

Transmitted by Expert from Japan

20-21 November 2017

Item 5 of the agenda

Automatic Emergency Braking Systems (AEBS)

Explanation of Japanese guideline

DETAIL

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1. Definition of AEBS

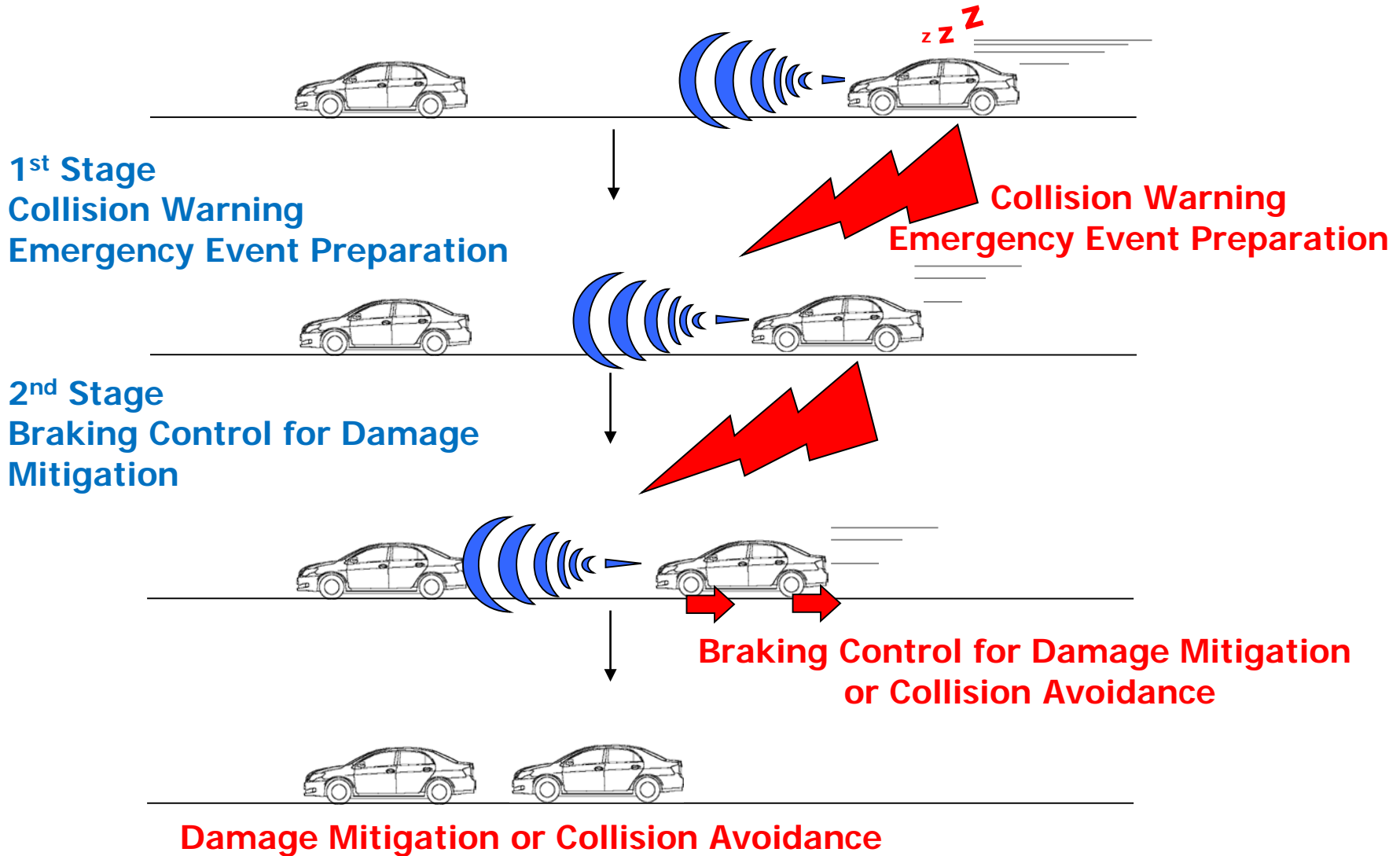
Definition of Automatic Emergency Braking Systems

"Automatic Emergency Braking Systems (hereafter AEBS)"

A) AEBS has functions of the **collision warning** and the **emergency event preparation** to the driver in case of occurrence of a danger of collision with a forward obstacle.

B) AEBS has a function of the **braking control for mitigating** the damage of vehicle collision with a forward obstacle in case of that collision is judged imminent or unavoidable.

