues, evaluation methods, and legal aspects
- Deliverable D2.1 - System Classification and Glossary
  - Describes harmonization of levels between BASt, VDA, and SAE
  - Applies these harmonized levels and SAE J3016 supporting terms
  - Provides further granularity via a systematic methodology for applying additional classification parameters
### Roadmap

<table>
<thead>
<tr>
<th>Long Term Gens.</th>
<th>Automation Gen. 2</th>
<th>Automation Gen. 1</th>
<th>ADAS new</th>
<th>ADAS established</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervening only in Emergency</td>
<td>0</td>
<td>1</td>
<td>Partial Automation</td>
<td>Conditional Automation</td>
</tr>
<tr>
<td>Driver Only</td>
<td>Assisted</td>
<td>Partial Automation</td>
<td>Conditional Automation</td>
<td>High Automation</td>
</tr>
<tr>
<td>Existing</td>
<td>Low velocity in structured environment</td>
<td>High velocity in structured environment</td>
<td>Unstructured environment</td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- **ADAS**: Advanced Driver Assistance Systems
- **AEBS**: Advanced Emergency Braking Systems
- **ABS**: Antilock Braking System
- **ESC**: Electronic Stability Control
- **LKAS**: Lane Keeping Assistance
- **ACC**: Adaptive Cruise Control
- **FCW**: Forward Collision Warning

**Roadmap Functions:**
- **Park Ass.**
- **Traffic Jam Ass.**
- **Highway System**
- **Valet Parking System**
- **Robot Taxi**

**Environments:**
- **Urban & rural roads**
- **Highway System**
- **Traffic Jam System**
- **Unstructured environment**

**Examples:**
- **Robot Taxi**
- **Urban & rural roads**
- **Highway System**
- **Traffic Jam System**

**Automation Levels:**
- **0**: Intervening only in Emergency
- **1**: Driver Only
- **2**: Assisted
- **3**: Partial Automation
- **4**: Conditional Automation
- **5**: High Automation
- **6**: Full Automation

**Note:**
Automated Driving, OICA, June 15, 2015
CAMP AVR (Crash Avoidance Metrics Partnership Automated Vehicle Research)

• Cooperative Research Agreement with NHTSA running from November, 2013 through July, 2015
• Consortium members: Ford Motor Company, General Motors, Nissan, Mercedes-Benz, Toyota, and Volkswagen Group of America
• Objectives included: functional descriptions of automation levels, list of potential driving automation features, level-specific safety principles, potential objective test methods for evaluating driving automation systems
• CAMP AVR Consortium incorporated the SAE J3016 levels and supporting terms and embellished upon them
• Final report has been submitted to NHTSA