New Safety Features for Crash Avoidance

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Robert Bosch LLC

Chassis Systems Control

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Agenda

- Overview and Technology Milestones
- U.S. Accident Statistics & Consumer Interests
- Concepts for Crash Avoidance Systems
- Vision Systems for Driver Assistance
- Conclusions

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The Bosch Group

Bosch Group
Sales: 46.3 billion euros[1)]
Associates on Jan. 1, 2008: 271,000

Automotive Technology

Sales: 28.4 billion euros
Share of total sales: 61 %

Industrial Technology

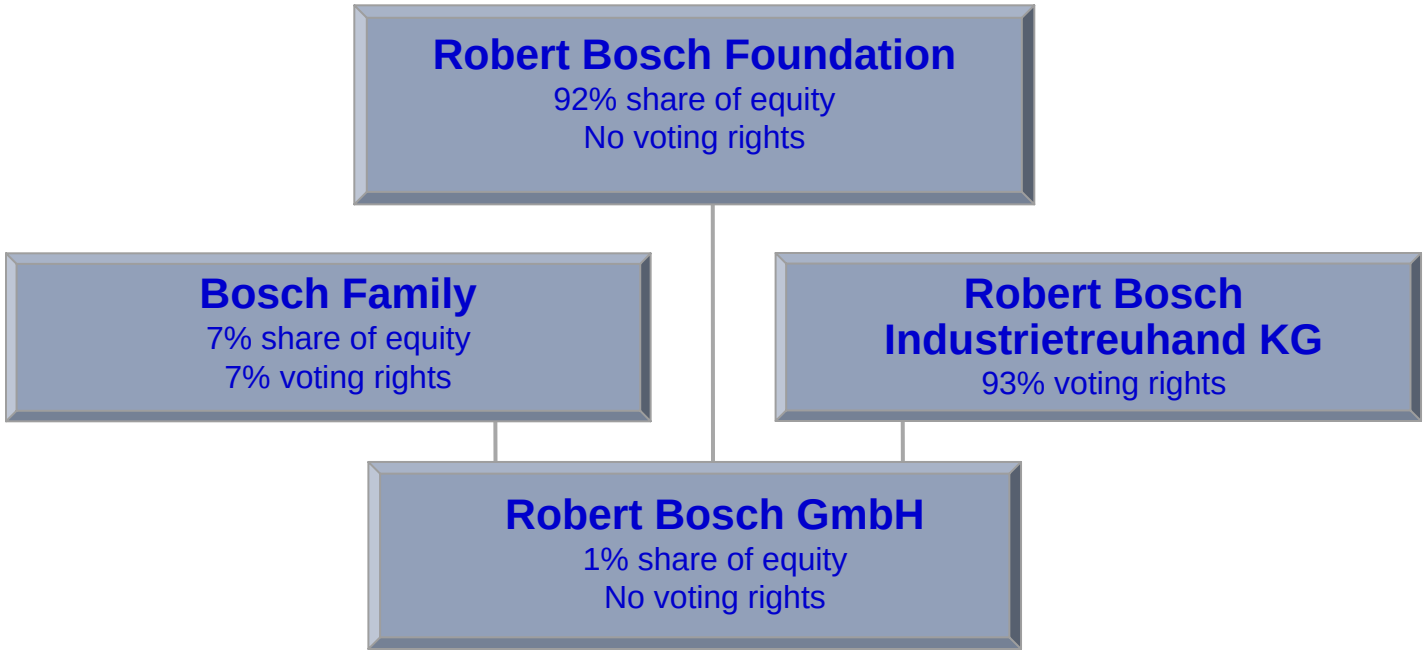
Sales: 6.0 billion euros
Share of total sales: 13 %

Consumer Goods & Building Technology

Sales: 11.7 billion euros
Share of total sales: 26 %

[1)] Including other business areas

Ownership structure



Robert Bosch Foundation

Established: 1964

Supports solely charitable purposes

92 % of the company's 1.2 billion euro capital stock is held by the foundation

Total project grants 2007: 58.9 m euros

Grants from 1964 to 2007: 840 m euros

Areas supported:

- Science and research
- Health and humanitarian aid
- International relations – western Europe, USA
- International relations – central and eastern Europe
- Education and society
- Society and culture

