Summary of International Guidelines for Human Machine Interface of Advanced Driver Assistance System

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Introduction

- Collision avoidance system has been rapidly spread
  - ✓ General users began to recognize the driving support system
  - ✓ Automatic driving technology might be developed rapidly
- Purpose of the automatic driving technology
  - ✓ Mitigation of driving load and environmental improvement
  - ✓ Reduction of traffic accidents
- Two international guidelines for driving assistance have been issued
  - ✓ Guidelines on requirements for high-priority warning signals
  - ✓ Design principles for Control Systems of Advanced Driver Assistance System (ADAS)
- Human Machine Interface in the highly ADAS is important

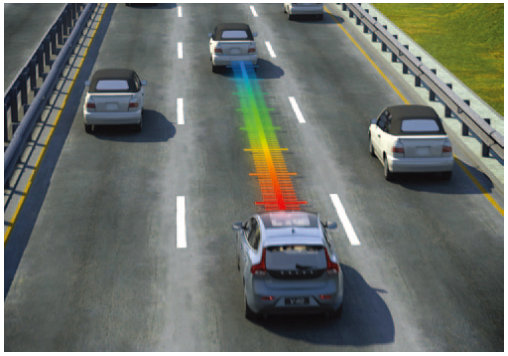
ADAS and Automated Driving

- Advanced Safety Vehicle (Japanese project)
  - ✓ Braking Control：Advanced Emergency Braking Systems (AEBS)
  - ✓ Longitudinal Control：Adaptive Cruise Control (ACC)
  - ✓ Horizontal Control：Lane Keeping Assist System (LKAS)

