DAIMLERCHRYSLER

Electronic Safety Systems in Commercial Vehicles Satisfy Special Demands

CarTronics - IEE Cambridge, 4th December 2003

Hagen Arlitt (GSP/TC-60)

Development of Goods Traffic

[%]

Mileage

Transport performance

Source: German Federal Statistical Office

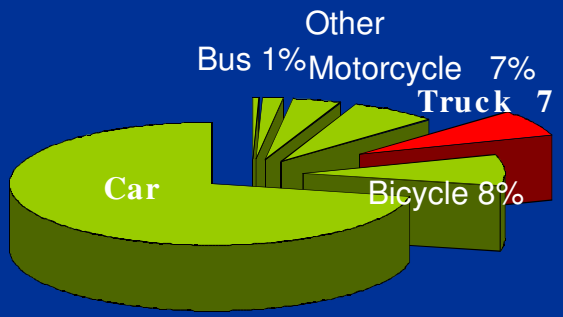
Causes of Accidents involving CVs

Expensive body damage and minor damage are not documented

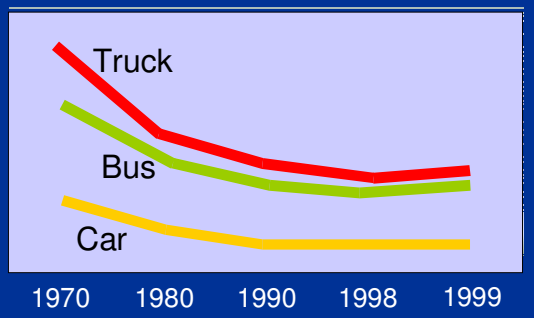
Source: German Federal Statistical Office