1. Definition of AEBS



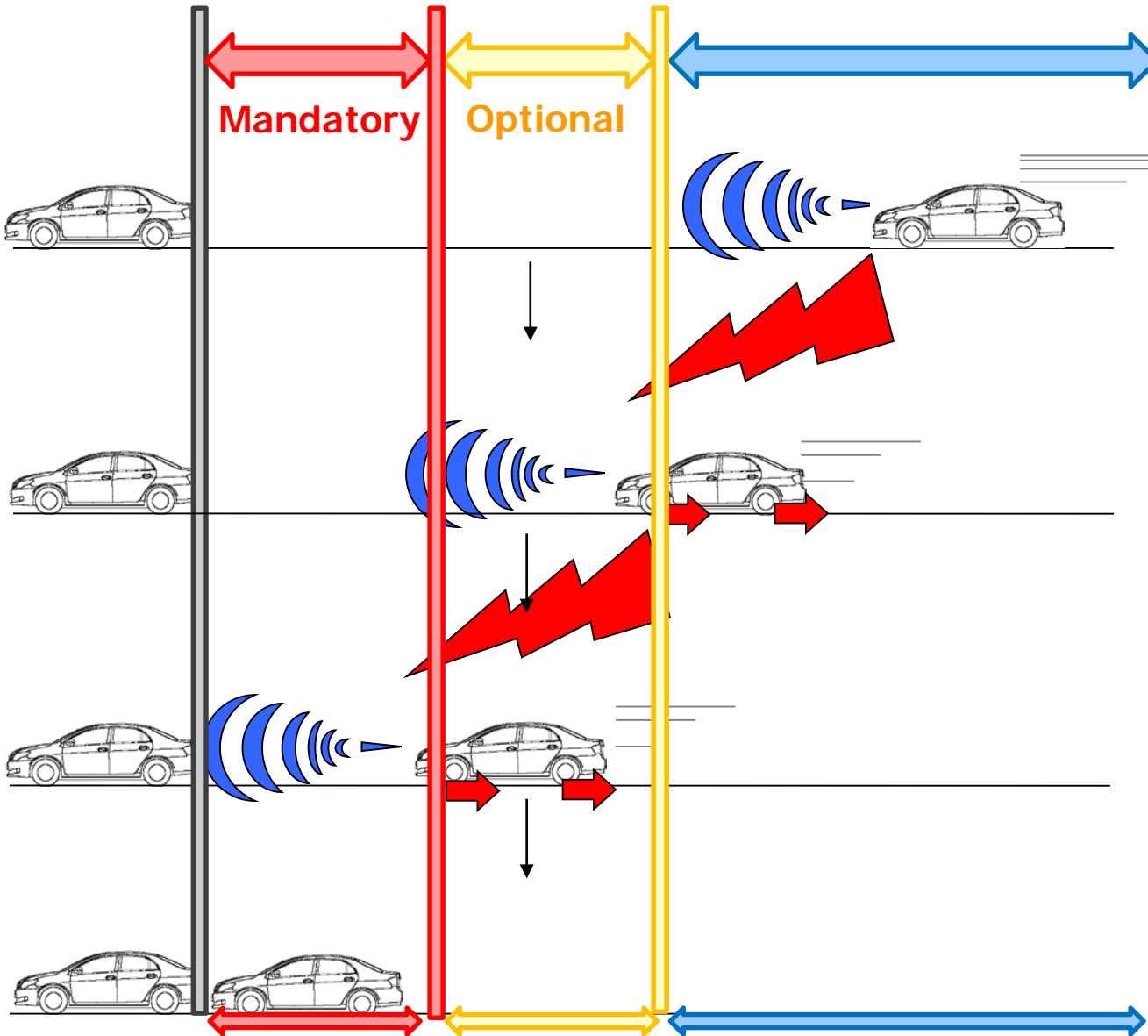
2. Speed Range

Speed Range

The system need not to start the braking control in the following speed ranges.

- (a) The vehicle speed is exceeding a maximum speed.
- (b) The absolute speed of the vehicle is equal to or less than 15 km/h.
- (c) The relative speed of the vehicle is equal to or less than 15 km/h.
- (d) In case of vehicle malfunctions.

3. Timing of Braking Control



The most of driver operates the braking or the steering in the normal driving.

The most of driver has already operated the braking or the steering in the emergency situation.

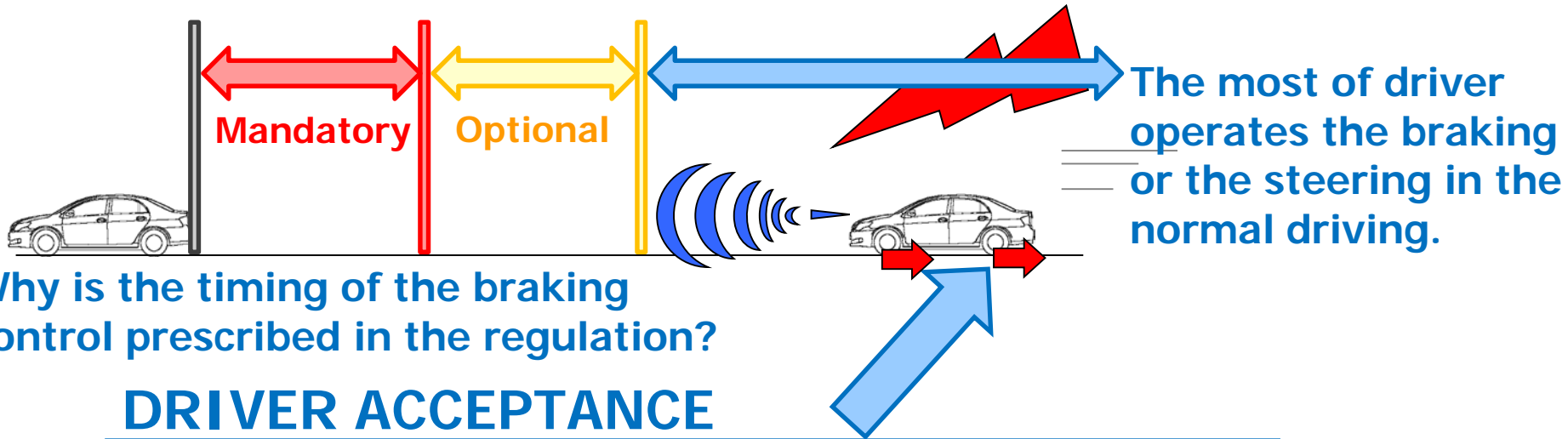
A driver can't avoid the collision, even if a driver operates the braking or the steering with the maximum vehicle dynamic performance.