AEBS

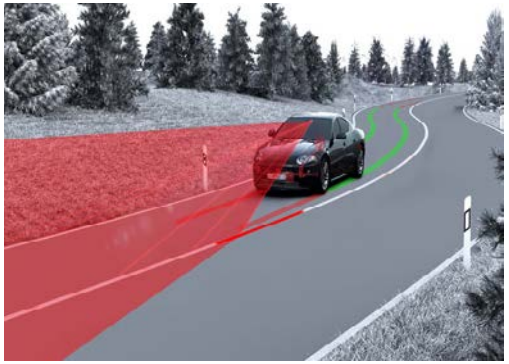
SUBARU HP, members.subaru.jp

ACC



http://v40.volvo-style.com/news_20130821109

LKAS



TRW HP
http://safety.trw.com

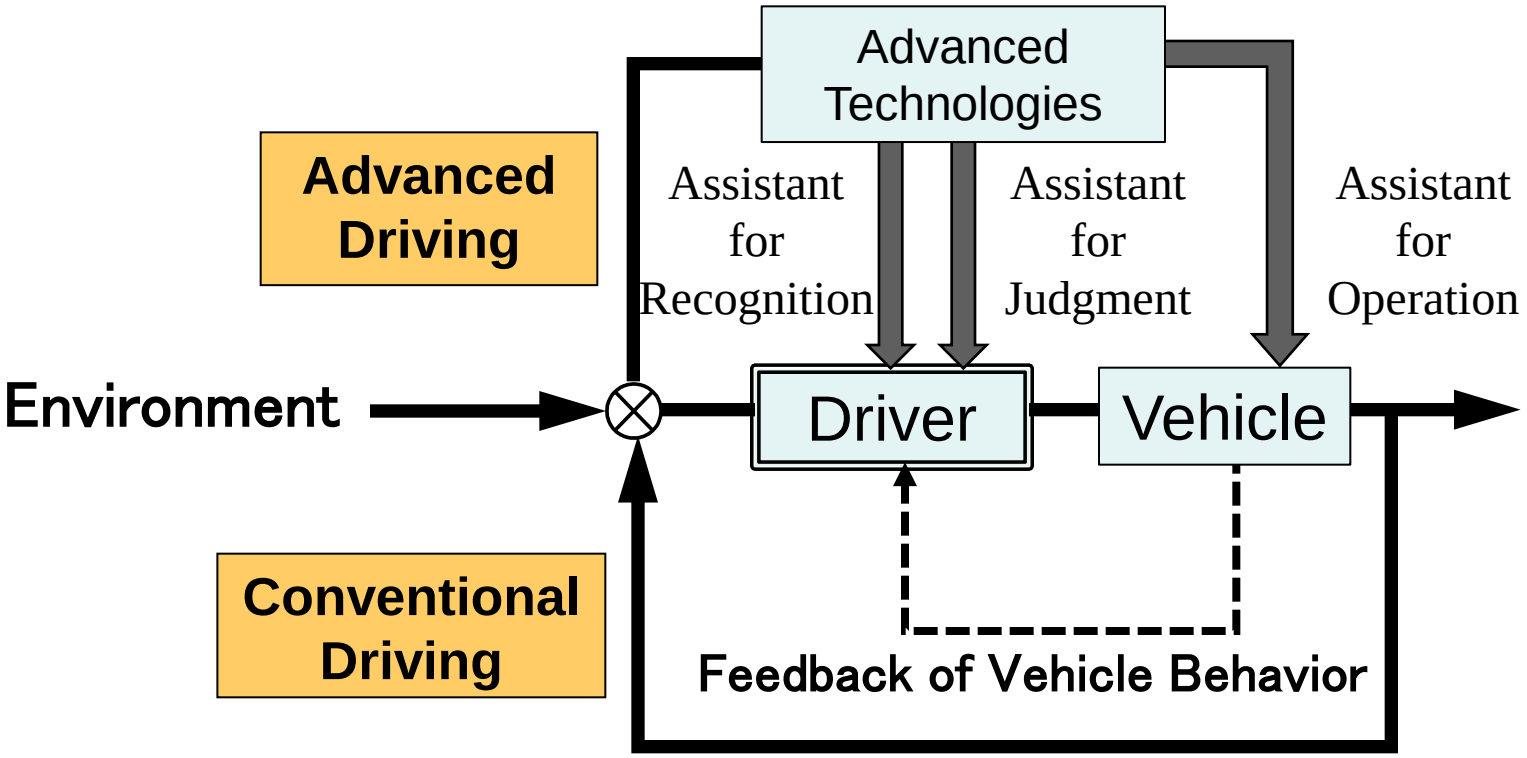
Automated driving is considered to be the development of these technologies

Relationship between driver and vehicle system

- Automated driving is expected to be continuously achieved through sophistication of driving support technologies

Principle of Driver in the Loop

- A driver is considered to be part of a safety system
- ADAS is intended to assist the driver

