TECHNICAL REFERENCE

Autonomous vehicles

– Part 4 : Vehicular data types and formats

Singapore Standards Council

TR 68 : Part 4 : 2021
(ICS 35.040.50; 43.020)

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Autonomous vehicles

– Part 4 : Vehicular data types and formats

The content of this Singapore Standard was approved on 14 July 2021 by the Manufacturing Standards Committee (MSC) under the purview of the Singapore Standards Council.

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MSC consists of the following members:

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Chairman	:	Dr John Yong	*Individual Capacity*
Deputy Chairman	:	Mr Brandon Lee	*Individual Capacity*
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Members	:	Dr Gavin Chua	*Science Engineering Research Council*
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MSC set up the Technical Committee on Automotive to oversee the preparation of this standard. The Technical Committee consists of the following members:

		Name	**Representation**
Co-Chairmen	:	Mr Lam Wee Shann	*Individual Capacity*
		Prof Marcelo H Ang Jr	*Individual Capacity*
Secretary	:	Mr Louis Lauw	*Singapore Manufacturing Federation – Standards Development Organisation*
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		Dr Chin Kian Keong	*Land Transport Authority*

Members	:	Dr Jaya Shankar s/o Pathmasuntharam	*Institute for Infocomm Research*
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		Mr Ling Yuan Chun	*Economic Development Board*
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		Dr Vrizlynn Thing	*ST Engineering Limited*

The Technical Committee set up the Working Group on Vehicular Data Types and Formats to prepare this standard. The Working Group consists of the following experts who contribute in their *individual capacities*:

		Name
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		Dr Jaya Shankar s/o Pathmasuntharam
Secretary	:	Ms Melody Yu
Members	:	Mr Bijoy Bhaskaran
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		Mr Dan Chia Wei Ming
		Mr Gadam Sivakumar
		Mr Ganesh Balasubramaniam
		Mr Alvin Lee
		Mr Ronnie Lim Chee Wee
		Mr James Poh
		Ms Nidhi Kashyap
		Ms Tan Ziyu
		Ms Andrea Teo
		Ms Katherin Wu Woon Hwee

The organisations in which experts of the Working Group are involved are:

Institute for Infocomm Research
Direct Asia Insurance (Singapore) Pte Ltd
HERE Technologies
Land Transport Authority
NCS Pte Ltd
Siemens Mobility Pte Ltd
Singapore Institute of Technology
ST Engineering Limited
TÜV SÜD Asia Pacific Pte Ltd

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Contents

Foreword

This Technical Reference (TR) was prepared by the Working Group on Vehicular Data Types and Formats set up by the Technical Committee on Automotive under the direction of the MSC.

TR 68 series of standard is intended to support the development of Autonomous Vehicle (AV) technology and deployment. It consists of the following parts under the generic title "Autonomous Vehicles":

Part 1 – Basic behaviour
Sets out fundamental behaviours AVs exhibit while driving on public roads in order to co-exist safely with entities on the roads such as other vehicles, cyclists, and pedestrians.

Part 2 – Safety
Sets out the safe design and continuing safety management process requirements, supported by competent personnel and organisational quality certifications that organisations can put in place so that the AVs driving on public roads are inherently safe and behave in the manner that they are designed to.

Part 3 – Cybersecurity principles and assessment framework
Sets out principles and assessment framework for organisations to support development and management of AVs. The assessment framework is intended to provide a cybersecurity safeguard for AVs to satisfy prior to on-road deployment.

Part 4 – Vehicular data types and formats
Sets out what data, resolution, capture frequency and the format in which they should be transmitted so that there is seamless communication between sending party and receiving party.

This TR is a provisional standard made available for application over a period of three years. The aim is to use the experience gained to update the TR so that it can be adopted as a Singapore Standard. Users of the TR are invited to provide feedback on its technical content, clarity and ease of use. Feedback can be submitted using the form provided in the TR. At the end of the three years, the TR will be reviewed, taking into account any feedback or other considerations, to further its development into a Singapore Standard if found suitable.

It is presupposed that in the course of their work, users will comply with all relevant regulatory and statutory requirements. Some examples of relevant regulations and acts are listed in the Bibliography. The Singapore Standards Council and Enterprise Singapore will not be responsible for identifying all of such legal obligations.

