



C L E P A
*European Association of
Automotive Suppliers*

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CLEPA/OICA proposal for AEBS Step 2

GRRF-AEBS/LDWS-17
Geneva, 17-18 September 2012



Summary

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- Vehicle dynamics
- Conclusions Part 1

➤ Part 2

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- Considerations on driver's acceptance
- TTC vs. Braking demand
- Warning phase vs. Emergency braking phase
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- Conclusions Part 2

➤ Annex 1

➤ Annex 2



Proposal

Part 1

A	B	C	D	E	F	G	H	Row
	Stationary target			Moving target				
	Timing of warning modes		Speed reduction	Timing of warning modes		Speed reduction	Target speed	
	At least 1 haptic or acoustic (ref. paragraph 6.4.2.1.)	At least 2 (ref. paragraph 6.4.2.2.)	(ref. paragraph 6.4.4.)	At least 1 haptic or acoustic (ref. paragraph 6.5.2.1.)	At least 2 (ref. paragraph 6.5.2.2.)	(ref. paragraph 6.5.3.)	(ref. paragraph 6.5.1.)	
M_3^1 , $N_2 > 8t$ and N_3	Not later than 1.4 s. before the start of emergency braking phase	Not later than 0.8 s. before the start of emergency braking phase	Not less than 20 km/h	Not later than 1.4 s before the start of emergency braking phase	Not later than 0.8 s. before the start of emergency braking phase	No impact	12 ± 2 km/h	1
$N_2 \leq 8t^2$ and M_2^2 4/	Not later than the start of the emergency braking phase 3/		Not less than 10 km/h	Not later than the start of the emergency braking phase 3/		No impact	67+/-2 km/h	2

1 Vehicles of category M3 with hydraulic braking system are subject to the requirements of row 2

2 Vehicles with pneumatic braking systems are subject to the requirements of row 1"

3/ Values shall be specified by the vehicle manufacturer at the time of Type Approval (Annex 1, paragraph 15).

4/ Approval to the entire values specified in row 1 may apply at manufacturer's choice



Difference

Category 2 vs. Category 3 vehicles

Category 3 characteristics

Dynamic response

- slower in terms of steering & manoeuvrability with respect to other vehicles categories.
- high centre of gravity

Driving style

- deliberate & considered (professional drivers).
- predominately used for long haul transportation on highways.
- relatively long distances between deliveries therefore higher risk of driver fatigue.

Pneumatic braking systems

- have appropriately sized energy reserves capable of delivering AEBS requirements.
- AEBS successfully engineered, developed & deployed.
- Practical knowledge & experience of AEBS in-use (beyond R&D).



Difference

Category 2 vs. Category 3 vehicles

Category 2 characteristics

Dynamically designed to be car like in terms of

- steering & manoeuvrability.
- acceleration & deceleration.
- centre of gravity
- Note: some M2/N2 vehicles are directly derived from M1/N1 vehicles.

Driving style similar to passenger cars

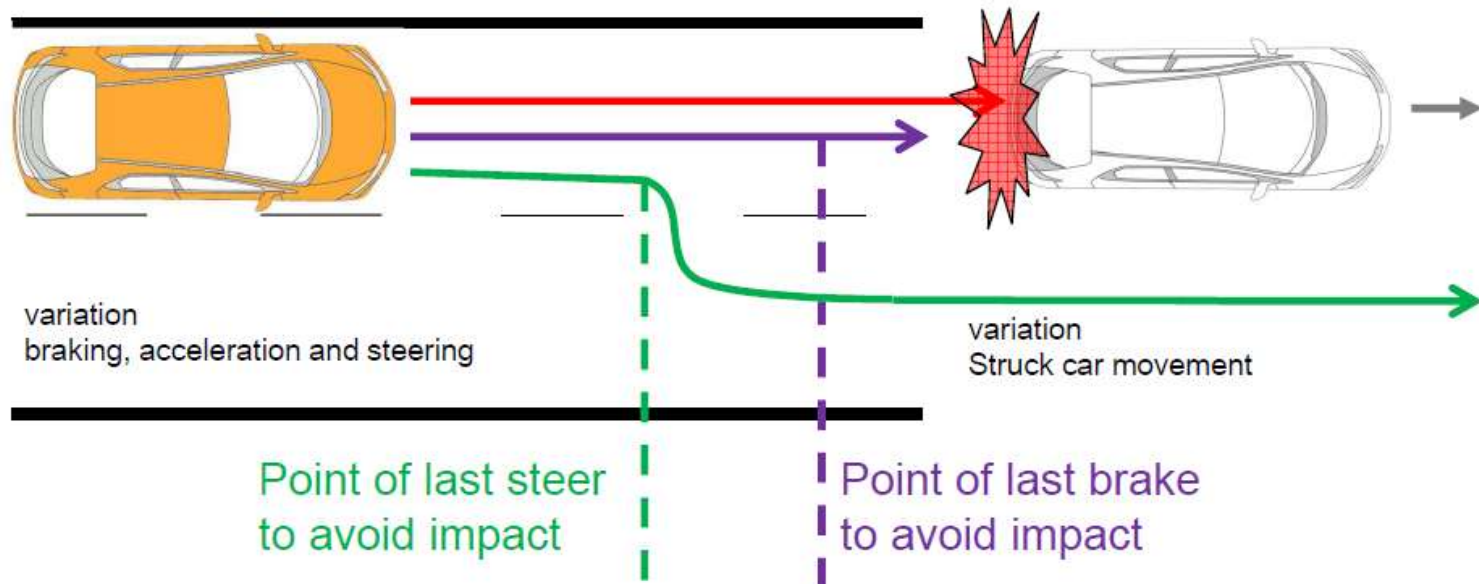
- overtaking, lane changes, close proximity to other vehicles/tail-gating.
- predominately driven in urban areas.
- relatively short distances between deliveries or workplace, therefore reduced risk of driver fatigue.