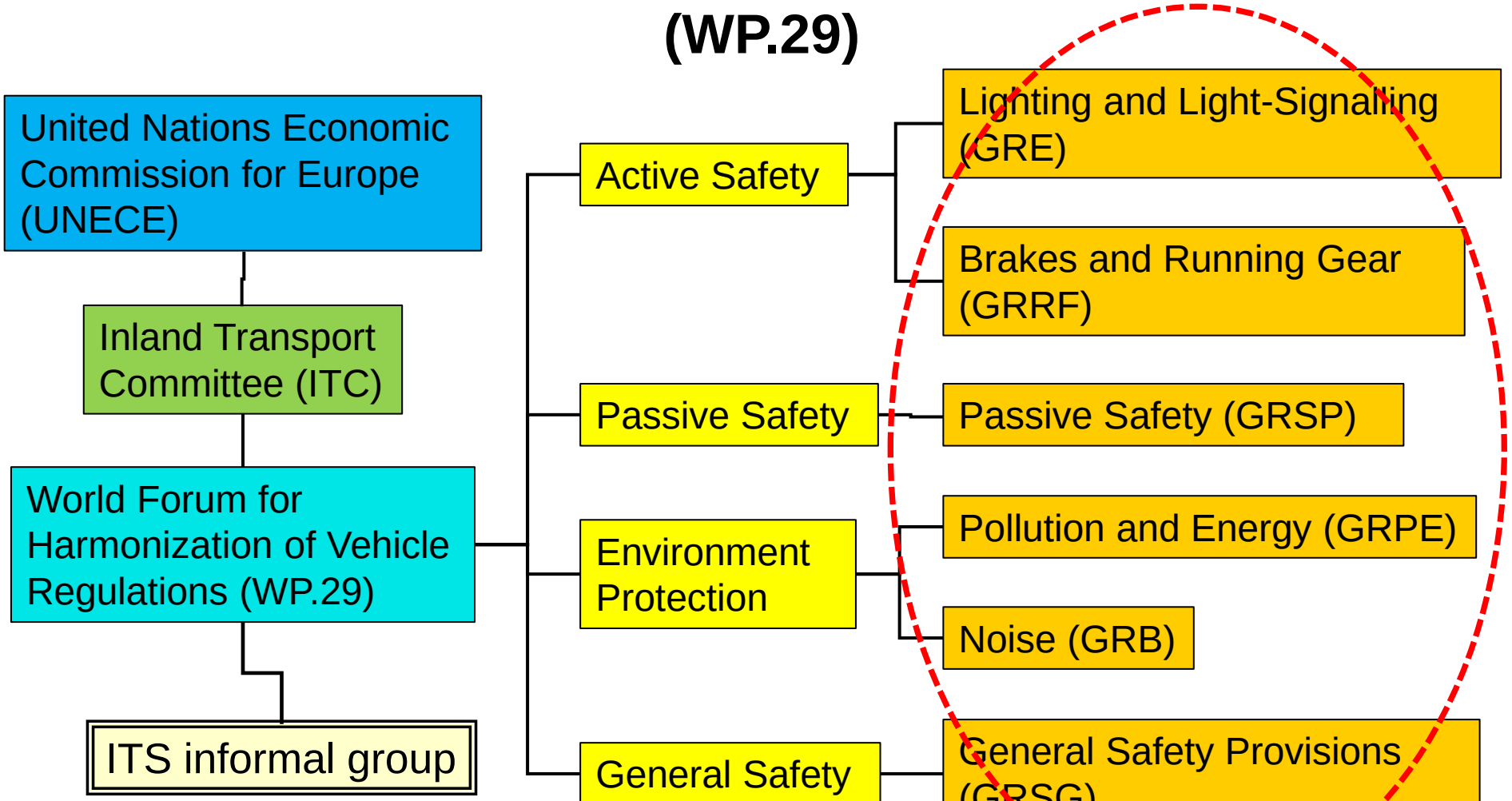


International Harmonization of ADAS

- The industry-government-academia projects in Europe
  - ✓ HAVEit, interactive, and AdaptIVe etc.
- International regulations on the new technologies have been studied

- World Forum for Harmonization of Vehicle Regulations（UN/ECE/WP29）
  - ✓ It is necessary for ADAS to evaluate the whole vehicle system
  - ✓ WP29/ITS informal group (ITS-IG)
    - To plan the direction of the international harmonization of ADAS
    - To share the information of the cross-sectoral new technology
    - IHRA-ITS conducts related researches and studies to support their discussion