Rear-Ending Accident

Traffic accidents involving injuries in 1999

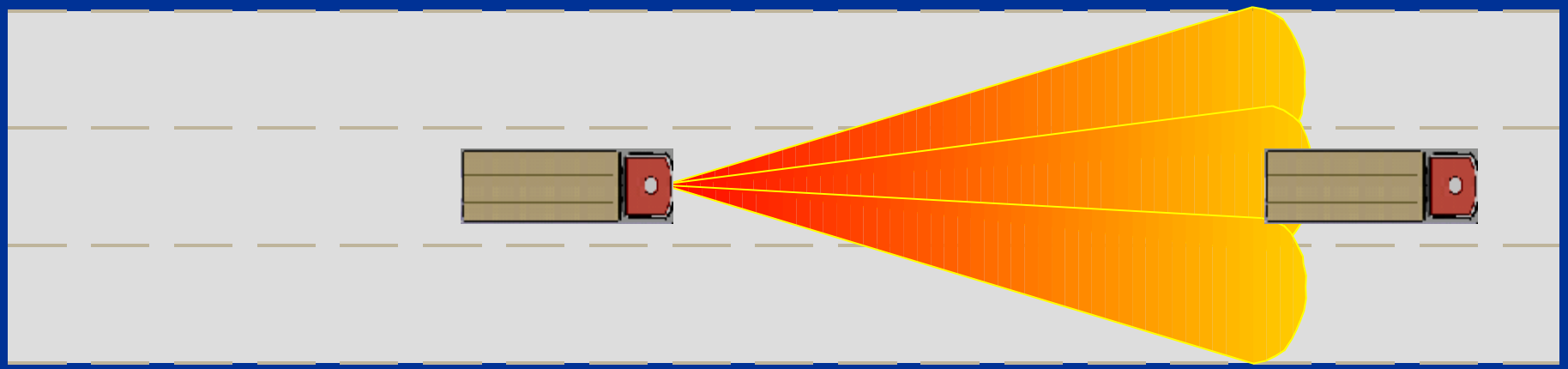


Persons injured



Trucks going 70 km/h have the equivalent kinetic energy of a car at 400 Km/h

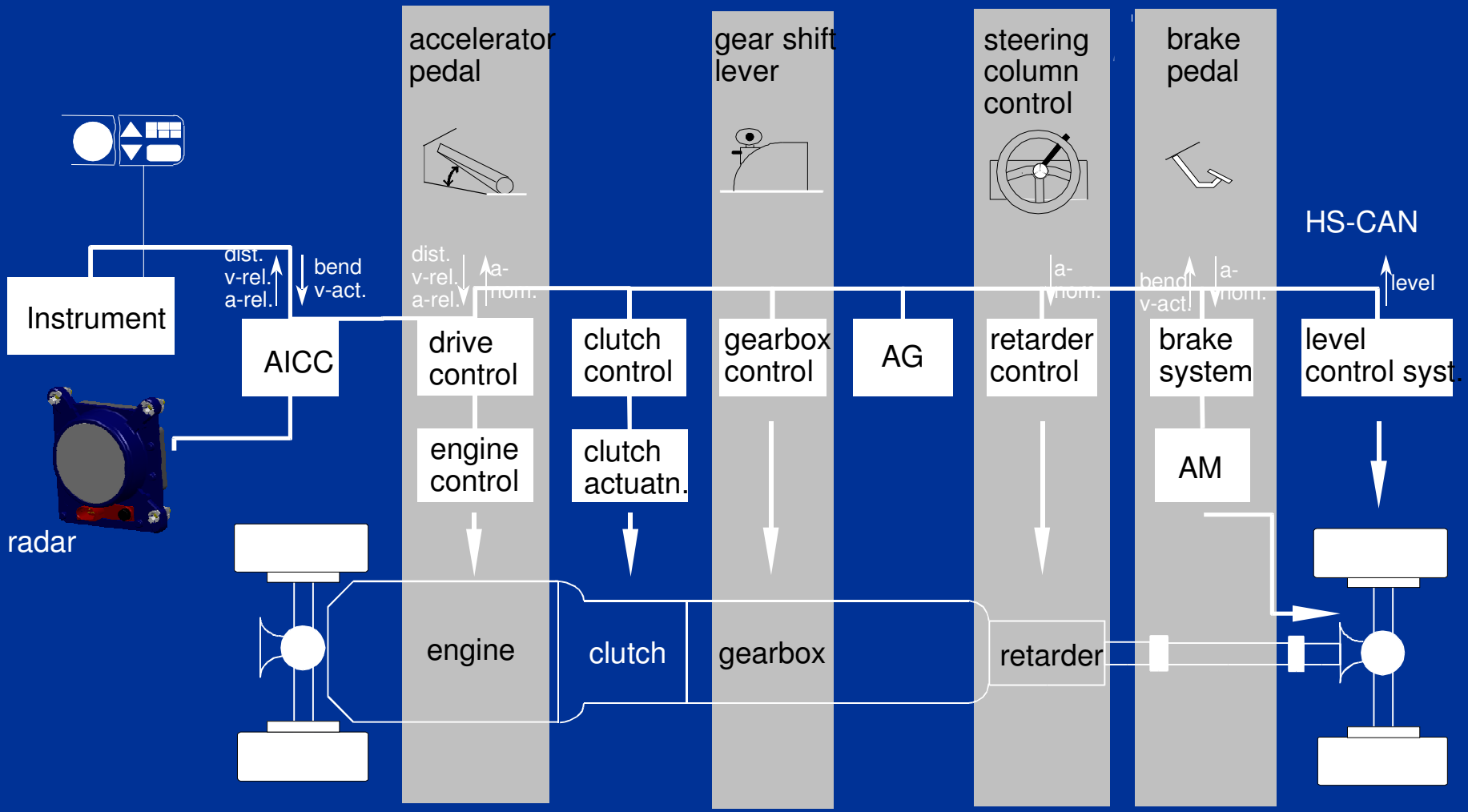
Autonomous Intelligent Cruise Control



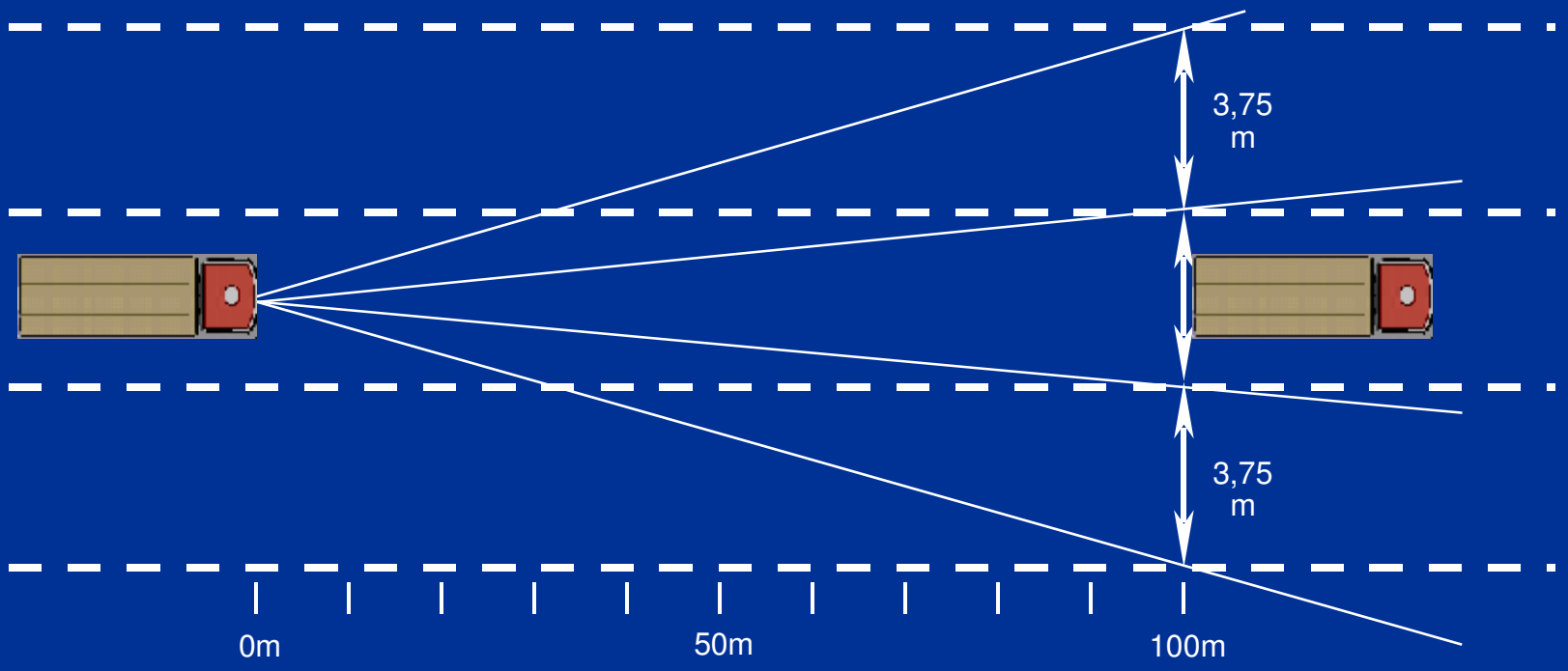
Customer Benefits

- Gain of comfort
- Less fuel consumption
- Economic vehicle control
- Good ‚stability' driving in a queue
- Less accident risk
- preserve the driver's condition
- reduction of crash energy

