

## **Consolidation of FRAV working papers “Document 5”**

### 1. Purpose of this document

- 1.1. FRAV has established this document to facilitate and record its work in progress. Contents of this document may change in accordance with FRAV decisions.
- 1.2. This document may inform interested parties on the status of work within FRAV.
- 1.3. This document does not constitute a formal or informal proposal. FRAV will issue such proposals in one or more separate documents as determined and approved by the group.
- 1.4. Significant open issues and comments on this document are under discussion within FRAV.

### 2. Definitions

- 2.1. “*Automated Driving System (ADS)*” means the hardware and software that are collectively capable of performing the entire DDT on a sustained basis.<sup>1</sup>
- 2.2. “*(ADS) feature*” means an application of ADS hardware and software designed specifically for use within an ODD.<sup>2</sup>
- 2.3. “*(ADS) function*” means an application of ADS hardware and software designed to perform a specific portion of the DDT.<sup>3</sup>
- 2.4. “*ADS vehicle*” means a vehicle equipped with an ADS.<sup>4</sup>
- 2.5. “*Driver*” means a human being engaged in dynamic control of the vehicle.<sup>5</sup>
  - 2.5.1. A driver should possess the necessary qualifications and be physically and mentally fit to engage in the dynamic control of a vehicle.<sup>6</sup>
- 2.6. “*Dynamic control*” means the real-time execution of operational and tactical functions required to operate a vehicle based on perception, information processing, and decision making.<sup>7</sup>

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<sup>1</sup> Based on FRAV-09-05.

<sup>2</sup> Ibid.

<sup>3</sup> Ibid.

<sup>4</sup> Ibid.

<sup>5</sup> Based on FRAV-16-12 (A driver is a human being who is engaged in real-time in the dynamic control of a vehicle.)

<sup>6</sup> Ibid. Para. 3.2. would provide ADS requirements related to ensuring user fulfilment of safety-relevant roles and responsibilities.

<sup>7</sup> Based on FRAV-09-05, Based on FRAV-14-07/Rev.1, FRAV-16-12 per WP.1/2021/2 (“Dynamic control” refers to carrying out the real-time operational and tactical functions required to move the vehicle. This includes controlling the vehicle’s lateral and longitudinal motion, monitoring the road environment, responding to events in the road traffic environment, and planning and signaling for manoeuvres) and Michon, J.A., 1979 (update

- 2.7. “*Dynamic driving task (DDT)*” means the real-time operational and tactical ADS functions collectively required to operate the ADS vehicle in on-road traffic.<sup>8</sup>
- 2.7.1. The DDT excludes strategic functions such as trip scheduling and selection of destinations and waypoints.<sup>9</sup>
- 2.7.2. The DDT functions can be logically grouped under three main categories:
- 1) Sensing and Perception
  - 2) Planning and Decision
  - 3) Vehicle Control.<sup>10</sup>
- 2.7.3. The requisite DDT functions depend upon the ODD specifications of the ADS feature(s).<sup>11</sup>
- 2.8. “*ADS fallback response*” means an ADS-initiated transfer of control or an ADS-controlled procedure to place the vehicle in a minimal risk condition.<sup>12</sup>
- 2.9. “*Fallback user*” means a user designated to assume the role of driver upon completion of a transfer of control.<sup>13</sup>
- 2.10. “*Operational Design Domain (ODD)*” means the operating conditions under which an ADS feature is specifically designed to function.<sup>14</sup>
- 2.11. “*Operational functions*” refer to basic capabilities such as the capacity to control lateral and longitudinal motion of the vehicle.<sup>15</sup>

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2008). “Dealing with Danger”, Summary Report of the Workshop on Physiological and Psychological Factors in Performance under Hazardous Conditions with Special Reference to Road Traffic Accidents, Gieten, Netherlands, May 23-25, 1978.

<sup>8</sup> Based on FRAV-14-07/Rev.1. This document defines DDT and DDT functions specifically “in the context of an ADS-equipped vehicle”. Therefore, the DDT definition specifically refers to “ADS functions” and “ADS vehicle”. The definition proposes “collectively” in lieu of “all of the” for editorial clarity.

<sup>9</sup> Ibid.

<sup>10</sup> Ibid.

