

Promoting advanced
vehicle safety technologies



eSafety background paper





Foreword



There is no doubt that new intelligent vehicle technologies have made cars safer than ever before. Yet not enough consumers are benefitting from these life-saving systems.

This is why we need to promote and encourage the use of vehicle safety equipment which can help to prevent accidents and ultimately save lives.

In Europe alone almost 40,000 people are killed in traffic every year and more than one million injured. New cars today are much safer than they were 10-15 years ago thanks to improved crash test standards, crumple zones, seatbelts, and air bags which help protect occupants in a crash.

Under the latest technological developments, safety systems like Electronic Stability Control (ESC) can prevent accidents from happening in the first place. If all cars in the EU used ESC it is estimated that at least 4,000 lives a year could be saved and more than 100,000 injuries avoided.

But currently just over half of new cars in the EU are equipped with ESC. In emerging vehicle markets like China, use of ESC is much lower and an even greater challenge is to increase awareness of the safety potential of such eSafety technologies.

This is why eSafetyAware is focused on increasing public awareness and supporting the deployment of these life saving systems.

Our first awareness campaign ChooseESC!, which was funded by the European Commission and FIA Foundation, has had a major impact in increasing the use of this technology. Other eSafety technologies such as Blind Spot Monitoring and Advanced Emergency Braking hold similar life-saving potential.

As President of eSafetyAware I am committed to promoting the wide-spread use of eSafety technologies on our roads and in doing so to help prevent lives being lost in vehicle accidents worldwide.

A handwritten signature in black ink, appearing to read 'Jean Todt'. The signature is fluid and cursive, with a long, sweeping underline that loops back under the first part of the name.

Jean Todt
President, eSafetyAware

eSafety Functions Summary

Electronic Stability Control (ESC) helps to avoid a crash by significantly reducing the risk of your car going into a skid during a sudden emergency manoeuvre like avoiding an obstacle in front of you. ESC identifies this risk early and stabilises the car by braking individual wheels.

Benefits: “ESC could save yearly up to 4000 lives in Europe alone”¹

Warning and Emergency Braking Systems detect at an early stage the danger of a crash with the vehicle in front of you. In the case of a potential collision, they warn you about the danger and when there is no reaction to the warning, the technologies activate the brakes together with systems such as seatbelt pretension to avoid or mitigate a crash.

Benefits: “28% less rear-end collisions with personal injury”²

Blind Spot Monitoring helps you avoid a crash with a vehicle in the lane next to you by continuously screening the blind spots to the side of your vehicle.

Benefits: “8% less accidents when changing lanes on motorways”³

Lane Support Systems can assist and warn you when you unintentionally leave the road lane or when you change lane without indication. Sometimes a moment of inattention is enough to make your vehicle stray from its lane. The systems monitor the position of the vehicle in the road lane and while Lane Departure Warning warns you if the car unintentionally wanders from the path, Lane Keeping Support helps you correct the course of your car.

Benefits: “15% less deaths on European roads”⁴

Speed Alert helps you keep the correct speed and avoid speed related traffic crashes and speeding. Speed Alert informs you about the speed limits and tells you when you are about to exceed them.

Benefits: “20% fewer injuries in urban areas”⁵

Adaptive Headlights systems, equipped with advanced light sources like Xenon or LED, offer an optimized illumination of the road during nighttime drives. The system continuously adjusts the beam pattern so that the entire scene is lit according to the driving situation to maximize drivers' visibility and enable earlier dangers detection.

Benefits: 4% decrease in front-to-rear, single driver, and run-off road accidents.⁶

¹ Institute for Transport Economics at University of Cologne, ESC Cost Benefit Study, 2007

² Study by German Insurance Association (GDV), Demonstration von Notbrems und Auffahrwarnsystemen am PKW, 2009

³ Insurance Institute for Highway Safety (IIHS), Crash Avoidance Potential of Five Vehicle Technologies, 2008

⁴ eIMPACT, Impact Assessment of Intelligent Vehicle Safety Systems, 2008

⁵ Swedish Road Administration, Intelligent speed adaptation (ISA)- Results of large-scale trials, 2002

⁶ Insurance Institute for Highway Safety (IIHS), Crash Avoidance Potential of Five Vehicle Technologies, 2008

What is eSafety?