Hydraulic brake systems

- relies on driver to provide brake input & up to 70 daN brake pedal force to achieve full braking.
- inherent response lag time in system due to pressure build-up time.
- current braking systems do not have sufficient fluid pumping capacity or energy reserves to achieve autonomous braking at high speed/high load scenario's.
- currently no AEBS are available for M2/N2 vehicles.
- no real world data or experience gained with M2/N2 vehicles equipped with AEBS therefore, increased risk of false activation due to technical immaturity.

Vehicle dynamics

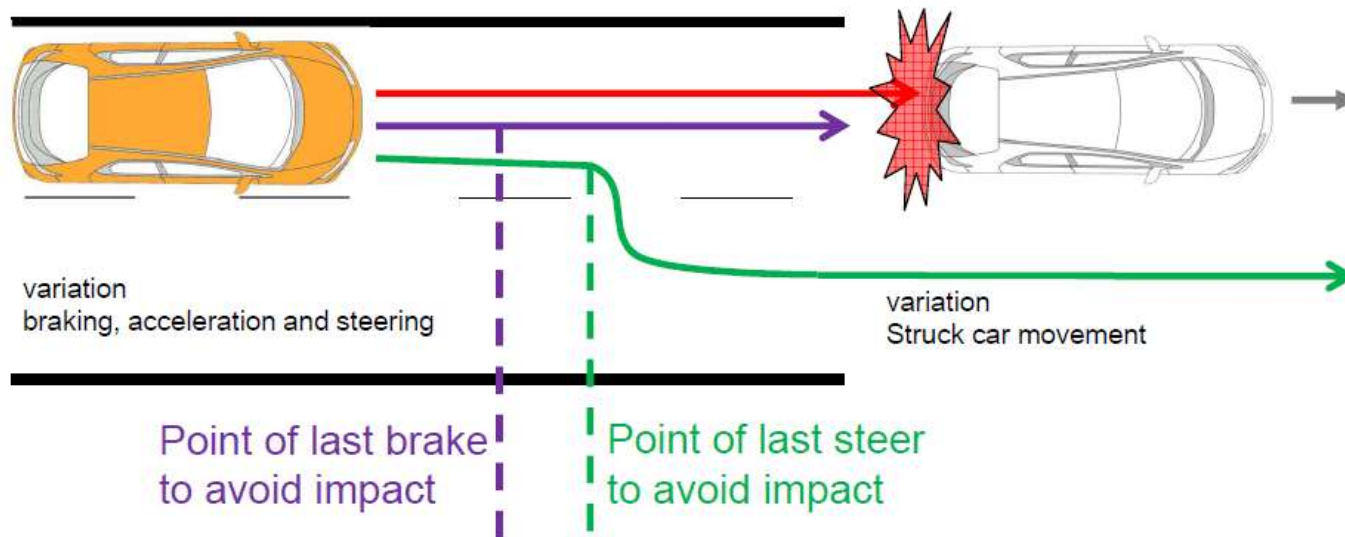
AEBS Expectation - Low Speed



- Collision avoidance by braking
- At lower speeds – braking avoidance point later than steering point