<sup>11</sup> Based on GRVA-07-54 and per para. 4.1.1.

<sup>12</sup> Based on SAE J3016 (2021): “[DDT] Fallback: The response by the user to either perform the DDT or achieve a minimal risk condition (1) after occurrence of a DDT performance-relevant system failure(s), or (2) upon operational design domain (ODD) exit, or the response by an ADS to achieve minimal risk condition, given the same circumstances.” The FRAV mandate is limited to ADS requirements; therefore, the definition is modified to specifically address ADS fallbacks. The reasons for the fallback are omitted because the fallback triggers are addressed by the ADS safety requirements.

<sup>13</sup> Based on SAE J3016 “fallback-ready user” (The user of a vehicle equipped with an engaged Level 3 ADS feature who is properly qualified and able to operate the vehicle and is receptive to ADS-issued requests to intervene and to evident DDT performance-relevant system failures in the vehicle compelling him or her to perform the DDT fallback.). In terms of WP.29 vehicle regulations, the FRAV anticipates requirements to meet the safety need for the driver to be qualified, able, and receptive. See para. 3.2.4.

<sup>14</sup> Based on FRAV-09-05.

<sup>15</sup> Michon, J.A., 1985. “A Critical View of Driver Behavior Models: What Do We Know, What Should We Do?” In L. Evans & R. C. Schwing (Eds.). Human behavior and traffic safety (pp. 485-520). New York: Plenum Press, 1985.

- 2.12. “*Minimal Risk Condition (MRC)*” means a stable and stopped state of the vehicle that minimizes the risk of a crash.<sup>16</sup>
  - 2.13. “*Real time*” means the actual time during which a process or event occurs.<sup>17</sup>
  - 2.14. “*Road-safety agent*” means a human being engaged in directing traffic, enforcing traffic laws, maintaining/constructing roadways, and/or responding to traffic incidents.
  - 2.15. “*Tactical functions*” refer to the real-time planning, decision, and execution of maneuvers.<sup>18</sup>
  - 2.16. “*Transfer of control (TOC)*” means a procedure by which the ADS engages the fallback user in dynamic control of the vehicle such that the fallback user assumes the role of driver upon completion.<sup>19</sup>
  - 2.17. “*(ADS) User*” means a human being engaged in the use of an ADS vehicle where dynamic control of the vehicle is entirely maintained on a sustained basis by the ADS performance of the DDT.<sup>20</sup>
3. Guidelines for ADS descriptions
- 3.1. General considerations
    - 3.1.1. ADS may be designed for specific purposes and to operate under prescribed conditions.<sup>21</sup>
    - 3.1.2. The conditions under which an ADS is designed to operate are known collectively as the Operational Design Domain (ODD).
      - 3.1.2.1. The ODD covers environmental conditions such as rainfall, scenery elements such as drivable area, and dynamic elements such as macroscopic traffic behavior and prescribed speed of the subject vehicle under the prevailing traffic laws.
    - 3.1.3. ADS may be designed to operate with or without a qualified driver in the vehicle. The roles and responsibilities of an ADS user differ depending upon the ADS configuration, intended uses, and limitations on its use.<sup>22</sup>

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<sup>16</sup> Based on SAE J3016 (2021): “A stable, stopped condition to which a user or an ADS may bring a vehicle after performing the DDT fallback in order to reduce the risk of a crash when a given trip cannot or should not be continued.” The revised wording focuses on what an MRC is without additional references to how or why the vehicle has been placed in the MRC. Current discussions on ADS management of safety-critical situations suggest that the safety requirements would stipulate conditions under which the ADS should place the vehicle in an MRC. User decisions to place the vehicle in an MRC manually fall outside the scope of ADS requirements.

<sup>17</sup> Proposed to ensure uniform interpretation of the term “real time”.

<sup>18</sup> Op. cit. Michon, J.A., 1985.

<sup>19</sup> Based on FRAV-16-12.

<sup>20</sup> Based on FRAV-16-12.

<sup>21</sup> GRVA-09-28

<sup>22</sup> Ibid.

