DAIMLER

The Road to Accident-free Driving.

125! years inventor of the automobile

Arriving safely. Around seven billion people throughout the world take to the road every day: on foot, on bicycle, by bus, truck or car. As driver, co-driver or passenger. We aim to make future mobility as sustainable and safe as possible for all these people. As a pioneer in matters of safety we are firmly committed to continuing along our “Road to Accident-free Driving.”

We invented the car and the truck and are passionate about their future.

“The Road to Accident-free Driving”		
Banishing driver stress	Actively mastering difficult situations with the vehicle	Maximizing safety for all road users

Individual mobility and goods transport are at the heart of every society’s growth and prosperity. We aim to cater to the great need for mobility for future generations by making mobility as sustainable and safe as possible. This guiding principle means preserving resources, preventing emissions and, at the same time, maximizing road safety. The goal of our safety research is “accident-free driving.”

As the inventor of the automobile, safety is one of our primary concerns. When developing new technologies and when improving both active and passive safety features, our pioneers were always ahead of their time. Banishing driver stress, providing active support in difficult situations, and maximizing safety for all road users – these are the pillars upon which our “Road to Accident-free Driving” is based, accident prevention being our foremost objective.

Banishing driver stress. We believe the driver is the key factor. The driver’s job is made easier thanks to high-performance systems which make him aware of his driving responsibilities and heighten his senses.

Actively mastering difficult situations with the vehicle. Assistance systems detect dangerous situations at an early stage, signal them to the driver, and intervene to provide assistance in order to minimize accidents and mitigate their consequences. The car becomes part of the “thinking process.”

Maximizing safety for all road users. For over 50 years, innovative vehicle concepts and intelligent protection systems have been helping to mitigate the consequences of accidents for all road users.

Daimler will continue to make future mobility even safer by introducing trend-setting milestones. In this brochure, we show how Daimler AG is working intensively towards continuing along the “Road to Accident-free Driving.”

The Road to Accident-free Driving. “We are continuing to play a pioneering role in matters of vehicle safety.”

Dr. Thomas Weber, member of the Board of Management of Daimler AG with responsibility for Group Research and Mercedes-Benz Cars Development.

Mr Weber, Daimler continues to set milestones in active and passive vehicle safety with its developments. Have you already achieved your aim?
We are still a long way from achieving our ultimate aim, but we are certainly well on the right track. Our “Road to Accident-free Driving” will continue to drive us forward in our quest to make mobility as safe as possible for all road users. The purpose of research and development is to identify accident-prone scenarios and critical situations and then to defuse them using the latest technological assistance and protection systems. Mercedes-Benz accident research identifies frequent causes of accidents and thus serves as a basis for the development of new safety systems. By way of example, the “Brake Assist” and “Lane Keeping Assist” systems for passenger cars and commercial vehicles address key causes of accidents such as head-to-tail collisions and vehicles leaving their lane.

How would you define safety?
We consider safety to be a global task, one which goes way beyond simply participating in and passing the specified crash tests. It encompasses all aspects of motoring – everything that is important for the safety of the occupants and other road users. This “integral safety” concept comprises four phases: safe driving, i.e. avoiding danger, providing timely warning and assistance; taking preventive action in case of danger; providing adequate protection in the event of an accident; and preventing a deterioration of the situation and offering swift assistance following an accident.

What are the challenges now being taken up by the researchers and developers?
We spend a great deal of time looking at how best to monitor the vehicle surroundings, which helps us to address further accident blackspots such as road junctions. Here we face a major challenge due to the complexity of inner-city traffic. Our vehicles need to detect every turn made by every road user and then warn the driver at an early stage if there is imminent danger. If necessary, the safety systems then have to intervene autonomously. In this case, improved monitoring of the surroundings will increase the options on the passive safety side as well as having a positive impact on the range of active safety measures. Preventive, anticipatory systems, which maximize occupant protection immediately before an accident that is recognized as unavoidable, are just one example.