The term eSafety arose following a joint industry-public sector initiative to improve road safety by using new Information Communication Technologies (ICT). The objective of the initiative was to build a strategy that accelerated research and development, deployment and use of Advanced Driver Assistance Systems (ADAS). The need for such a strategy was backed by research showing that 90-95% of road accidents have an element of human error, and if fitted in vehicles, ADAS would help prevent or correct some of these errors.

As the activities of the eSafety initiative intensified, ADAS came to be known as eSafety technologies. Since then, eSafety has come to encompass all vehicle-based electronic safety systems which can improve road safety through risk exposure reduction, crash avoidance, injury and death reduction. eSafety takes an integrated approach: interactions between the driver, the vehicle and the road environment are addressed together in the effort to increase road safety; all three of these factors are equally important in tackling the high number of deaths and injuries on roads worldwide.

After many years of successful development, passive safety systems such as seat belts and airbags have achieved a high penetration in cars. eSafety involves crash avoidance technologies that protect car occupants by informing, advising and alerting the driver about dangerous situations and by assisting him/her to avoid the accident.

To date, support for eSafety has focused on the deployment of Electronic Stability Control (ESC). ESC was introduced in passenger cars in 1995 and initially had a low take up rate. However, recently countries around the world have decided to make ESC mandatory and to support this, the UN created a global technical regulation which can easily be translated into national law.

Beyond ESC, other eSafety systems could also have an important impact on road safety, but still suffer from low installation rates. Though ESC market wide deployment is being achieved through legislation, it is important to recognise that market deployment could be achieved for other eSafety technologies by addressing the elements that hamper their take up: lack of consumer information, lack of availability in small and medium sized cars, and the high market price.

eSafety technologies can not only decrease the number of injuries and deaths but can also have significant positive economic impact on society.

Key eSafety Applications

Among the numerous eSafety technologies that exist on the market, eSafetyAware is focusing on five that offer significant potential benefits and are already at an advanced stage of development: Electronic Stability Control (ESC), Warning and Emergency Braking, Blind Spot Monitoring, Lane Support Systems and Speed Alert. These systems exist under different names and exhibit minor differences in functionality depending on the manufacturer.

① Electronic Stability Control

ESC was first introduced in passenger cars in 1995 and it has been hailed by manufacturers, suppliers and road safety advocates as the most important safety technology since the seat belt. With skidding being the main cause of traffic accidents that result in serious injuries or deaths, this anti-rollover and anti-skid technology senses when the driver is losing control of the car and autonomously applies braking pressure to individual wheels to help stabilise the vehicle.

How does ESC work?

ESC integrates Anti Lock Braking (ABS) and Traction Control System (TCS) with the added feature of a “yaw torque control”, a function that prevents skidding. It is designed to help drivers maintain control of their vehicles in the event of sudden manoeuvres such as rapid steering and countersteering, sudden lane changes, and obstacle-avoidance manoeuvres.

ESC compares 25 times a second whether the driver’s steering corresponds to the actual direction in which the vehicle is moving.

