

# INNOVATIONS AND TRENDS IN ASSISTANCE SYSTEMS FOR TRUCKS







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In accordance with its “Vision Zero” policy, the EU intends to once again halve the number of fatalities in road traffic accidents in Europe by 2020. One of the measures aimed at achieving this is to require all new heavy commercial vehicles to be equipped with an advanced emergency braking system from 2013. OnGuardPlus from Wabco is the first system in the commercial vehicle sector in compliance with the expected regulations.

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## BACKGROUND

Between 2001 and 2010, annual fatalities related to road traffic accidents in Europe fell by 46 % from 54,000 to 29,000 [1]. Even though these figures closely match the ambitious goal of the European Union to halve the number of road fatalities by 2010, there is still room for improvement, particularly regarding commercial vehicles, for which maintenance condition, driver qualification and international transit present further challenges. It is alarming that each year accidents involving trucks cause approximately 6,500 road deaths in the European Union [2]. Overall, commercial vehicles represent 7 % of all kilometres driven in Europe [2], while in terms of accidents, they are twice as dangerous per kilometre driven as passenger cars.

The European Union has launched several regulatory initiatives to accelerate the broad implementation of more sophisticated safety systems. For example, Electronic Stability Control (ESC) has been mandatory for commercial vehicles since November 2011. In addition, Advanced Emergency Braking Systems (AEBS) will be required on new heavy commercial vehicles starting in November 2013 [3].

## DEVELOPMENT OF ACTIVE SAFETY SYSTEMS FOR COMMERCIAL VEHICLES

The first few generations of active safety systems for commercial vehicles helped to stabilise and control the vehicle while braking. They include the industry's first ABS system, which was pioneered by Wabco and Daimler for application on trucks and buses in 1981, as well as EBS, a system launched in 1996 by Wabco, and their extension – ESC – which has been available since 2001, ①.

ABS is used to prevent locking of a vehicle's wheels as a result of road friction being lower than the braking forces, ②. In 1991, the European Union made ABS mandatory for heavy commercial vehicles. Transmitting the driver's actuation of the brake pedal into electronic signals, EBS significantly reduces the braking distance of a commercial vehicle and also greatly improves driving stability and steerability. As an extension of EBS and ABS, ESC helps to correct any possible instability and helps to prevent the vehicle from oversteering or understeering, ③. Since November 2011, electronic stability control has been mandatory for all new commercial vehicles in Europe.



① Wabco ESC ECU module



2 Test drive with ABS at the Wabco test track in Jevern (Germany)

## OVERVIEW OF DRIVER ASSISTANCE SYSTEMS

Examples of advanced driver assistance systems (ADAS) are Collision Warning Systems (CWS) and Adaptive Cruise Control (ACC). They help to control the distance to the vehicle ahead and if necessary warn the driver to react. Furthermore, ACC can automatically adjust the vehicle's speed to maintain a safe following distance [4].

In a further development, Collision Mitigation Systems (CMS) not only warn the driver in collision-imminent situations but will also autonomously apply the brakes to decrease the impact of a collision. Current versions of ACC, CWS and CMS, however, are not ready to react to stationary vehicles ahead in order to address potential accidents.

Another kind of ADAS is Lane Departure Warning (LDW). LDW could nearly

halve the number of commercial vehicle accidents on highways caused by lane departures simply by alerting drivers who are unintentionally leaving their current lane [5]. 4 shows an overview of dangerous road situations and safety systems that help to mitigate them.

## ONGUARD COLLISION MITIGATION SYSTEM


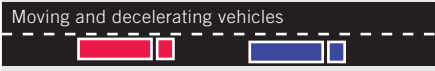


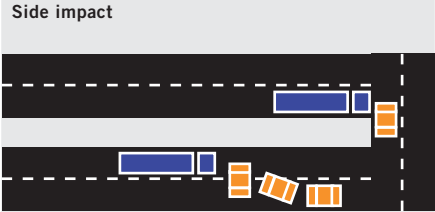
One example of an advanced safety system that combines ACC technologies with brake application and CMS capabilities is OnGuard from Wabco. It is the first collision mitigation system on the North American market, and was introduced by Meritor Wabco in 2008.

OnGuard can automatically maintain a safe following distance and helps to avoid or reduce the impact of rear-end collisions by monitoring the traffic ahead, recognizing potentially dangerous situations and by braking as needed. Its forward-looking radar sensor uses advanced algorithms to monitor the distance, speed and deceleration of a vehicle ahead. With its internal gyro, the system is also able to select the relevant objects in the radar beam. When detecting that a potential collision with a moving or decelerating object is developing, the system sends a series of audible and visual warnings through an in-cab dashboard display alerting the driver to take the appropriate corrective action. If the driver does not immediately decelerate the vehicle, OnGuard automatically reduces engine speed and provides the necessary braking power by applying the service brakes, which results in a deceleration of up to  $3.5 \text{ m/s}^2$ , almost 50 % of a full brake application.

