Low-speed automated driving system (LSADS) service — Safety Functional Gap analysis

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- This document was created by ISO Technical Committee, ISO/TC 204, Intelligent transport systems under the lead of WG19.
- This document:
  - examines and analyses the safety environment for low-speed automated driving services (LSADS).
  - describes the safety role supplement to the functional model described in ISO/TS 5255-1.
  - describes the supplemental safety points for LSADS
  - describes **AI** role for the functional model of service applications for LSADS

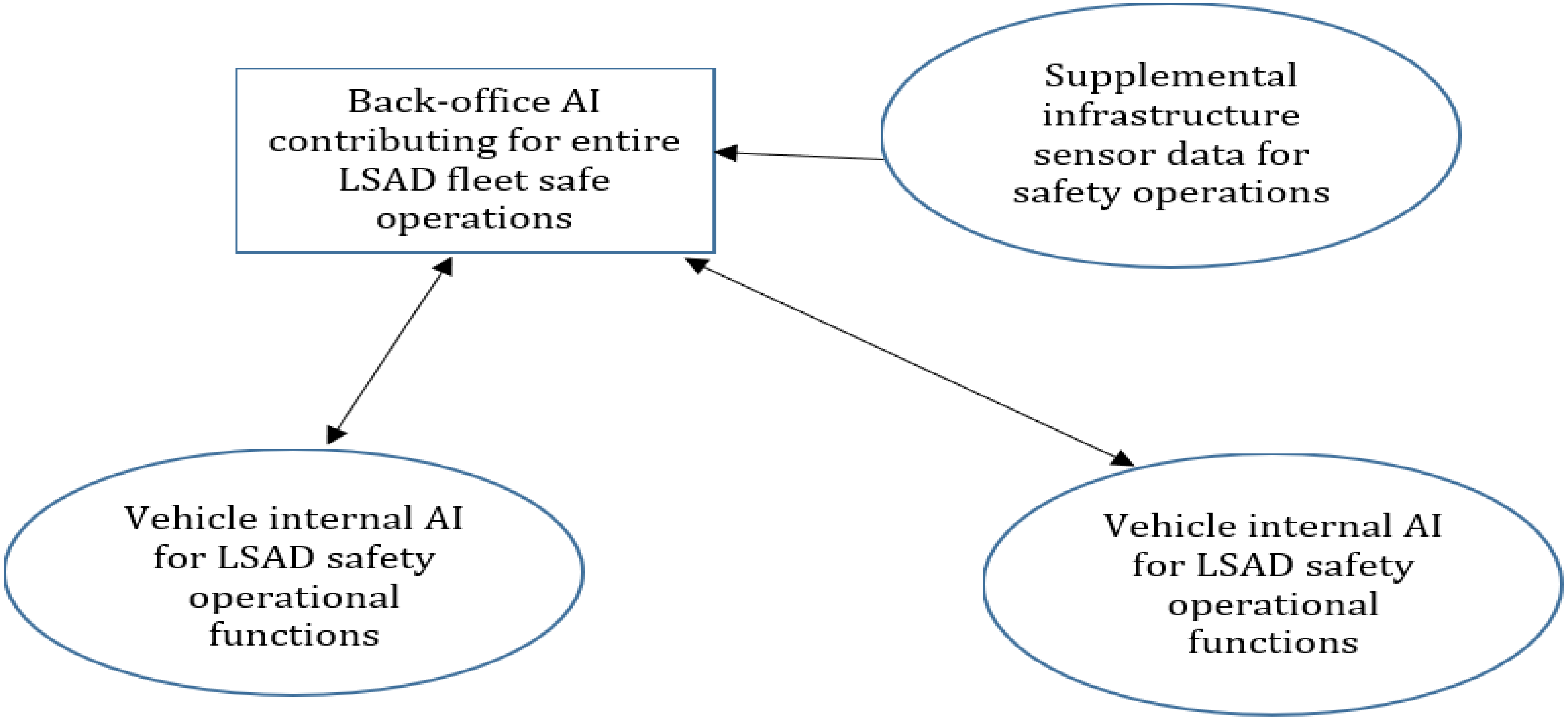
LSADS safety environment using AI

- The LSAD (Low-speed automated driving) fleet safe operation function should be maintained by using support from vehicle internal safety driving **AI** (Artificial intelligence) which provides safe LSAD automated driving function and back-office (LSAD system service control center) AI which remotely provides overridden AI service function superseding LSAD vehicle AI function when vehicle AI requests supplemental support from back-office AI. For the decision making by back-office AI, supplement infrastructure sensor data is necessary. Each vehicle's internal AI also sends a huge amount of data to back-office AI for the same reason.