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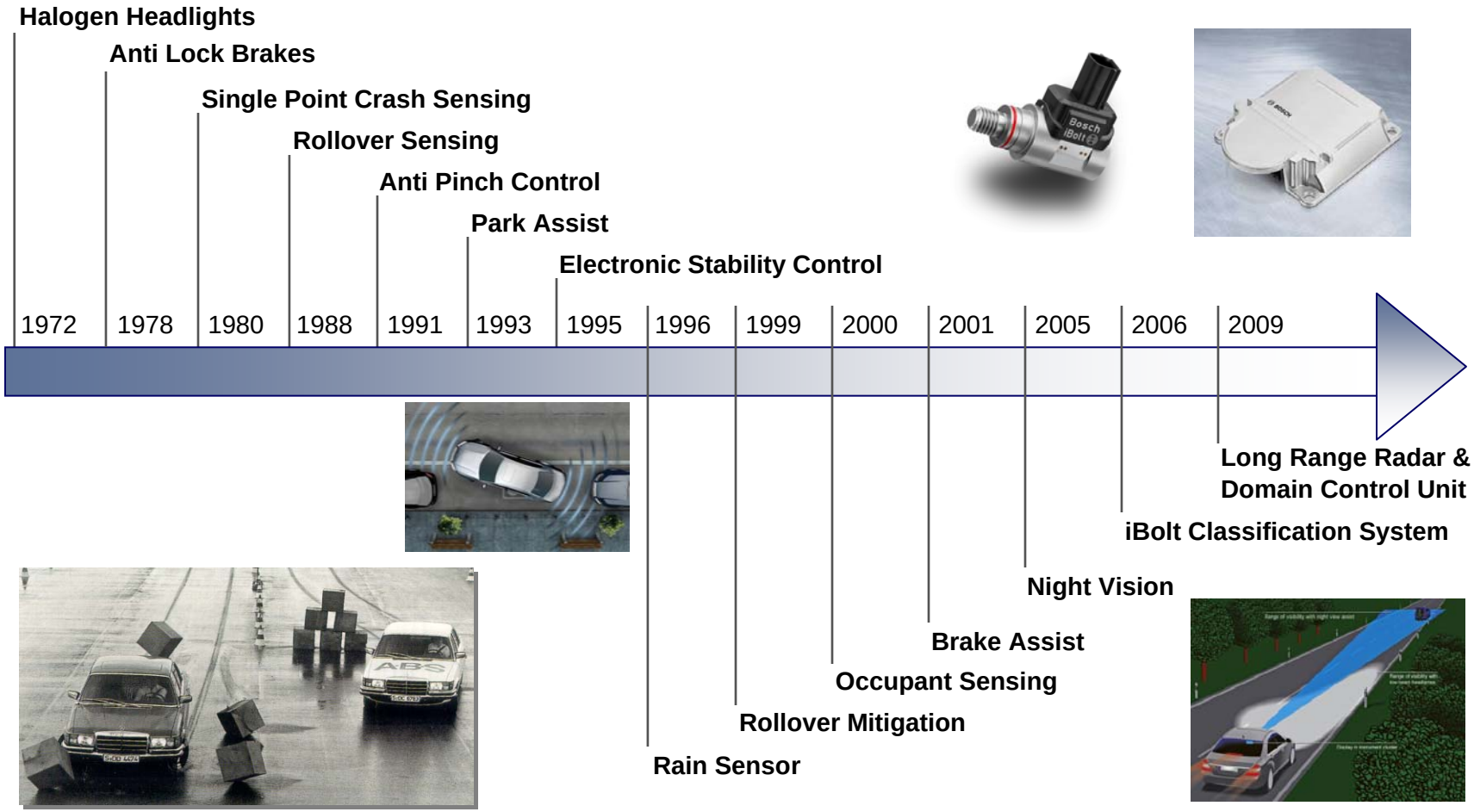
Automotive Safety Technology Milestones



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U.S. Automotive Consumer Trends

1. Hassle Free	2. Relaxed Driving	3. Affordable Driving	4. Safe Driving

5. Driving Pleasure	6. Personalized Usage	7. Inexpensive Vehicle	8. Be Premium

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Driver Behavior and Consumer Assessment

Key Findings from Accident Research:

- Most accidents are caused by driver error
  - Driver distraction in particular

Key Findings from Consumer Clinics:

- Most drivers believe they are “good drivers” and don’t need “assistance”
- Many drivers do not really understand driver assist systems
- System assessment based on individual experience, i.e.
  - Blind Spot Detection popular due to exposure in everyday driving
  - Minor interest in Lane Departure Warning, unless incident experienced

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Road safety – A public health issue[1]

	Registered motor vehicles [Mio]	Road accidents involving injuries [Mio]	Fatalities (fatalities within 30 days after accident)	Fatality risk per vehicle
	91.4	0.89	**7,272**	**1 : 12,500**
	293.8	1.28	**42,953**	**1 : 6,800**
	251.4	1.78	**42,642**	**1 : 5,900**
	19.5	0.21	**6,327**	**1 : 3,100**
	45.4	0.32	**19,755**	**1 : 2,300**
	145.2	0.38	**89,455**	**1 : 1,600**
	36.9*	0.23	**32,700****	**1 : 1,200**
	87.9	0.46	**105,749**	**1 : 830**

* 2005

** fatalities within 7 days after accident

[1]Sources: IATSS Yearbook 2006, CARE 2006 (EU27), DfT- Transport Statistics GB 2007, NHTSA Traffic Safety Facts 2006, Road Traffic Safety Authority Korea 2006, Yearbook 2006 Traffic Accidents China, Sindipeças 2007, DENATRAN 2006, RAMI Annual Report 2006, Ministry of Shipping, Road Transport & Highways, govt. of India

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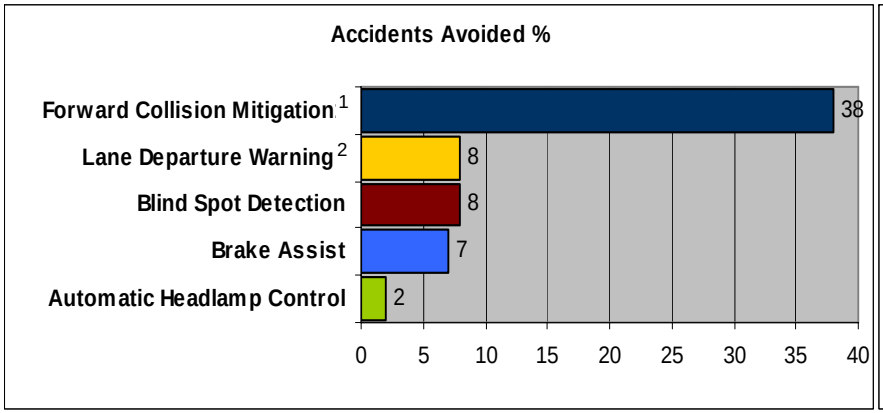
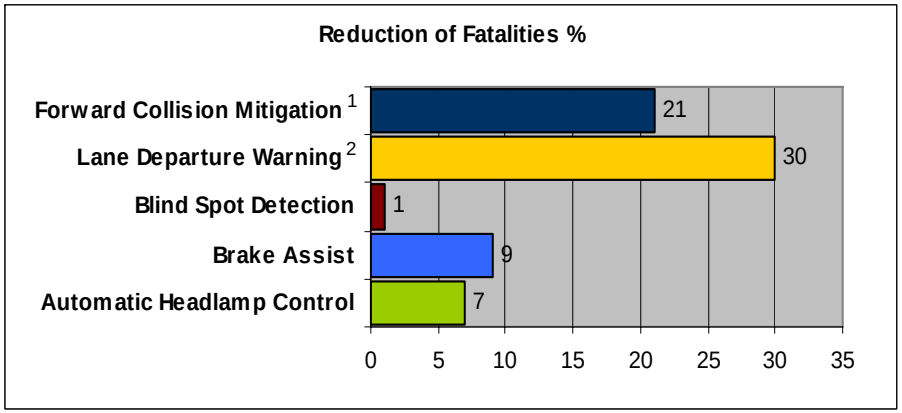
New Safety Features for Crash Avoidance

