



中国汽车技术研究中心有限公司

China Automotive Technology and Research Center Co., Ltd.

Report of “Other Road User” Workstream

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ORU cases Table

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Category	Subclass	Enumerations			
vehicle	Common Vehicle/ Emergency Vehicle/ Special Vehicle	<ol style="list-style-type: none"> 1. Passenger cars 2. Buses 3. School buses 4. Trams 5. Goods vehicles 6. Dangerous goods vehicles 	<ol style="list-style-type: none"> 7. Long, large vehicles 8. Vehicles transporting protruding cargo 9. Vehicles towing trailers 10. Vehicles towing combination trailers 11. Special convoys, slow-moving vehicles 	<ol style="list-style-type: none"> 12. Caravans/recreational vehicles, including towing trailers 13. Agricultural vehicles 14. Fire trucks 15. Ambulances 16. Police vehicles 17. Rescue vehicles 	<ol style="list-style-type: none"> 18. Street sweepers 19. Road sprinklers 20. Training cars 21. Cranes, NRMM 22. Other automated/connected (V2V) vehicles 23. Disabled (broken down) vehicles

Category	Enumerations		
Pedestrian	<ol style="list-style-type: none"> 1. Child pedestrian 2. Adult pedestrian 3. Persons with disabilities 4. Hearing-impaired pedestrians 	<ol style="list-style-type: none"> 5. Visually-impaired pedestrians 6. Road-work crews 7. Visually-impaired pedestrians 8. Road-work crews 	<ol style="list-style-type: none"> 9. Persons directing traffic 10. Persons pushing strollers 11. Persons in wheelchairs 12. Motorists on the roadside (stranded vehicles, changing tire)
Cyclist	<ol style="list-style-type: none"> 1. Bicyclists 2. e-Bike users 	<ol style="list-style-type: none"> 3. Skaters (roller, skateboard) 4. Motorcycles 	<ol style="list-style-type: none"> 5. Mopeds/scooters 6. Powered three-wheelers 7. Quadricycles

Performance-relevant ORU Property Generalization Standard and Principle

Physical

1. Mobility (fixed/mobile)
2. Dimensions
3. Path (fixed/free)
4. Visual markings
5. Audible signals
6. Light signals
7. Visibility
8. Vulnerability
9. Location

Functional

1. Personal transport
2. Mass transit
3. Transport of children
4. Commercial goods
5. Dangerous goods
6. Exceptional cargo
7. NRMM
8. Emergency
9. Law enforcement

Behavioral

1. Relative speeds
2. Trajectories
3. Predictability
4. Authority
5. Legal exemptions
6. V2V relationships

Demonstration of Property Based Approach

ORU cases	Physical	Functional	Behavioral
School buses	<p>1. Dimensions: Medium - large.</p> <p>2. Visual markings: Uniform striking colors(yellow), specific vehicle livery and marks</p> <p>4. Light signals: Warning lights and stop arms, could stretch out the stopping signs to warn the ego vehicle behinds cannot overtake the school bus</p> <p>6. Vulnerability: High</p>	<p>2. Mass transit</p> <p>3. Transport of children</p> <p>10. Public service</p>	<p>1. Relative speeds: slow (<50kph outside campus, <10kph in campus)</p> <p>2. Trajectories: stop at the dedicated stations</p> <p>3. Predictability: predictable when loading/unloading students</p> <p>4. Authority: High right of way (during operation)</p>
Ambulances	<p>2. Visual markings: Specific livery and markings</p> <p>3. Audible signals:</p> <p>4. Light signals:</p>	<p>8. Emergency</p> <p>10. Public service</p>	<p>1. Relative speeds: high</p> <p>4. Authority: High right of way, cannot be overtake by rear vehicles</p> <p>5. Legal exemptions: can violate traffic rules when necessary</p>

