# DATA ELEMENTS FOR DSSAD ALIGNMENT

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# Introduction

- Purpose: Support the identification of **triggers and data elements for DSSAD**
  - Alignment with Japanese approach
  - Technical definition of single data elements

- Japanese approach: two main categories (with four sub-categories)
  - ADS Status
    - Activation/deactivation, Transition of control, Fallback to an MRC, Detected severe failure, EDR trigger input, ….
  - ADS Behavior
    - [Perception] - Detected Objects
    - [Judgement] - Feature activation/end/abortion
    - [Control] - Control signal to the steering, brake etc.
    - [Dynamics] - Velocity, acceleration, yaw rate

# Methodology for Alignment

- In a first step the categories for data elements need to be aligned
  - Japanese proposal on ADS Status and ADS behavior (in 4 sub-categories
  - EU proposal on VMAD occurrences
- The categories can be applied to the data elements resulting from the occurrences

- In a second step additional data elements can be identified (see red colored data elements in the following slides)

- In a third step the identified data elements need to be defined in detail (technical definition) (this is NOT part of this presentation yet!)

# ADS Status

| Data elements/Occurrences | 1a | 1.b. | 1.c. | 1.d. | 1.e. | 2.a. | 2.b. | 2.c. | 3.a. | 3.b. | 3.c. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ADS status | X | | x | X | X | x | x | x | x | x | x |
| ADS status time stamp | X | | X | X | X | X | x | X | x | X | x |
| Failure flag | X | | x | X | | | x | x | x | X | X |
| Failure flag time stamp | X | | X | x | | | x | x | x | X | x |
| Acceleration threshold | X | | | | | | | | | | |
| ADS Position (location) GNSS positioning to at least 5 decimal places | X | x | x | | x | x | x | | | | |
| ADS position certainty | X | | | | | | | | | | |
| [Engine throttle] | X | | | | | | | | | | |
| [Continue the trip or initiate some action (e.g. call ambulance, inform others)] | X | | | | | | | | | | |
| ODD exit | | x | | | | | | | | | |
| ODD exit reason | | x | | | | | | | | | |
| ADS Activation Status | | x | | | | | | | | | |
| Sensor failure status | | x | | | | | | | | | |
| System failure status | | x | | | | | | | | | |
| Driver communication status | | x | | | | | | | | | |
| MRM activation status | | | x | | | | X | x | x | | |
| MRM activation time stamp | | | x | | | | x | x | x | | |
| MRM status | | | | X | X | | | | | X | |
| MRM status time stamp | | | | X | X | | | | | X | |
| Communication status | | | | X | | | | | | | |
| Communication status time stamp | | | | X | | | | | | | |
| Communication message | | | | | | | X | | | | |
| Cybersecurity monitoring | | | | | X | | | | | | |
| Driver Warning Status | | | | | | X | X | x | | | |
| Driver Warning Status time stamp | | | | | | x | X | x | | | |
| Driver Monitoring System (DMS) status | | | | | | X | X | x | | | |

# ADS Behaviour - Perception

| Data elements/Occurrences | 1a | 1.b. | 1.c. | 1.d. | 1.e. | 2.a. | 2.b. | 2.c. | 3.a. | 3.b. | 3.c. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Object number | X | | x | | | | X | X | | | |
| Object Position: long. distance, lateral distance, angle | X | | x | | | | X | X | | | |
| Object longitudinal velocity | X | | x | | | | X | X | | | |
| Object lateral velocity | X | | x | | | | X | X | | | |
| Object longitudinal accelerations | X | | x | | | | X | X | | | |
| Object lateral accelerations | X | | x | | | | X | X | | | |
| Object classification | X | | x | | | | X | X | | | |
| Objection classification time stamp | X | | | | | | | | | | |
| Object detection | X | | | | | | | | | | |
| Object detection time stamp | X | | | | | | | | | | |
| Object distance | X | | | | | | | | | | |
| Object Classification certainty | X | | | | | | | | | | |
| Object prediction position | X | | | | | | | | | | |
| Object prediction longitudinal velocity | X | | | | | | | | | | |
| Object prediction lateral velocity | X | | | | | | | | | | |
| Object prediction longitudinal acceleration | X | | | | | | | | | | |
| Object prediction lateral acceleration | X | | | | | | | | | | |
| Object prediction classification | X | | | | | | | | | | |
| Object prediction longitudinal velocity | X | | | | | | | | | | |
| Object prediction lateral Velocity | X | | | | | | | | | | |
| Object prediction longitudinal acceleration | X | | | | | | | | | | |
| Object prediction lateral acceleration | X | | | | | | | | | | |
| | | | | | | | | | | | |
| Sensor limits due to weather conditions | | | | | | | | | | | |