The braking control shall be activated.

The braking control may be used.

The braking control shall not be activated.

3. Timing of Braking Control



If AEBS activates in the normal driving condition, a driver has nuisance feeling.

- A driver may use off-control.
- A driver may have distrust to AEBS.

And then, AEBS might not activate efficiently in the emergency situation.

Consideration of driver acceptance is important for the effect of AEBS. Therefore, the timing of the braking control is prescribed in this draft.

3. Timing of Braking Control

Operational Range Based on Physical Avoidance Limit

Operational range based on physical avoidance limit

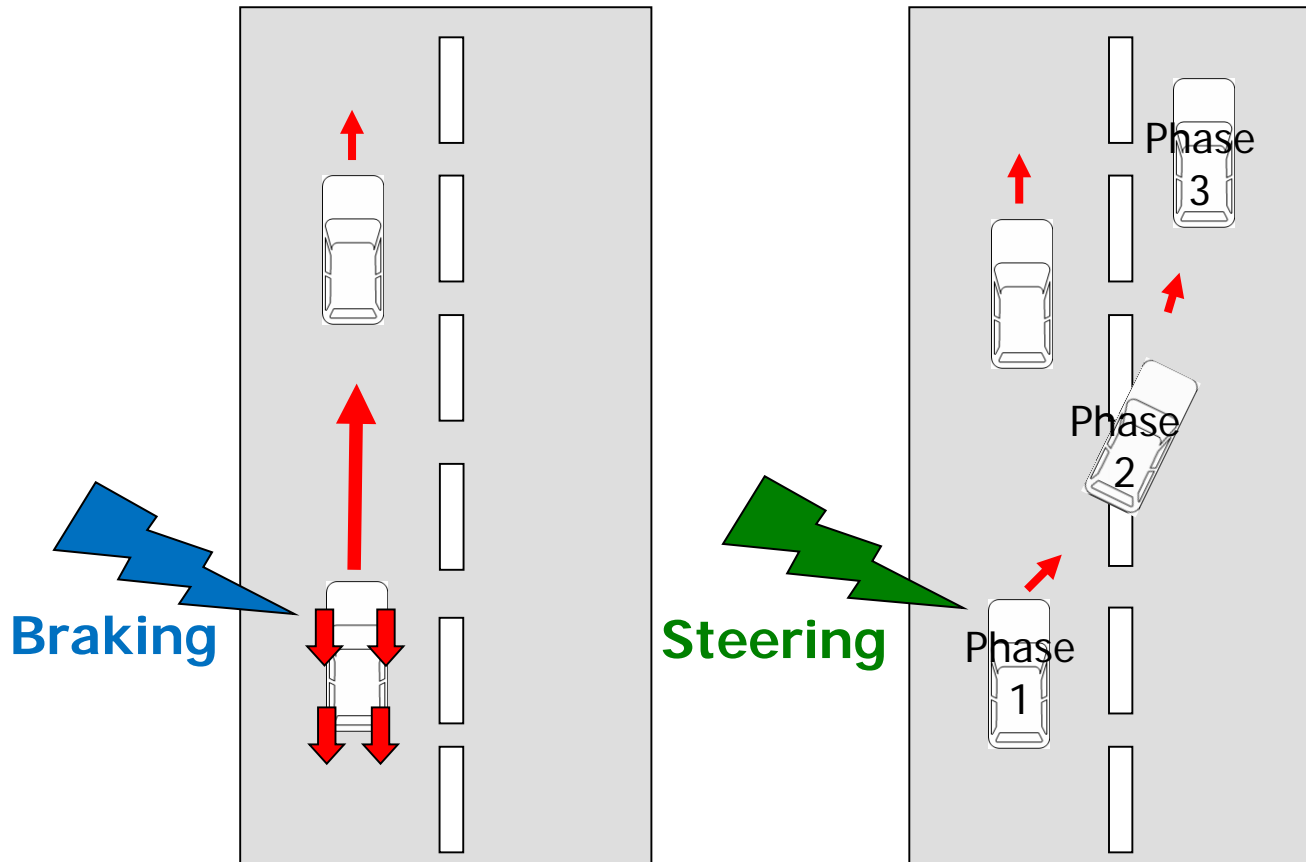
The timing of the braking control is called **collision judgment line** in this draft.

Collision judgment means a state of a judgment that a collision cannot be avoided physically by operating either the braking or the steering.

The braking control shall be activated.