- 3.1.4. ADS safety requirements need to address the diversity of configurations, intended uses, and limitations on use while addressing usage specifications of individual ADS.
- 3.1.5. Therefore, FRAV intends to provide guidelines for the manufacturer's description of an ADS, including measurable/verifiable ODD specifications, to enable the application of safety requirements to the ADS under assessment.
- 3.2. The manufacturer shall describe the ADS configuration and the intended uses and limitations on the use of its feature(s).
  - 3.2.1. The manufacturer shall list the potential faults covered by the diagnostic system(s) of the ADS.<sup>23</sup>
- 3.3. The manufacturer shall establish the ODD conditions and boundaries of each ADS feature in measurable and/or verifiable terms.<sup>24</sup>
  - 3.3.1. The ODD conditions addressed by the manufacturer shall, at a minimum, include:<sup>25</sup>
    - 3.3.1.1. Precipitation (rain, snow)
    - 3.3.1.2. Time of day (light intensity, including the case of the use of lighting devices)
    - 3.3.1.3. Visibility
    - 3.3.1.4. Road and lane markings
    - 3.3.1.5. Country of operation<sup>26</sup>
    - 3.3.1.6. V2x dependencies<sup>27</sup>
- 3.4. The manufacturer shall establish terms for the correct use of the ADS.<sup>28</sup>

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<sup>23</sup> Based on FRAV-18-06 (“The ADS should perform self-diagnosis of faults in accordance with the OEMs prescribed list”). The proposal presupposes that the OEM provides the prescribed list, suggesting an element for inclusion in the manufacturer description of the ADS.

<sup>24</sup> Based on FRAV-18-06 (“The ODD conditions and boundaries (measurable limits) should be established by the manufacturer.”). Because Section 3 will provide guidelines for declaring the ODD conditions and boundaries of each ADS feature, it is proposed to place this requirement in this section.

<sup>25</sup> Based on FRAV-18-06 (“The ODD conditions to be recognized by the ADS should include: Precipitation (rain, snow), Time of day (light intensity, including the case of the use of lighting devices), Visibility, Road and lane markings”). Per the requirement that the ADS shall recognize its ODD conditions (4.1.2. below), it seems appropriate to cross-reference this performance requirement with the manufacturer's establishment of the conditions relevant to the ADS under assessment pursuant to the Section 3 guidelines.

<sup>26</sup> Based on FRAV-18-06 (“The ADS should comply with traffic rules [in the country of operation / within the ODD]”). FRAV agreed that the country or countries of operation would be included in the ADS description to enable application of requirements specific to such jurisdictions (e.g., traffic laws, languages, special vehicle markings).

<sup>27</sup> Based on FRAV-17-09 (“The ADS should establish a stable connection and response correctly if the vehicle has V2X options.”).

<sup>28</sup> Based on FRAV-18-06 (“The ADS manufacturer should provide tools for the authorized user to learn about system functionality and operation.”) Input on requirements for ADS interactions with ADS users relate to the ADS configuration, intended uses, and limitations on use that would be established by the manufacturer. Per para. 3.1.3 on the diversity of possible user roles and responsibilities depending upon the ADS configuration, the

- 3.4.1. The manufacturer shall provide written information on the intended uses and limitations on the use of the ADS feature(s).<sup>29</sup>
- 3.4.2. The manufacturer shall describe means made available to the public to promote a correct understanding of the intended uses and limitations on the use of the ADS.<sup>30</sup>
- 3.4.3. The manufacturer shall provide the following information for ADS designed to interact with a fallback user.<sup>31</sup>
  - 3.4.3.1. The manufacturer shall provide written information on the roles and responsibilities of the fallback user, including on non-driving-related activities.<sup>32</sup>
  - 3.4.3.2. The manufacturer shall provide written instructions for the activation and deactivation of the ADS.<sup>33</sup>
  - 3.4.3.3. The manufacturer shall provide written information on ADS responses to fallback user interventions in the dynamic control of the vehicle.<sup>34</sup>
  - 3.4.3.4. The manufacturer shall provide written descriptions of the transfer of control procedures, including ADS notifications and fallback user responses.<sup>35</sup>

#### 4. ADS Safety Requirements

##### 4.1. ADS performance of the DDT<sup>36</sup>

- 4.1.1. The ADS shall be capable of performing all DDT functions necessary to operate the vehicle within the ODD of its feature(s).<sup>37</sup>

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manufacturer would need to provide information on correct use. This information would enable the application of requirements for user notifications and other ADS responses to incorrect use.