System Architecture



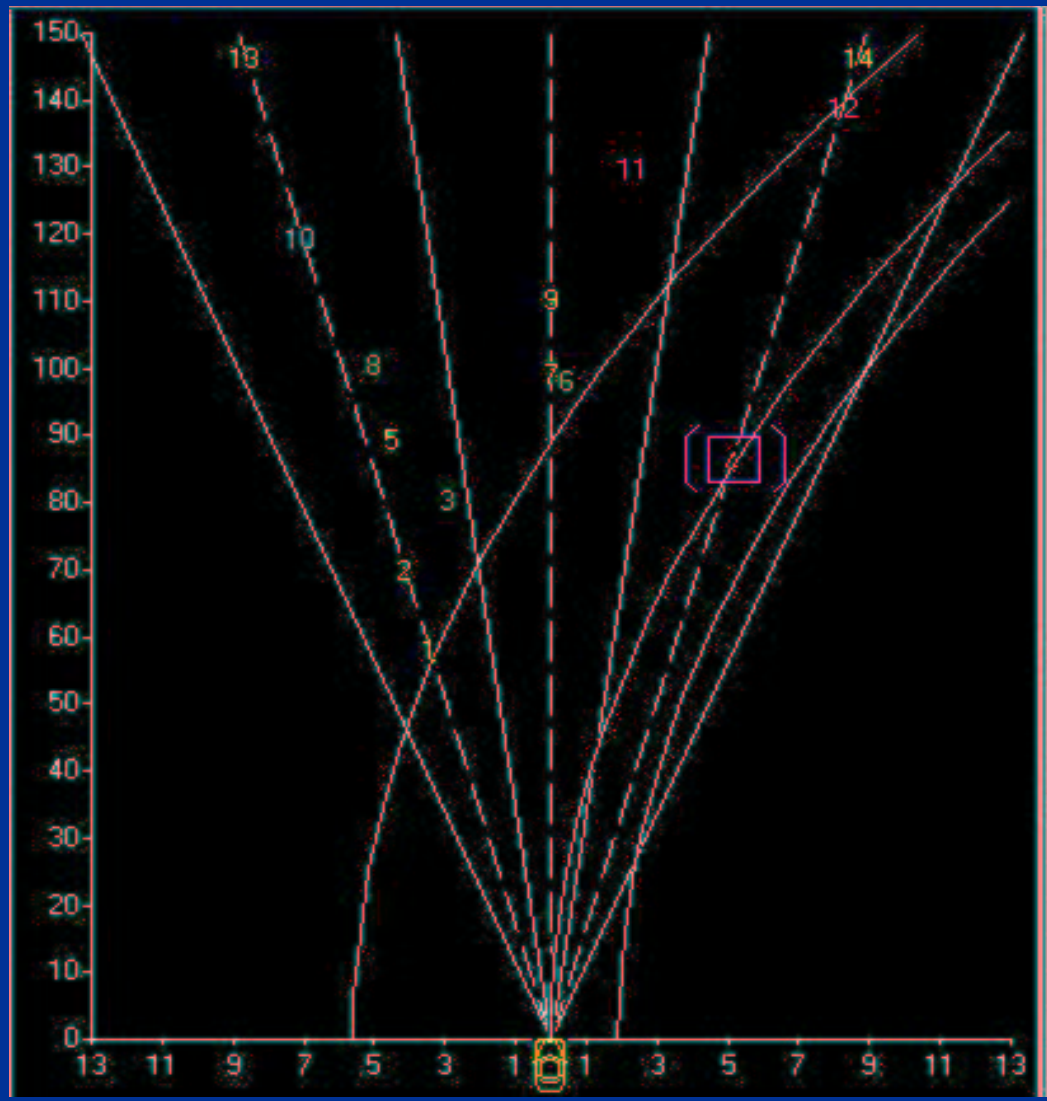
Radar Sensor



- Radar principle: Puls-Doppler
- Frequency: 77 GHz
- Number of radar beams: 3
- Multiple objects: yes
- Distance res./accuracy: 5/1 m
- Speed res./accuracy: 5 /1 km/h
- Relative speed: -50 to 200 km/h