If the vehicle moves in a different direction– understeering or oversteering – ESC detects the situation and reacts accordingly. It uses the vehicle’s brakes as a tool for ‘steering’ the vehicle back on track. Specific braking is applied to individual wheels, such as the inner rear wheel to counter under-steer, or the outer front wheel during over-steer. This selective braking generates a counter balance force enabling the car to react in line with the steering and as the driver intends. To

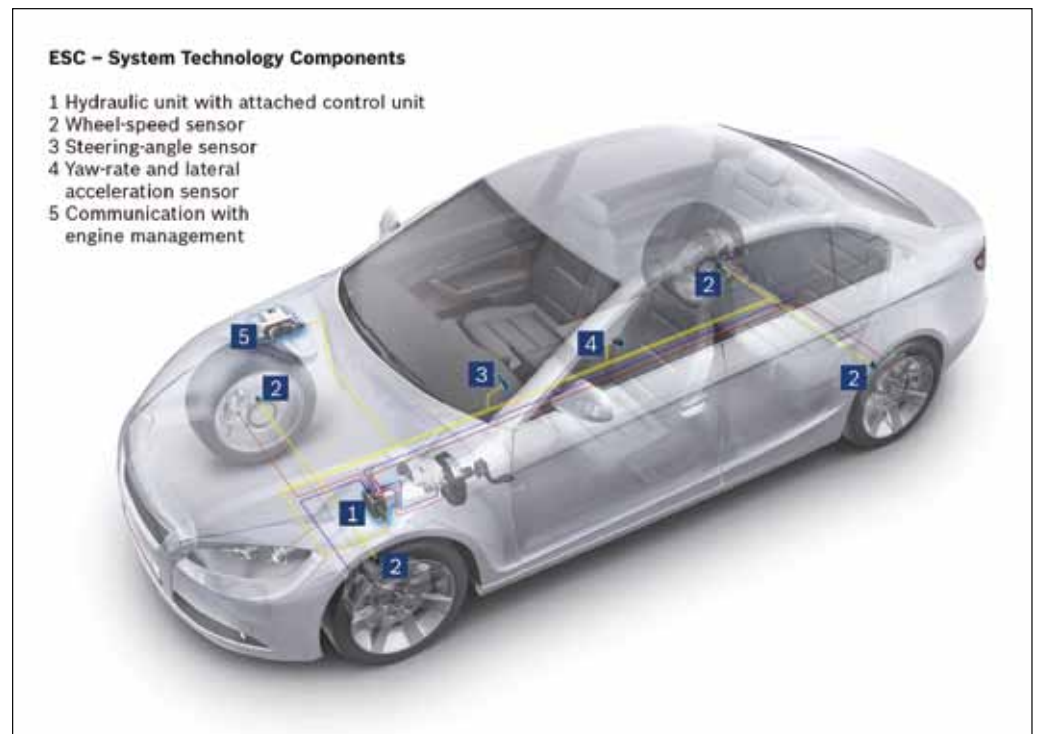
fully optimise stability, ESC not only initiates braking but can also act on the engine side to decelerate the driven wheels. ESC substantially reduces the complexity of the steering process and lessens the demands placed on the driver.

Benefits

ESC is a prime example of how crash avoidance systems can greatly reduce casualties. Various studies on the impact of ESC have shown the potential that this system has in reducing the number of fatalities and injuries. It is estimated that in US alone 10,000 lives could be saved and 240,000 injuries can be avoided per annum, while in Canada these figures



amount to 255 deaths and 1,440 injuries. In Australia, ESC would be able to decrease the number of deaths in crashes involving light vehicles by 29% and in Japan this reduction could be as high as 35% in single vehicle crashes.



An impact assessment in Europe showed that 4,000 lives could be saved each year and 100,000 injuries could be avoided if all cars were equipped with ESC. A cost-benefit analysis made by the Institute for Transport Economics, University of Cologne indicated that for every euro invested in ESC society would save between €3.5 and €5.8, which translates into a net benefit of €10 billion to €16 billion per annum for a full ESC penetration rate in Europe. These calculations show that not only would the global impact of ESC be considerable in reducing the number of road accident victims, but that there is also a clear economic benefit associated with ESC as well.

