Document No. ITS-20-05
(20th ITS, 16 March 2012, agenda item 4)

Design Principles for Advanced Driver Assistance Systems

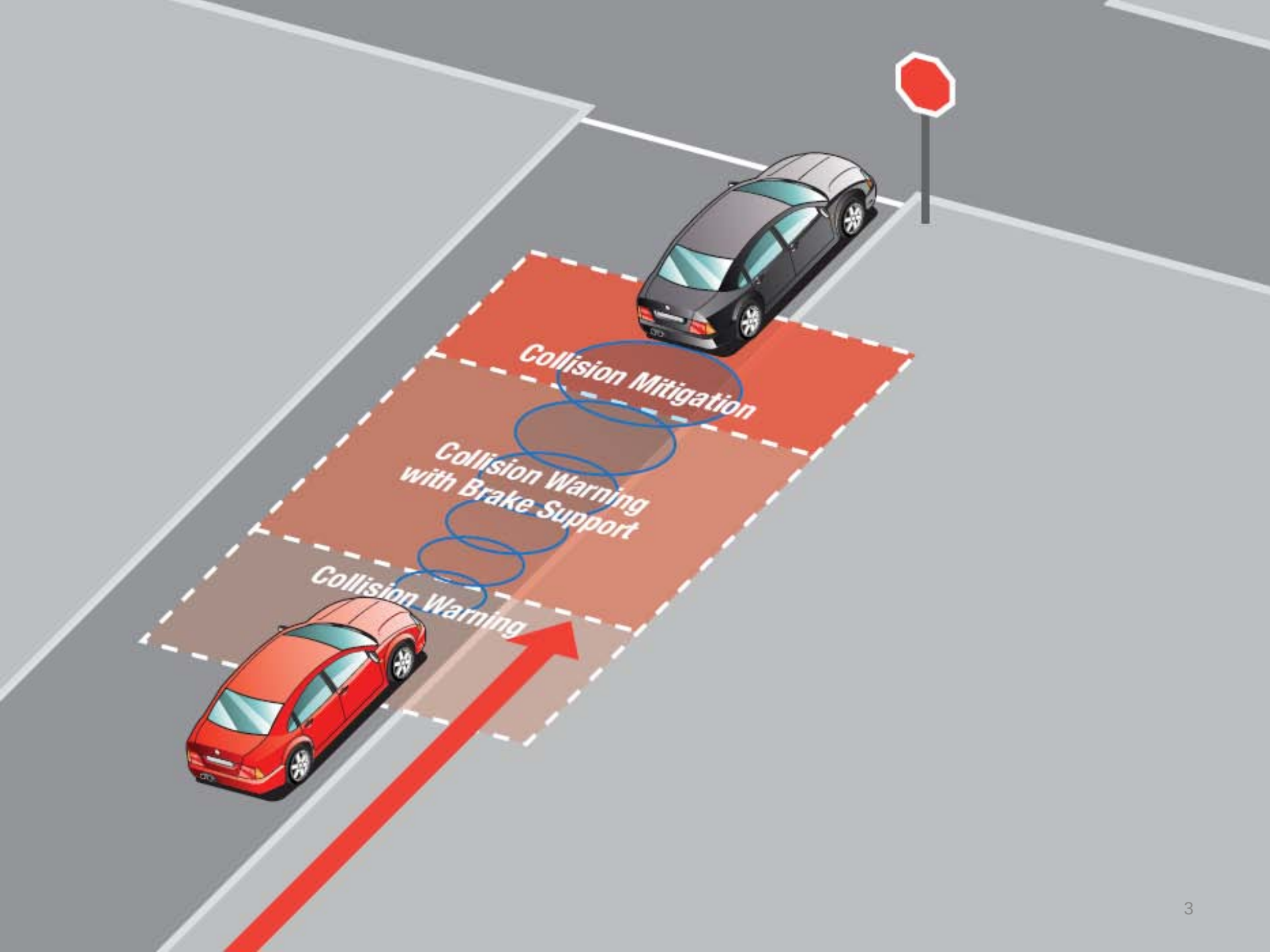
IHRA-ITS

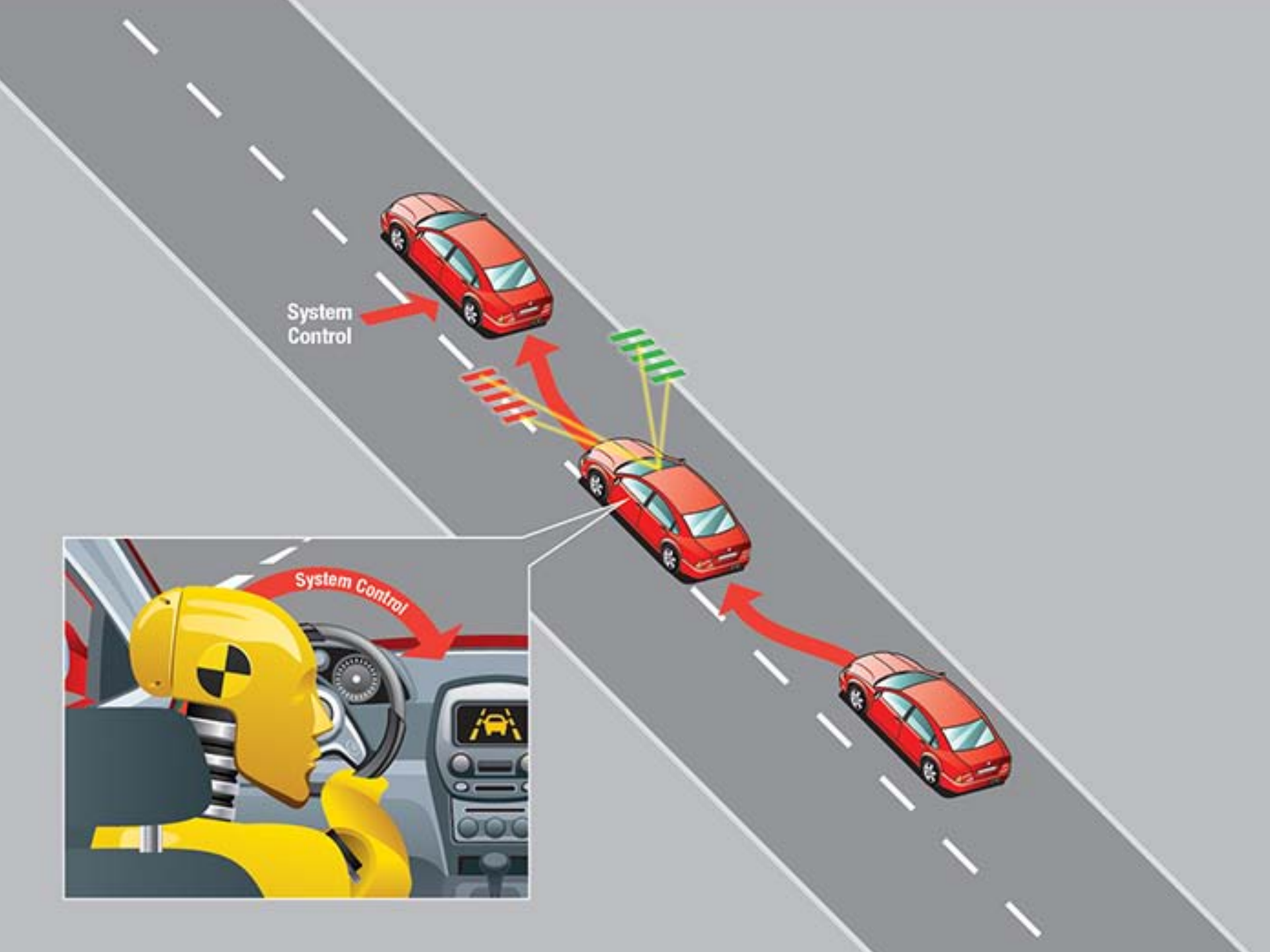
UN-ECE WP.29 ITS Informal Group

Geneva, March, 2012

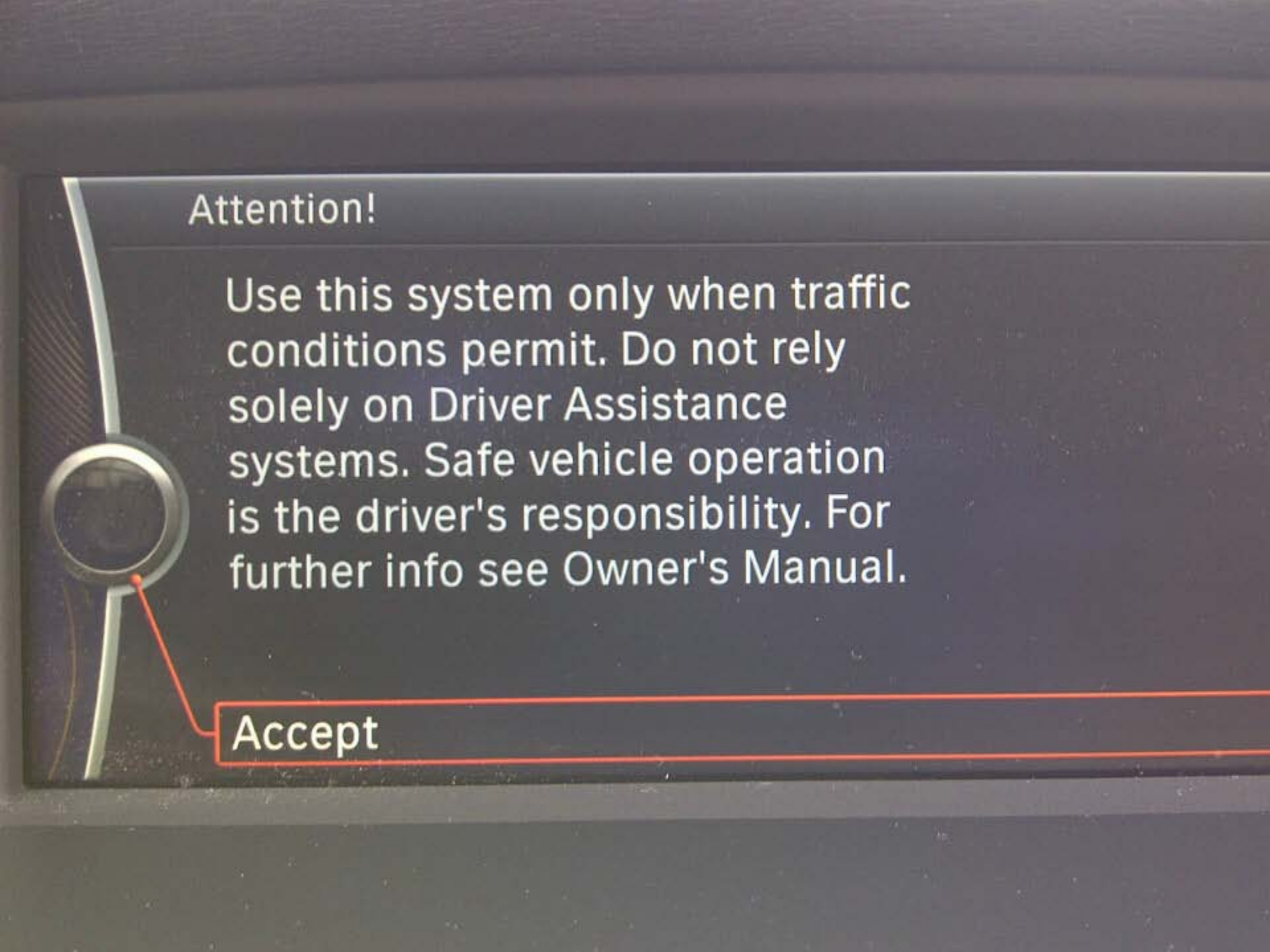
Outline

1. Background
2. Scope
3. Control Principles
4. Summary


Collision Mitigation
Collision Warning
with Brake Support
Collision Warning


System
Control
System Control


Impact
time
Normal driving
Danger phase
Crash unavoidable
In crash
Post-crash


Attention!
Use this system only when traffic conditions permit. Do not rely solely on Driver Assistance systems. Safe vehicle operation is the driver's responsibility. For further info see Owner's Manual.
Accept

Lane Departure Warning – display


RES


ENTER
FCW
LDW

In-the-Loop Performance

In-the-Loop

- the driver is involved in the driving task and is aware of the vehicle status and road traffic situation.
- driver plays an active role in the driver-vehicle system.

Out-of-the-Loop (potential negative consequence of automation)

- Reduced situational awareness - driver is not immediately aware of the vehicle and the current or developing road traffic situation.
- not actively monitoring, making decisions or providing input to the driving task.
- diminished ability to detect system errors and manually respond.

Scope and Overview of Principles

The principles apply to passenger cars but they are relevant to other vehicles.