<sup>29</sup> Based on FRAV-18-06 (“ADS manufacturer should provide documented information on ADS (features) capabilities and limitations (the information should also refer to specific scenarios)”).

<sup>30</sup> Based on FRAV-18-06 (“ADS manufacturer should describe the possible educational approach: Theoretical and practical training, How it aligns with common HMI and interaction”). Statement provided to facilitate FRAV discussions on the role of public and consumer education (if any) in the establishment of ADS safety requirements.

<sup>31</sup> Based on FRAV-18-06 (“ADS manufacturer should provide documented information on allowed transition of roles and procedure for the transition (activation/deactivation, ToC, Override)”).

The proposed requirements would only concern ADS designed for use with a fallback user, so this paragraph clarifies the scope.

<sup>32</sup> Based on FRAV-18-06 (“ADS manufacturer should provide documented information on roles and responsibility of Driver/user and ADS when ADS (feature) is on/off” and “ADS manufacturer should provide a list of NDRA allowed when an ADS feature is active”).

<sup>33</sup> Op. cit. FRAV-18-06 (“ADS manufacturer should provide documented information on allowed transition of roles and procedure for the transition (activation/deactivation, ToC, Override)”).

<sup>34</sup> Ibid.

<sup>35</sup> Ibid.

<sup>36</sup> Based on FRAV-05-02 (“ADS should drive safely”).

<sup>37</sup> Based on FRAV-18-06 (“The ADS should be capable of performing the entire Dynamic Driving Task (DDT)”); “The capability of the ADS to perform the entire DDT should be determined in the context of the ODD of the ADS”). Per GRVA-07-54, an ADS integrates functions that enable performance of the DDT within the ODD of its feature(s). A feature may use all or some of the ADS functions and features may share ADS functions.

- 4.1.1.1. The ADS shall maintain a safe vehicle speed in accordance with the prevailing traffic laws and traffic conditions.<sup>38</sup>
- 4.1.1.2. The ADS shall position the vehicle at safe distances from [other road users] via longitudinal and lateral motion control.<sup>39</sup>
- 4.1.1.3. The ADS shall adapt its driving behavior to the prevailing traffic conditions (e.g., avoid disruption of the flow of traffic).<sup>40</sup>
- 4.1.1.4. The ADS shall adapt its driving behavior in line with safety risks (e.g., prioritize the safety of all road users and the ADS vehicle occupants).<sup>41</sup>
- 4.1.2. The ADS shall recognize the conditions and boundaries of the ODD of its feature(s) pursuant to the manufacturer’s declaration under paragraph 3.2.<sup>42</sup>
  - 4.1.2.1. The ADS shall be able to determine when the conditions are met for activation of each ADS feature.<sup>43</sup>
  - 4.1.2.2. The ADS shall detect and respond when one or more ODD conditions of the feature in use are not or are no longer fulfilled.<sup>44</sup>
  - 4.1.2.3. The ADS shall anticipate predetermined ODD exits.<sup>45</sup>
- 4.1.3. The ADS shall detect and respond to DDT-relevant objects and events.<sup>46</sup>

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<sup>38</sup> Based on FRAV-18-06 (“As part of the DDT, the ADS shall be able to...Operate at safe speeds”). The text reflects discussions on traffic laws and the requirements concerning adapting to prevailing conditions.

<sup>39</sup> Based on FRAV-18-06 (“As part of the DDT, the ADS shall be to...Maintain appropriate distances from [other road users] by controlling the longitudinal and lateral motion of the vehicle”). “Other road users” is in brackets pending further elaboration of requirements relevant to interactions with other road users, road occupants, and safety-relevant objects.

<sup>40</sup> Based on FRAV-18-06 (“As part of the DDT, the ADS shall be able to...Adapt its behaviour to the surrounding traffic conditions (e.g., by avoiding disruption to the flow of traffic)”). Pursuant to comments on the interpretation of “surrounding conditions”, the term “prevailing conditions” is suggested. “Prevailing” means existing in a particular place at a particular time.

<sup>41</sup> Based on FRAV-18-06 (“As part of the DDT, the ADS shall be able to...Adapt its behaviour in line with safety risks (e.g., by giving all road users and passengers the highest priority)”).