ESC actions around the world

On 26 June 2008 the UN World Forum for Harmonization of Vehicle Regulations (WP29) approved a global technical regulation (GTR) for ESC. In establishing the regulation, the UN Forum took into account international safety concerns as well as available technological developments. The GTR addresses the needs for standard specifications on ESC and its testing procedures, and provides an indication of the costs and benefits of the system. The GTR will translate into the ECE regulation ECE R 13 H and will be available to transpose for any national authorities across the world planning to introduce ESC regulations in their own country.

• US

In 2007, the US government approved the Federal Motor Vehicle Safety Standard No. 126 making ESC mandatory in all new US light vehicles up to 4.5 tons, sold in the US market from 1 September 2011. The National Highway Traffic Safety Administration (NHTSA) estimates that ESC will:

Reduce single vehicle crashes by 34% and single vehicle crashes of sport utility vehicles (SUVs) by 59%;

Reduce passenger car rollovers by 71% and that of SUVs by 84%;

Save 5,300 to 9,600 lives and prevent 156,000 to 238,000 injuries in all types of crashes annually if all light vehicles on US roads are equipped with ESC.

- **Europe**

In the European Union, the Regulation No 661/2009 of the European Parliament and of the Council of 13 July 2009 makes ESC mandatory. According to the regulation, from November 2011 all new passenger cars and commercial vehicle models registered in the European Union will have to be equipped with ESC. From November 2014 this will then apply to all new vehicles including old models. The impact assessment that accompanied the Commission's proposal concluded that relying on market forces alone was unlikely to achieve full fleet penetration, justifying the regulation.

Recognising the importance of the system, the European New Car Assessment Programme (EuroNCAP) decided on 5 November 2008 to include ESC on its list of safety requirements necessary for a car to receive its highest five star rating. This decision was made as part of the organisation's new rating system, which included the assessment of driver assistance systems and active safety technologies. EuroNCAP's decision is recognition of the important role active safety systems such as ESC can play in making cars safer.

- **Australia**

In June 2009, the federal government announced that ESC would become mandatory on all new models of passenger vehicles from November 2011 and all models from November 2013. The regulation is part of the National Road Safety Action Plan for 2009 and 2010 and it is seen as playing an important role in the effort to reduce the number of road deaths in Australia. In addition to this proposal, the Action Plan identifies the government as an important actor in taking the necessary steps to encourage consumers to purchase ESC equipped cars. In January 2008, the Australian New Car Assessment Programme (ANCAP) was the first NCAP to award the highest five star ranking only to cars that are equipped with ESC.