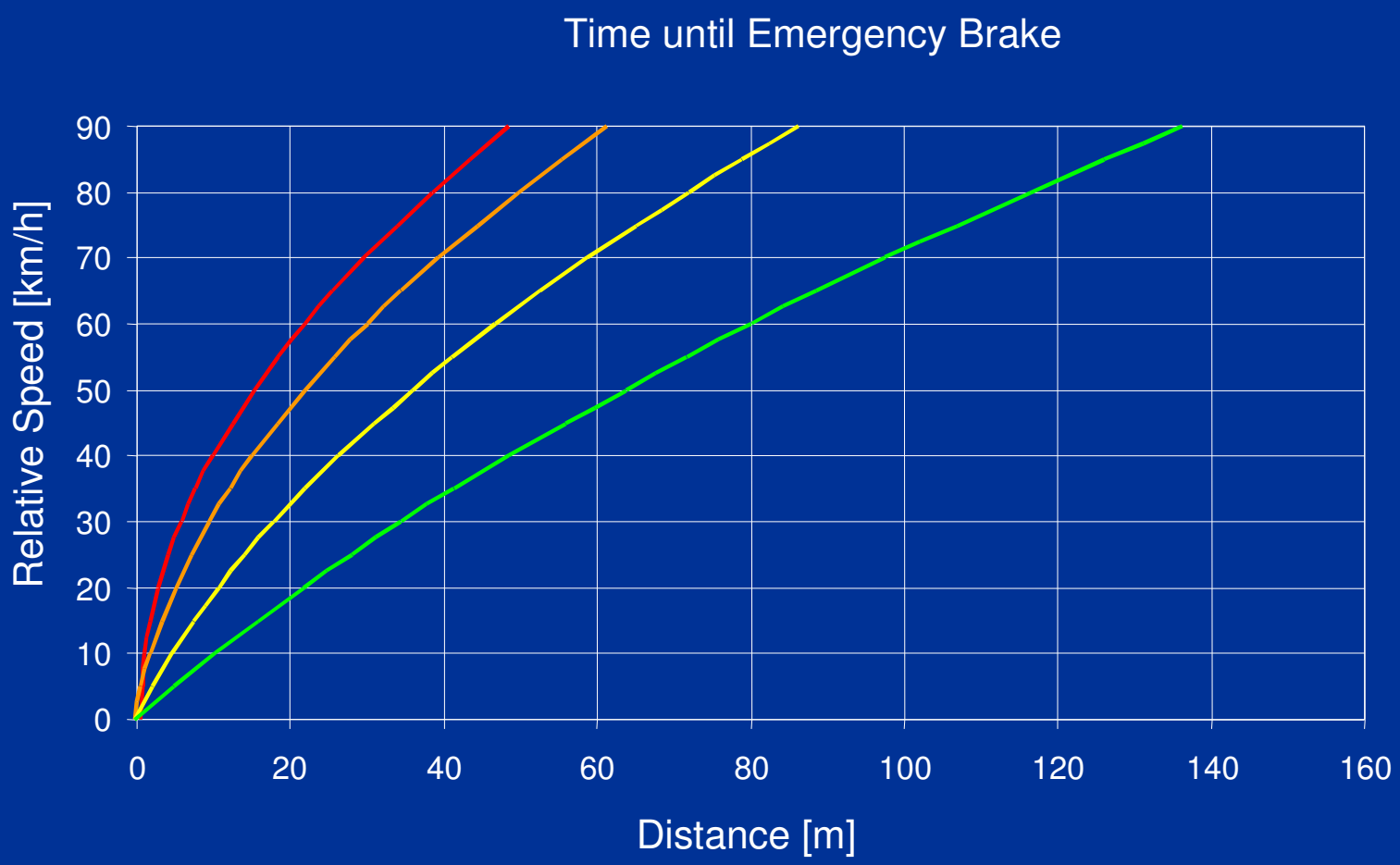
DaimlerChrysler

Sensing the Surrounding Environment



	dist [m]	vrel [m/s]	offset [m]	accel [m/s2]	offgrad [m/s]	state	angl [°]	angl DIG	conf [%]
0	+86.31	-1.48	+5.14	+0.48	+0.03	0x40	340	1	
6	96.06	-13.14	25	2	114	-282	33.21		
5	89.49	89.39	-288	0	0	0	2.60		
4	86.25	5.71	340	1	245	245	714330.69		
3	80.60	-13.70	-208	0	0	0	28.97		
2	69.98	89.14	-340	1	9	-509	1.19		
1	58.17	87.77	-340	1	-39	-450	1.36		