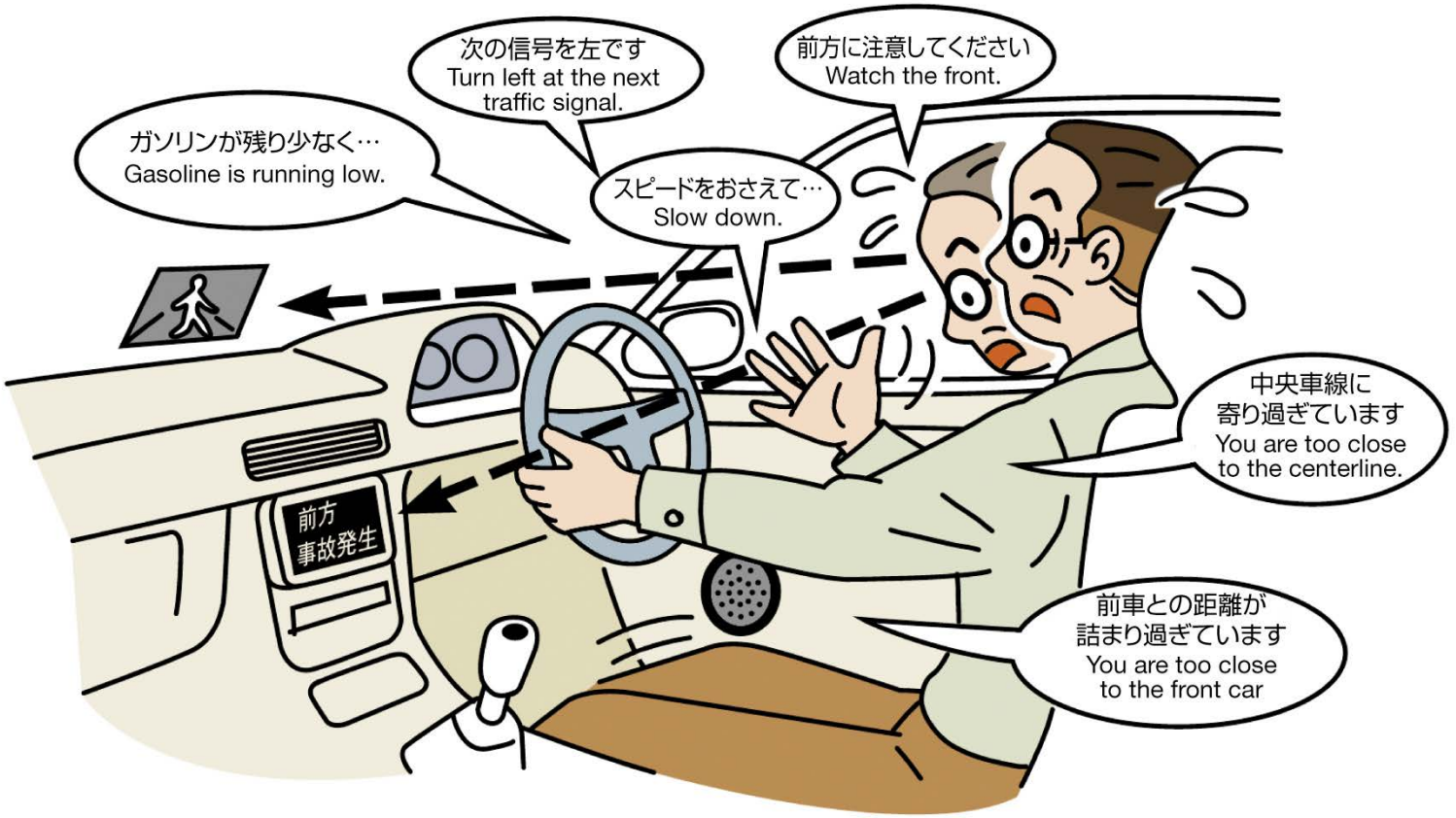
World Forum for Harmonization of Vehicle Regulations (WP.29)



