Informal document No. **GRRF-S08-13**

Special GRRF brainstorming session
9 December 2008
Agenda item 5

Japan Presentation

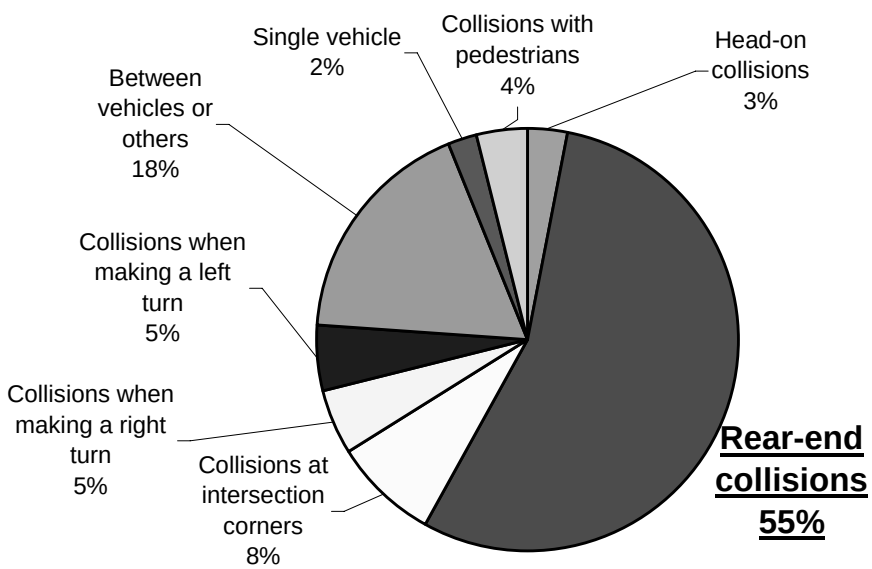
Consideration of Issues

a. Accident Scenarios in JAPAN

- The rear-end collisions of heavy duty truck accounts for more than half of the whole accidents. (Fig.1)
- The rate of fatality in rear-end collisions involving heavy duty truck >= 8t are about 12 times higher than that of passenger cars. (Fig.2)