Warning Concept



Experimental Results after 1 000 000 km

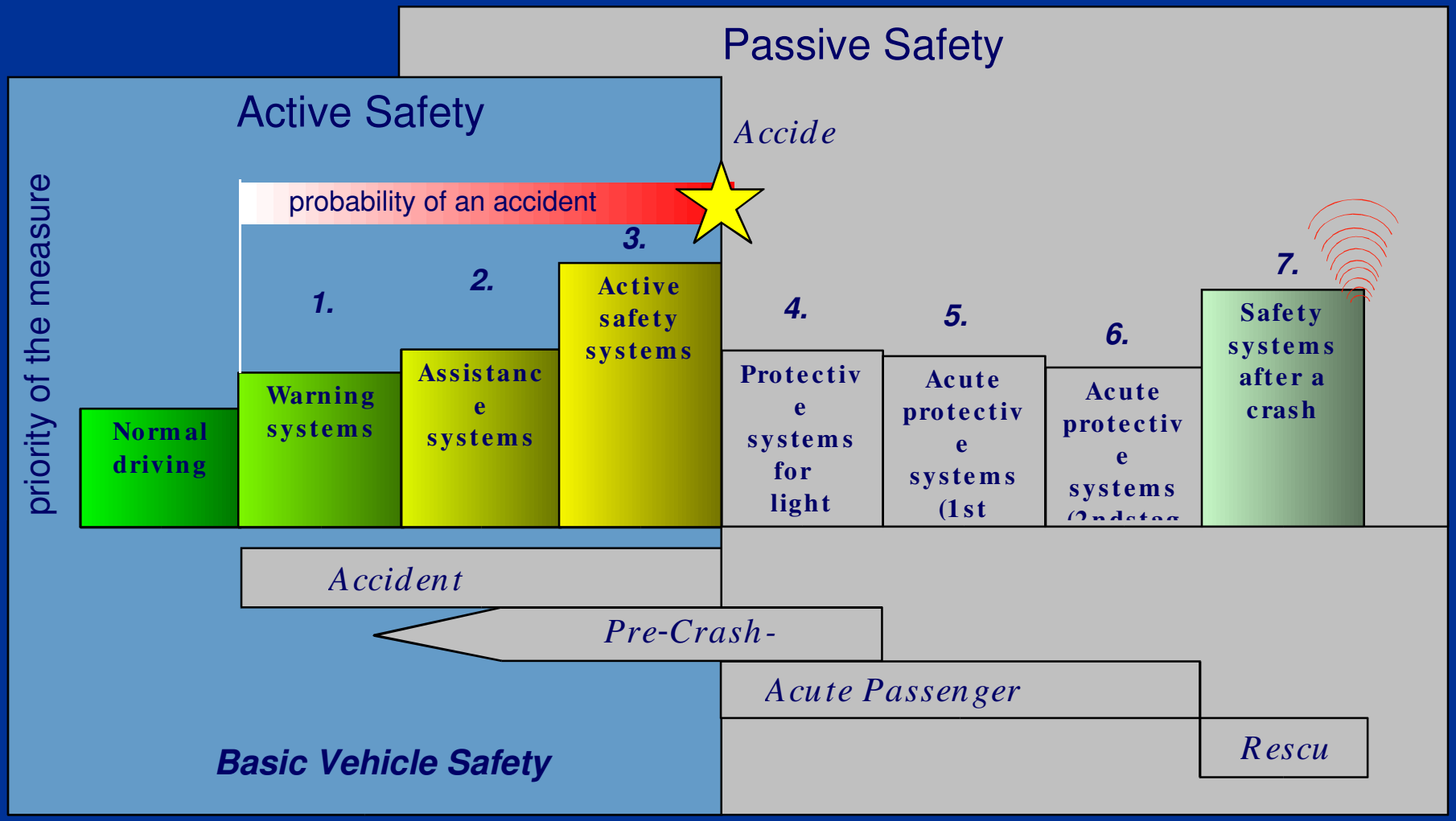
Stage 1: 40 times

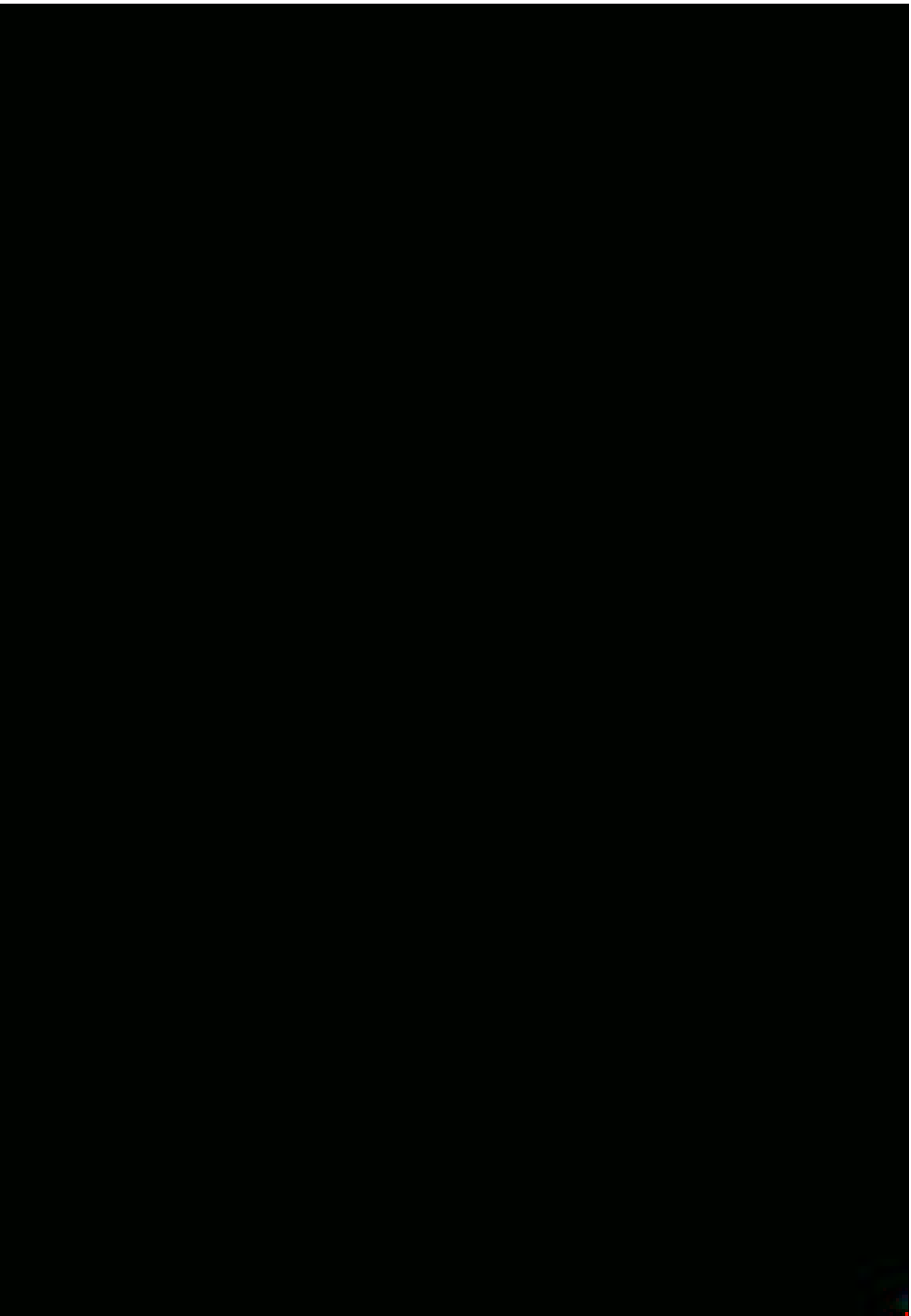
Stage 2: 118 times

Stage 3: 50 times

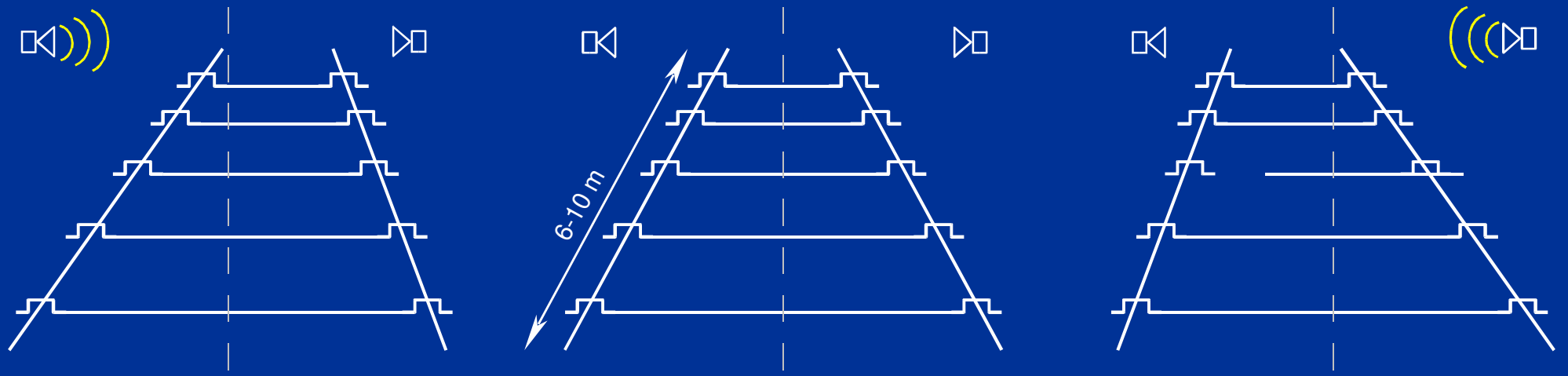
Stage 4: 2 times

Safety Strategy





Function of the Lane Assistant

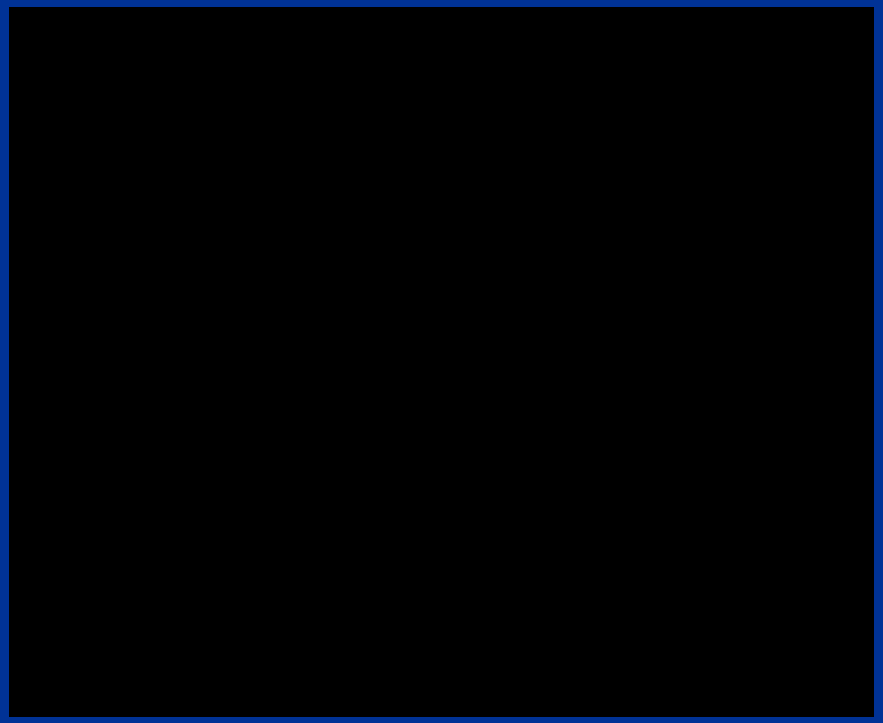


Possible new Application Development Efforts

- Obstacle warning (front, side)
- Radar/image fusion
- Smart headlamps
- Warning when a curve is detected and vehicle is too fast
- Tunnel sensor
- Night vision
- Lane departure warning with blind spot detection
- Active lane assistant

