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| **Public Document** |
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| **Source** | MPAI-CAV Group |
| **Title** | MPAI Application Note #9 - MPAI-CAV – Connected Autonomous Vehicles |
| **Target** | MPAI Members |

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**Description**: This use case addresses the Connected Autonomous Vehicle (CAV) domain and the 3 main operating instances of a CAV:

1. Autonomous Motion, i.e., the operation of the portion of a CAV that enables its autonomous motion
2. Human-to-CAV interaction, i.e., the operation of the portion of a CAV that responds to hum­ans’ commands and queries and senses humans’ activities
3. The CAV-to-environment interaction, i.e., the operation of the portion of a CAV that commun­icates with other CAVs and sources of information.

**Comments**:

Significant research and experimentation has been carried out in the domain addressed by this Application Note. However,

1. While there is a high level of knowledge and result sharing about the algorithms studied and experimented, e.g., in the several challenges, and there is a rough commonality in the Auton­omous Motion reference models, no attempt has been done to formalise such a reference model and identify the (classes of) data types in and out of the CAV subsystems.
2. There has been no significant effort to identify and classify human commands and queries to CAVs and the level of passenger activity in the CAV passenger compartment.
3. While there are significant studies and even a standard addressing CAV-to-CAV interaction, the communication payload considered is not directly connected with the use and relevance of the data that flow inside the CAV.

**Examples**:

A preliminary study carried out by the MPAI-CAV Requirements group has identified the fol­lowing subsystems (AIMs, in the MPAI language)

1. Vehicle Localiser
2. Route Planner
3. Occupancy Grid Map Creator
4. Environment Mapper
5. Moving Objects Tracker
6. Traffic Signalisation Detector
7. World Representation Creator
8. Path Planner
9. Behavior Selector
10. Motion Planner
11. Obstacle Avoider
12. Command and Control

A first identification of of input/output data has already been achieved.

A similar work is under way for the Human-to-CAV interaction.

Initial work to identify the CAV-to-environment interaction is under way.

**Object of standard**:

1. Reference models for the 3 CAV components: 1) Autonomous Motion, 2) Human-to-CAV interac­tion and 3) CAV-to-environment interaction
2. Functionalities of AIMs of 1) Autonomous Motion and formats of data between AIMs
3. Functionalities of AIMs of 2) Human-to-CAV interac­tion and formats of data between AIMs, taking into account other MPAI projects
4. Messages and data format formats of CAV-to-environment interaction.

**Benefits:** The standard would help

1. development and maturation of technologies required for high performance Autonomous Motion AIMs.
2. create synergies between CAV-specific and wider use human-machine interaction.
3. develop CAV-to-environment protocols that are focused on the actua needs of CAVs.

**Bottlenecks**: actual experimentation will require large amounts of data available from market players.

**Social aspects**: availability of superior technologies, especially in the Autonomous Motion com­ponent, will accelerate the development of a much needed application.

**Success criteria**: the progress of technology triggered by the MPAI Reference Models.

**References:**

[1] MPAI N242: MPAI-CAV Reference Models

[2] ETSI TR 103 562 V2.1.1 (2019-12), Analysis of the Collective Perception Service (CPS);

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