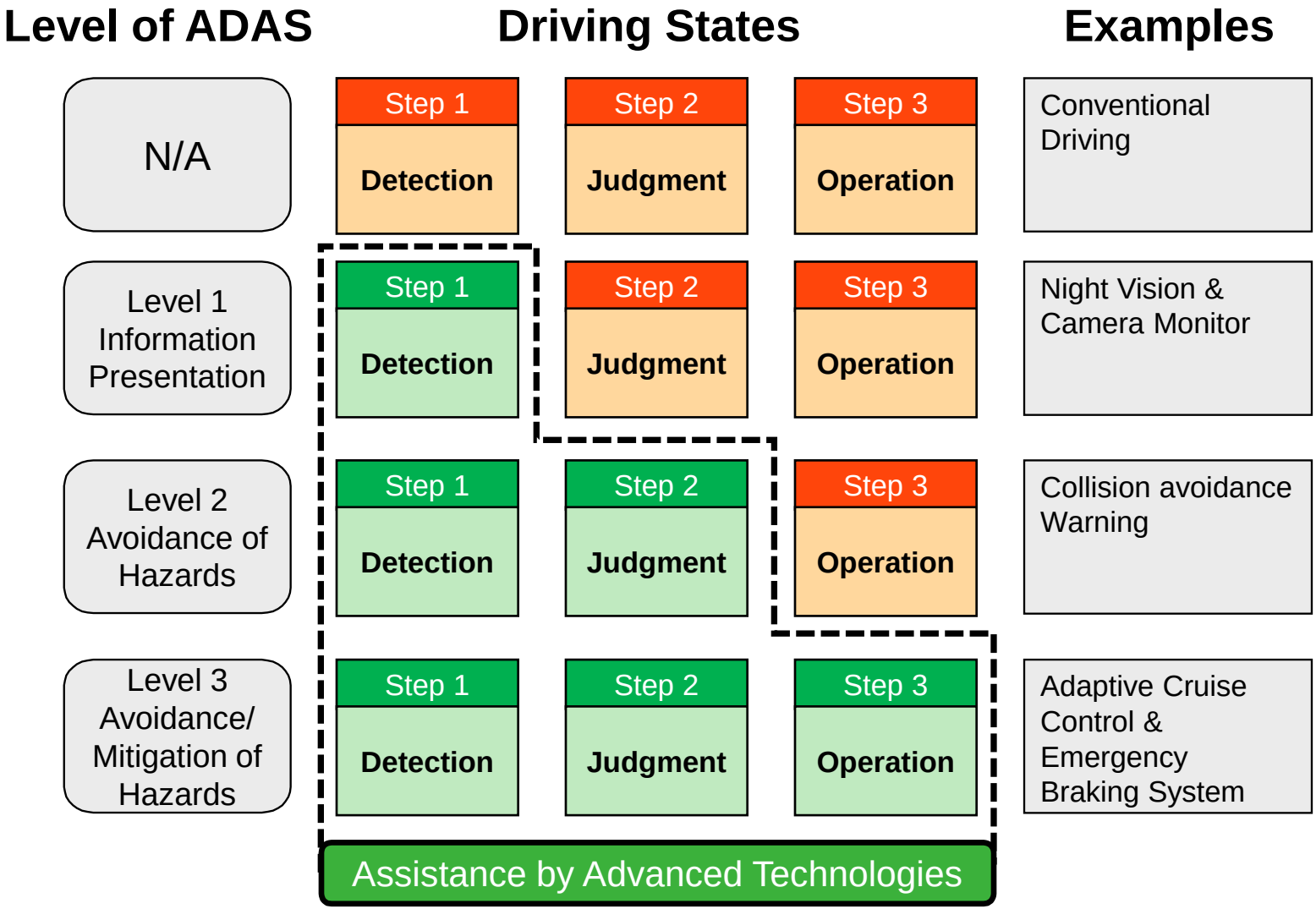
- Established in 2002
- Sharing information of cross-sectoral new technology
- Drafting new guideline

ADAS and Human Machine Interface (HMI)

- ITS-IG assumes the three support levels, information presentation, warning and vehicle control
- Appropriate HMI between the vehicle and the driver is important