Active Lane Assistant (Experimental V.)

Limits of the Lane Assistant

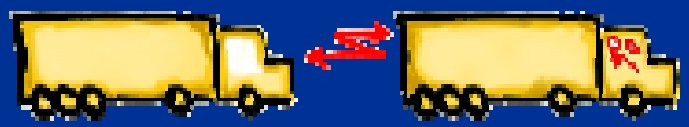


No warning at low speeds, when braking or when indicator is put on !

Limits when ...

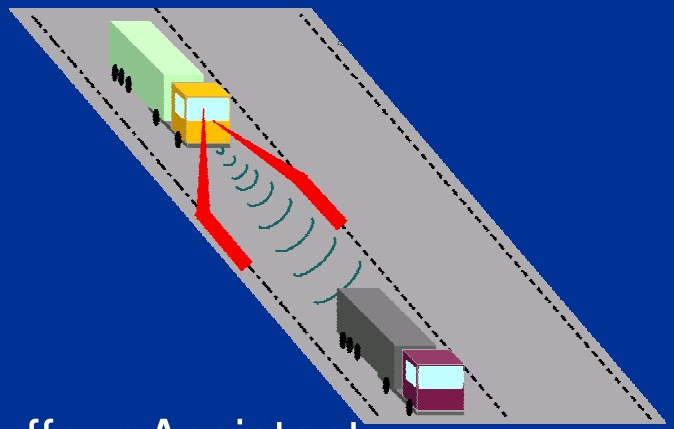
- little contrast or lane marking in bad condition
- ambiguous marking at construction sites
- generally similar limits as the human eye (reflections, snow, ...)

The Electronic Tow Bar and Related Ideas



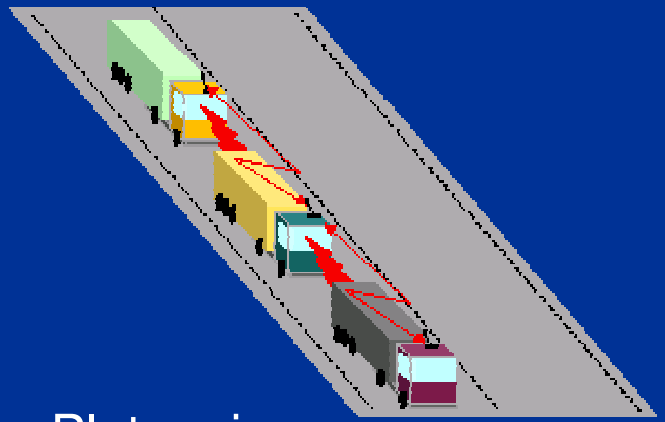
Electronic Tow Bar

- Leading vehicle is driven conventionally
- 2nd vehicle automatically follows like a “trailer”
- Very close following distance (6-12m)