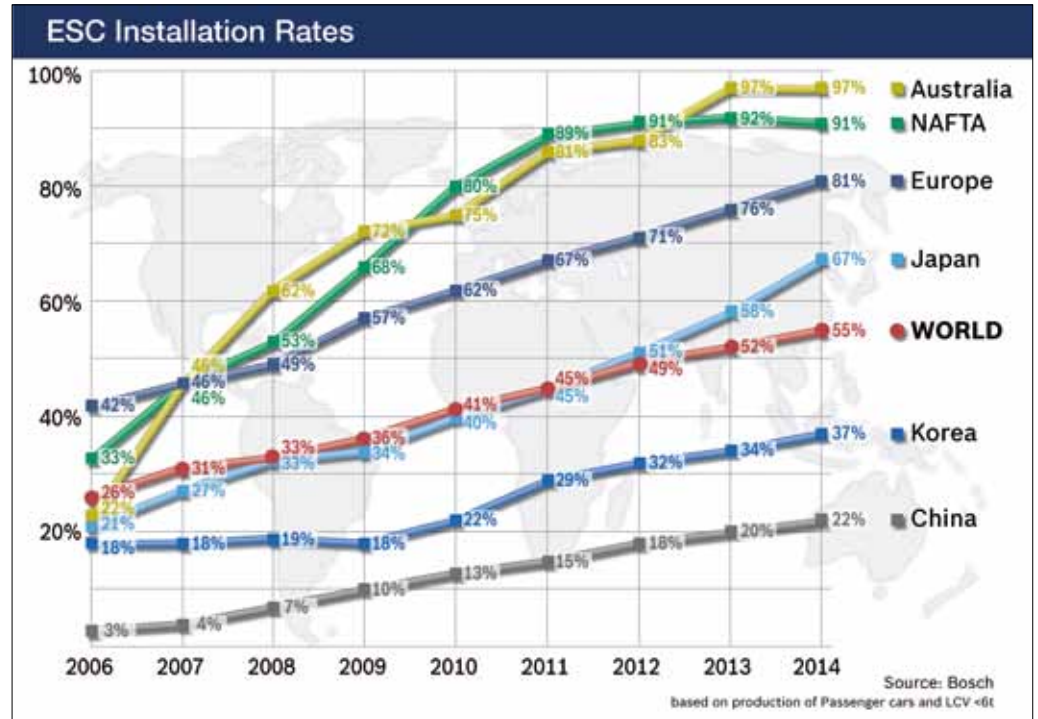
- **Canada**

The Canadian Government has signed the Motor Vehicle Safety Standard 126 which makes ESC compulsory in all new vehicles from 1 September 2011. The law applies to passenger cars, multi-purpose vehicles, trucks and buses weighing 4,536 kilograms or less. In addition, Canada has chosen to support a rapid take-up of ESC through educational and promotional campaigns. Such a campaign was launched in October 2008 by the Canadian Automobile Association (CAA) with support from the FIA Foundation. As part of the campaign, Transport Canada has asked manufacturers to distribute ESC promotional material through advertising, car dealers and promotional events.

ESC installation rates worldwide

In 2008, only a third of the worldwide production of passenger cars and light commercial vehicles up to 6 tons were equipped with ESC. By 2012, it is estimated

that every other vehicle will have ESC on board. The acceleration of ESC installation has been strongly influenced by the regulatory actions in US, Europe, Canada and Australia, and also the growth in ESC take-up in China, which is increasingly substituting ABS for ESC.



② Warning and Emergency Braking

The Warning and Emergency Braking system brings together a number of technologies such as forward collision warning systems, automatic braking and pre-crash safety systems. The system detects, at an early stage, the danger of an

imminent rear-end collision, warns the driver about the danger and assists the driver with braking. If there is no reaction from the driver the system activates the brakes automatically together with systems such as seatbelt pretension to avoid or lessen the intensity of the crash.



How does Warning and Emergency Braking work?

The systems found on the market vary slightly, but most include:

- **Collision warning**

A surround (radar) sensor in the vehicle recognise the danger of a collision based on the distance to the obstacle ahead and the speed. When the system's sensor detects that a collision is imminent it issues both audio and visual warnings to the driver. Some systems also include a brake jerk.

- **Emergency Braking Assist and secondary warning**

If the driver reacts by applying the brake, the system interprets this action as an emergency braking and provides maximized braking support by boosting the

brake pressure to the optimum to assure that the vehicle stops and avoids the collision. Some variations of the system include haptic feedback in the seat belt or the steering wheel.

- **Collision mitigation**

If the system detects that the collision is unavoidable, the vehicle's seatbelts retract with enough force to compensate for seatbelt slack and offer passengers maximum protection in advance of the collision. At the same time the system applies automatic braking pressure to the vehicle to reduce its speed and minimise the impact of the collision.

Benefits

Studies show that more deaths occur from rear-end crashes than any other kind. The Insurance Institute for Highway Safety (IIHS) has estimated that the Forward Collision Warning function with Automatic Braking alone could be relevant for around 2,268,000 accidents every year in the US, of which 7,166 are fatal.

In Europe, an impact assessment released by the European Commission estimates the benefits of Advanced Emergency Braking for different vehicle categories and different functionalities. The results of the assessment are summarised in table 1 (see next page).