U.S. Accident Data*





- **Forward Collision Warning with Automatic Braking[1]** could prevent approximately 2,300,000 crashes and approximately 7,200 fatalities per year
- **Lane Departure Warning[2]** could prevent approximately 480,000 crashes and approximately 10,000 fatalities per year

[1] Systems which mitigate frontal crashes by alerting drivers and/or by automatic braking

[2] Systems which alert drivers if the vehicle is drifting out of lane

* Source: IIHS 2008: Analysis of 2002-2006 NASS accidents. Various function definitions in use

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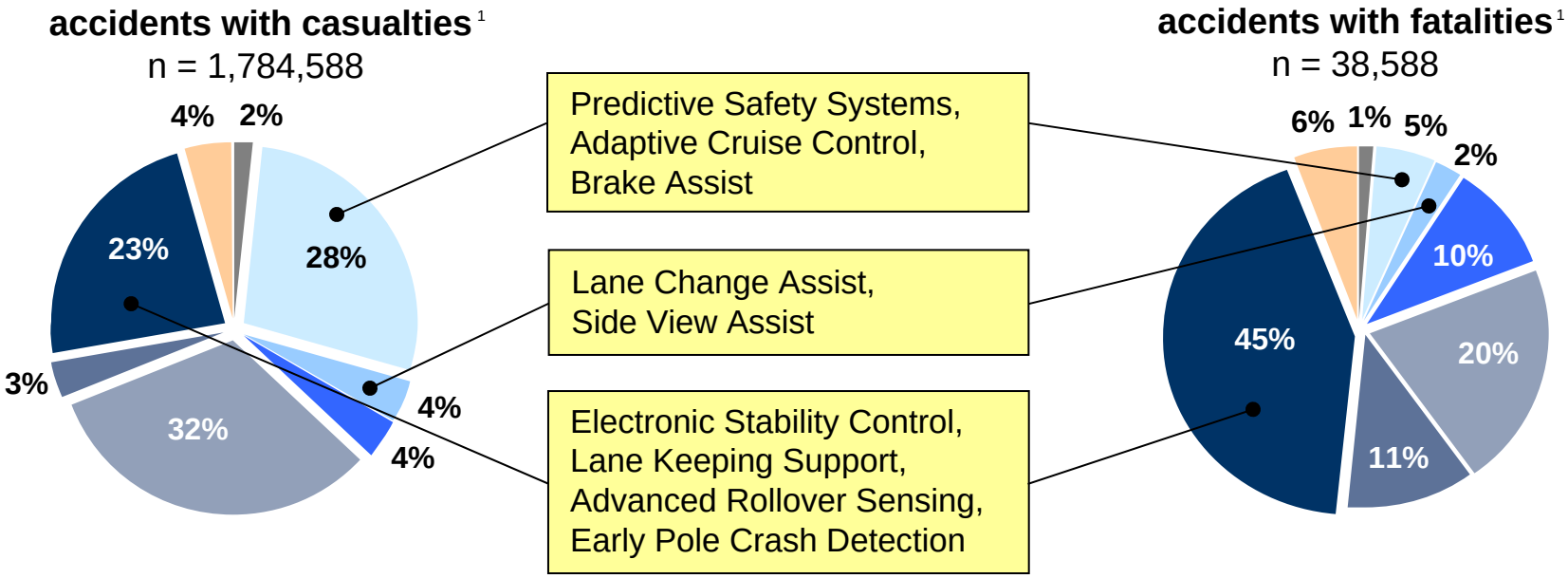
Collision data (1/2)



[1] Vehicle to Bicycle - accidents in category „Others“

sources: NHTSA/NCSA 2006

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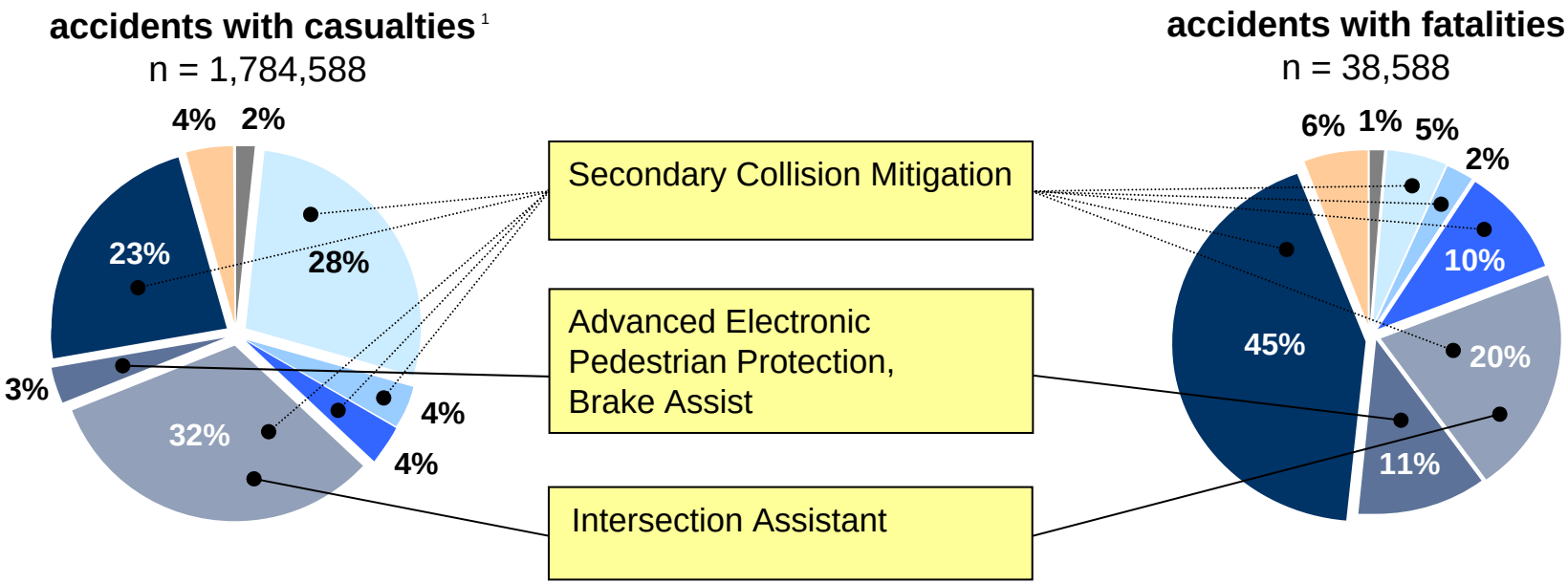
Collision data (2/2)