The main changes made in this revision are as follows:

–   Addition of new terms and definitions for AV external assistive infrastructure. AV external assistive infrastructure refers to physical roadside systems (e.g. signs and traffic lights) or virtual systems (e.g. cloud-based HD maps) deployed externally to the AV to enhance AV efficiency and safety. Physical roadside systems may include sensors, computing and communication modules that perform real-time data acquisition, analysis, processing, sense making and exchange of data with the AVs.
–   Inclusion of new use cases on road infrastructure, AV exchanging priority information and charging station.
–   Insertion of new Figure 4.
–   Addition of missing data for road features.
–   Creation of 6 new data frames:
    •   Charging stations;
    •   Charging slots;

6

- Electronics toll;
- Infrastructure info;
- Transit stops;
- Service request information.

Acknowledgement is made to the Singapore Police Force for their kind permission to reproduce materials from the Basic Theory of Driving Handbook and Final Theory of Driving Handbook into this TR.

Attention is drawn to the possibility that some of the elements of this TR may be the subject to patent rights. Enterprise Singapore shall not be held responsible for identifying any or all of such patent rights.

NOTE

1. *Singapore Standards (SSs) and Technical References (TRs) are reviewed periodically to keep abreast of technical changes, technological developments and industry practices. The changes are documented through the issue of either amendments or revisions. Where SSs are deemed to be stable, i.e. no foreseeable changes in them, they will be classified as "Mature Standards". Mature Standards will not be subject to further review, unless there are requests to review such standards.*

2. *An SS or TR is voluntary in nature except when it is made mandatory by a regulatory authority. It can also be cited in contracts making its application a business necessity. Users are advised to assess and determine whether the SS or TR is suitable for their intended use or purpose. If required, they should refer to the relevant professionals or experts for advice on the use of the document. Enterprise Singapore and the Singapore Standards Council shall not be liable for any damages whether directly or indirectly suffered by anyone or any organisation as a result of the use of any SS or TR. Although care has been taken to draft this standard, users are also advised to ensure that they apply the information after due diligence.*

3. *Compliance with a SS or TR does not exempt users from any legal obligations.*

Technical Reference for autonomous vehicles – Part 4: Vehicular data types and formats

0   Introduction

This TR is intended to give the provisions for standardised services and data exchange formats to facilitate efficiency in communication processes that involve multiple parties. In doing so, interoperability among parties in an autonomous vehicle (AV) ecosystem can be enabled. Hence, while identification of possible use cases where data exchange and/or transfer may be necessary, TR 68 : Part 4 defines and describes the datasets required, and provides guidance on vehicular data types and formats that all players in the AV ecosystem should use.

This TR acknowledges that some data mentioned herein may be constituted as intellectual property and business proprietary information owned by any actors/entities. While this TR sets out best practices for industry practitioners and regulators to independently consider adoption; it does not intend to mandate any industry compliance or data sharing.

This TR is applicable to the following stakeholders:

a)   Public or private entities which design and/or manufacture and/or procure and/or install and/or test and/or commission AV technologies, systems and/or solutions;

b)   Public or private entities that which use AV and/or are in charge of operation and/or maintenance of AV and provides transportation services in public areas;

c)   Independent bodies which check and/or assess AV technologies, systems and/or solutions and/or the operation and maintenance of AV.

1   Scope

This TR is written for level 4 and level 5 AVs, as defined in SAE J3016, to be deployed as people and goods mover systems (i.e. mobility-on-demand and scheduled transportation services that are equivalent to Class 3 and Class 4 motor vehicle driving licenses in Singapore). This TR is applicable to level 4 and level 5 AVs in mixed-use traffic and on public roads. Hence, the safety of internal occupants and external road users is paramount.

This TR specifies vehicular data types and formats (but not the interchange syntax) for the following purposes:

a)   Data to be recorded by the data storage system for automated driving;

b)   Reasonable and adequate use of AV data to continuously improve safety;

c)   Management of dynamic content (e.g. high-definition (HD) mapping, road traffic information);

d)   Data to be used in investigation and reporting of accidents and claim disputes; and

e)   V2X (vehicle to everything) information exchange for enhancing safety and efficiency.

This TR is based on the premise that to send, retrieve, return and track messages on a shared platform, a common communication and messaging protocol should be observed. This TR sets out the formats in which data elements should be recorded and/or relayed only; and it does not mandate data provision between or among any actors/entities. It also does not cover data ownership and privacy.

The scope of the TR excludes the following:

a)   Over-the-air software updates;

b)   AV fleet management system;

c)   Interface between AV and any human operator/driver; and

d)   Data privacy and ownership.

The meaning of automation driving levels, automated driving system (ADS), operational design domain (ODD) and dynamic driving task (DDT) are as defined in SAE J3016.

2   Normative references

There are no normative references in this TR.