Accidents Involving Large Trucks by Accident Type

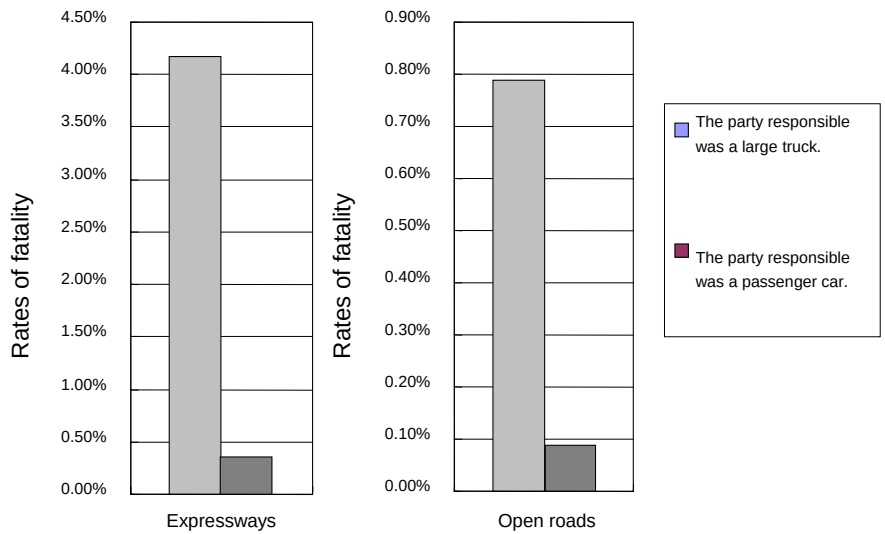
Fig.1



Source: Macro Accident Data 2005

Rate of Fatality in Rear-end Collisions by Type of Vehicle Responsible

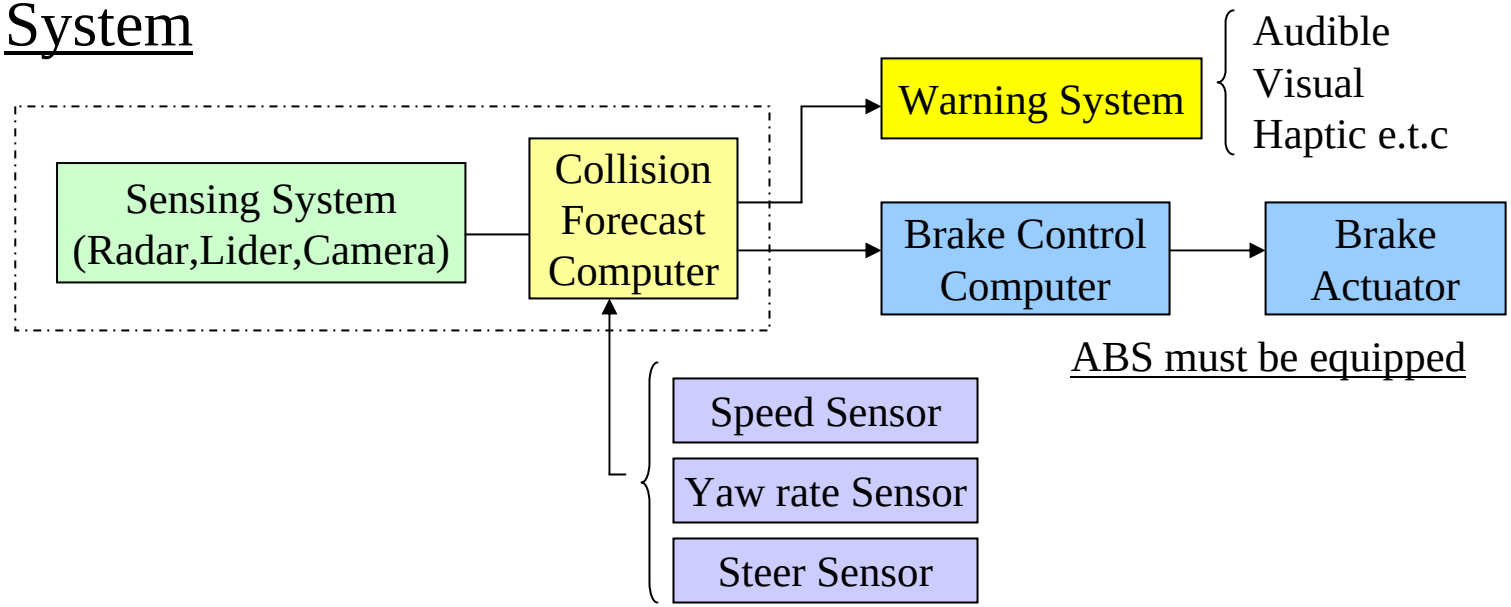
Fig.2



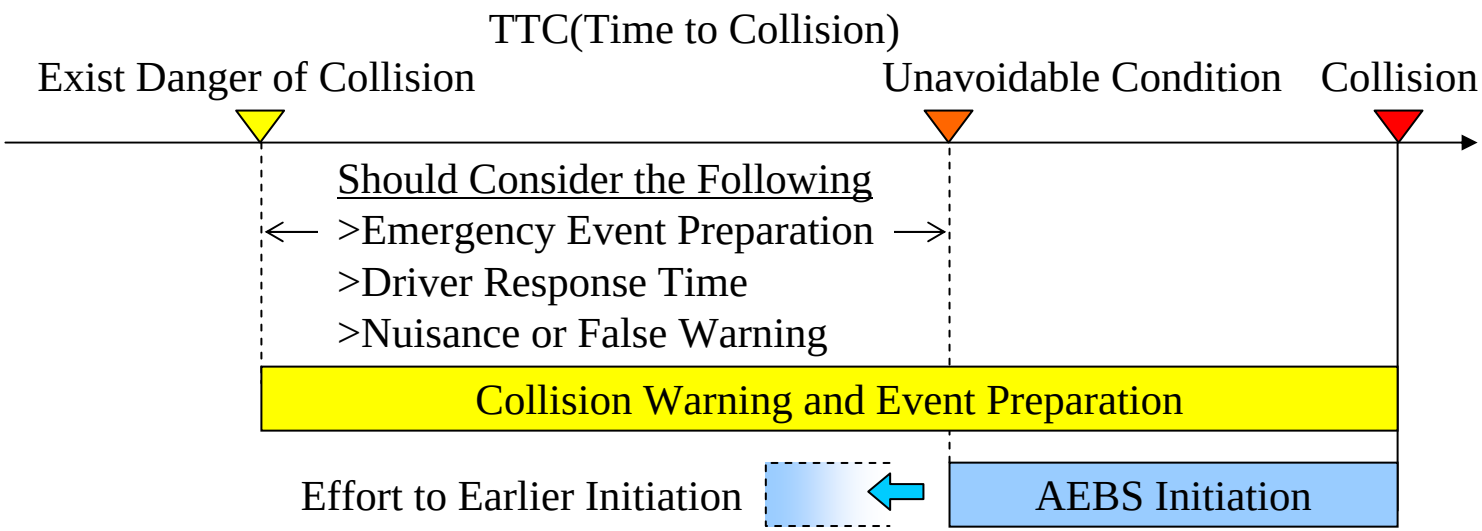
Source: Report on Study and Research for Promotion and Popularization of ASV Technologies 2004 (Macro Accident Data 2001 to 2003)