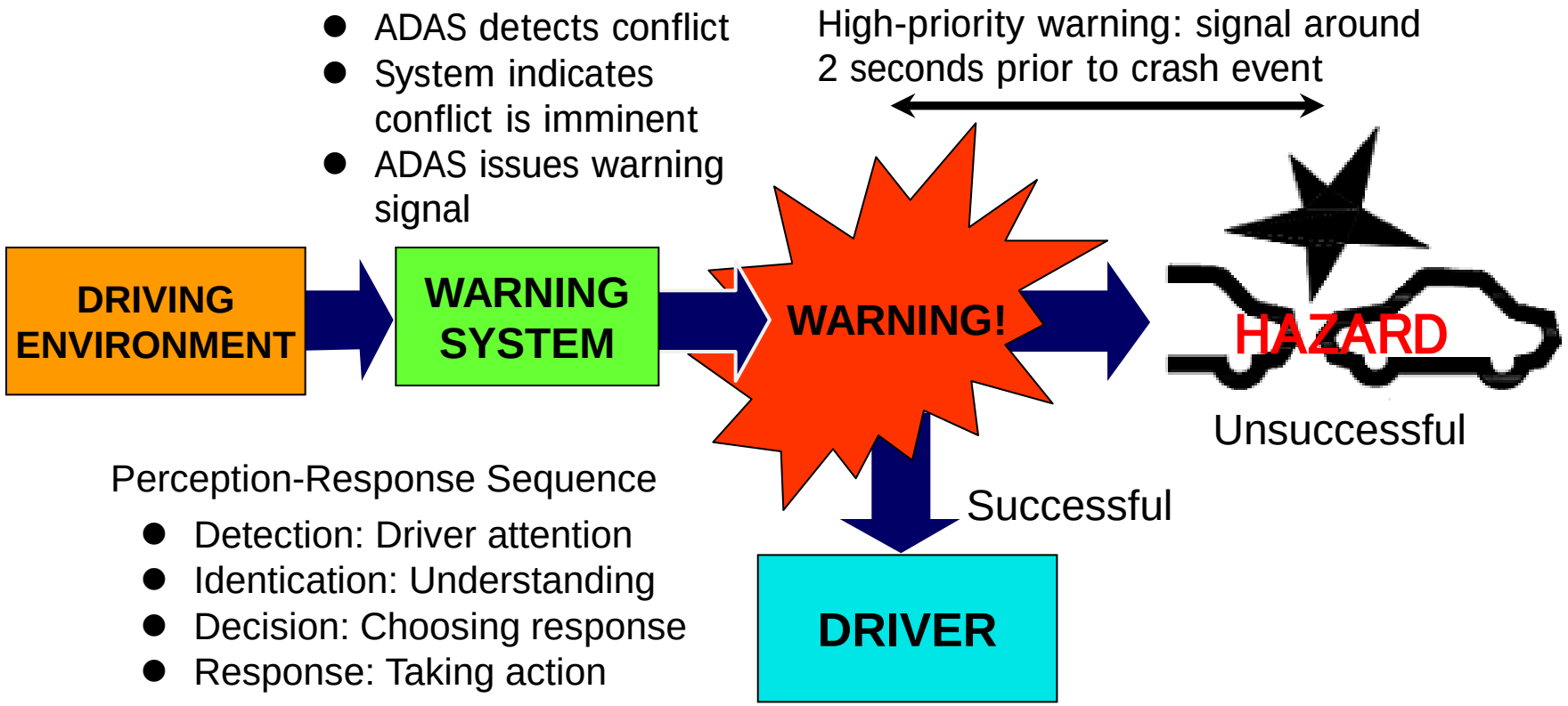


Bahavioural Model of a Driver and Level of Driver Assistance



Guidelines for high-priority warning signals (2011)

- Definition of emergency warning that is presented just before the collision



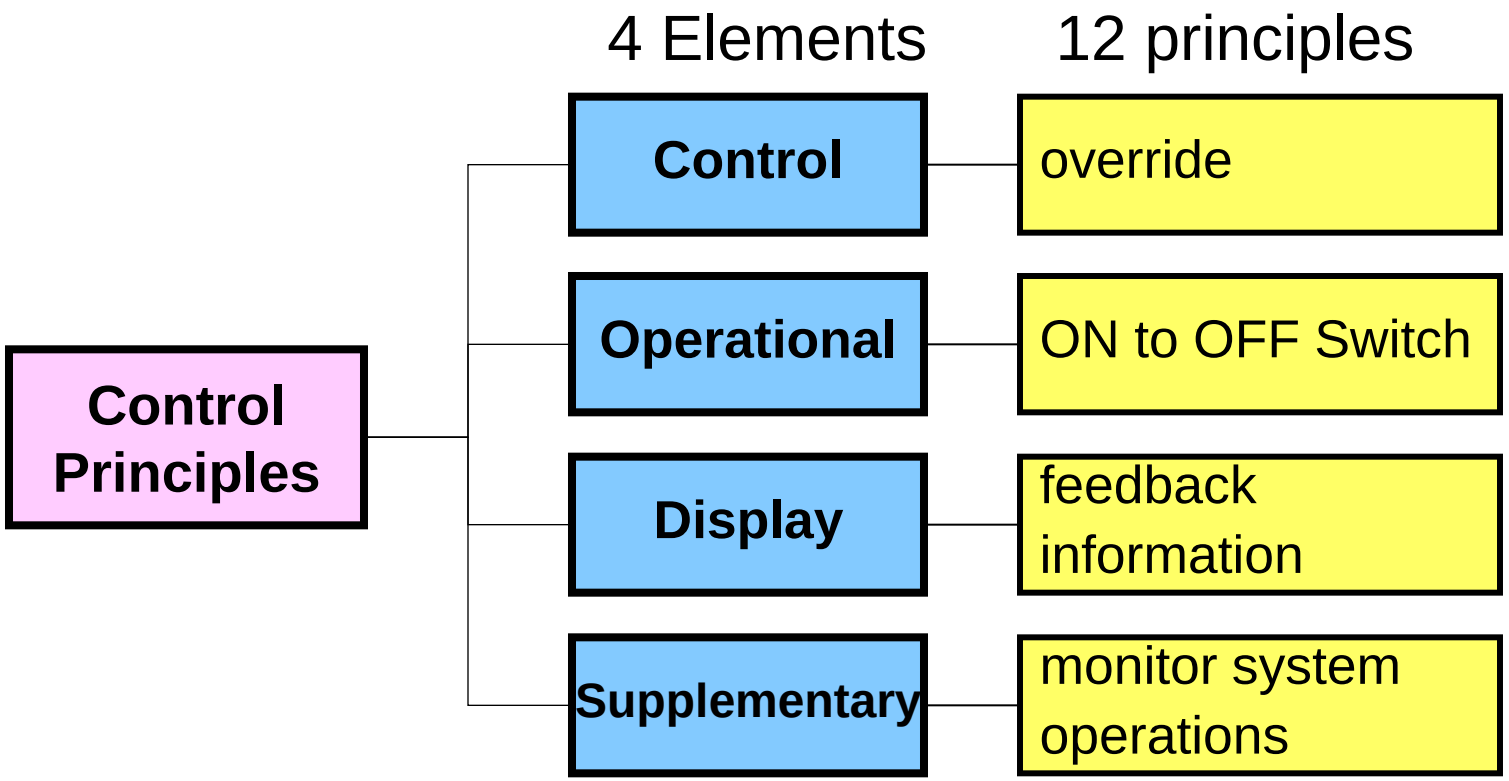
Requirements for high-priority warning signals