Chauffeur Assistant

- No equipment necessary in leading vehicle
- Truck follows any vehicle



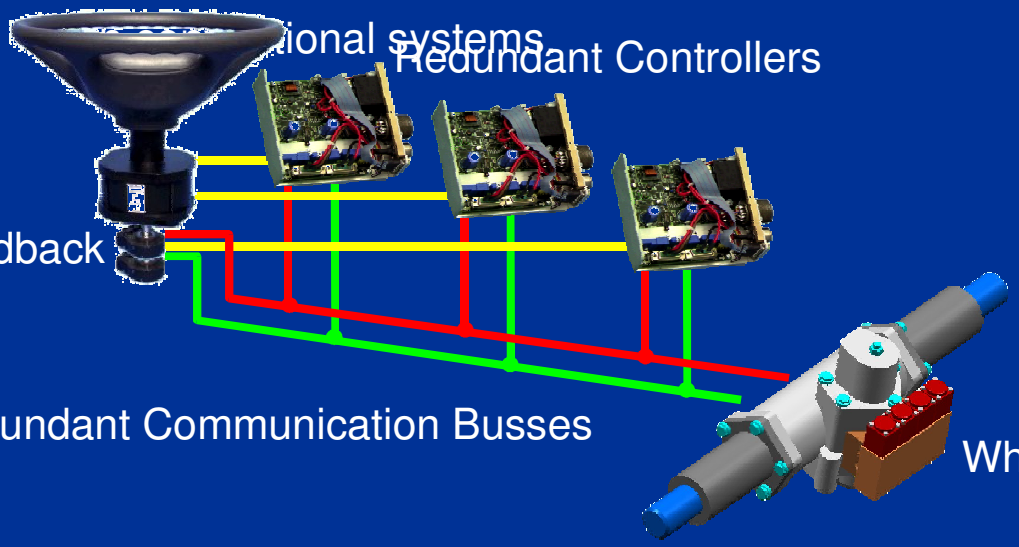
Platooning

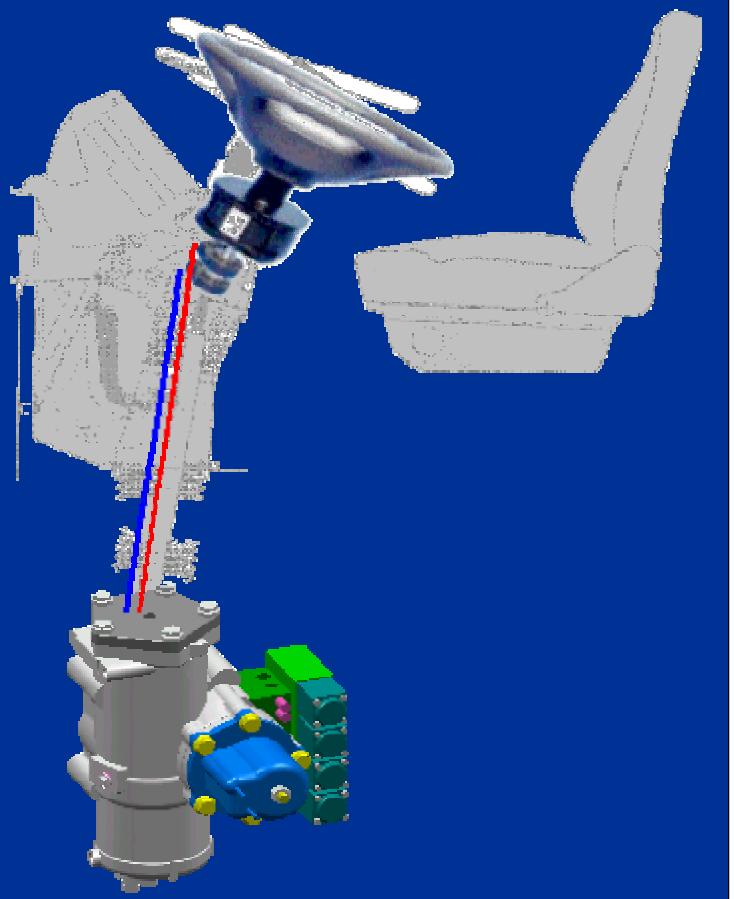
- Towing of more than one vehicle
- Higher transport efficiency

Steer-by-Wire

Function: - Separates the mechanical connection between wheels and steering wheel.
- Realises force feedback from the wheels to the steering wheel.
- Influences steering in unstable driving conditions e.g. side wind, bad road surface