Vehicle dynamics

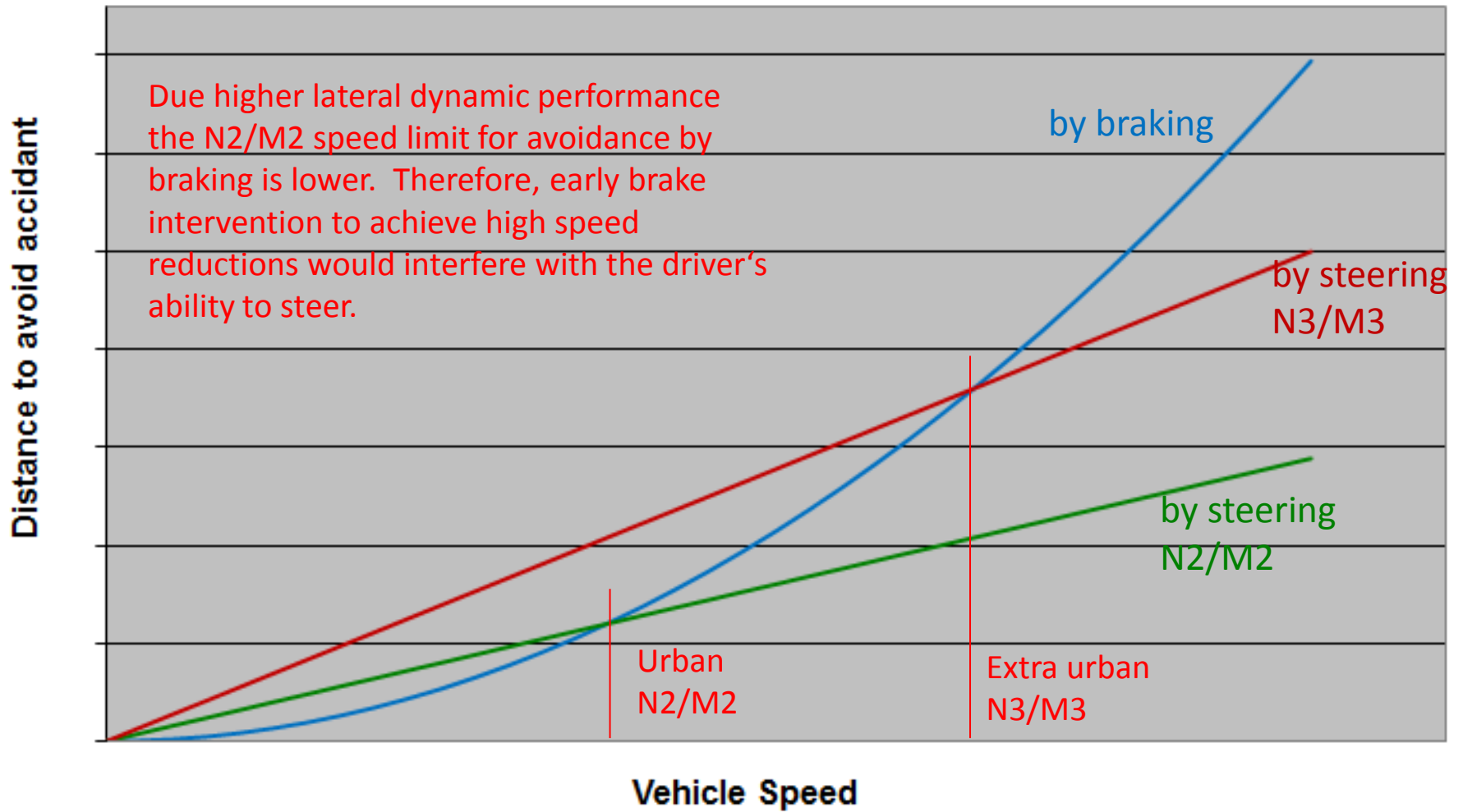
AEBS Expectation – high Speed



- As speed builds – steering avoidance point later than braking point
- Latest time point for braking may be earlier than last time for steering response
- Therefore cannot necessarily expect full AEB avoidance at all speeds