- High-priority warnings should
  - ✓ be noticeable in the driving environment
  - ✓ be distinguishable from other messages in the vehicle
  - ✓ provide spatial cues to the hazard location.
  - ✓ inform the driver of proximity of the hazard
  - ✓ elicit timely responses or decisions

- Multiple warnings should be prioritized
- False / nuisance warnings rate should be low
- System status and degraded performance of high-priority warnings should be displayed

Design principles for Control Systems of ADAS (2014)

- Basic principles that describe the role of the system and the driver in consideration of human characteristics



UNECE Guidelines for Keeping Drivers In-the-Loop

Principles to allow drivers to easily and accurately understand driving situations and effectively use partial-automation; e.g.,

- System actions should be easy to override at any time under normal driving situations;
- Drivers should have a means to transition from ON to OFF manually;
- Drivers should be provided with clear feedback informing them when the system is actively controlling the vehicle;
- Drivers should be informed of the system status when system operation is malfunctioning or when there is a failure;
- Drivers should be notified of the proper use of the system prior to general use.
- Drivers should be notified of any system-initiated transfer of control between the driver and vehicle;

UNECE WP.29 ITS-IG (2013). Design Principles for Advanced Driver Assistance Systems. United Nations Economic Commission for Europe, World Forum for Harmonization of Vehicle Regulations (WP.29), ITS Informal group.

Issue of Transfer of Control between the driver and vehicle

- At the time of system is out of use, it is necessary to switch from automatic operation to manual operation
  - ✓ Appropriate timing and method of switching are required
  - ✓ It is necessary to design the HMI considering the driver's behavior and awareness when he/she is using the system