[1] Vehicle to Bicycle - accidents in category „Others“

sources: NHTSA/NCSA 2006

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Predictive Safety System

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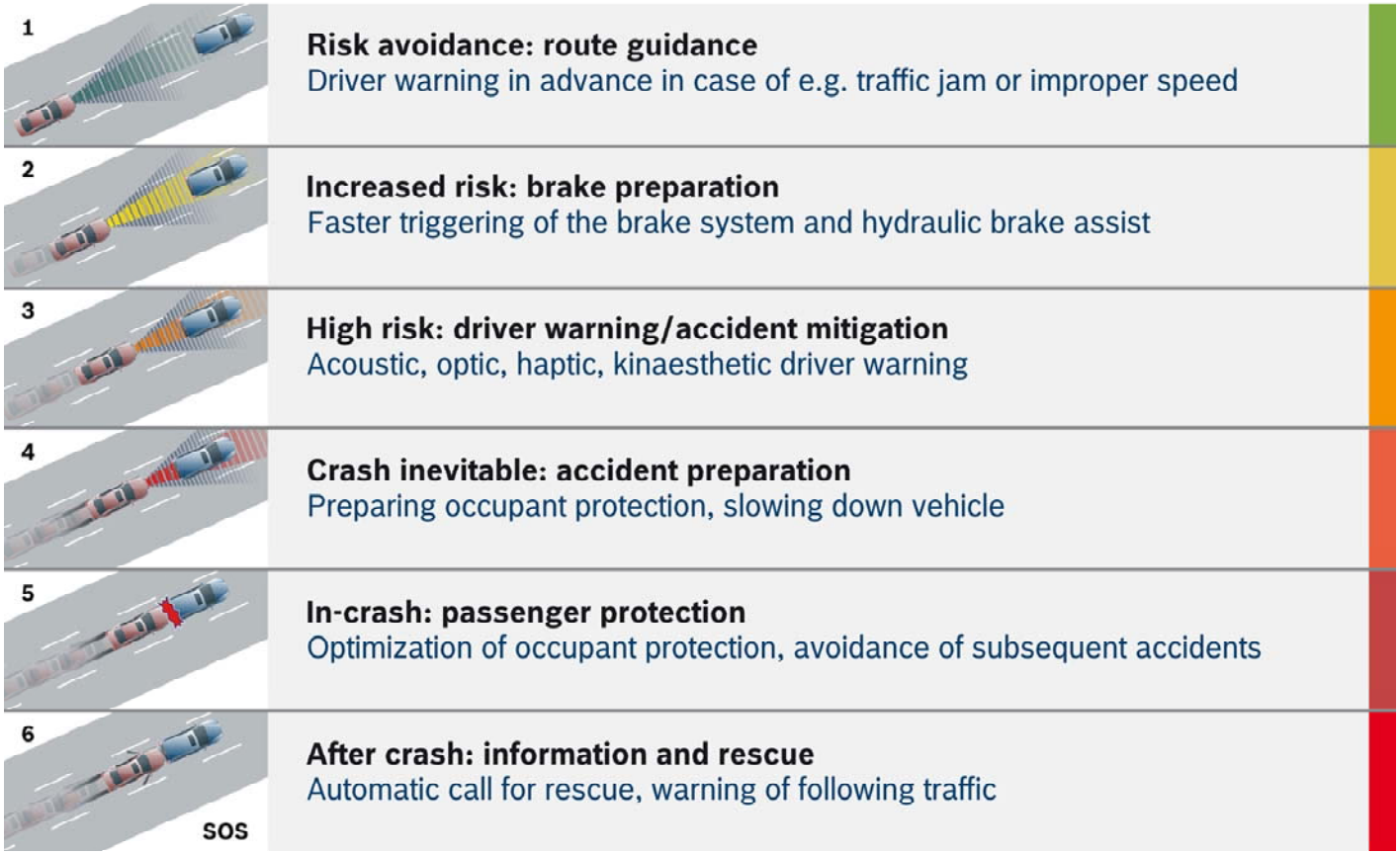
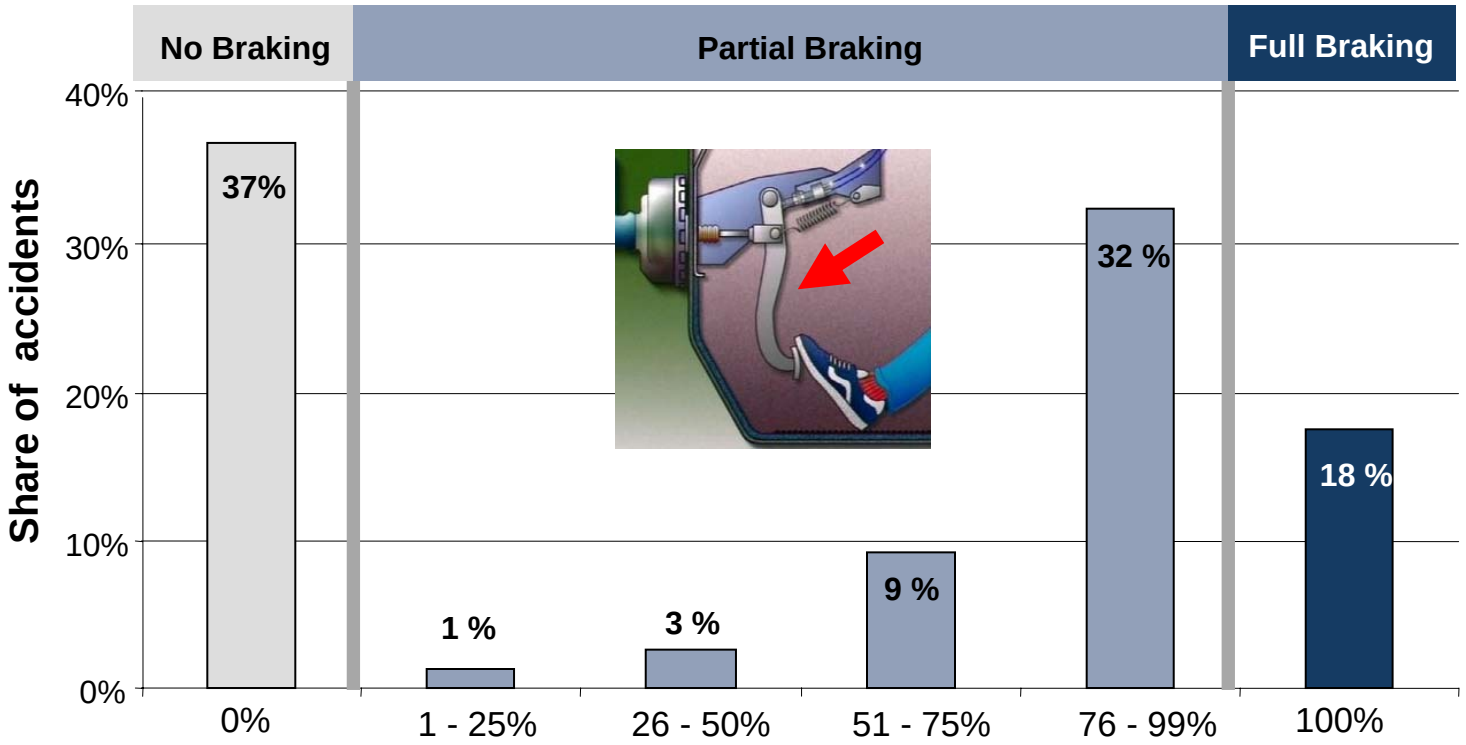
Multiphase safety concept