ORU cases	Properties Requirements for Each Case	Safety Requirements(Tentative)
School buses	<p>1. ADS should detect the object, and complete classification and decide whether that is stationary or not.</p> <p>2. ADS should keep a safe distance when detecting that the object is slowing down, especially when prepare to load or unload pupils around the dedicated stations.</p> <p>3. ADS should adopt more cautious strategy, not overtake when it is driving on the lane or neighbor lane just behind the object, even stop thoroughly.</p> <p>4. The ADS should recognize the dedicated pathways upon its ODD (e.g. reserved lane for bus).</p>	<p>1. The ADS should detect, recognize accurately and provide space to minimize collision risks with objects capable of movement within its ODD.</p> <p>2. The ADS should detect visual markings and signals and respond in accordance with functions and authorizations of vehicles that may operate within the ODD of its features.</p> <p>3. The ADS should predict the intents of vehicles and vulnerable road users and response safely.</p> <p>4. The ADS should respond in accordance with traffic rules to objects with special functions and authorizations.</p> <p>5. The ADS should recognize pathways and related infrastructure designed to separate modes and lanes of traffic.</p>
Ambulances	<p>1. ADS should be able to detect, classify the object, and keep a safe distance from the object, not overtake if drive just behind the object.</p> <p>2. The ADS should give the way to the object if the later is detected to move quickly as well as alarm sound continuously.</p> <p>3. Visual, audible, and light signals should be detected to identify if it is running emergency task</p>	

General requirement from ORU

General Requirement	Detailed Requirements
The ADS should interact safely with other road user.	
<p>1 The ADS should detect, classify, and recognize different kind of ORU.(Doc-5 4.1.3)</p>	<ul style="list-style-type: none"> ● ADS shall detect, classify, and recognize objects of a minimum size.(Doc-5 4.1.3.2) ● The ADS shall recognize objects as static or mobile. (Doc-5 4.1.3.3) ● The ADS shall signal its operational status (active/inactive) as needed.(DOC-5 4.1.5.3)
<p>2 The ADS should avoid collision with ORU of a minimum size.(DOC-5 4.1.1.2, 4.1.5.1)</p>	<ul style="list-style-type: none"> ● ADS shall avoid contact with objects of a minimum size. ● ADS shall ensure a safe minimum lateral distance when passing.
<p>3 The ADS should respond in line with traffic laws to markings and signals used to identify the functions and authorizations of ORUs.(DOC-5 4.1.4)</p>	<ul style="list-style-type: none"> ● The ADS should respond in accordance with traffic rules upon the operational status or dedicated signals displayed by emergency/enforcement vehicles. ● Visual, audible, and light signals should be detected to identify if it is running emergent/special task.
<p>4 The ADS should predict the intents of ORUs and respond safely.</p>	<ul style="list-style-type: none"> ● ADS should response properly if signals detected from other ORU could indicate its drive intent. ● ADS should keep a more cautious strategy if there detect ORU behave oddly.
<p>5 The ADS should recognize pathways and related infrastructure designed to separate modes and lanes of traffic.</p>	
<p>6 The ADS should establish a stable connection and response correctly if the vehicle has V2X options.</p>	

Signaling and External HMI requirements

Main Focus of GRE TF AVSR:

1. Is there a safety requirement for AV's to provide signals to indicate their status and to communicate their next intended actions?
2. If so, shall such signals
 - be visual, - audible, - or a combination of both?

Research of ORU Workstream:

- ✓ Certain entities like enforcement vehicles(Police vehicle, Special Task vehicle) would have the necessity to get the operational status of AD vehicles;
- ✓ Requirements of interaction(audible or both) with handicapped peoples in communicative scenarios, may be taken into account.
- ❑ New and different HMI signals should avoid causing confusion when road users have to interact with both conventional and automated vehicles;
- ❑ New external HMI requirements shall be in line with existing regulations and local laws;
- ❑ There exists potential risks in unrestricted signaling of the ADS status;

Signaling of maneuver intentions

- In line with local traffic/signaling regulations;
- In line with driving habits of human drivers;
- Shall not cause confusion or misunderstanding(direction indicators, brake lights, horn, etc.);

External signaling of ADS operational status

- Use existing external signalization devices when realize interaction functions as needed.
- Optical/audible signals to inform operational status should be well defined to avoid confusion;