<sup>42</sup> Based on FRAV-18-06 (“The ADS should recognize the ODD conditions and boundaries of the ODD of its feature(s)”). The manufacturer establishes the conditions for the individual ADS and its features in accordance with the guidelines under Section 3.

<sup>43</sup> Based on FRAV-18-06 (“The ADS should be able to determine when the conditions are met for activation.”). Per GRVA-07-54, the ADS enables the activation of a feature (when its ODD conditions are satisfied).

<sup>44</sup> Based on FRAV-18-06 (“The ADS should detect and respond when one or more ODD conditions are not or no longer fulfilled.”).

<sup>45</sup> Based on FRAV-18-06 (“The ADS should be able to anticipate planned exits of the ODD”). “Predetermined” is proposed as preferable to “planned”. “Predetermined” is a neutral term referring to, in this case, an ODD exit (meaning the existence of conditions outside the ODD) established or decided in advance. “Planned” has a larger meaning associated with the act of planning and existence of a plan.

<sup>46</sup> Based on FRAV-18-06 (“The ADS should detect and respond to objects and events relevant for the DDT”). Under its ORU workstream, FRAV is developing a properties-based approach to defining OEDR requirements.

- 4.1.3.1. [Objects and events might include, but are not limited, to:
  - 4.1.3.1.1. Vehicles, motorcycles, bicycles, pedestrians, obstacles
  - 4.1.3.1.2. Road accidents
  - 4.1.3.1.3. Road safety agents / enforcement agents
  - 4.1.3.1.4. Emergency vehicles]
- 4.1.3.2. The ADS shall detect objects in and around its path of travel that exceed a minimum size.<sup>47</sup>
- 4.1.3.3. The ADS shall recognize objects as static or mobile.<sup>48</sup>
- 4.1.4. The ADS shall operate the vehicle in compliance with traffic laws relevant to the ODD of the feature in use.<sup>49</sup>
- 4.1.5. The ADS shall interact safely with other road users.<sup>50</sup>
  - 4.1.5.1. The ADS shall avoid collision with safety-relevant objects.
  - 4.1.5.2. The ADS shall signal intended changes of direction.<sup>51</sup>
  - 4.1.5.3. The ADS shall signal its operational status (active/inactive) as needed.<sup>52</sup>
- 4.2. ADS interactions with ADS vehicle users<sup>53</sup>
  - 4.2.1. General considerations

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<sup>47</sup> Based on FRAV-17-09 (“ADS shall detect, classify, and recognize objects of a minimum size.”). The ADS should detect any object that could present a safety risk based on its size.

<sup>48</sup> Based on FRAV-17-09 (“ADS shall detect an object and classify that object according to whether it may be capable of moving.”) The ADS should differentiate between static and mobile objects even if the object is stationary at the moment (e.g., a pedestrian standing near the road may move into the roadway).

<sup>49</sup> Based on FRAV-18-06 (“The ADS should comply with traffic rules [in the country of operation / within the ODD]”). Per the FRAV discussions, “country of operation” has been placed under the ADS description/ODD guidelines. Regarding discussions on the proposal “ADS should comply with the traffic laws in nominal conditions, except when in specific circumstances or when necessary to enhance the safety of the vehicle’s occupants and/or other road users”, FRAV recognizes that traffic laws aim to prioritize road safety such that the laws may permit prioritization of individual provisions over others and/or deviations from strict adherence in the interests of safety. FRAV is discussing possibilities to reflect this “safety vs. strict compliance” balance.

<sup>50</sup> Based on FRAV-18-06 (“The ADS should interact safely with other road users”).

<sup>51</sup> Based on FRAV-18-06 (“The ADS should interact safely with other road users, such as via...[Signaling maneuver intentions]”).

<sup>52</sup> Based on FRAV-18-06 (“The ADS interact safely with other road users, such as via...[Signaling ADS status (active/inactive)]”). FRAV recognizes that certain entities such as police have raised interest in means to ascertain whether an ADS is operating a vehicle. FRAV has consulted with the leader of the GRE task force on AV light-signaling. FRAV stakeholders have suggested potential risks in unrestricted signaling of the ADS status (e.g., changes in human road user behaviors based on assumptions concerning ADS responses to unsafe behaviors). OEDR requirements specific to recognizing certain road users based on their detectable properties may enable reconciling the interests of specific actors and risks of unsafe behaviors (e.g., differentiating police vehicles from other vehicles).