Vehicle dynamics





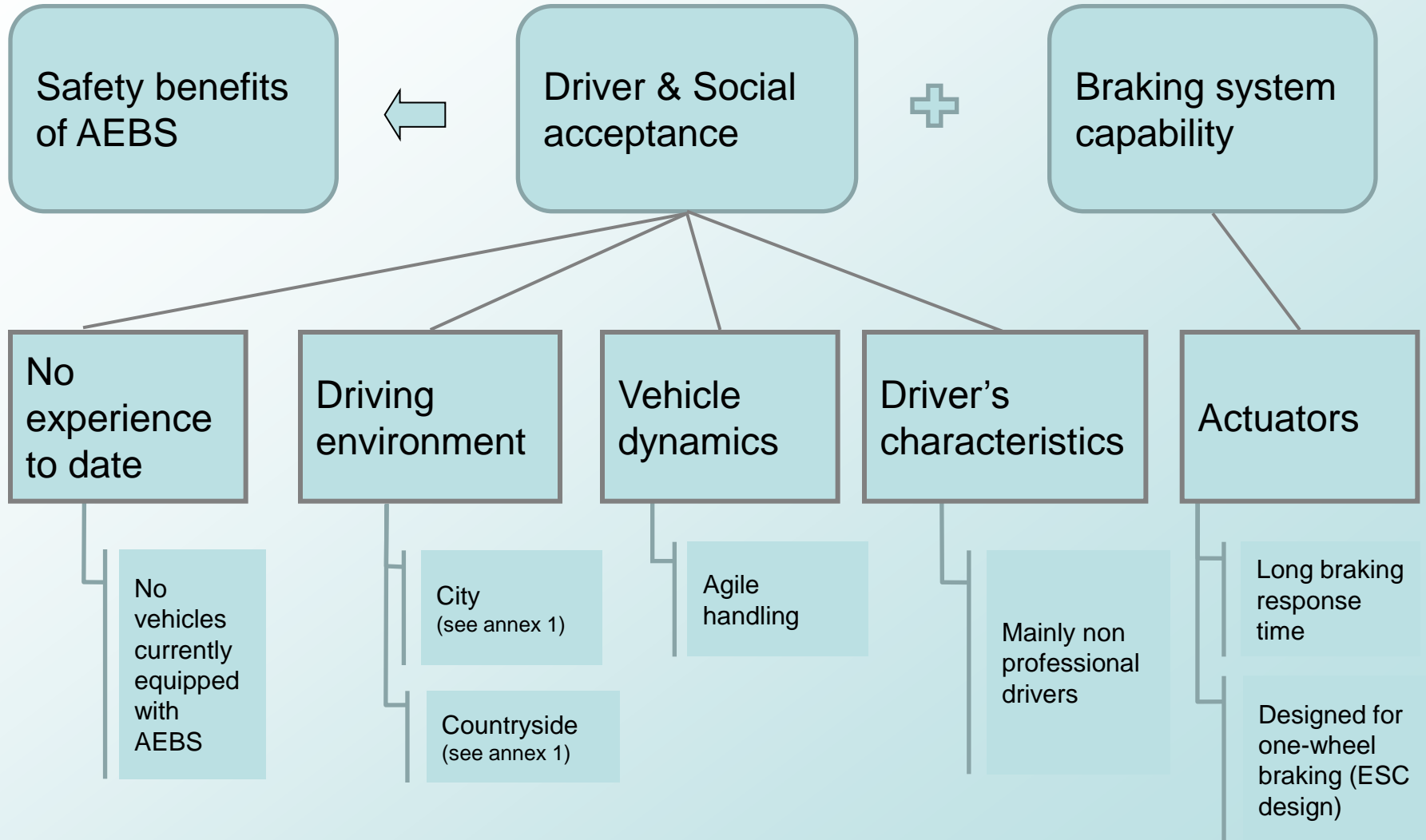
Conclusions Part 1

- Analysis of vehicle characteristics support the assumption that M2/N2 vehicle dynamic response is similar to that of M1/N1 vehicles.
- Future development of AEBS following initial implementation may lead to an increase in braking levels, if necessary.



General considerations concerning row 2 category vehicles

Part 2





Considerations on Driver acceptance & Social acceptance

- Which parameter can best determine AEBS driver's acceptance regarding :
 - system nuisance
 - unnecessary warning?
 - unnecessary emergency braking?
- Answer:

TTC (Time To Collision)

means the value of time obtained by dividing the distance between the subject vehicle and the target by the relative speed of the subject vehicle and the target, at an instant in time.



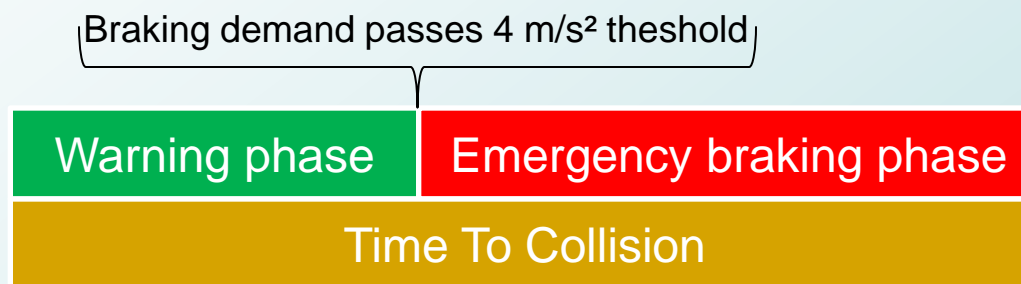
Considerations on Driver acceptance & Social acceptance

- TTC is an effective measure for rating driver's acceptance: Warning when TTC is too long results in unnecessary / false warnings and emergency brake activations, and may lead to lose the system credibility, possibly up to system off.
- Unnecessary emergency braking may lead to unacceptable secondary accidents