Even if an accident is unavoidable, OnGuard's intervention effectively helps to mitigate the impact of a potential collision. On the other hand, if the driver reacts within an appropriate time and starts a braking or steering intervention, the system disengages and allows the driver to take full control of the vehicle. More than 10,000 OnGuard systems have been sold as of March 2011. This technology has proven its effectiveness, as customers have so far collectively driven more than 1.6 billion km protected by OnGuard.



3 Test drive with ESC at the Wabco test track in Jevern (Germany)

ACTIVE SAFETY SYSTEMS	
	: Stability control : Lane departure warning (LDW)
	: Adaptive cruise control (ACC) : Collision mitigation
	: Full autonomous emergency braking : Advanced emergency braking
	: Collision mitigation : Autonomous emergency braking
	: Advanced emergency braking : Autonomous emergency braking

4 Dangerous road situations and systems that can help to prevent accidents in these situations

**ONGUARDPLUS EMERGENCY BRAKING SYSTEM**

OnGuardPlus takes the technology of the OnGuard collision mitigation system to the next level. It is an advanced emergency braking system (AEBS) that was first publicly demonstrated in September 2010 by Wabco. The system extends the OnGuard family’s functional range by integrating the latest EBS and ABS technology. Unlike previous systems, OnGuardPlus reacts to moving and decelerating vehicles ahead that come to a standstill, and its collision mitigation function also reacts to stationary vehicles ahead, for example when approaching traffic congestion as shown in 5. While OnGuard is a collision mitigation system with autonomous partial braking of 35 to 40 % in collision-imminent situations, the OnGuardPlus system fully applies brakes in situations with moving or decelerating vehicles.

It uses a single radar sensor and proprietary algorithms to monitor and analyse vehicles ahead. The sensor’s detection area covers the complete width of its own

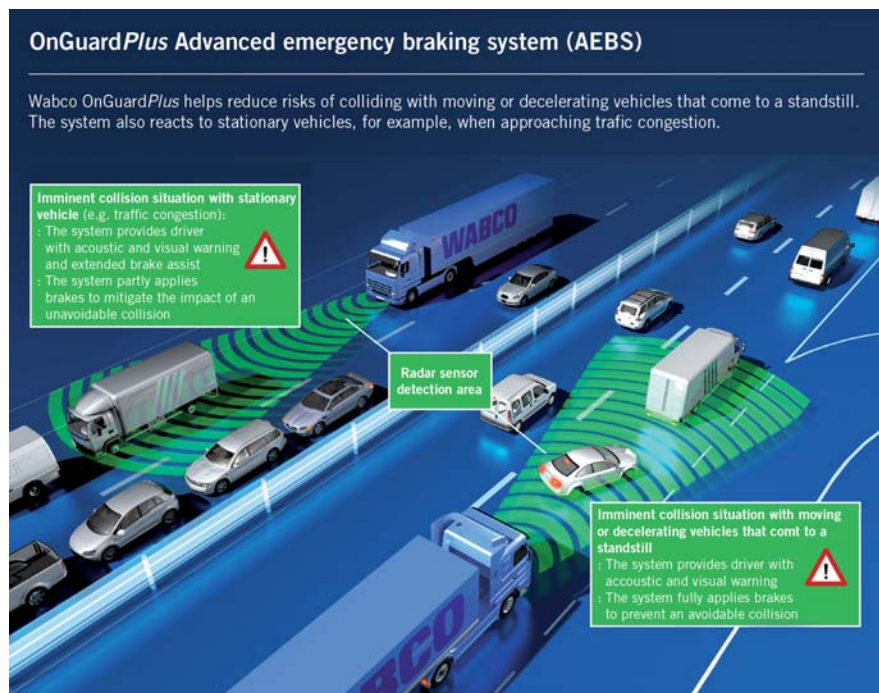
lane, including an area 3 m ahead of the preceding vehicle and both neighbouring

lanes ahead.

When a collision-imminent situation is detected, OnGuardPlus initiates several steps of escalation, 6. At first, a combined audible and visual warning is triggered to get the driver’s attention. If the driver does not react to this warning, the system will induce a haptic warning. This indicates the last chance to prevent a crash without the system’s intervention. If the driver still does not react, then the system will initiate autonomous braking.

If the brake pedal is even slightly applied during the collision warning, OnGuardPlus will switch to the Extended Brake Assistant (EBA) function, which commands a service brake application to decelerate the vehicle. Under good friction conditions, this step will stop the vehicle directly behind the preceding vehicle – regardless of whether or not the driver applies the brake pedal fast and strongly enough.