# ADS Behaviour - Judgement

| Data elements/Occurrences | 1a | 1.b. | 1.c. | 1.d. | 1.e. | 2.a. | 2.b. | 2.c. | 3.a. | 3.b. | 3.c. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Delta time between object detection and mitigation action | X | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

# ADS Behaviour - Control

| Data elements/Occurrences | 1a | 1.b. | 1.c. | 1.d. | 1.e. | 2.a. | 2.b. | 2.c. | 3.a. | 3.b. | 3.c. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Brake pressure | X | | | | | | | | | | |
| Steering angle | | | | | | | | | | | |
| Steering torque | | | | | | | | | | | |
| Throttle position | | | | | | | | | | | |

# ADS Behaviour - Dynamics

| Data elements/Occurrences | 1a | 1.b. | 1.c. | 1.d. | 1.e. | 2.a. | 2.b. | 2.c. | 3.a. | 3.b. | 3.c. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Initial vehicle longitudinal velocity | X | | | | | | | | | | |
| Initial vehicle lateral velocity | X | | | | | | | | | | |
| Initial vehicle longitudinal acceleration | X | | | | | | | | | | |
| Initial vehicle lateral acceleration | X | | | | | | | | | | |
| Initial vehicle yaw rate | X | | | | | | | | | | |
| Vehicle longitudinal velocity | X | x | x | X | X | X | X | | X | X | x |
| Vehicle lateral velocity | X | x | x | X | X | X | X | | X | X | x |
| Vehicle longitudinal acceleration | X | x | x | X | X | X | X | | X | X | x |
| Vehicle lateral acceleration | X | x | x | X | X | X | X | | X | X | x |
| Vehicle yaw rate | X | x | x | X | X | X | X | | X | X | x |
| Vehicle Speed | X | | | | | | | | | | |
| Vehicle ODD position | | X | | | | | | | | | |
| Vehicle position | | X | | | | | | | | | |
| Vehicle longitudinal velocity time stamp | | | | X | X | | X | | X | X | x |
| Vehicle lateral velocity time stamp | | | | X | X | | X | | X | X | x |
| Vehicle lateral acceleration time stamp | | | | X | X | | X | | X | X | x |
| Vehicle longitudinal acceleration time stamp | | | | X | X | | X | | X | X | x |
| Vehicle yaw rate time stamp | | | | X | X | | X | | X | X | x |

# To Do

- 1. Check, if data elements fit into categories
- 2. Complete data elements / add data elements not yet identified
- 3. Discuss data elements
- 4. Technical description of data elements (separate document)

# Annex

- Slides from Japan from Tokio meeting

# Primary purpose of DSSAD data usage

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- **Monitor ADS safety performance**
- For the purpose, following category of data need to be recorded;
  - ➢ **ADS status through entire ADS operation**
    - – e.g. Activated / deactivated, MRM, TOR etc.
    - – Event flag with time stamp can provide an entire sequence of ADS status change
  - ➢ **Triggering event for performance monitoring**
    - – Entire travel data can't be useful (huge data size and difficult to find focusing point, from normal operation under "nothing wrong" situations.)

    ⇒ Need to focus on safety events on which ADS performance may influence. (e.g. crash with other objects)

    - ➢ **Vehicle behavior data** – How the ADS vehicles behaved around the triggering event. (e.g. for judging whether the accidents is avoidable or unavoidable)
- Fundamental Approach
  - ➢ Case specific investigation and analysis is required for evaluating safety performance of each specific ADS
  - ➢ DSSAD data can't be comprehensive itself, without combining with other information (e.g. road structure, road surface condition, vehicle deformation/occupant injury condition, witness observation, other evidences (e.g. skid mark etc.))