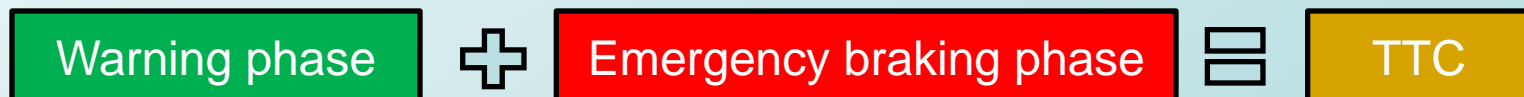
TTC vs. braking demand

- Current text of AEBS draft regulation proposes “braking demand” as the reference parameter for defining the “emergency braking phase”



This is in fact the “time to collision” if the vehicle speed remains constant

- TTC is the warning phase + the emergency braking phase





Warning phase vs. Emergency braking phase

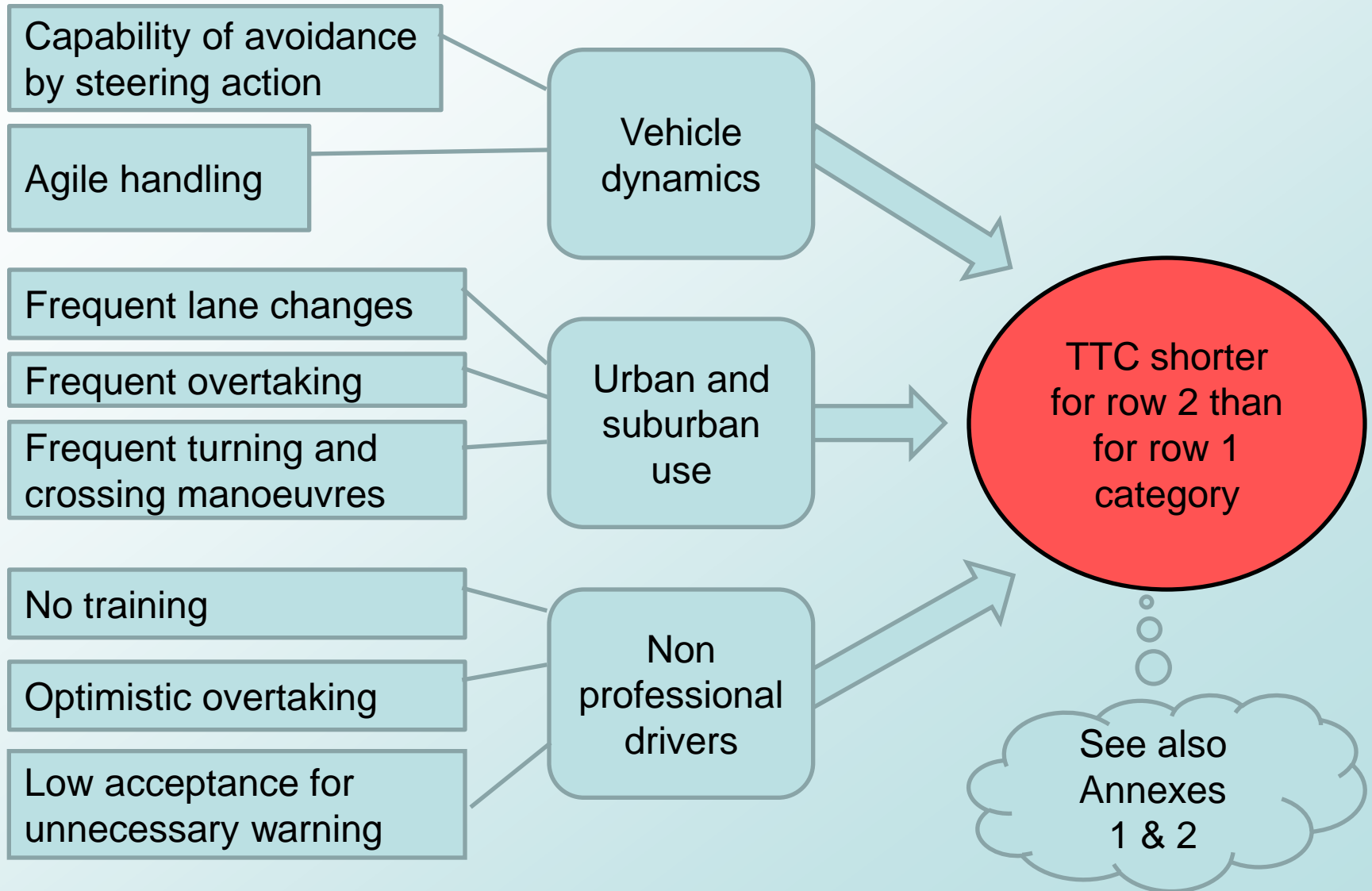
- For a given TTC, the warning phase and the emergency braking phase are inter-dependant and must be considered as a package.