AEBS Basic System (Example)

System



Initiation



b. Sensing Systems

Sensor		Resolution of Distance	Resolution of Direction	Ability of Object Discrimination	Robustness against Weather	Detection of Forward Vehicle
Millimeter -wave RADAR	**Scanning -Beam**	Good	Good	Good (Vehicle)	Good	Excellent
	Switched -Beam	Good	Fair	Good (Vehicle)	Good	Good
LIDAR		Good	Good	Good (Vehicle)	Fair	Good
Camera	**Stereo**	Fair	Excellent	Excellent (Small vehicle and Pedestrian)	Fair	Good
	Monocular	Poor	Good	Good (Small vehicle and Pedestrian)	Fair	Fair

The appearance (1)

Millimeter-wave RADAR
(DENSO)

LIDAR
(OMRON)

The appearance (2)

Stereo Camera
(LEXUS / TOYOTA)

Stereo Camera
(SUBARU)

Monocular Camera
(TOYOTA)

Collision Forecast Technology(Example)

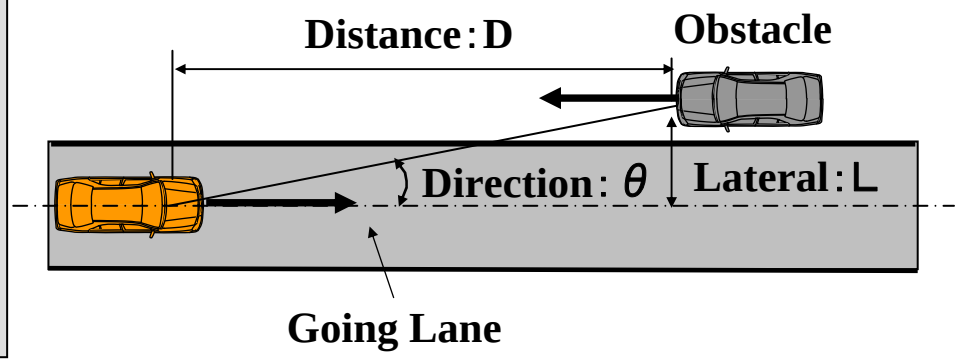
Algorithm based on Millimeter-wave Radar

Forecast a Collision from the TTC (time to collision) and in the lane or not

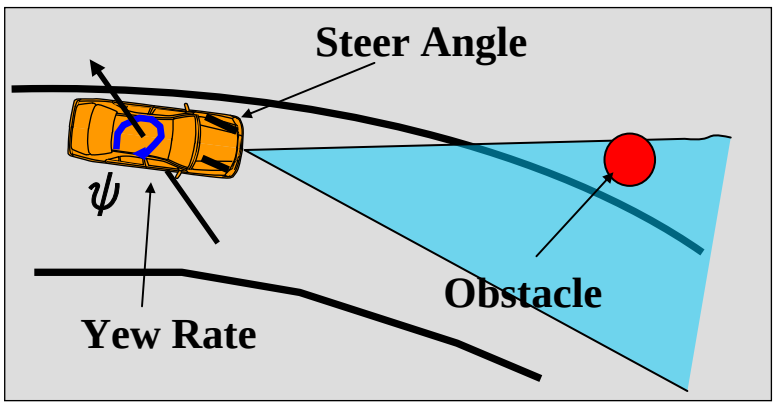
①Time to Collision ≦ Approx.1sec
（=D÷Relative Speed）

AND

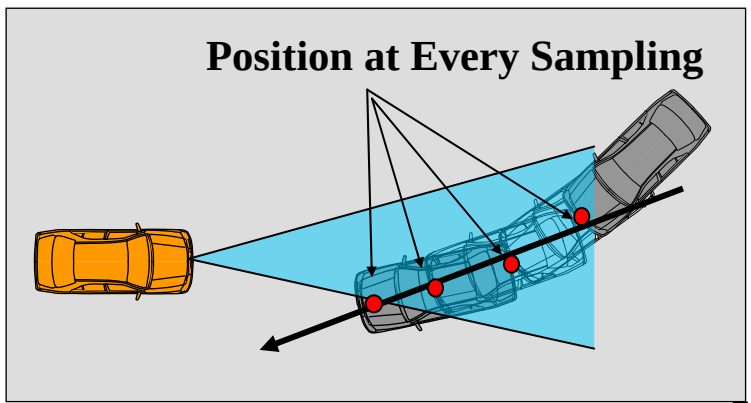
②Lateral Distance ≦ Vehicle Width＋α
（=D×tanθ）