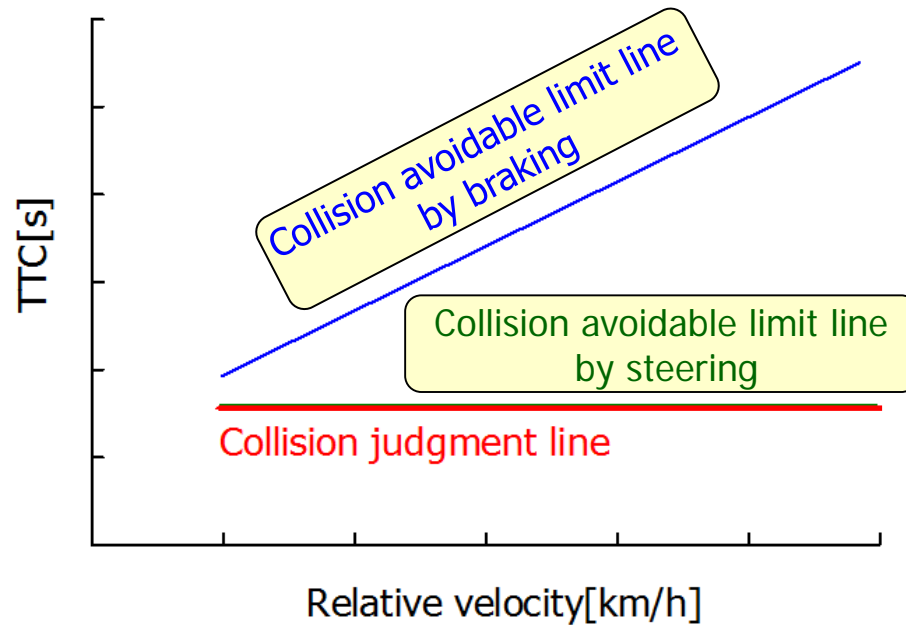
3. Timing of Braking Control

Driver operates either the braking or the steering for the purpose of avoiding the collision.



The timing of braking control is prescribed in this draft based on considering the operation of both the braking and the steering.

4. Collision Judgment Line



Collision avoidable limit line
by braking

Collision avoidable limit line by braking is TTC which is calculated by minimum stopping distance with the braking test.

Collision avoidable limit line
by steering

Collision avoidable limit line by steering is TTC which is calculated by minimum lateral displacement with the steering test.

Braking: Braking performance of each vehicle is different.

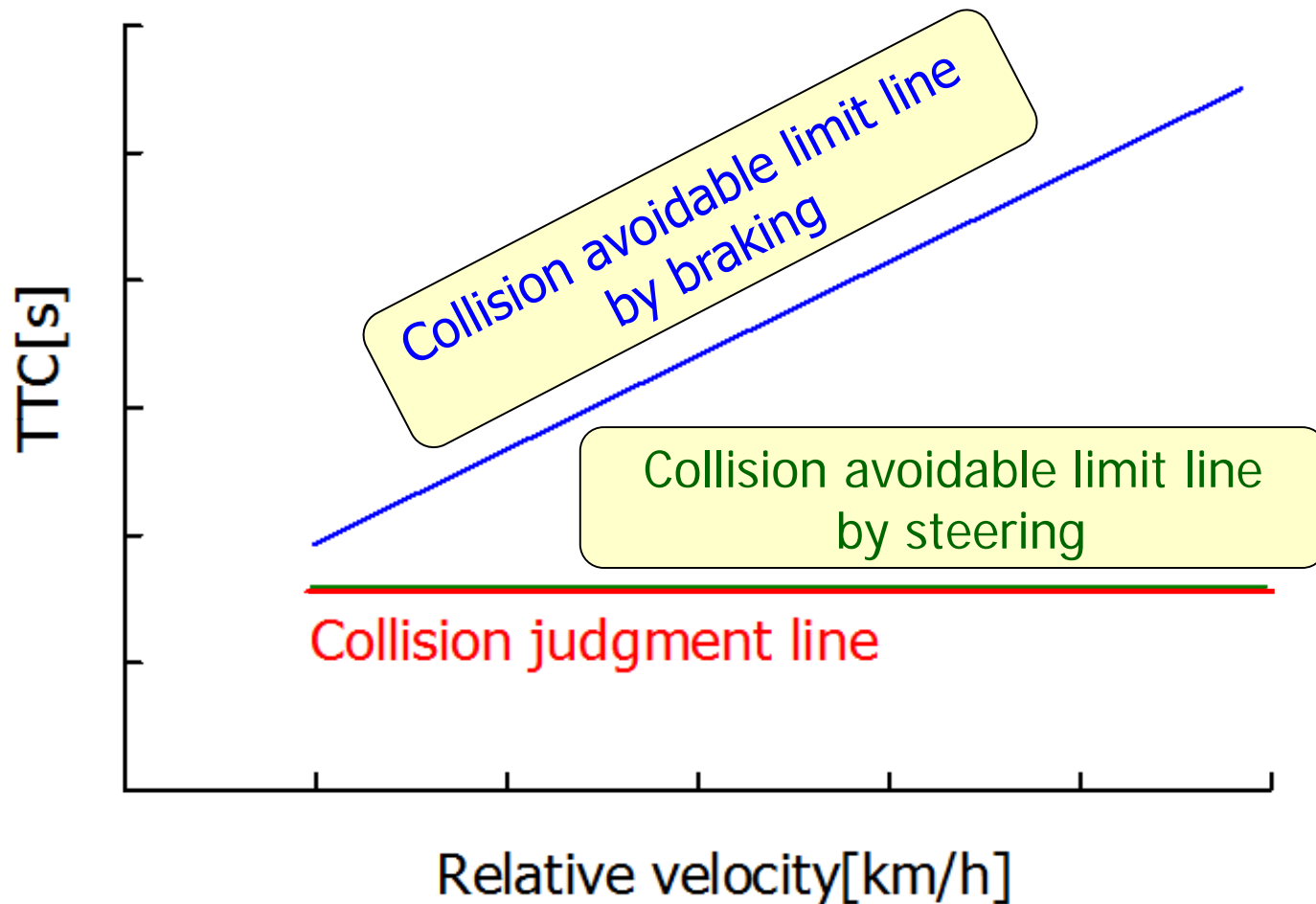
Therefore, this line is changed by each vehicle.