What other accident blackspots are you targeting?
We are also continuing to concentrate on preventing collisions and ensuring that our vehicles stay in their lane at the right speed. On a specific level, for example, we want to provide assistance in situations where there is restricted visibility or on expressways. To this end, intelligent assistance systems will receive information from other nearby vehicles by radio and then forward this information to other road users so that drivers can react correctly to any sudden changes in the road conditions – whether it be a sudden traffic tailback, road works or black ice, for example. Various sensors will therefore allow the car of the future to become part of the “thinking” process, making the driver’s job even easier. Nevertheless, it will still always be the driver who is ultimately responsible for safety.

The challenge of accident prevention.

Accident statistics and causes. The number of vehicles on the road is rising worldwide, posing a challenge for road safety.

The most frequent types of accident* in Germany at a glance

- Junctions 28.2 %
- Head-to-tail collision 22.0 %
- Vehicle leaving its lane 15.5 %
- Other type of accident 12.0 %
- Pedestrians 9.5 %
- Oncoming traffic 7.7 %
- Lane changes 4.4 %
- Collisions with an obstacle 0.7 %

* Accidents involving injuries according to 2009 German accident statistics, source: Federal Statistical Office

The number of cars on the roads around the globe is growing, and growing fast – five times faster than the world's population. Since the 1950s, the number of vehicles has increased more than tenfold. Today there are almost one billion motor vehicles; by 2030, the number of passenger cars on the road will probably have doubled. And around three billion cars will be registered by the year 2050 – with a world population of over nine billion. The greater part of this growth is in China, India, and other emerging and developing countries, which is hardly surprising as individual mobility has always played a key role when societies modernize. As well as promoting growth and prosperity, cars also represent a gain in personal freedom for many people. But more vehicles on the road mean more accidents. Worldwide, two people are killed and more than 95 are seriously injured every minute in road accidents.

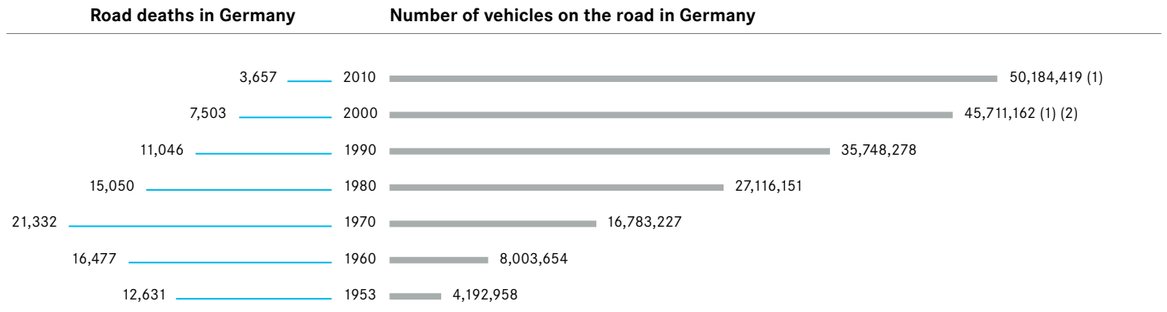
Road accident victims. In 2009, however, there were once again significantly fewer fatal road accidents in Germany than in the previous year: According to the figures released by the Federal Statistical Office, the number of road deaths fell to around 4,152 – a decrease of 7.3 percent compared to 2008. This figure is also the lowest since statistical records began in 1953. Safety initiatives launched in the 1970s, which led to the introduction of the three-point inertia-reel seat belt and the compulsory wearing of seat belts, for example, have proven to be effective. In 1970, the number of road deaths in Germany still stood at more than 21,000. Likewise in Japan and Europe (EU-25 not including Estonia, Latvia, Lithuania, Malta, Slovenia, and Cyprus), the number of road fatalities has been falling for years and has now reached a historic low. These figures highlight the major impact the introduction of sophisticated assistance and safety systems has already had. Safety pioneer Daimler was the first company to introduce many of these extremely effective systems into standard production vehicles – inventions that were later copied by other manufacturers. So Daimler has played a key role in this success story.