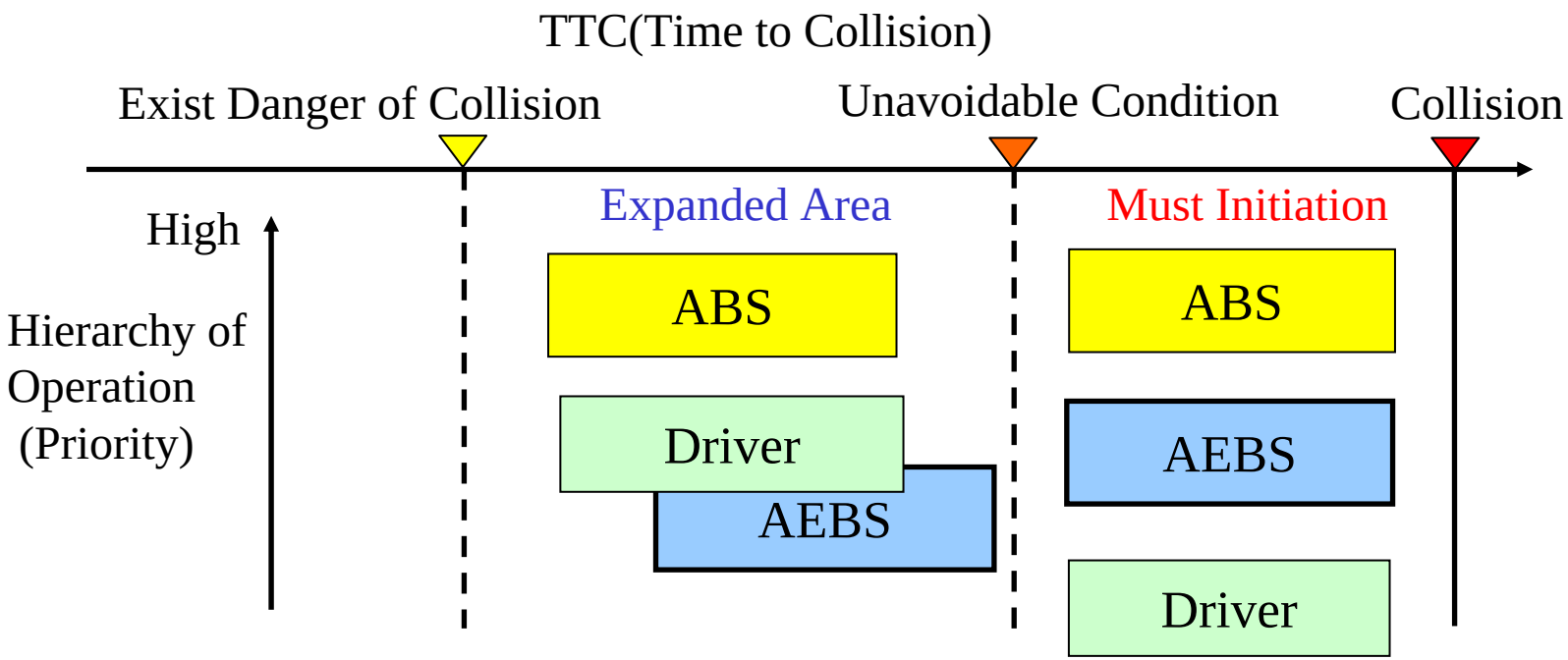
(Curve Detection)



(Course Prediction)



C. Hierarchy and Decision Control



>AEBS equipped vehicle must have ABS.

>In case of unavoidable condition, AEBS has priority over the driver.

>In case of expanded area, eliminate obstruction of driver's avoiding maneuvers.

d. Braking and Driver Information

(1)Initiation Timing of AEBS

Basic Concept

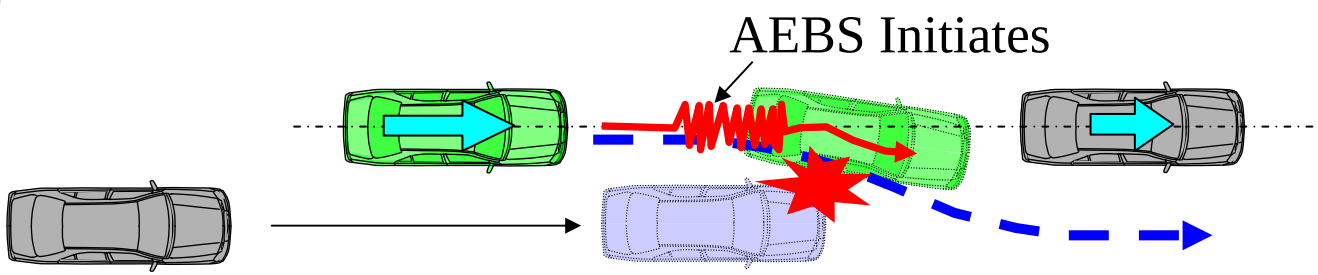
The initiation timing of AEBS should be the case that a collision can not be avoided by the driver or the case that the possibility of the collision is judged high.
In other cases, because there is possibility of interference with the driver's maneuver, the AEBS should not be activated.