- Key parameter is then the TTC, which is relative to the driver's acceptance:
 - Emergency braking phase duration depends on the requested subject vehicle speed reduction
 - The higher the subject vehicle speed reduction, the shorter the warning phase



Which TTC for row 2 category?





Conclusion Part 2

- Acceptable TTC for light vehicle drivers is shorter than that for HCV drivers.
- Acceptable TTC for row 2 category will be around 2 s as a minimum requirement.
- Hydraulic Braking pressure build-up response time is longer than that of air brake system
- Although there is currently a lack of data and experience, it is time to determine warning phase and emergency phase values.
- Therefore, the proposed performance requirements are based on our analysis of the data available and combined technical knowledge.



Proposal

(Part 1)

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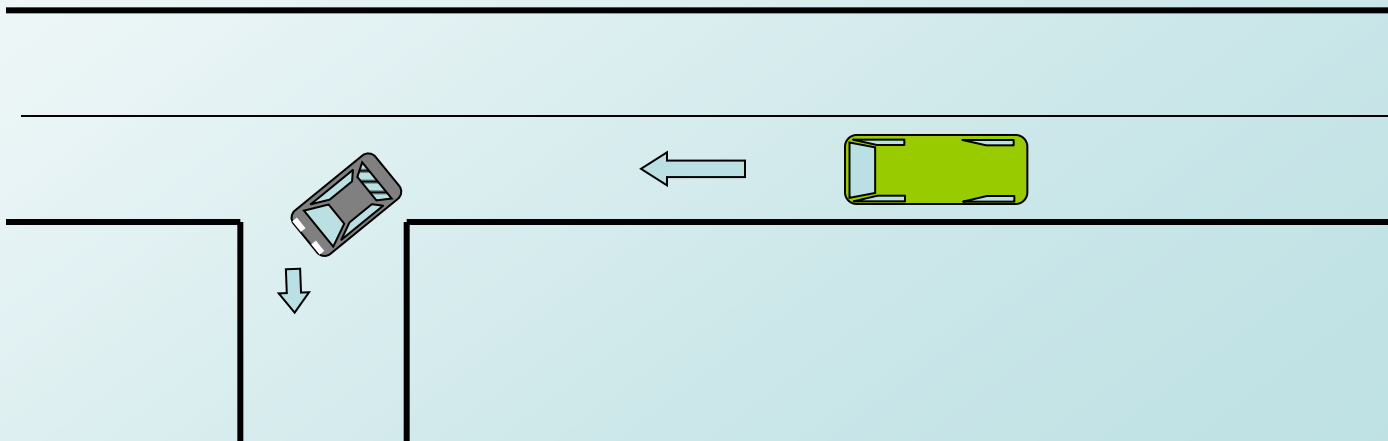
Annex 1

Examples of scenarii where AEBS
might be misled by the traffic
(passenger car)

Scene 1

Possibility of unnecessary warning and/or unnecessary braking initiation

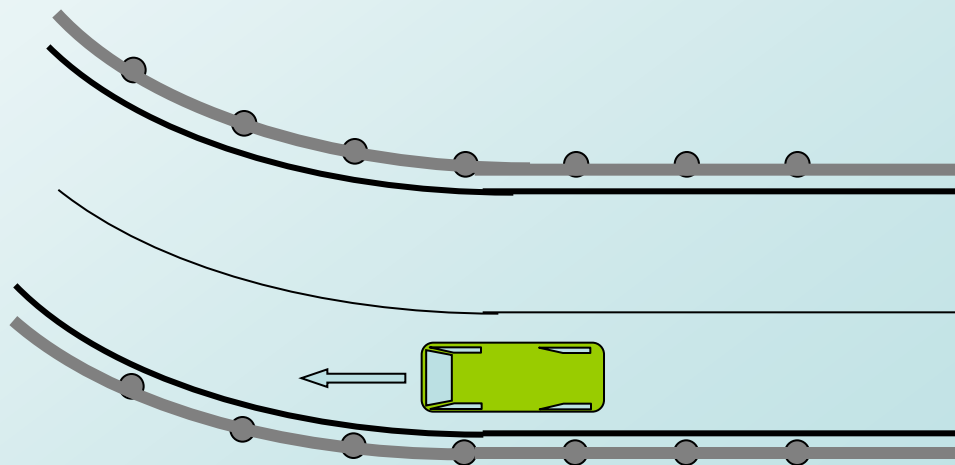
- Ordinary road and exit to a secondary road
- Leading vehicle decelerates to exit ordinary road.
- Following driver recognises lead vehicle's intention and maintains own vehicle speed.
- TTC is around 1.5 second, minimum.



Scene 2

Possibility of unnecessary warning and unnecessary braking initiation

- Ordinary road and entry into sharp curve
- Road-side structures (guardrail etc.) stand just in front a vehicle when it enters the curve.
- TTC is around 1.5 second, minimum.