In the assessment, 'Current' systems are defined as systems that are effective in rear end collisions with vehicles with four or more wheels and collisions with rigid fixed objects on the carriageway. 'Near future' systems also include collisions with rigid fixed objects off the carriageway and with pedestrians. 'Longer term' systems are expected to add functionality in head-on collisions and front to side collisions at junctions.

Supportive Actions

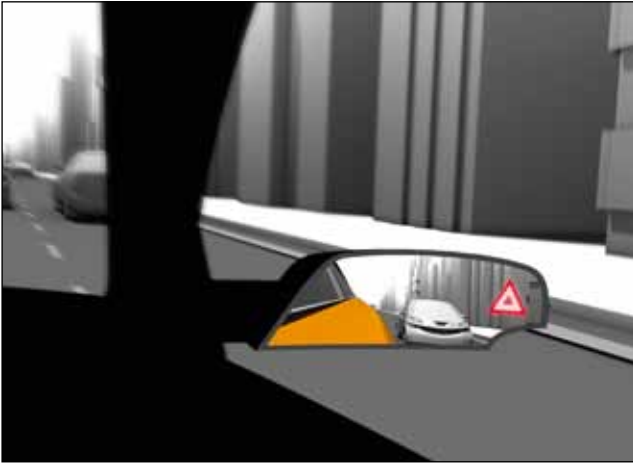
In the European Union, the Regulation No 661/2009 of European Parliament and the Council mandating the introduction of ESC as standard, also stipulates the standard fitment of Advanced Emergency Braking System (AEBS) in all new vehicles types M2, M3, N2, N3 – meaning commercial vehicles above 3.5 tons and buses as per November 2013. All vehicles from the aforementioned categories sold in the European Union from November 2015 will have to be fitted with AEBS.

③ Blind Spot Monitoring

This system helps drivers to avoid a crash with a vehicle in the neighbouring lane by continuously screening the blind spots to the side of the vehicles. The blind spot is the area not covered by the driver's line of sight and mirrors, alongside and off-set to the rear of the moving car on both sides. This is a particularly dangerous hazard when changing lanes on a multi-lane road. The Blind Spot Monitoring system has an informative role and does not intervene.

How does Blind Spot Monitoring work?

Blind Spot Monitoring uses radar, camera or ultrasonic technologies to monitor the blind spot area of the vehicle. If a moving object is detected within the specified



zone, a warning signal is issued. Warning signals vary from one version of the system to another and include visual, audio or haptic signals.

Some of the systems are able to recognise both regular sized vehicles (cars and trucks) and motorcycles in both daylight and night-time driving conditions. The different versions of the system are able to recognise the obstacles at different speed conditions. To give an example, one such system is active at all speeds above 10 km/h. It is designed to alert the driver about vehicles moving at a maximum of 20 km/h slower and a maximum of 70 km/h faster than the driver's own vehicle.

Benefits

At a European level, the benefits of the system have been studied in the eIMPACT project funded by the European Commission. The project analysed an extended function of the Blind Spot Monitoring system known as Lane Change Assist which monitors the lateral and rear area of the vehicle, assisting the driver when changing lanes. It is estimated that in Europe the system could save approximately 975 lives each year and avoid 2,100 injuries if all cars were equipped with the system.

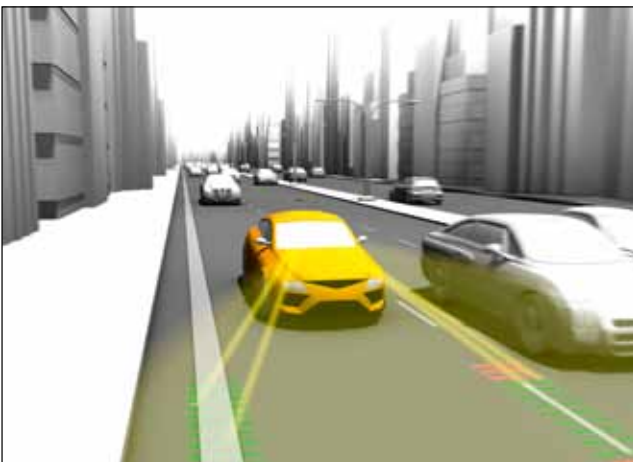
In the US, the IIHS has estimated that the Blind Spot Monitoring system could be relevant in more than 457,000 accidents every year, of which 428 are fatal.