Safety operational concept using AI

- The back-office AI contributes safety operational support for the entire LSAD fleet. For the decision making by back-office AI, the supplemental infrastructure sensor data are used. Vehicle internal AI for LSAD usually takes control of safety operations and receives support from back-office AI when needed. See Annex for use cases.
- The AI learns safety operation decision making by consuming rich safety operation driving data. AI does not have the thinking ability to make decisions without external support. Therefore, when AI encounters a newly experiencing situation, it needs external support from matured AI or other decision-making ability role entities.

Figure 1


Back-office AI contributing for entire LSAD fleet safe operations
Supplemental infrastructure sensor data for safety operations
Vehicle internal AI for LSAD safety operational functions
Vehicle internal AI for LSAD safety operational functions

AI education on safety function

- AI should be designed to be educated constantly by rich and properly structured big data provided by smart city infrastructure sensors and real time automated driving records. But pre-matured AI sometimes need supplemental support from matured AI. In this manner, pre-matured AI should be able to be become more matured AI. For this reason, AI supporting automated driving need experiences to meet new situations where first first-hand safety decision making is taking place, so the necessary, proper and correct decision making becomes possible.

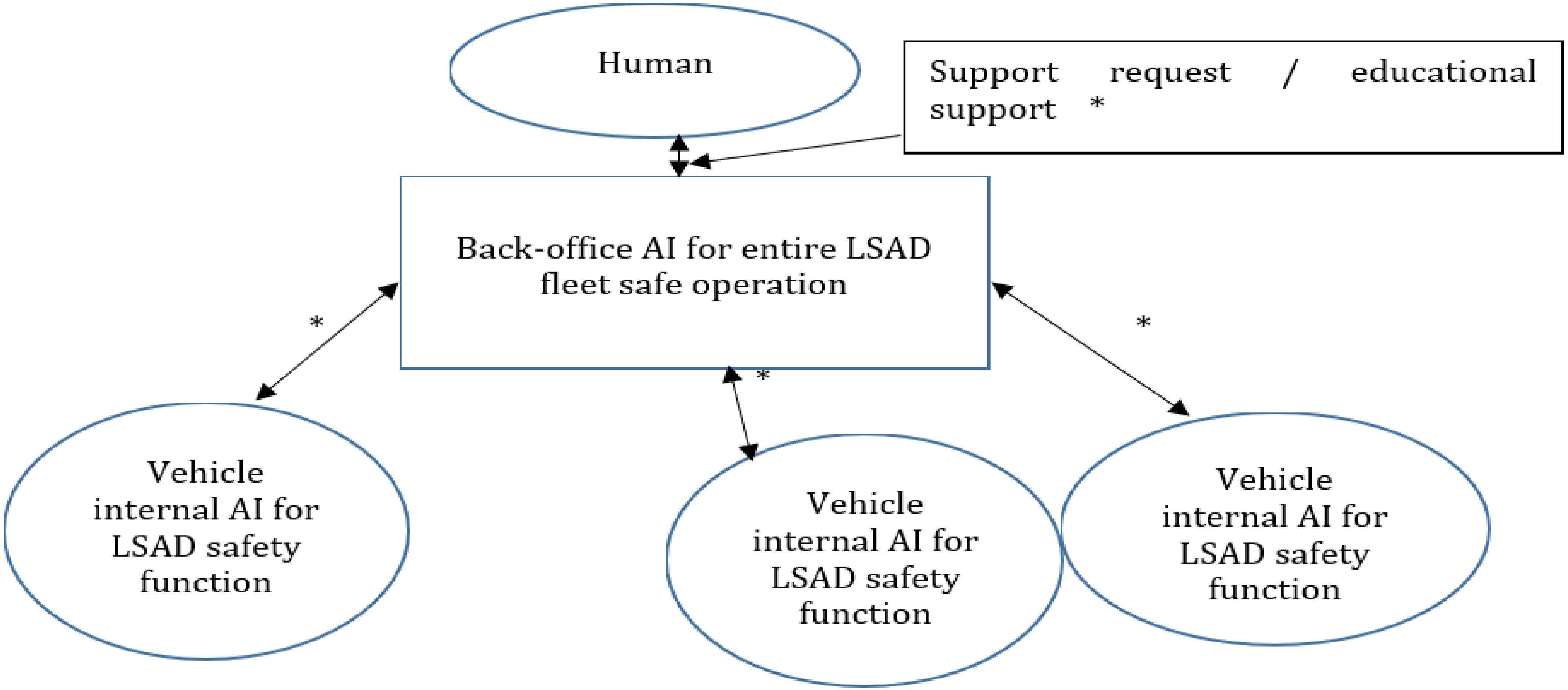
Education sharing among AIs

- Education provided by back-office AI to one vehicle AI should be shared by all other vehicle AI's so that entire LASD service system fleet vehicle AIs are kept on similar and/or same matured levels.

Supplemental safety support function of LSAD system service