In combination with a Wabco braking system during the collision warning phase, the AEBS orders the braking system to apply a “response pressure” to prepare the foundation brakes for an upcoming hard braking event. This “pre-fill” reduces the delay time of the brakes when being subsequently actuated by the driver or by the emergency braking



5 The reaction of OnGuardPlus in collision-imminent situations

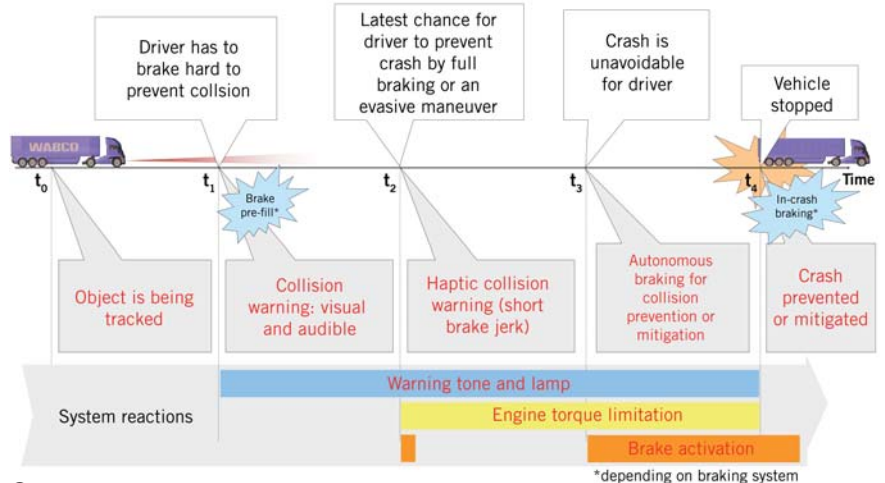
system. The time saving that is achieved is between 100 and 300 ms, depending on the vehicle type. The stopping distance reduction for this speed (90 km/h) is 2.5 to 7.5 m.

The system integration also enables “in-crash braking.” It helps to improve situations when a crash is unavoidable. This includes, for example, close cut-in manoeuvres of a slower preceding vehicle or low-friction conditions. During in-crash braking, the brake application continues as long as possible. The impact energy can be reduced by utilisation of wheel brakes instead of using the crush zones of the other accident participant.

OnGuardPlus is the commercial vehicle industry’s first system to be in compliance with the European Union’s expected regulation to make AEBS mandatory on new heavy commercial vehicles for new vehicle type approvals in 2013. The system will be available from 2012 for trucks and buses worldwide, which is timely for original equipment manufacturers to meet the new European regulatory requirements.

#### FURTHER DEVELOPMENTS AND OUTLOOK

OnGuard paved the way for new developments in driver assistance systems – such as OnGuardPlus. Another more advanced system is OnGuardMax, the first system for autonomous emergency braking (AEB) that, together with a full brake application, reacts to moving and stationary vehicles alike and can bring the vehicle to a complete stop to avoid a collision. This system was demonstrated by Wabco at IAA Commercial Vehicles 2008 and will be available to truck and bus manufacturers from 2015 onwards [6].



6 OnGuardPlus escalation stages

Other currently developed systems will be ready for market launch in the near future. These include blind spot detection, lane change assistants and systems that monitor the vehicle’s immediate surroundings. There are also systems that track information on driver behaviour and allow the timely identification and prevention of risky driving behaviour before accidents are caused.

Policy makers and industry leaders in the European Union and worldwide have made road safety a priority, and commercial vehicle technology leaders are committed to sustaining the pace of development. Legislation will also speed up the implementation of sophisticated electronic safety technologies. Meanwhile, the European Union is issuing directives promoting higher levels of training and education for professional drivers, and it is working on making the infrastructure of roads safer. Altogether, these measures increase the likelihood

that the European Union can accomplish its new goal to halve fatal road accidents by 2020.

#### REFERENCES

- [1] Nissler, W.; Europäische Kommission, Generaldirektion für Energie und Verkehr, Unit “Road Safety and Transport of Dangerous Goods”: Road Traffic Safety: Recent EU Developments. 13 April 2011
- [2] European Federation for Transport and Environment: Background Briefing: Conclusions and Recommendations From the Report “Are Trucks Taking Their Toll?”. January 2009
- [3] European Union Press Release: Improving the Safety and Environmental Performance of Vehicles. <http://europa.eu>, Brussels, 23 May 2008
- [4] Deutsche, S.; Kessler G. C.; Lank C.; Hoffmann, G.; Hakenberg, M.; Brummer, M.: Einsatz elektronisch gekoppelter Lkw-Konvois auf Autobahnen. In: ATZ 112 (2010), Nr. 7-8, S. 570 – 575
- [5] Allianz Zentrum für Technik (AZT): Wirkungspotenziale von ACC und Lane-Guard-System bei Nutzfahrzeugen. München, 2006
- [6] Wiehen, C.; Lehmann, K.; Figueroa, J.-C.: Aktuelle Entwicklungen bei Fahrerassistenzsystemen für Nfz. In: ATZ 111 (2009), Nr. 7-8, S. 518 – 524