Steering: $TTC = 0.6$ (s) fixed value is used for all large trucks.

5. Requirement of Braking Deceleration

Requirement of automatic braking:

Braking control shall be activated with average deceleration of 6.0 m/s² or more.



6. Enhance Damage Reducing Effect Operational Range Based on Driver's Normal Maneuvers Limit

Operational range based on driver's normal maneuvers limit

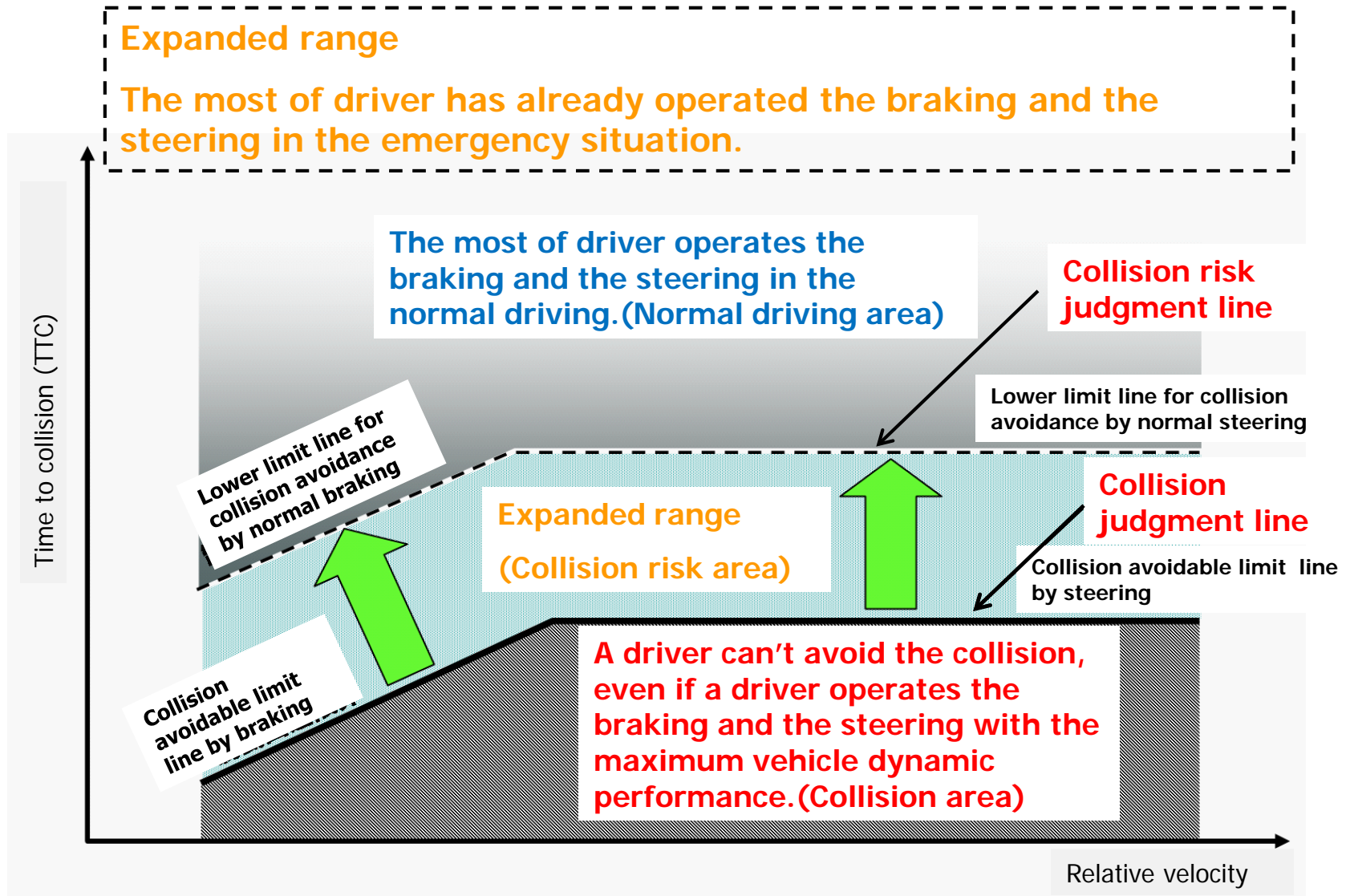
The timing of the braking control is called **collision risk judgment line** in this draft.