- It has been understood in recent years that the most appropriate teacher for educating premature AI to matured level is the human brain. A safety support hierarchy model employing this human-on-top concept is expected to be the most reasonable solution. Figure 2 describes this concept.

Figure 2


Human
Support request / educational support *
Back-office AI for entire LSAD fleet safe operation
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Vehicle internal AI for LSAD safety function
Vehicle internal AI for LSAD safety function
Vehicle internal AI for LSAD safety function

Role of humans

- The LSADS discussed in this document is designed to comply with operational design domain level 4 and 5 (SAE J3016). Various dynamic human interventions are assumed to occur on an on-demand basis depending on the maturity of the AI mounted on the LSADS vehicle.
- The role of the human is expected to be initiated only when back-office AI is unable to make a safe and suitable decision. The back-office AI needs some level of human educations when expected necessary support is assumed. For decision-making by humans, various sensor data from the entire LSAD service system and surrounding smart city infrastructure facility sensors are to be used. Such supplemental data is essential for safe decision making.

Use case example

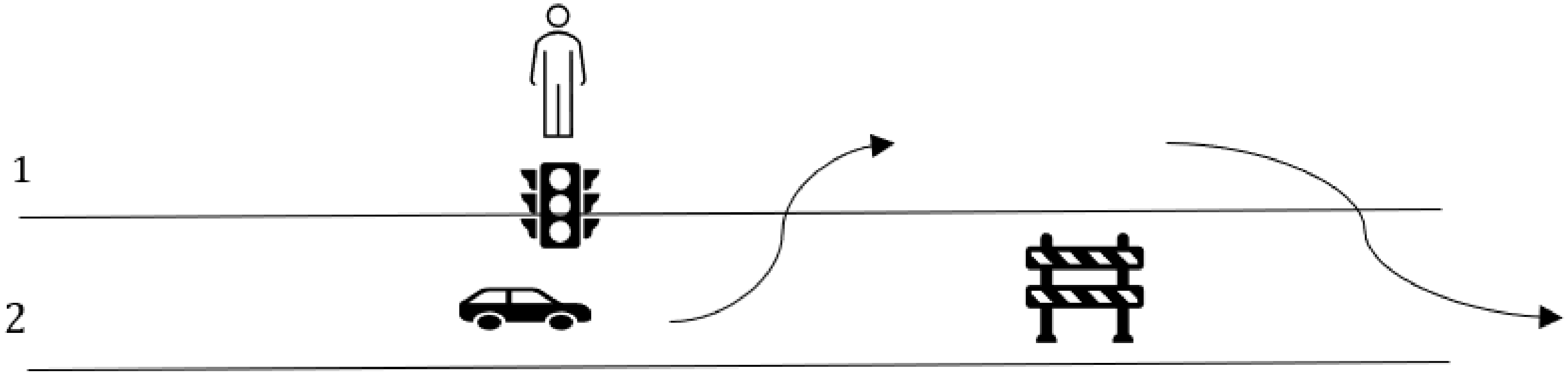
- This provides use case where LSAD service vehicle with information on which path to take when the vehicle is unable to continue driving because it does not know where to break traffic rules."

- This use case demonstrates a situation in which exceptional traffic rules have conflict with the rules to obey normally, and it is impossible for the in-vehicle AI to make a suitable decision.

Figure of use case example

-1: Oncoming Lane
-2: Main Lane

-Centre line is solid: do not cross
-Traffic signal is red: stop
-Worker flags to proceed: go



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