Effect to the Driver when the initiation timing of AEBS is not reasonable.

Interference with the Driver's avoiding maneuver
=>Nuisance System
=>Obstruction of Driver's avoiding maneuver

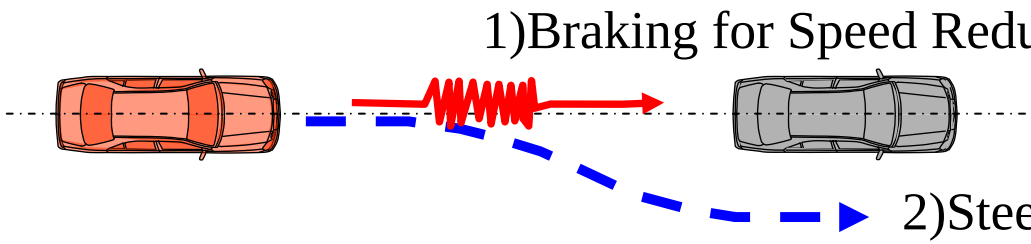
Estimated Case (for example)

When the subject vehicle overtakes the forward vehicle which speed is low by changing the lane, Mitigation Brake works and the subject vehicle can not overtake the forward vehicle. Additionally there may be a dangerous that the the following vehicle collides the subject vehicle



Driver's Avoiding Maneuver

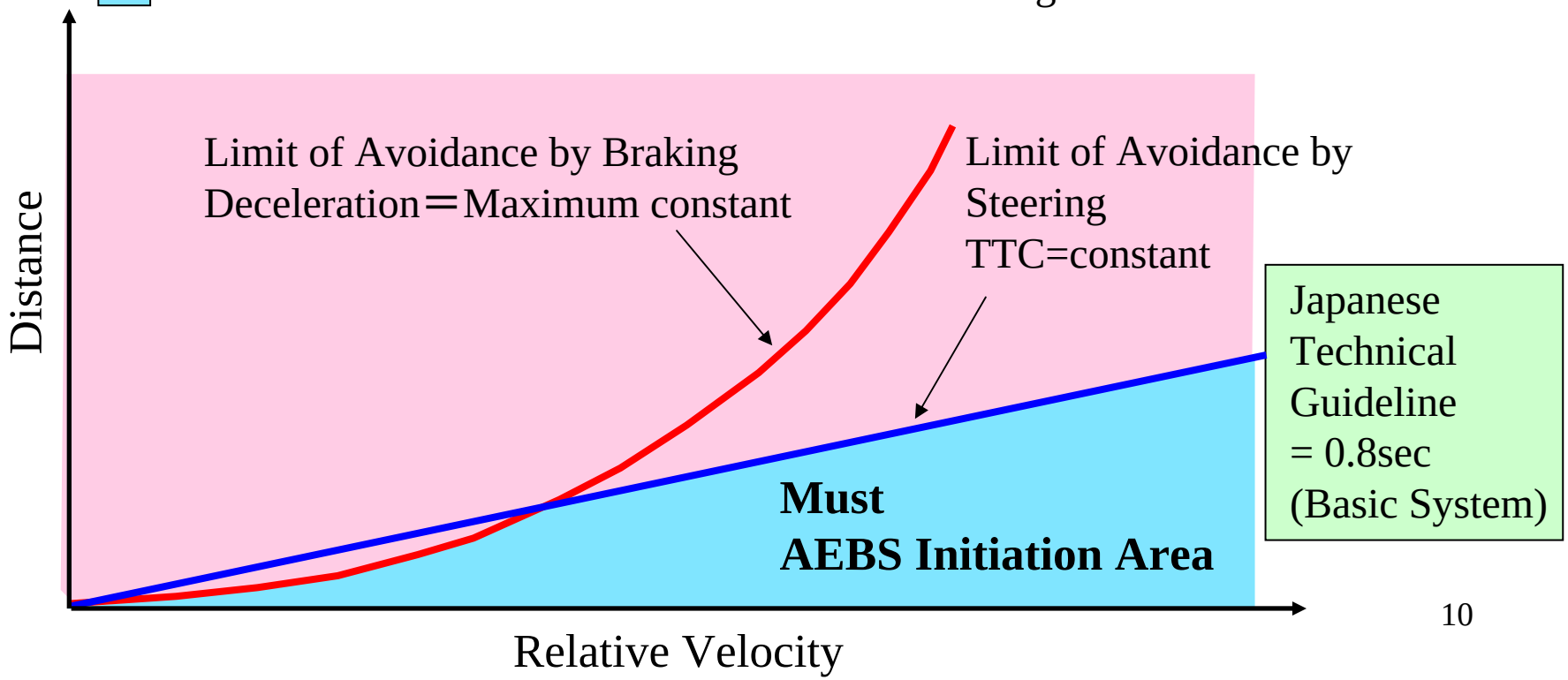
1)Brake
2)Steer



AEBS Initiation Area ('03 First Step)