Risk phases (e.g. front crash)



Driver Braking Behavior

Vehicle Deceleration Prior to Rear End Crashes[1]



[1] Based on 1184 rear end crashes in GIDAS (German In-Depth Accident Study). For 727 cases deceleration, weather and road conditions are known.

[2] Maximum possible deceleration was determined based on weather and road conditions.

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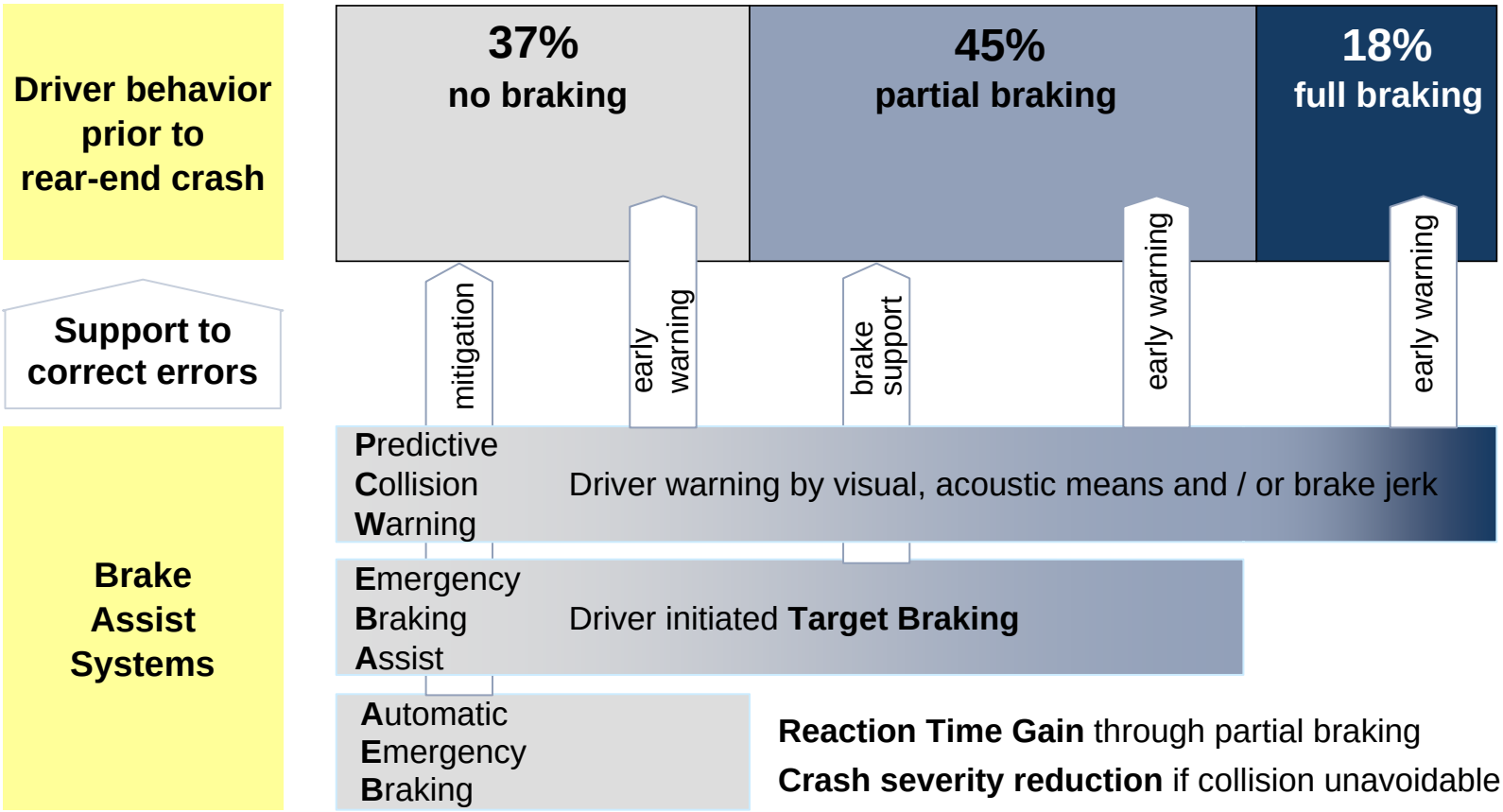
Optimal Deceleration with Emergency Braking