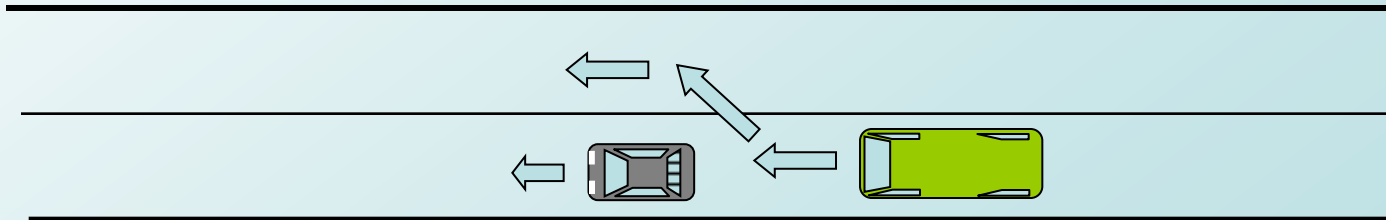




Scene 3

Possibility of unnecessary warning and unnecessary braking initiation

- Ordinary dual carriage way.
- Lead vehicle traveling at low speed
- Following vehicle traveling a high relative speed and overtakes after having approached very close to leading vehicle
- TTC is around 1.5 second, minimum

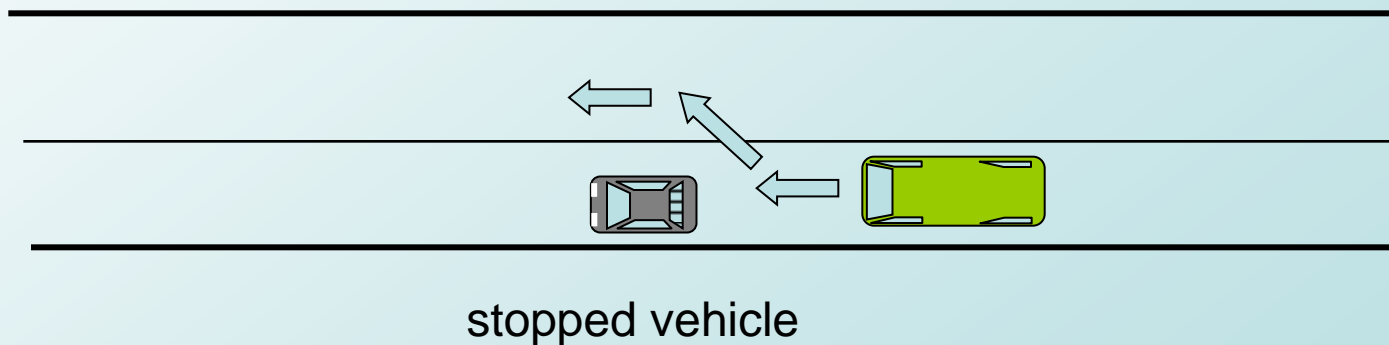




Scene 4

Possibility of unnecessary warning and unnecessary braking initiation

- Ordinary road
- Stationary vehicle
- Following vehicle traveling at high relative speed and overtaking after having approached very closely
- TTC is around 1.5 second, minimum.



Scene 5

Possibility of unnecessary warning and unnecessary braking initiation

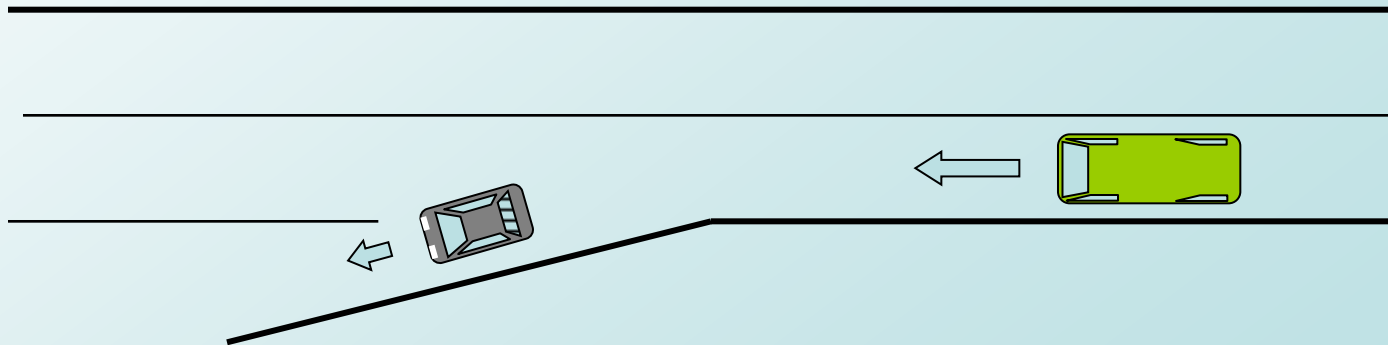
- Expressway and gentle curve (The curve shows radius higher than that of ordinary road.)
- Leading vehicle traveling at low speed in the outside lane (e.g. on a congested expressway exit).
- Following vehicle traveling on the inside of the curve at high relative speed.
- TTC is around 2 seconds, minimum.