<sup>53</sup> Based on FRAV-05-02 (“ADS should interact safely with the user”).

- 4.2.1.1. User interface requirements should ensure sufficient commonality across ADS to avoid foreseeable risks of user confusion, misuse, and excessive learning curves.<sup>54</sup>
- 4.2.1.2. FRAV is discussing interactions and user cognitive burdens such as simplification of user roles and of TOC sequences.
- 4.2.1.3. The ADS should present information to users to ensure safe interactions:
  - Timing
  - Priorities
  - Saliency (conspicuity)<sup>55</sup>
- 4.2.2. User information
  - 4.2.2.1. Vehicle status
    - a) ADS status
    - b) ADS feature availability
    - c) ADS failure warning
    - d) “Standard information” (speed, range, Time2Fuel, etc.)
  - 4.2.2.2. User status
    - a) User role
    - b) User responsibilities
- 4.2.3. User activation of an ADS feature
  - 4.2.3.1. The ADS shall inform the user when the conditions for activation of a feature are met.<sup>56</sup>
  - 4.2.3.2. The ADS shall prevent activation of a feature when the conditions for its activation are not met.<sup>57</sup>
  - 4.2.3.3. User activation of the ADS shall follow a common activation sequence (to be determined).<sup>58</sup>
  - 4.2.3.4. The ADS should provide confirmation that the system is activated.<sup>59</sup>
- 4.2.4. ADS transfer of control to the fallback user

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<sup>54</sup> “Commonality” refers to a level of harmonization sufficient to enable ADS vehicle users to form reliable mental models applicable to any ADS.

<sup>55</sup> Based on FRAV-17-10 (The ADS should present the information so as to assure a safe interaction: Timing requirements, Priority requirements, Saliency requirements.)

<sup>56</sup> Based on FRAV-17-10 (The ADS should inform the user that preconditions for activation are met.)

<sup>57</sup> Based on FRAV-17-10 (The ADS should be designed to avoid activation of an ADS outside its ODD.)

<sup>58</sup> Based on FRAV-17-10 (The activation should follow a common sequence—common sequence to be in requirements.)

<sup>59</sup> Based on FRAV-17-10 (The ADS should provide confirmation that the system is activated.)



- 4.2.4.1. The provisions under 4.2.4. shall only apply to ADS designed to interact with a fallback user.<sup>60</sup>
- 4.2.4.2. General considerations
  - 4.2.4.2.1. The fallback user shall be provided with access to controls sufficient to enable dynamic control of the vehicle.<sup>61</sup>
  - 4.2.4.2.2. Requirements for interactions with the fallback user shall ensure commonality in the sequence of steps in the transfer of control procedures across ADS.<sup>62</sup>
- 4.2.4.3. The ADS shall ensure that the fallback user is qualified, able, and receptive to ADS-issued requests to intervene.<sup>63</sup>
- 4.2.4.4. The ADS shall inform the fallback user regarding permitted non-driving-related activities.<sup>64</sup>
- 4.2.4.5. The ADS shall inform the fallback user upon detection of one or more ODD exit conditions of the feature in use.<sup>65</sup>
- 4.2.4.6. The ADS shall warn the fallback user of an anticipated TOC.<sup>66</sup>
- 4.2.4.7. The ADS shall request fallback user acknowledgement of the anticipated TOC warning.<sup>67</sup>

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<sup>60</sup> FRAV recognizes that individual ADS may or may not be designed for use with a fallback user. For example, driverless shuttles may be designed solely to transport passengers or goods.

<sup>61</sup> The fallback user is expected to assume the role of driver upon completion of a transfer of control. Therefore, the fallback user will need access to vehicle controls. The requirement for controls should be limited to vehicles designed to transfer control to a fallback user. This general requirement may involve attention to whether the fallback user is in the vehicle or the fallback involves external control of the vehicle.

<sup>62</sup> Based on FRAV-17-10 (The interaction should follow a common sequence in the transition of control (change of user roles) –Common sequence to be in requirements).