④ Lane Support Systems

Lane Support Systems monitor the upcoming road markings and the position of the vehicle within the road lane. While Lane Departure Warning warns the driver if the vehicle is unintentionally leaving the lane, Lane Keeping Support goes beyond a simple warning by assisting the driver with an active steering support to keep in the lane. By doing so, both systems give the driver time to correct the vehicle's trajectory before an accident happens.

How do Lane Support Systems work?

Lane Departure Warning uses the road marking to identify the position of the vehicle in the lane. If the vehicle crosses the lane markings without signalling, the system issues a visual, acoustic or haptic warning. The system uses various sensors or a camera to detect the road markings and it is active only above a minimum speed. The system is intended to operate on roads with good markings, and can if wanted be switched off by the driver.



Lane Keep Support identifies the position of the vehicle in the lane by using the road markings. In addition to issuing a warning, the Lane Keep Support will assist the driver with steering support; some versions of the system will even steer through motorway bends. The system works both during the day and also at night.

However, the technology has been designed to ensure that the driver always remains in control, easily being overridden and automatically shutting down if it detects that the driver does not have his hands on the wheel.

Benefits

The European Commission funded project eIMPACT estimated that if all vehicles in Europe were equipped with the Lane Keep Assist system, the number of deaths would decrease by 15% and the number of injuries by 8.9%. Given today's number of deaths in Europe this would represent 6,300 lives saved each year.

The impact assessment study that accompanied the European Commission regulatory proposal COM(2008) 316 which included stipulations for Lane Departure Warning (LDW), has studied the benefits of the system together with the Lane Change Assist(LCA) which is an extended functionality of Blind Spot Monitoring. It has been found that if all vehicles in Europe were fitted with LDW and LCA, 5,500 deaths, 30,800 serious injuries, and 208,500 minor injuries would be avoided.

In the US, the IIHS estimates that the Lane Departure Warning system could help in approximately 483,000 accidents every year, of which 10,345 are fatal.

Supportive actions

In Europe, the Regulation No 661/2009 of European Parliament and of the Council of 13 July 2009 mandating the introduction of ESC and Advanced Emergency Braking System (AEBS), stipulates also the standard fitment of Lane Departure Warning in the same vehicle categories and with the same deadlines as AEBS. The system is expected to be equipped in all new vehicles types M2, M3, N2, N3 – meaning commercial vehicles above 3.5 tons and buses as per November 2013 and in all vehicles from those categories sold in the European Union from November 2015.

5 Speed Alert

Speed alert helps drivers maintain a correct speed, avoid speeding, and prevent speed related accidents. Speed Alert informs the driver about the speed limit of the road he/she is using and issues a warning when the driver is about to exceed them.



How does Speed Alert work?

The system uses a camera to distinguish speed signs on the road and also receives speed limit information from a navigation system. In this way it ensures that even speed limits that are not explicitly visible, i.e. within a city, will be displayed to the driver. Both sets of data are then compared with the speed of the vehicle. If the speed of the vehicle is exceeding the limit a warning is issued.

Benefits

The European Commission funded project eIMPACT

estimated the Speed Alert system could reduce the number of fatalities in Europe by 8.7% and the number of injuries by 6.2% each year if all cars were to be equipped with the system. Given the current number of deaths at European level, this could translate into 3,690 lives saved each year.

The largest study so far on Speed Alert systems was carried out in Sweden. The study involved 5,000 equipped vehicles driven by more than 10,000 drivers from different age groups, and an accident analysis. It was estimated that with all cars equipped there would be 20% fewer injuries in Swedish urban areas each year.