Reaction Time Gain through partial braking

Crash severity reduction if collision unavoidable

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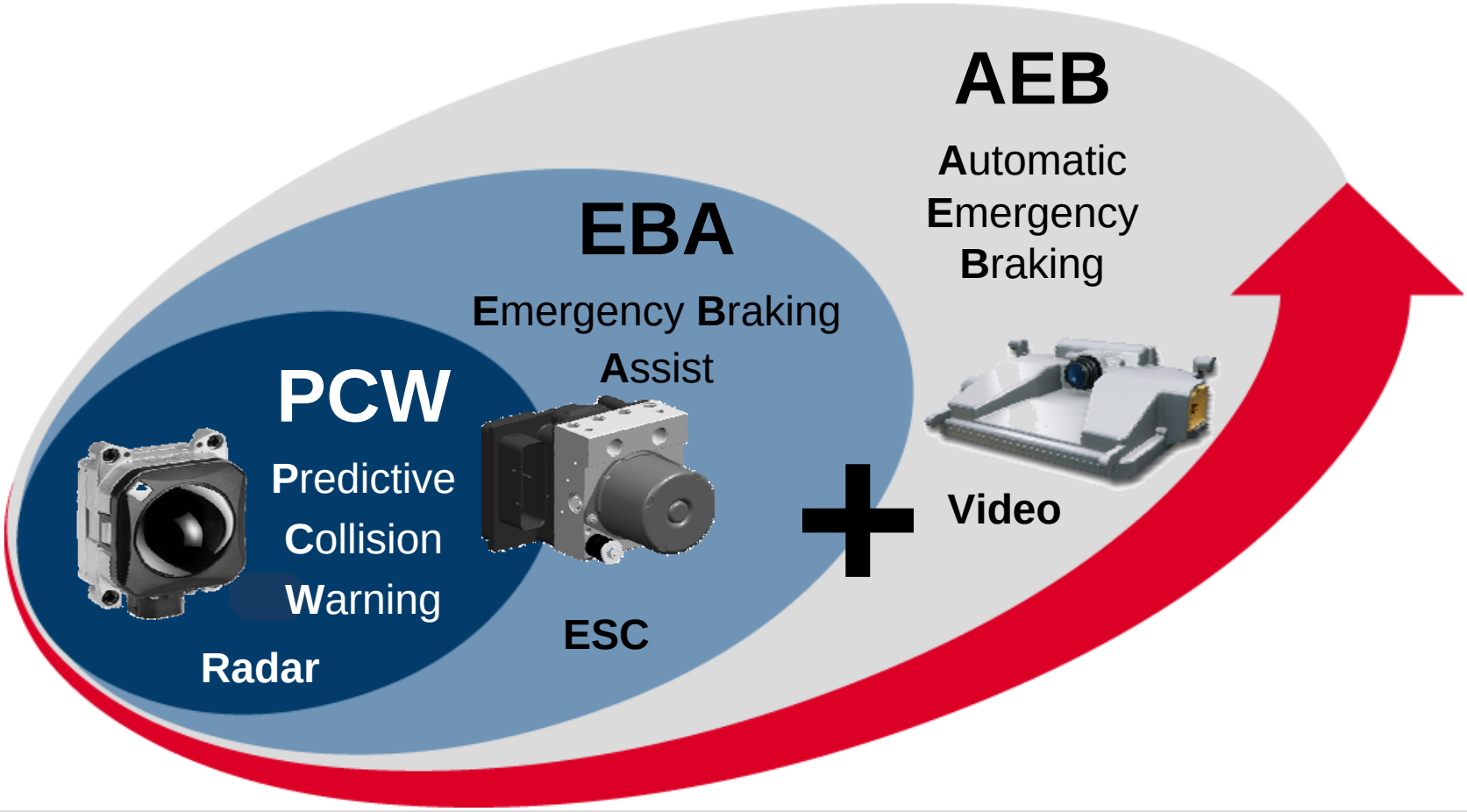
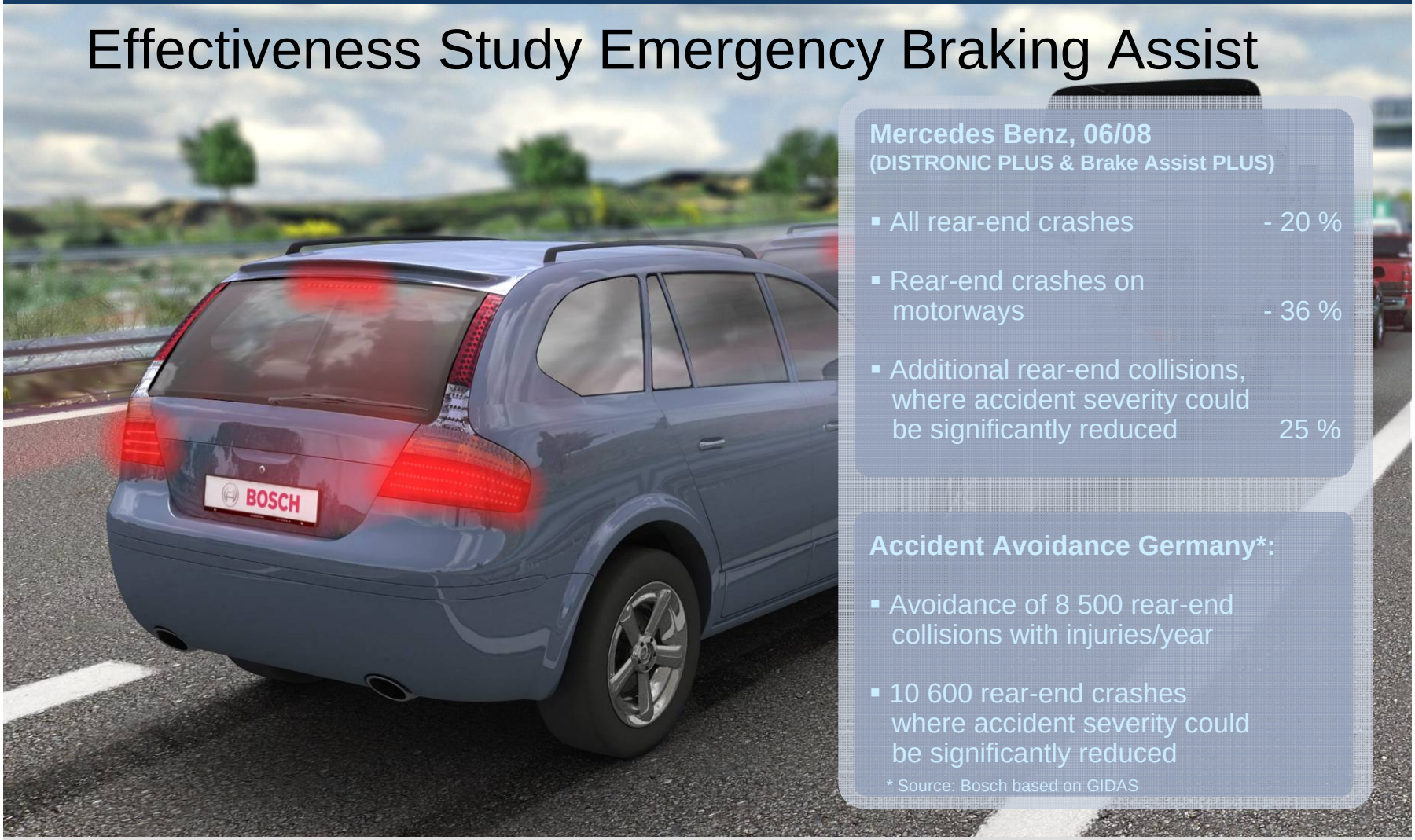
Predictive Emergency Braking Systems