<sup>63</sup> Based on SAE J3016 definition of “fallback-ready user” that includes this requirement for user readiness. Based on FRAV-17-10 (The ADS should verify that the user is available for the transition of control.) ADS vehicles designed to transfer control to a fallback-ready user (Level 3) would need to ensure that such a user fulfills prerequisites for ADS activation.

<sup>64</sup> Based on FRAV-17-10 (The ADS should present information to the user on permitted NDRA). This requirement would relate to the manufacturer’s information on user roles and responsibilities for correct use of the ADS (e.g., warning the fallback user of a failure to meet readiness/receptivity requirements).

<sup>65</sup> Based on FRAV-17-10 (The ADS should present information to the user on upcoming ODD boundaries). This general requirement will involve attention to foreseeable and unforeseen ODD exit conditions.

<sup>66</sup> Based on FRAV-17-10 (The ADS should present a warning for upcoming transition requests). This general requirement will involve attention to foreseeable and unforeseen conditions that would trigger a transfer of control procedure.

<sup>67</sup> Based on FRAV-17-10 (The ADS should present information concerning confirmation of the request for an upcoming transition).

- 4.2.4.8. The ADS shall request fallback-user intervention in dynamic control of the vehicle upon initiation of the TOC.<sup>68</sup>
- 4.2.4.9. The ADS shall inform the fallback user of a successful or inadequate response to the fallback-user intervention request.<sup>69</sup>
- 4.2.4.10. The ADS shall inform the fallback user upon completion of a successful TOC (i.e., confirmation that the fallback user has achieved stable dynamic control and assumed the role of driver).<sup>70</sup>
- 4.2.5. Fallback-user-initiated takeover of dynamic control<sup>71</sup>
  - 4.2.5.1. The ADS shall permit the fallback user to assume the role of driver.<sup>72</sup>
  - 4.2.5.2. The ADS shall inform the fallback user of a successful intervention to take over dynamic control of the vehicle.<sup>73</sup>
  - 4.2.5.3. The ADS may delay or prevent a fallback-user takeover under unsafe conditions and shall inform the fallback user accordingly.<sup>74</sup>
- 4.2.6. Misuse prevention
  - 4.2.6.1. The ADS shall prevent inadvertent activation or deactivation.<sup>75</sup>
  - 4.2.6.2. ADS controls shall be clearly distinguishable from other controls.<sup>76</sup>

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<sup>68</sup> Based on FRAV-17-10: Request for fallback user intervention “Request to Intervene” in the diagram and implicit in the proposed TOC requirements.

<sup>69</sup> Based on FRAV-10-06 (Japan comment concerning ADS response to a “lack of necessary input from the user”).

<sup>70</sup> Based on FRAV-17-10 (The ADS should verify that the driver is in stable control of the vehicle to complete the Transfer of Control to the user; Transition of control should return to a common default user role (to prevent mode confusion); This should normally be fully engaged driving (conventional driver).)

<sup>71</sup> Based on FRAV-17-10 (The ADS should assure a safe user initiated take over.)

<sup>72</sup> Based on FRAV-18-06 (“The user should be permitted to override the ADS to assume full control over the vehicle”) and the ADS users workstream recommendations to address interactions from the perspective of user roles (in this case, “driver”) and responsibilities.

<sup>73</sup> Based on FRAV-17-10 (The ADS should provide a clear feedback of the successful user initiated take over.) A successful takeover of dynamic control means that the fallback user has assumed the role of driver (The user initiated take over should return to a common default user role (to prevent mode confusion); This should normally be fully engaged driving (conventional driver)).

<sup>74</sup> Based on FRAV-17-10 (The ADS should warn a user for an user initiated take over that will lead to an unsafe situation and prevent this (consider if a first attempt prevention is enough or the ADS has a better overview of complex traffic situations).)

<sup>75</sup> Based on FRAV-17-10 (The ADS should be designed to prevent inadvertent activation or deactivation.)

<sup>76</sup> Based on FRAV-17-10 (The ADS controls should be clearly distinguishable from other controls.) Presumably, this general requirement would relate to ensuring commonality across controls, symbols, etc.