Collision risk judgment means a state that has a risk of a collision. The most of driver has already operated the braking or the steering in the emergency situation.

The braking control may be used by manufacture.

6. Enhance Damage Reducing Effect

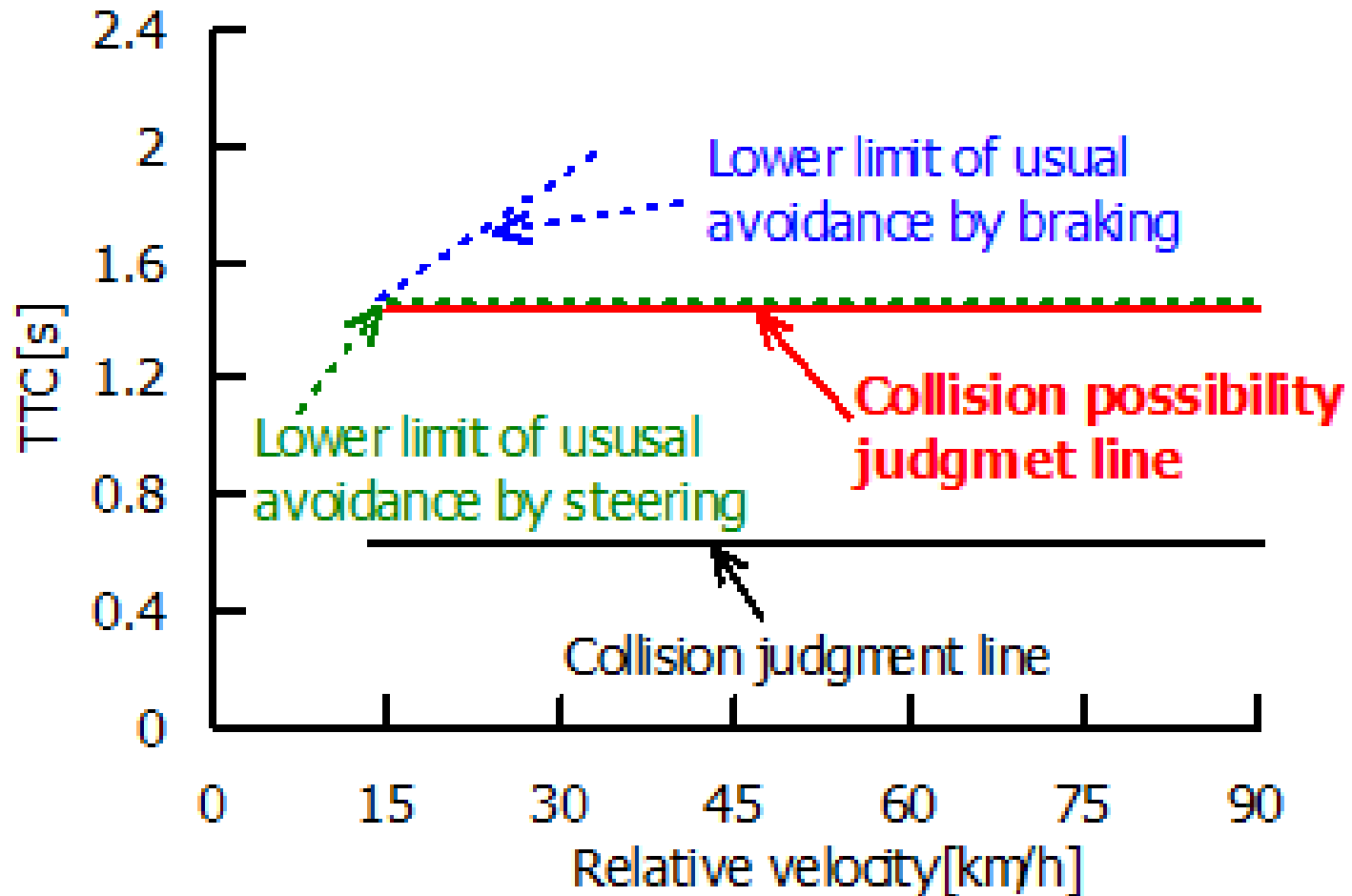
Operational Range Based on Driver's Normal Maneuvers Limit



Braking control may start functioning in the collision risk area.

6. Enhance Damage Reducing Effect

Collision Risk Judgment Line



Collision risk judgment line is **the lowest limit of drivers' normal avoiding maneuver.**