Further reducing the number of accidents worldwide is a challenge for all automotive manufacturers. To this end, critical driving situations have to be defused further. Most accidents occur at crossroads and T-junctions due to excessive speed, head-to-tail collisions and vehicles leaving their lane. Another main cause is the single-vehicle accident, in which the driver loses control of the vehicle. Daimler safety systems assist the driver in precisely these situations, and they have demonstrably brought about a reduction in the number of road accidents.

The ESP® success story. The Electronic Stability Program (ESP®), which Daimler was the first manufacturer to install in a passenger car, reduces the risk of skidding and helps the driver to maintain better control in demanding situations. It has brought about a lasting improvement in road safety in Germany. In 2004, five years after Daimler started installing the system as standard in its passenger cars, a sharp fall in driver-related accidents in which drivers lost control of their vehicles and left their lane was recorded. If all cars were equipped with the Electronic Stability Program, more than 20,000 of these serious road accidents – involving over 27,000 victims – could be prevented every year. Analysis of data provided by the Federal Statistical Office (50 % random samples from two successive years) conducted by Mercedes-Benz found that Mercedes-Benz passenger car models have been involved in serious driver-related accidents far less frequently than vehicles from other brands since being fitted with ESP® as standard. Whereas the average percentage of newly registered Daimler models involved in such accidents in 1998 / 1999 was 20.7 percent, ESP® helped to reduce this figure to 12 percent (a reduction of more than 42 percent) in 2002 / 2003. When it comes to passenger cars built by other manufacturers, however, the percentage of driver-related accidents in relation to all accidents fell by only around 13 percent.

The Brake Assist success story. The proximity control and Brake Assist systems based on sophisticated radar technology for passenger cars, buses, vans, and trucks are likewise highly effective at helping to prevent accidents. An analysis of accident data conducted by Mercedes-Benz looked at the effect of the proximity control system (DISTRONIC PLUS) and Brake Assist PLUS for passenger cars. This accident data was based on the official accident statistics and data from a total of around 16,000 traffic accidents analyzed as part of the GIDAS project (German In-Depth Accident Study). The result: If all passenger cars were equipped with this system, an average of 20 percent of all head-to-tail collisions could be prevented in Germany alone. In a further 25 percent of these collisions, the systems could help to greatly reduce accident severity. This combination of state-of-the-art radar and brake technology offers the greatest safety potential on expressways, where around 36 percent of all head-to-tail collisions could be prevented. In the case of trucks, around 50 percent of the serious expressway accidents that occur could be prevented if all trucks were equipped with Lane Keeping Assist, proximity control and Telligent stability control.

Caution: accident risk! Precarious situations are becoming more and more prevalent on increasingly busy roads. In such situations, assistance systems can help to prevent accidents and mitigate their consequences. The ongoing further development of these systems is the key to road safety.



(1) Not including vehicles taken off the road temporarily (explanation: all pre-2000 figures include vehicles taken off the road temporarily, i.e. seasonal vehicles, for example).
(2) Figures from this year onwards are for the whole of Germany. Figures before this year are for West Germany only.
Source: Federal Statistical Office

Our Tradition.

Safety pioneer. As the inventor of the car and the truck, Daimler has been leading the way in vehicle safety for many decades.

Daimler understands safety as a responsibility to all road users. Not only manufacturing vehicles, but working continuously to further develop and improve safety systems – this has always been and remains one of the company's key objectives. Daimler has been performing crash tests systematically since the 1950s and, during this time, has recorded a number of pioneering achievements in the field of automotive safety. Back then, steam rockets or cables were still used to propel the test cars. And the absence of dummies meant that some of the engineers even had to take part in the tests themselves. The technology is more sophisticated these days, but the aim remains the same: enhancing vehicle safety. Crash tests still are, next to simulations, an important basis for all Daimler safety developments, while the "Road to Accident-free Driving" is the motivating force behind innovative developments that make motoring safer.