Reliability: - To be legally approved, the reliability must be greater than





Wheel Angle Actuator

Electronic Tow Bar - Further Requirements

Brake Performance Estimation

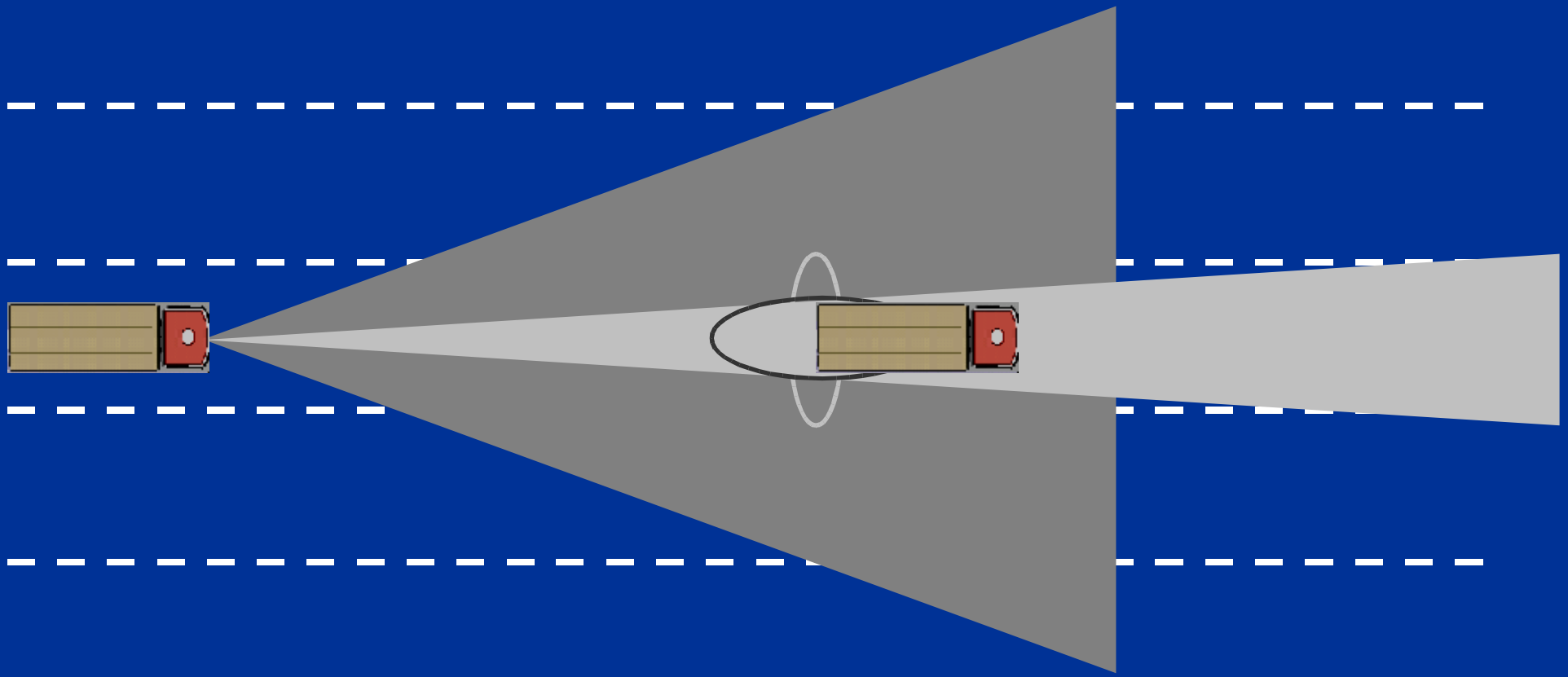
- An electronic brake system is required to do brake performance estimation
- Friction estimation will be requested by all future driver assistance systems
- Algorithm is based on wheel slip while accelerating or braking (friction coefficient)
- Payload is taken into account to calculate stopping distances
- The estimation does not allow “looking ahead”

Locating the Vehicle in Front

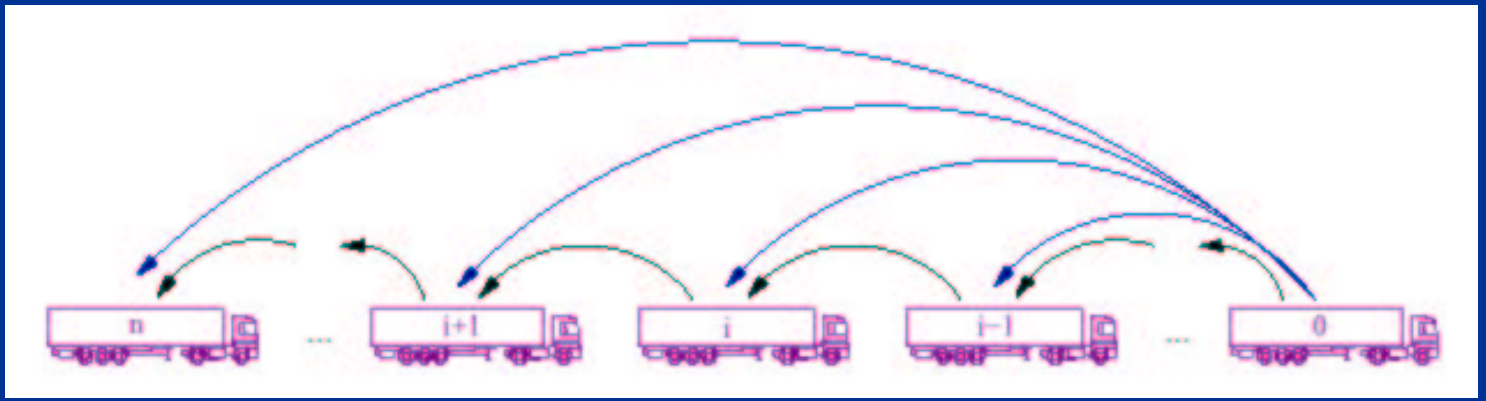
- Active IR-pattern allows robust and accurate detection
- The „seen“ size of the IR-pattern is a measure for the distance
- Distortion of the IR-pattern is a measure for the tow bar angle
- This principle requires a specially prepared vehicle in front

Chauffeur Assistant-Further Requirements

Accurate determination of the lateral and longitudinal position of the preceding vehicle by means of a „sensor fusion“



Platooning

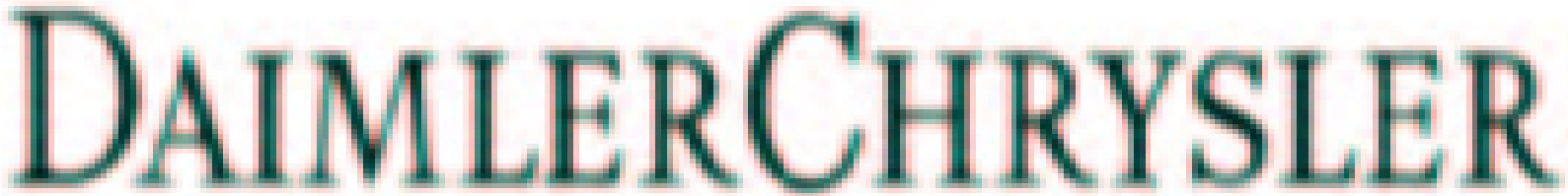


Longitudinal Platoon Control (Distance Controller)

- IR image processing (distance)
- Speed and acceleration of the leading/preceding and own vehicle
- Challenges: Platoon Safety and Platoon Stability

Lateral Platoon Control (Tow Bar Controller)

- IR image processing (Tow Bar angle)
- Steering control to follow the preceding vehicle


DAIMLERCHRYSLER