Scene 6

Possibility of unnecessary warning and unnecessary braking initiation

- Expressway exit and a branch
- Leading vehicle decelerates to exit expressway.
- Following driver recognises lead vehicle's intention and maintains own vehicle speed.
- TTC is around 2 seconds, minimum



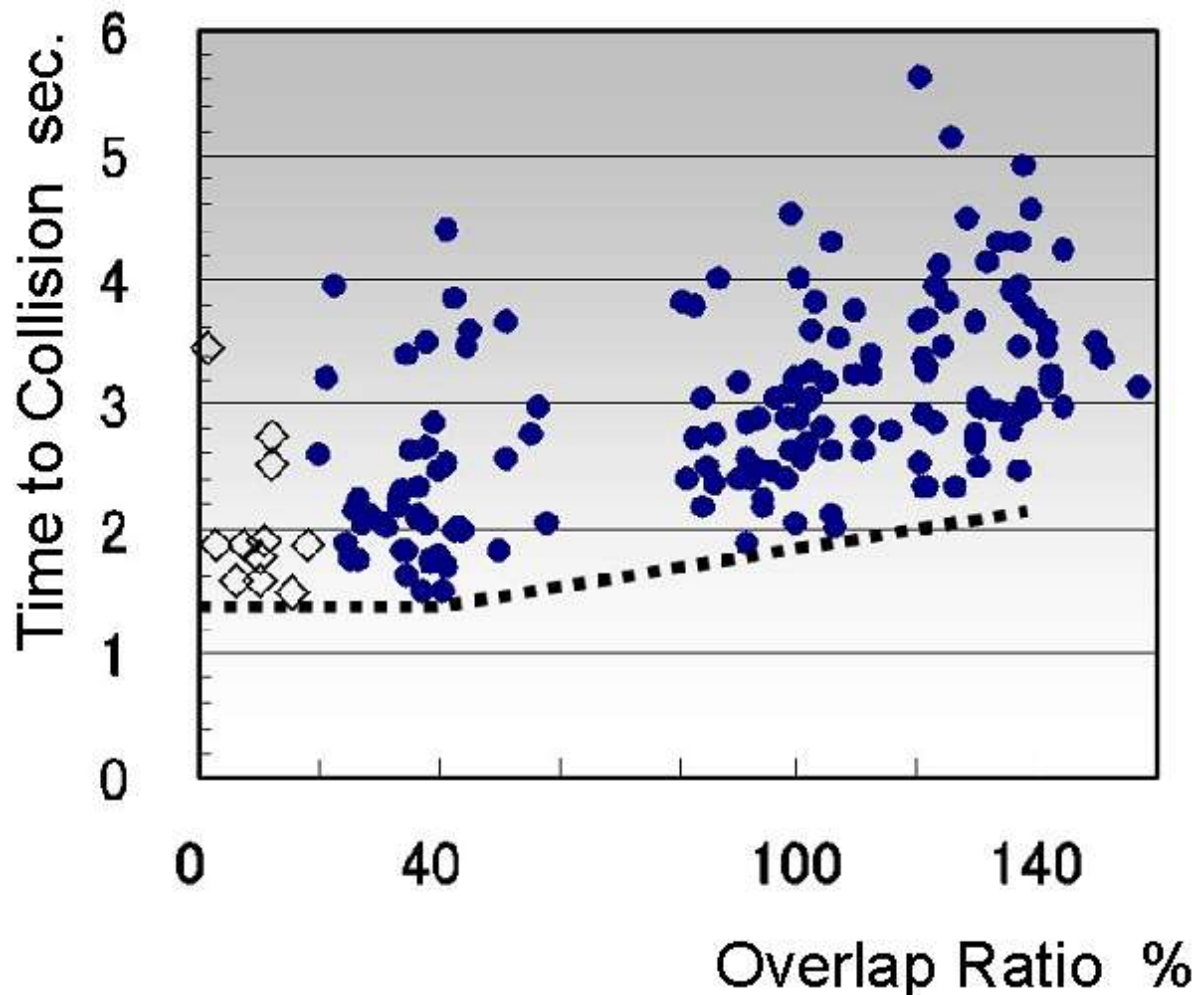


Annex 2

Typical steering manoeuvre times



Timing of Steering Maneuver for Collision Avoidance in Ordinary Driving; Passenger Car (stationary target)



Source: ASV
report, Mar. 2005



Last point to steer