Weld spots - the body shell provides the basis for safety, strength, and comfort.

The pioneer of safety.

A long tradition of safety. Daimler leads the way when it comes to vehicle safety – whether it be the first safety engineer or the first crash test.

The history of occupant safety began at the Mercedes-Benz plant in Sindelfingen in 1939. Béla Barényi, a young engineer who set himself the aim of revolutionizing automotive safety technology, worked here. At Daimler he got the chance to realize this ambition. The "platform frame for motor vehicles" was his first invention for his new employer. It improved directional stability and road adhesion whilst also improving side impact protection. The new design was patented in February 1941. But Barényi wanted to go further still: His vision was a robust passenger cell "surrounded by crumple zones front and rear." He achieved his aim in 1952, following several project studies, when his vision was patented. And it remains a fundamental principle on which the entire field of passive safety technology is based to this day. The crumple zone first went into series production in 1959. Béla Barényi was the first ever safety engineer at Daimler – indeed possibly the first anywhere. Dozens of engineers have followed in his footsteps, all of them recognizing, as Barényi did, the need to improve road safety.

Fundamental definition. Barényi kept working at Daimler until the 1970s. As an example, he formulated the principle of splitting safety into two distinct areas – active safety and passive safety – together with Chief Development Officer Hans Scherenberg in 1966. According to this principle, active safety describes systems and technologies designed to prevent accidents, while passive safety technologies aim to mitigate the consequences of accidents for the occupants. Today electronic assistance systems play a crucial role in improving accident safety. But the distinction between active and passive safety has become increasingly blurred, leading Daimler to formulate its new "integral safety philosophy."

The first crash tests. In 1959, the Mercedes-Benz plant in Sindelfingen once again provided the stage for a world premiere when, on September 10, the engineers started conducting systematic crash tests there. These tests have been performed continuously ever since. Whole-vehicle crash tests were pioneering feats back then. In the early years, the developers used cables and steam rockets to accelerate the test cars. For the rollover test, the technicians designed a "corkscrew ramp." And store window mannequins were used until finally, in 1968, the first test dummies took their seats in the cars.

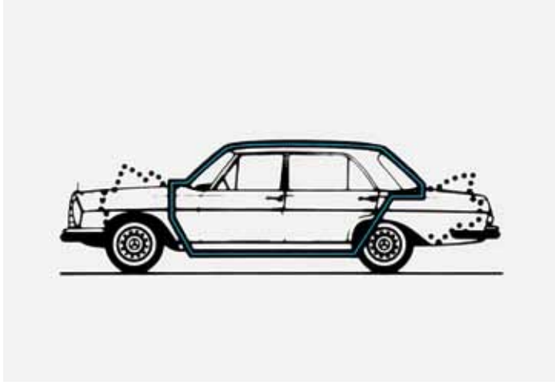
Crash tests still form the basis of safety development at Daimler to this day. A vast array of crash tests involving passenger cars is conducted every year at the Mercedes-Benz Technology Center in Sindelfingen. The program includes crash tests which are specified for the worldwide approval of new cars or are performed in order to achieve the prescribed ratings. But for Daimler, safety is about more than just legal requirements and ratings.

The company puts its passenger cars, sold all over the world, through even tougher tests: nine additional, extremely demanding in-house crash tests which are based on real-life accidents. Today these cars have to pass around 40 different crash tests before they can be awarded the famous Mercedes star.

When it comes to safety developments for commercial vehicles, too, the company has been performing pioneering work for many years. In 1992, Daimler conducted the first crash test for a truck during development of the new Actros series. The Actros was the first truck series whose design and series production development were shaped by the results of crash tests. Since then, all trucks produced by Daimler take part in several crash tests, even though these are still not a legal requirement.

Constructive: Béla Barényi (3rd from left) in conversation with his colleagues following a successful crash test at the Daimler proving ground in Sindelfingen.