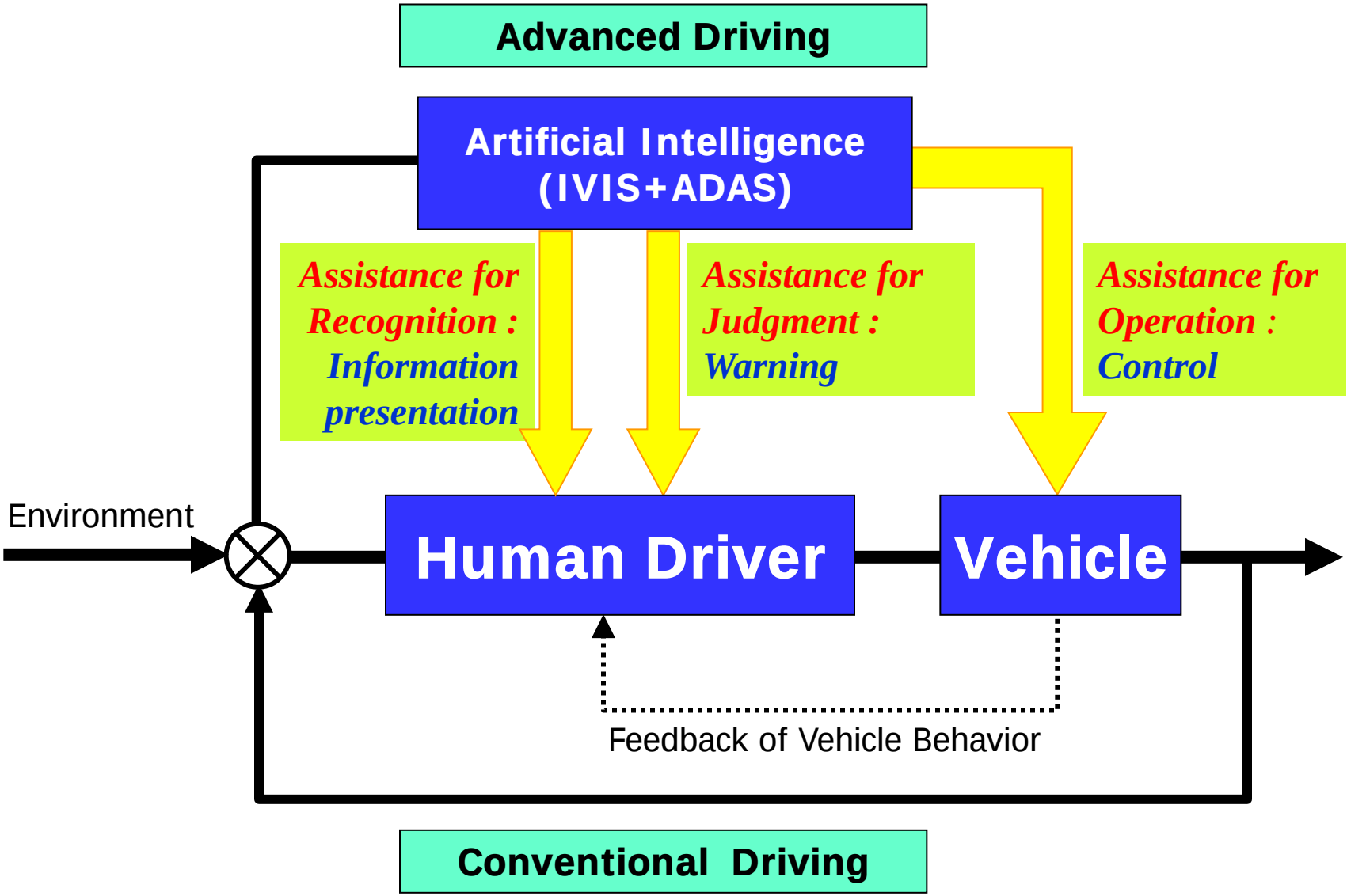
- HMI standardization activities for automatic driving system has been initiated
  - ✓ ISO TC204/WG14
  - ✓ ISO TC22/SC13/WG8

Summary

- Automated driving is considered to be the development of ADAS technologies
- In the highly advanced driving support system, principle of “Driver in the Loop” should be applied
- HMI design based on the Guidelines for high-priority warning and control principle is required for proper development of the technology
- It is important to clarify the appropriate timing and how to switch from automatic operation to manual operation when the system is out of use

Thank you for your kind attention

Block Diagram of Car Driving



Harmonization of Levels of driving automation

- Classification in 4-5 levels from manual to full automation
- Name and support are little different by country and organization

Level	Examples of name	Examples of support
0	Manual Driving, No automation	Conventional Driving
1	Individual System, Assisted, Driver Assistance	Single function assistance (ACC, LKAS, AEBS etc.)
2	System Integration, Partial Automation	Combined function assistance (ACC+LKAS)
3	Advancing System, Conditional Automation	Highly Automated driving mode by intelligent control in limited situation
4	Full Automation, High Automation	The driver has been released from the all operation

Level of assistance and driver responsibility

- International consensus is necessary for responsibility in the case of an accident

Level	Examples of name	Responsibility of Safety
0	Manual Driving, No automation	Driver
1	Individual System, Assisted, Driver Assistance	Driver
2	System Integration, Partial Automation	Driver
3	Advancing System, Conditional Automation	Driver? System?
4	Full Automation, High Automation	System