# Data Elements for monitoring ADS performance

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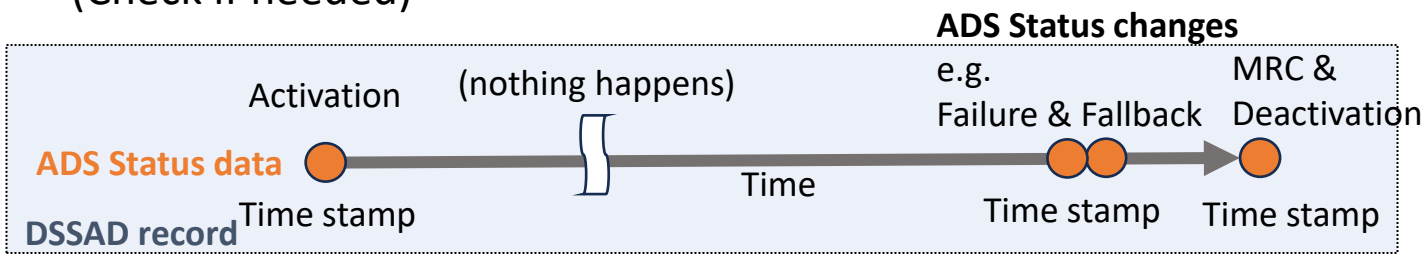
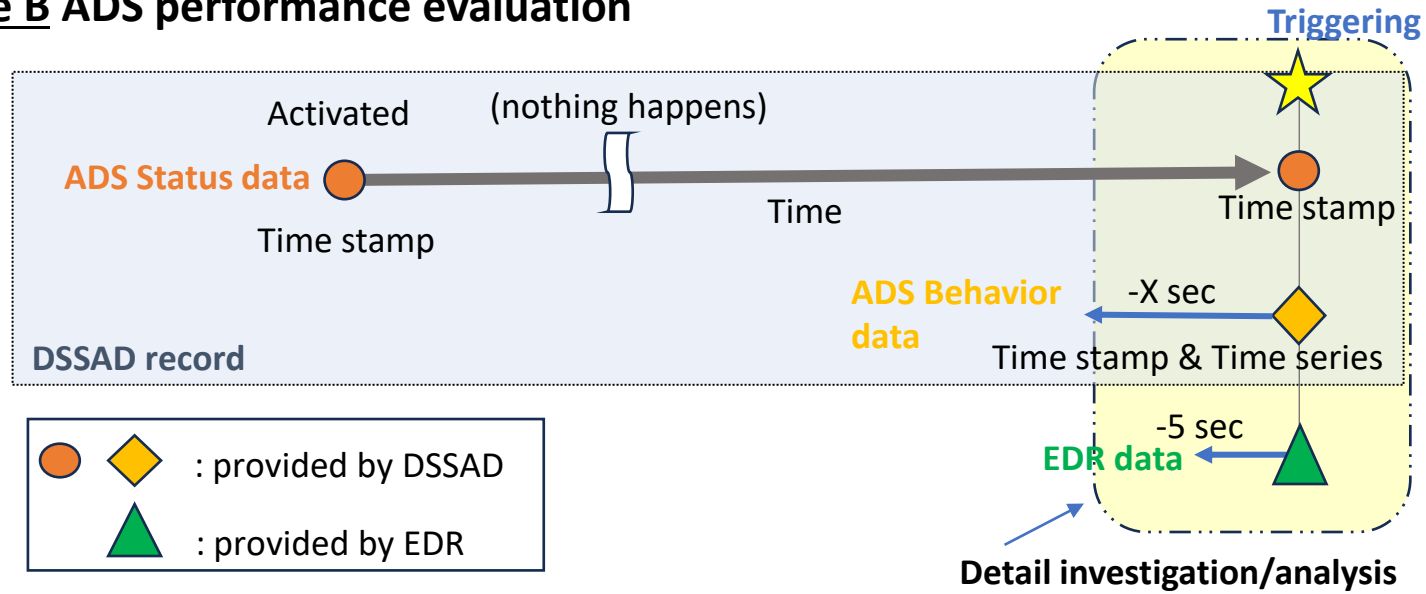
## Case A Keep monitoring ADS status
(Check if needed)




**Point**
- When did the status change?
- What was the status at a certain point of time?

➡ ADS status data

## Case B ADS performance evaluation




**Point**

What happened around the event?

➡ ADS Status data
ADS Behavior data
✚
EDR data
Other information

# Data Elements for monitoring ADS performance

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| ***What*** | ***How*** | ***When*** | ***Why*** |
|---|---|---|---|
| **ADS Status**<br>• Activation/deactivation<br>• Transition of control<br>• Fallback to an MRC<br>• Detected severe failure<br>• EDR trigger input<br>• …. | Time stamp data | Whenever it happens whilst the ADS is active | To identify if the ADS was operating the vehicle at a certain point of time |
| **ADS Behavior**<br>• [Perception] Detected Objects<br>• [Judgement] Feature activation/end/abortion<br>• [Control] Control signal to the steering, brake etc<br>• [Dynamics] Velocity, acceleration, yaw rate | Time series data<br>Time stamp data<br>Time series data | [X] sec before the triggering events | To evaluate how the ADS vehicle behaved around the triggering event. |