There is possibility of interference with the driver's maneuver.

Interference with the driver's maneuver could be ignored

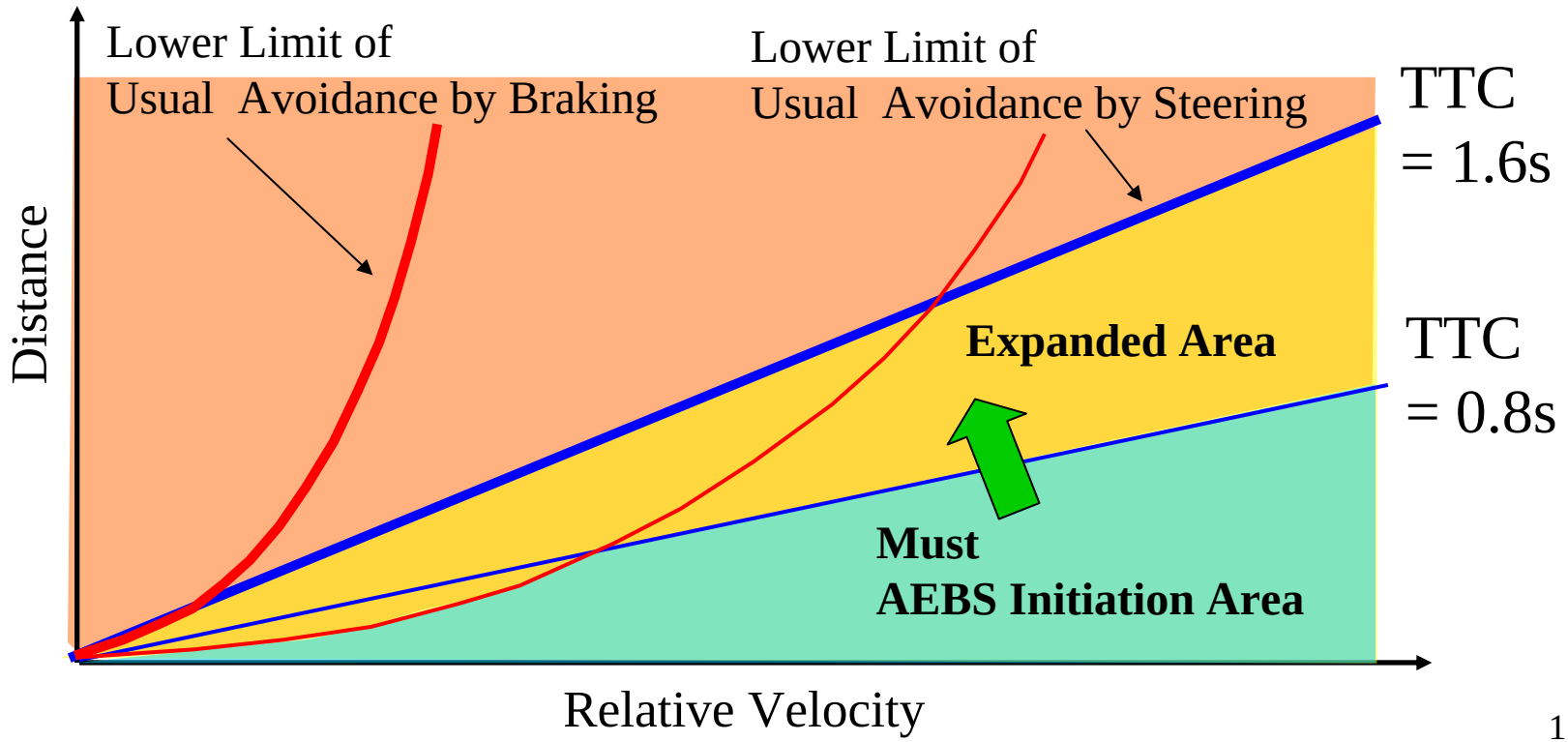


Enhance the Damage Reducing Effect (Second Step Consideration)

There is interference with the driver's maneuver.