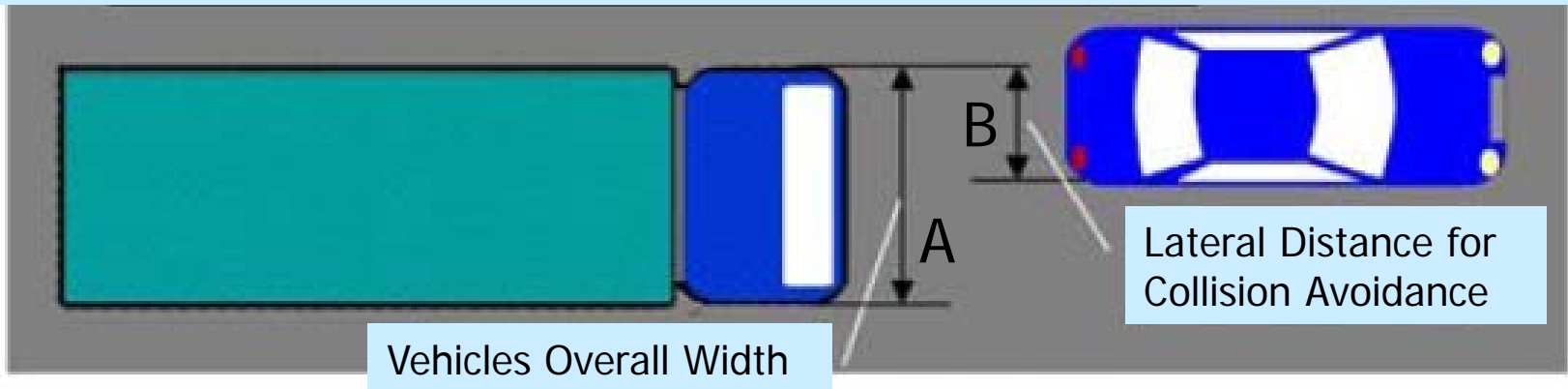
Braking: $TTC = 0.0167 * Rv + 1.00$ Rv : Relative velocity
Steering: $TTC = 0.0167 * R + 1.13$ (s) R : Overlapping ratio

6. Enhance Damage Reducing Effect

Collision Risk Judgment Line

Overlapping Ratio

Lateral Distance for Collision Avoidance (B) =
Overlapping Ratio x Vehicles Overall Width (A)



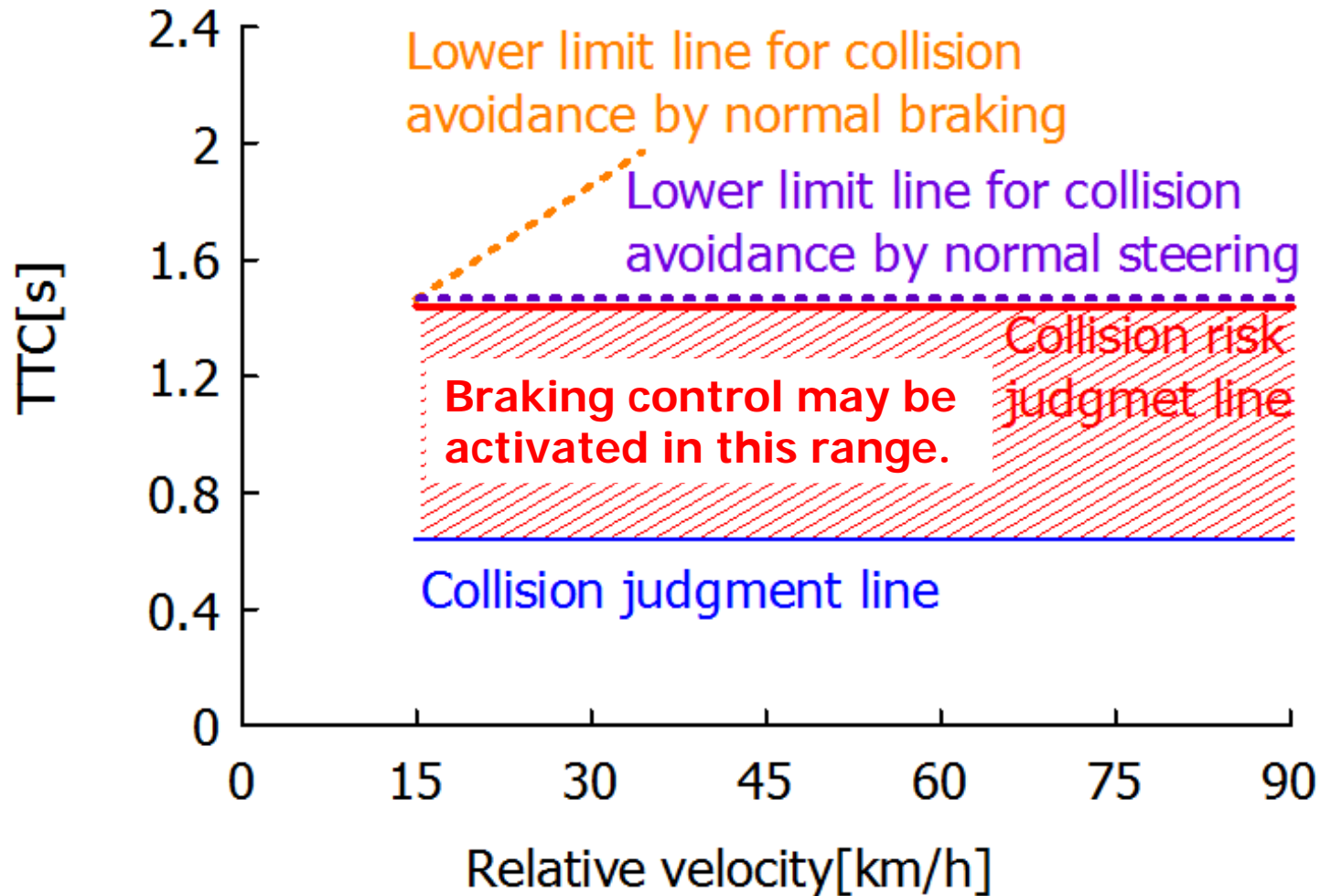
Steering: TTC = 1.4 (s)

$$\text{Overlapping Ratio} = \frac{B}{A}$$

If the AEBS can detect the overlapping ratio, TTC can be increased by the overlapping ratio.