The principles are divided into four sections:

1. Control elements;
2. Operational elements;
3. Display elements and
4. Supplementary elements.

A total of twelve principles were established . Each principle defines the minimum requirements to be fulfilled for the HMI to allow the driver to easily and accurately understand and judge driving situations and effectively use the control system.

Control Elements

(i) System actions should be easy to override at any time under normal driving situations and when collisions are avoidable.

Explanation: One of the main objectives of ADAS such as ACC, etc., used in normal driving situations, is to reduce the driving workload. During normal driving, the system should be capable of being overridden by the driver using simple, deliberate action(s) at any point in time.

(ii) When a collision is determined to be imminent, the system can take actions intended to avoid and/or mitigate the crash severity.

Explanation: In critical driving situations where the driver has not taken proper avoidance actions because of impairment, distraction, inattention, or other unforeseen incidents, it should be possible to apply system intervention to try to avoid the collision or mitigate the crash severity.

Operational Elements

(iii) For systems that control the vehicle under normal driving situations, the driver should have a means to transition from ON to OFF manually and to keep the system in the OFF state.

Explanation: For ease of use and/or convenience in driving, the driver's intentions should be ensured as a priority, so that the driver can switch the state of control from system to driver, that is from ON to OFF, and the OFF state should be kept under the driver's operation.

(iv) For systems that control the vehicle under critical driving situations, the initial set state of the system should be ON.

Explanation: For collision avoidance and/or mitigation, the first priority is to reduce trauma, therefore the system status ON should be maintained during driving and should be clearly visible to the driver. However, accounting for driver preferences, the system can be equipped with a manual OFF switch.

Display Elements

(v) Drivers should be provided with clear feedback informing them when the system is actively controlling the vehicle's speed and/ or path.

Explanation: When the system is actively controlling the vehicle, the driver should be provided with clear feedback on its activation. The driver has to be made aware of system activation so as to properly manage driving a car with assistance systems.

(vi) Drivers should be informed of the conditions when system operation is malfunctioning or if when there is a failure.

Explanation: When the system is malfunctioning or has failed, the driver should be informed of the system status. This is needed to avoid any misunderstanding by the driver that the system is still working.

Display Elements continued

(vii) Drivers should be informed of the conditions when system operation is not guaranteed.

Explanation: When the system is not fully functioning, for example, the sensor performance is impaired under certain driving conditions, the driver should be informed of the status to allow a smooth transfer of control to the driver.

(viii) Drivers should be notified of any system-initiated transfer of control between the driver and vehicle.

Explanation: Transfer of control between the driver and the vehicle would be the point when automation is realized. Any transfer of control should be transparent to the driver, but at the very least, the driver should be notified of any transfer initiated by the system so the driver is always aware if they have full control of the vehicle.

Supplementary Elements

(ix) In cases where systems automatically control the longitudinal and lateral behaviour of the vehicle, and the driver's task is to monitor system operations, appropriate arrangements should be considered to support drivers continued monitoring of the vehicle, road and traffic situation.

Explanation: When the driver is using highly automated systems such as ACC with LKS, which is the automation of longitudinal and lateral control, the driving tasks are reduced and the driver simply monitors the systems and surroundings. In these situations, it is important to ensure the driver's attention to the driving task is maintained. To ensure that the driver stays aware of the driving situation, appropriate measures should be considered to keep the driver in-the-loop.

(x) Drivers should be notified of the proper use of the system prior to general use.

Explanation: The manufacturer should provide information on correct system use to avoid any misunderstanding and/or over-dependence on the system. For example, it is required that the driver understand what assistance systems are installed in the vehicle, and that instructions be provided on the physical limitations of the system functions prior to its use.

Supplementary Elements continued

(xi) If symbols are used to notify the driver, a standard symbol should be used if available.

Explanation: Taking into account the use of different and/or unfamiliar vehicles, commonality of information should be secured, therefore standard symbols should be used, if available.

(xii) System activation should be displayed to other road users.

Explanation: To help surrounding road users, such as other drivers, pedestrians, and cyclists, be aware of vehicle actions, the system's actions should be displayed when braking, turning or for hazards.

Summary

- Safe driver-vehicle interaction is important for the effectiveness of driver assistance systems.
- These draft control principles are limited to minimum requirements.
- Advanced driver assistance systems that control the vehicle are evolving rapidly.
- In time, these principles will need to be updated in order to remain relevant.

Thank you