Effectiveness Study Emergency Braking Assist



Mercedes Benz, 06/08
(DISTRONIC PLUS & Brake Assist PLUS)

- All rear-end crashes - 20 %
- Rear-end crashes on motorways - 36 %
- Additional rear-end collisions, where accident severity could be significantly reduced 25 %

Accident Avoidance Germany*:

- Avoidance of 8 500 rear-end collisions with injuries/year
- 10 600 rear-end crashes where accident severity could be significantly reduced

* Source: Bosch based on GIDAS

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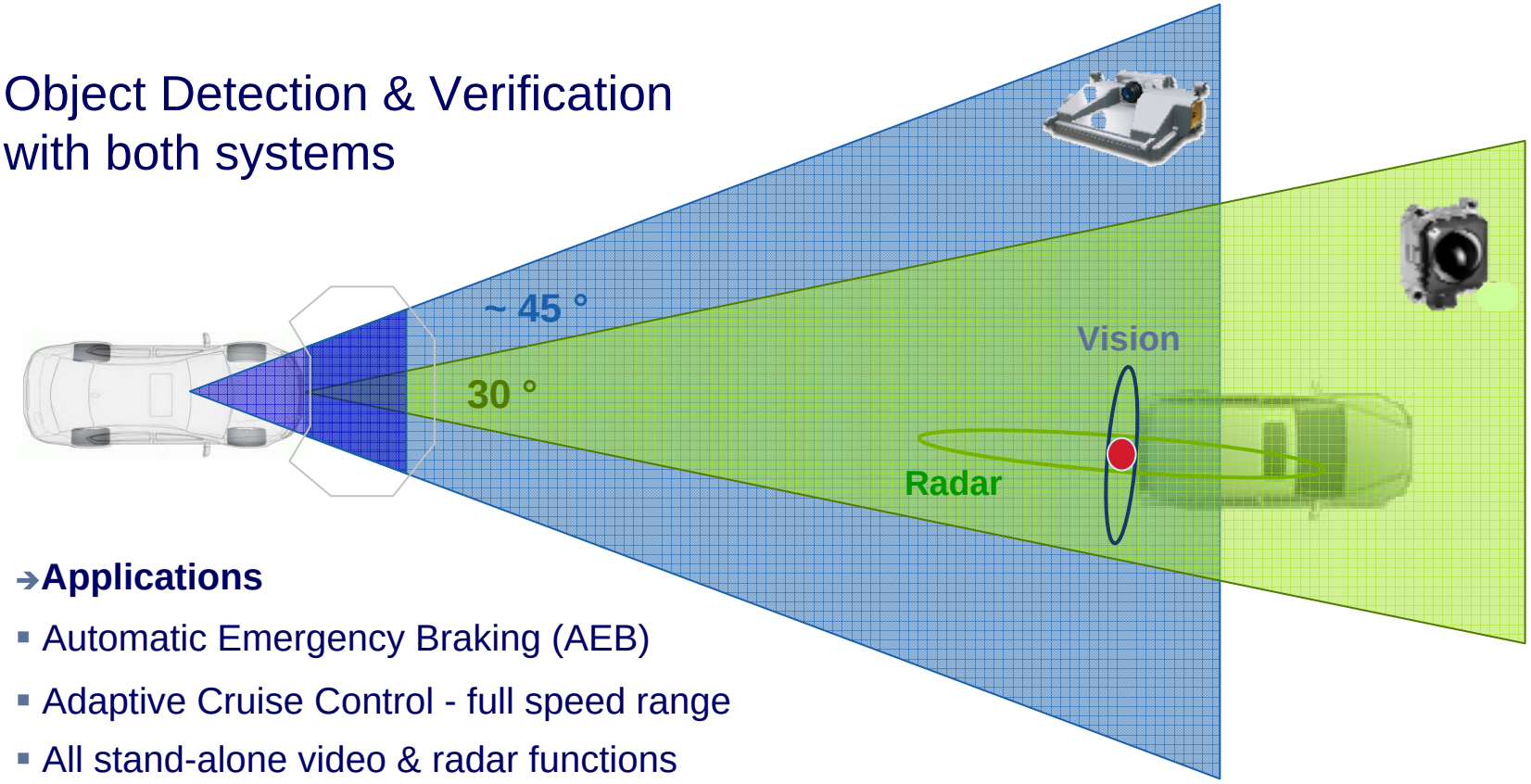
Sensor Data Fusion Video & Radar