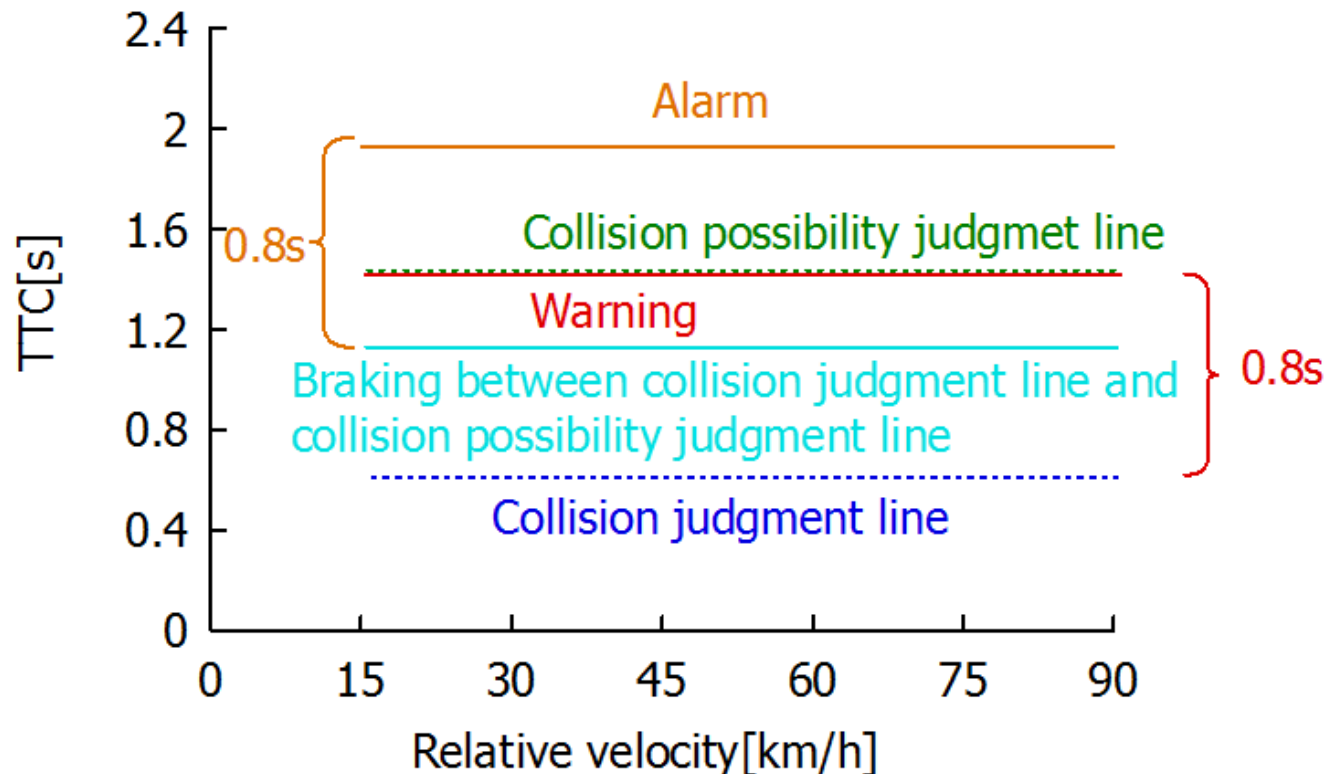
6. Enhance Damage Reducing Effect Requirement of Braking Deceleration

From collision risk judgment line :
Braking control may be activated.



7. Emergency Event Preparation and Collision Warning

- "Collision Warning" means a function that alerts the driver to a risk of collision in advance and prompts him/her to make an avoiding action.
- "Emergency Event Preparation" means a function that notices the driver in advance that the system detects an unavoidable collision and starts controlling the brake system.
- "Collision Warning Braking" means a function that alert the driver a risk of collision by the braking. Warning braking have a limitation of deceleration that shall not exceed 6.0 m/s^2 .



8. Other Principal Requirements

➤ **“AEBS Off” control**

The vehicle may be equipped with a means to manually deactivate the AEBS.

If the vehicle may be equipped with a means to manually deactivate the AEBS, a deactivation warning shall be given when the system is deactivated.

➤ **Fail safe function**

The system shall have a function to monitor the operating state of the system, and shall detect failures by means of this function.

If any failure has occurred in the system, the operation of the system shall stop safely and the system shall return to its basic (manual) braking function as a brake system.

➤ **Malfunction tell-tale**

If any failure occurs with the system, a warning shall be given.

➤ **Indication of over limit of function**

If AEBS recognizes an unfavorable situation which precludes its operation, such as when the system detects contamination on the forward obstacle sensor, the driver in the driver's seat shall be warned by an optical warning indicating that AEBS is not able to function.