The deformation principle: Rigid occupant cell (safety cell), but energy-absorbing, deformable crumple zones in the front and rear sections (left). Crash test with a truck: Daimler has also led the way in this field for many decades (right).



Safety innovations.

Milestones in safety. Daimler has invented innovative safety technologies – and development continues.

Daimler has been working on improving automotive safety for many decades. To date, the company has brought to market an array of technologies and systems which are proven to enhance safety in all Daimler models, whether they be passenger cars or commercial vehicles. As time has gone by, many of these systems have also been copied by other manufacturers, resulting in the prevention of numerous accidents or a reduction in their severity. So the Daimler safety solutions are for the good of all road users. But Daimler is far from finished in this area. The research and development of new technologies has always been of key importance to the Group. And, despite all the successes achieved thus far, Daimler will continue on its "Road to Accident-free Driving" to get closer to its objective. In 2010, for instance, the company invested more than four-and-a-half billion euros in research and development, including innovative safety systems.

Trailblazing inventions. One innovation still important today is the world's first safety body, including integrated crumple zones, which was conceived by Béla Barényi and went into series production for the first time in 1959. The anti-lock braking system (ABS) for passenger cars, which Daimler was the first automotive manufacturer to bring to market in 1978, prevents the wheels from locking up under braking, meaning that the vehicle can still be steered, even during an emergency stop. In 1980, Daimler was the first manufacturer to install a driver airbag and belt tensioner in a standard production passenger car. A further milestone followed in 1995 with the introduction – as standard equipment in the S-Class Coupé – of the Electronic Stability Program (ESP®). In 1996 Daimler was the world's first manufacturer to introduce the Braking Assist system as standard in a passenger car. Since 1999, all Mercedes passenger cars have been equipped with ESP® as standard. That same year, the company introduced ABC (Active Body Control) and a tire pressure monitoring system.

In the year 2000 the first Lane Keeping Assist system for trucks followed, and one year later the Telligent stability control system – ESP® for trucks. With PRE-SAFE®, a system which activates protective measures as a precaution in the event of an impending collision, Daimler made vast strides forward in the field of anticipatory occupant protection for passenger cars in 2002. In the years 2003 to 2005 came the active light function and the adaptive brake light function, DISTRONIC and Brake Assist PLUS as well as the Night View Assist system. The company has offered the PRE-SAFE® Brake, which can brake the vehicle autonomously when danger is detected, since 2006. The first Brake Assist system for trucks (Active Brake Assist) was launched in the same year. This system can bring the vehicle to a standstill autonomously in a critical situation. In 2009 Lane Keeping Assist, Speed Limit Assist and ATTENTION ASSIST for passenger cars were introduced. This last system emits visual and audible warnings if it detects signs of driver drowsiness. With the introduction of the LED high-performance headlamps, Active Lane Keeping Assist and Blind Spot Assist, as well as the improved Night View Assist PLUS for passenger cars, and of the second-generation emergency brake for trucks, Daimler continued the tradition of innovative safety solutions with determination in 2010.

Key Daimler safety innovations at a glance

1931
First standard production passenger car with hydraulic braking system and independent front and rear wheel suspension

1959
World's first safety body with robust passenger cell and integrated crumple zones for passenger cars

1964
First bus with wear-free brake (retarder)

1978
World premiere of anti-lock braking system (ABS) for passenger cars; Daimler launched the first ABS for commercial vehicles in 1981

1981
Airbag and belt tensioner available for a standard production passenger car for the first time

1987
First acceleration skid control (ASR) system for commercial vehicles

1995
First Electronic Stability Program (ESP®); all Mercedes passenger cars have been equipped with ESP® as standard since 1999

1996
Brake Assist introduced as standard – a world-first for passenger cars

1998
First TRIDION safety cell in smart car

2000
First Lane Keeping Assist system for trucks

2001
Telligent stability control for trucks and buses

2002
First anticipatory occupant protection system for passenger cars: PRE-SAFE®

2006
PRE-SAFE® Brake for passenger cars: autonomous partial braking; Active Brake Assist for Mercedes-Benz trucks

2009
Drowsiness detection (ATTENTION ASSIST) for passenger cars; PRE-SAFE® Brake: with the option of autonomous emergency braking; Night View Assist with pedestrian detection for cars

2010
Emergency braking system (Active Brake Assist 2) for trucks brakes when stationary obstacles are encountered

2010
Active Lane Keeping Assist and Active Blind Spot Assist, Night View Assist PLUS, LED-High-Performance headlamps for passenger cars

Accident research.