Object Detection & Verification with both systems



➔**Applications**

- Automatic Emergency Braking (AEB)
- Adaptive Cruise Control - full speed range
- All stand-alone video & radar functions (e.g. Lane Departure Warning)

● = Object to detect and classify

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Lane Keeping

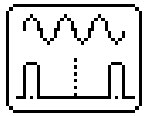
Multi Purpose Camera

Lane Departure Warning

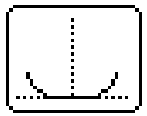
- Camera tracks vehicle' s course within lane markings
- Acoustic & haptic warning if vehicle drifting out of lane
- Early detection of driver' s inattention
- No false alerts by evaluating the driver's intention

Lane Keeping Support

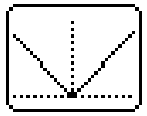
LKS1: Weak steering torque
or brake activation when
vehicle approaching lane marking



LKS2: Smooth returning to center line
Medium steering torque



LKS3: Keeping the vehicle
along the center line
Stronger steering torque



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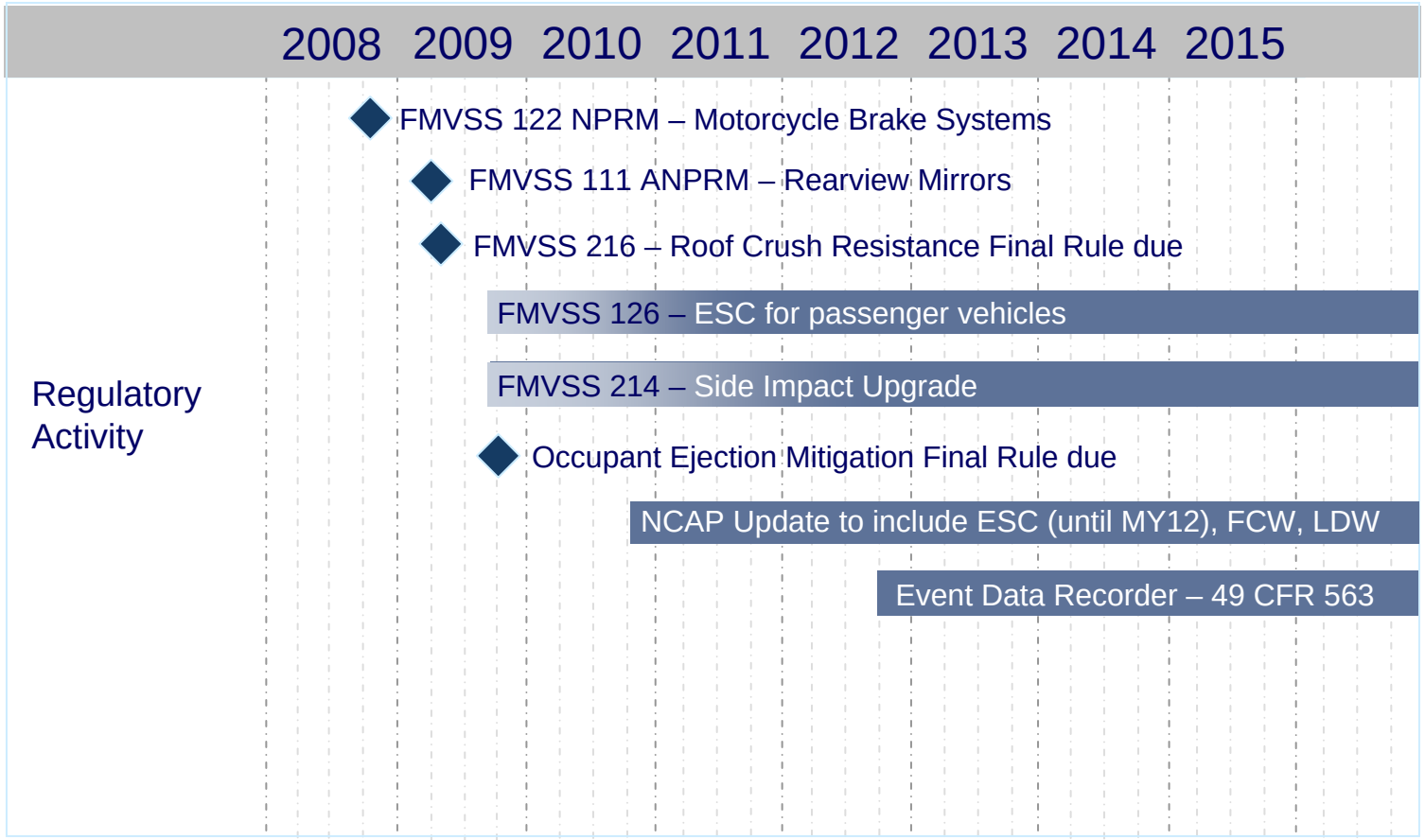
Regulation Trends



Conclusions

- Crash avoidance and driver assistance systems have a high potential to prevent crashes and reduce road fatalities and injuries.
- With the new New Car Assessment Program (NCAP) for model year 2011, NHTSA encourages vehicle manufacturers to implement these new safety systems.
- Cost effective technologies for crash avoidance and driver assistance are in mass production today.
- In order to realize the crash avoidance potential, a high market penetration will be needed.

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