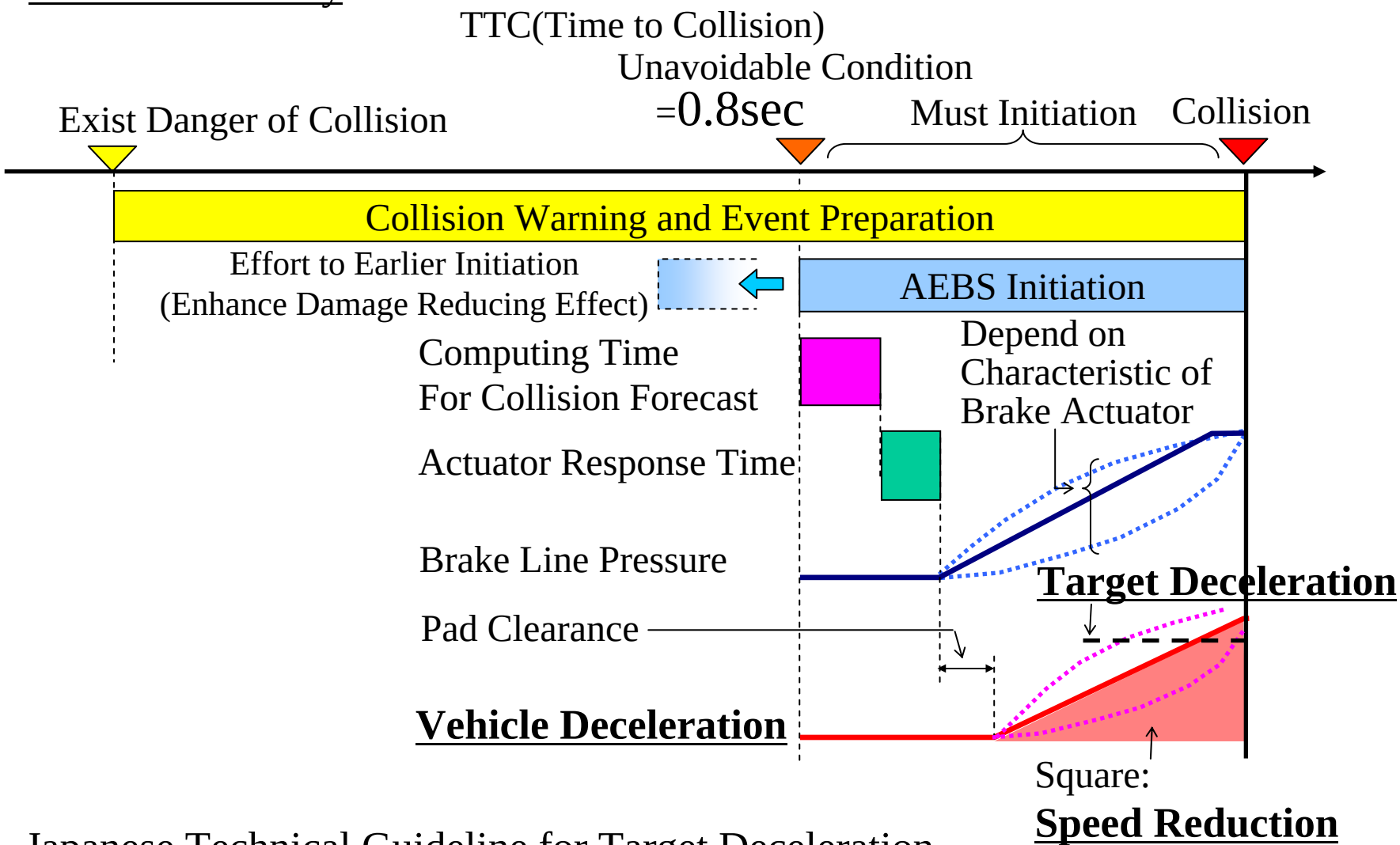
There is not possibility of interference with the driver's maneuver at usual condition.
> Eliminate Obstruction of Driver's avoiding maneuver
> Eliminate Nuisance or False Braking

Interference with the driver's maneuver could be ignored.