- 4.2.6.3. The ADS shall provide feedback when the user attempts to enable a feature under prohibited conditions.<sup>77</sup>
- 4.2.6.4. The ADS shall be designed to avoid illegal settings.<sup>78</sup>
- 4.2.6.5. The ADS shall be accompanied by materials to promote correct use.<sup>79</sup>
- 4.3. ADS management of safety-critical situations<sup>80</sup>
  - 4.3.1. The ADS shall execute a fallback response in the event of a failure in the ADS and/or other vehicle system that prevents the ADS performance of the DDT.<sup>81</sup>
  - 4.3.2. The ADS shall notify the ADS vehicle user(s) of the initiation of a procedure to place the vehicle in an MRC.<sup>82</sup>
  - 4.3.3. The ADS shall emit an external signal to indicate the initiation of a procedure to place the vehicle in an MRC.<sup>83</sup>
  - 4.3.4. The ADS shall place the vehicle in an MRC in the event of a failure during a transfer of control.<sup>84</sup>
- 4.4. ADS management of system failures<sup>85</sup>
  - 4.4.1. The ADS shall perform a self-diagnosis prior to activation of its feature(s) to determine the absence of faults in accordance with the manufacturer's documentation provided under Section 3.<sup>86</sup>
  - 4.4.2. The ADS shall detect and evaluate system malfunctions/abnormalities relevant to its performance of the DDT.<sup>87</sup>

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<sup>77</sup> Based on FRAV-17-10 (The ADS should provide feedback when the user attempts to enable not allowed functions.)

<sup>78</sup> Based on FRAV-17-10 (The ADS should be designed to avoid illegal settings.) Requires clarification regarding meaning of "illegal settings".

<sup>79</sup> Based on FRAV-17-10 (The OEM should provide tools for the user to learn about system functionality and operation.) This general requirement serves as a placeholder pending additional FRAV consideration of the various proposals related to supplemental measures to ensure safe use beyond specifications for ADS performance.

<sup>80</sup> Based on FRAV-05-02 ("ADS should manage safety-critical situations").

<sup>81</sup> Based on FRAV-18-06 ("The ADS should execute a safe fallback response in the event of a failure of the ADS and/or other vehicle system that prevents the ADS from performing the DDT").

<sup>82</sup> Based on FRAV-18-06 ("The ADS should signal its intention to place the vehicle in an MRC to: ADS user or vehicle occupants, Other road users (e.g., by hazard lights)").

<sup>83</sup> Ibid.

<sup>84</sup> Based on FRAV-18-06 ("If the ADS is designed to request and enable intervention by a human driver, the ADS should execute an MRM in the event of a failure in the transition of control to the user"). Neither ISO, SAE, nor FRAV have adopted the term "minimal risk maneuver" due to the diversity of strategies to secure occupant and road safety.

<sup>85</sup> Based on FRAV-05-02 ("ADS should safely manage failure modes").

<sup>86</sup> Based on FRAV-18-06 ("The ADS should perform self-diagnosis of faults in accordance with the OEMs prescribed list" and "ADS reactivation should not be possible until the safe operational state of the ADS has been verified").

<sup>87</sup> Based on FRAV-18-06 ("The ADS should detect system malfunctions/abnormalities and evaluate system's ability to fulfill the entire DDT").

- 4.4.3. The ADS shall signal [faults/failures] compromising its capability to perform the entire DDT relevant to the ODD of its feature(s).<sup>88</sup>
- 4.4.4. The ADS shall prohibit unauthorized modifications to safety-critical hardware and software in accordance with best engineering practices.<sup>89</sup>
- 4.4.5. The ADS may continue to operate in the presence of [faults/failures] that do not prevent that ADS from fulfilling the applicable safety requirements.<sup>90</sup>

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<sup>88</sup> Based on FRAV-18-06 (“The ADS should signal [faults/failures] affecting the ability to execute the DDT”).

<sup>89</sup> Based on FRAV-18-06 (“The ADS should be protected from unauthorized access” and “The measures ensuring protection from an authorized access should be provided in alignment with engineering best practices”). Pursuant to FRAV-18 discussions, the text is modified to be more explicit concerning “access”.

<sup>90</sup> Based on FRAV-18-06 (“Provided a failure does not significantly compromise ADS performance, the ADS should respond safely to the presence of a [faults/failure] in the system.” and “The limited operation of the ADS should comply to the normally applicable safety requirements”).