⑥ Adaptive Headlights

Adaptive Headlights systems, equipped with advanced light sources like Xenon or LED, offer an optimized illumination of the road during night time drives. The system continuously adjusts the beam pattern so that the entire scene is lit according to the driving situation (city light, motorway light, adverse weather light, bending light). Even up hills and around curves, the system maximizes drivers' visibility, enabling earlier dangers detection and quicker reaction.

How do Adaptive Headlights work?

Conventional fixed headlights cast their beam straight ahead only. Following, in bends, the beam can fall on the oncoming traffic, blinding other drivers while leaving the road ahead in darkness. In contrast, Adaptive Headlights use a dynamic headlamp control system which collects information such as speed or steering angle and triggers small electric motors to orient and adapt the beam which fits perfectly to the driving situation.



The latest Adaptive Headlight systems include features such as the “Adaptive Beam” which adapts the beam range to the distance of vehicles ahead or oncoming and the “Glare-Free High Beam”. The latter adjusts permanently the beam pattern of specifically designed

headlamps so that the entire scene is lit with the exception of the zones where the other road users are.

Benefits

The road ahead is better illuminated and obstacles become visible sooner. This provides significant safety benefits when taking bends at night or whenever visibility is poor.

It also profits to the other drivers: the glare of oncoming headlights can cause serious visibility problems. Since adaptive headlights are directed at the road, the risk of glare is reduced. A study¹ conducted by the Insurance Institute for Highway Safety estimates that Adaptive Headlights could help avoiding about 4% of front-to-rear, single driver, and run-off road accidents. In the US these types of crashes translate to 143,000 accidents a year involving 2,553 fatalities and 31,000 injuries.

¹ “Crash Avoidance Potential of Five Vehicle Technologies” (2008), Charles M Farmer

Awareness Campaigns

Despite a number of studies showing that consumers rate safety as their primary concern, the take-up of eSafety technologies has been slow. Market penetration remains low in many countries, especially in lower vehicle classes, where all too often, it is the small family car and super mini classes which are missing out on the extra safety equipment.

It has become clear that although concerned about safety, consumers lack the key information about the existence of these technologies. Given their benefits to road safety, there is a clear need to accelerate the use of eSafety systems in all motor vehicle classes in all major world markets, by breaking down the current knowledge barriers.

In 2007, eSafetyAware was founded with the specific aim to raise awareness of eSafety among end users. The organisation brings together 37 members from industry, public authorities, motoring clubs and other organisations.

- **ChooseESC!**

eSafetyAware launched the ChooseESC! campaign in May 2007 to inform car buyers about the benefits of ESC. During the launch, European Commissioner Viviane Reding and FIA President Max Mosley collectively called for measures to advance the ESC take-up and save up to 4,000 lives annually on European Roads alone. Since the launch, some of the world's best drivers have actively supported the campaign, including seven-time Formula One World Champion Michael Schumacher, five-time FIA World Rally Champion Sebastian Loeb as well as Formula One drivers like Pedro de la Rosa and Marko Asmer. The campaign has also enjoyed support from prominent figures such as Prince Michael of Kent and several Members of the European Parliament.

Campaign website:
www.chooseesc.eu

- **eSafety Challenge and eSafety On Board**

The two activities, targeting different stakeholder groups, were launched in April 2009 and are being run in parallel. While the eSafety Challenge brings the eSafety message to key decision makers as well as specialised and general media, the eSafety On Board activities inform car buyers about the existence and benefits of the safety technologies. The systems supported by the activities are: Electronic Stability Control, Blind Spot Monitoring, Lane Keep Support Systems, Warning and Emergency Braking Systems, Speed Alert and Adaptive Headlights. The eSafety Challenge activities will continue in the coming years and are co-funded by the European Commission and FIA Foundation.

Campaign websites:
www.esafetychallenge.eu and www.eSafetyOnBoard.eu



www.eSafetyChallenge.eu

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