(2)Deceleration and Speed reduction

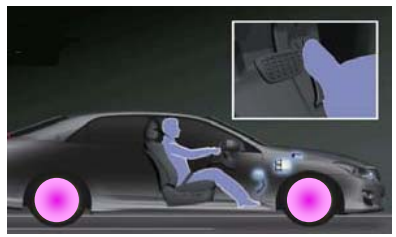
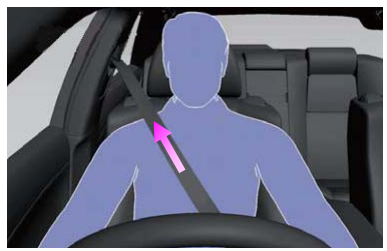
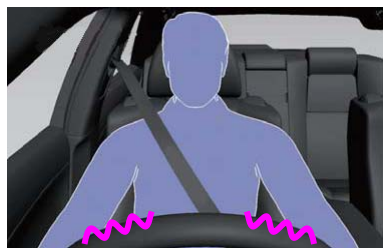
Actual Case Study



Japanese Technical Guideline for Target Deceleration

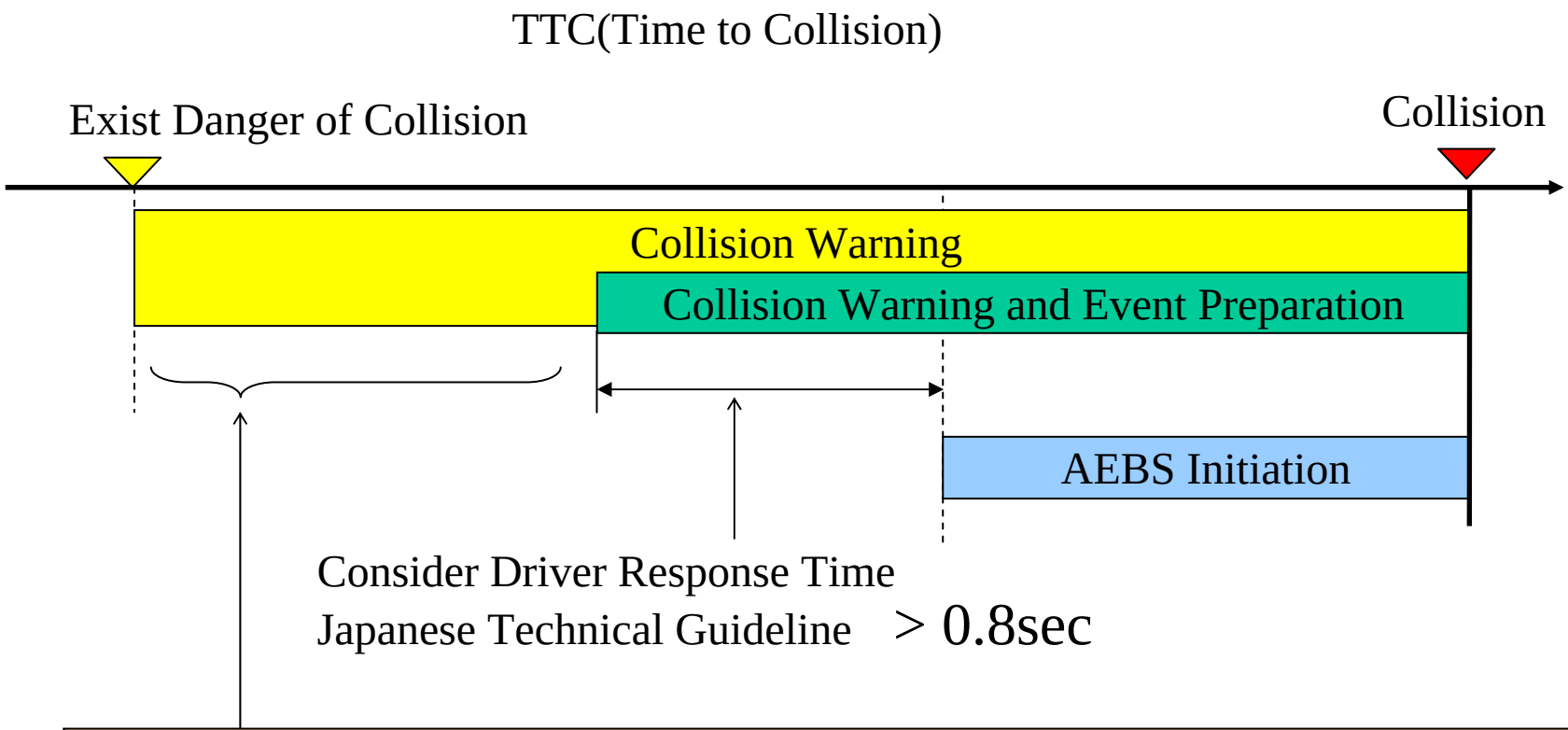
Peak Deceleration > 3.3m/s^2

Driver Information

Audible	- Warning sound
Visual	-Warning indication in the instrument panel 
Haptic	-Warning braking  - Seat belt retraction  - Vibration of steering wheel - Vibration seat ,Active pedal 

Collision Warning and Event Preparation

Actual Case Study



Earlier Warning is effective for the Collision Mitigation.
However the nuisance or false Warning must be eliminated.

END

Thank you for your attention.