The road shows the way. Real-life accidents best highlight the effectiveness of safety systems and areas in which further development is required.

The Daimler safety concept – the "real-life safety" philosophy – is based on accidents that actually occur. The company has been analyzing accidents on German roads since 1969, with the findings being used to provide key impetus for the development of new safety systems. Every vehicle series produced by Daimler – whether it be passenger cars, trucks, buses, coaches or vans – has its own designated accident-research team. The analysis of real-life accidents involving Daimler vehicles began in 1966. Then, in 1969, this project led to the start of official accident research for passenger cars in Stuttgart and the surrounding area, conducted by the newly formed Accident Analysis department. Commercial vehicles followed around a year later. Today, the passenger car accident researchers analyze about 100 accidents per year, while their counterparts in the commercial vehicle section examine around 30 serious crashes every year. Both departments have their own extensive databases containing details of serious accidents and their causes. The accident researchers study the deformation pattern on the vehicle at the accident scene or after the vehicle has been recovered, as well as analyzing the scene of the accident itself and any injuries suffered by the occupants. Using photos, diagrams and the accident report, the researchers can produce a computer simulation that allows them to analyze the accident details from various perspectives and to draw conclusions as to the course of events that led to the collision.

Daimler vehicles are becoming increasingly safe. In this way, the accident researchers gather information to help develop new, even more effective protection systems. On several occasions already, accident research has provided the foundations for the development of innovative safety systems. And the results of the accident analyses are proof that the concept is having a positive impact: The risk of being injured in a Daimler vehicle has been falling continuously for a number of years.

Both Lane Keeping Assist and Active Brake Assist for trucks and touring coaches are the result of information gathered during the course of accident research. The researchers established that the vehicle leaving its lane before a head-to-tail collision was the most frequent cause of accidents in the case of trucks. The developers got to work, and Daimler was the first automotive manufacturer to launch Brake Assist and a system capable of warning the driver if the vehicle leaves its detected lane unintentionally.

In the case of passenger cars, too, the accident researchers often provided the decisive input when it came to further improving occupant protection, one notable example being the design of the interior in the 1960s. Belt tensioners and belt force limiters followed in the 1970s and 1980s. In the 1990s, accident research provided the key impetus for further progress: The experts had determined that over two-thirds of all road accidents were preceded by a typical, critical driving situation such as skidding, emergency braking or sudden evasive action – situations that already indicate an imminent collision. In the past, these precious few seconds before the crash had not been utilized for the benefit of safety. The answer to these findings from accident research is called PRE-SAFE®, a Daimler system which heralded a new era of vehicle safety when it was first launched in late 2002.

PRE-SAFE® is based on the principle of prevention: If the system detects an impending accident, it goes into action immediately, activating reversible measures to prepare the occupants and the car for a possible collision, for example by initiating precautionary tensioning of the seat belts, closing the side windows or raising the rear head restraints pneumatically – depending on the vehicle type, vehicle equipment, and driving situation. It thus makes the best possible use of the brief period before a collision to initiate preventive safety measures. NECK-PRO head restraints, introduced as standard for the first time in 2005, are another advanced safety development based on analysis of real-life accidents. NECK-PRO is effective in helping to reduce the risk of whiplash injuries in the event of a rear impact.

The accident researchers are continuing their work to enable the detection of dangerous driving situations and to provide the developers with key information for defusing such situations.

Daimler accident researchers at work: The Accident Research unit at Mercedes-Benz has been analyzing and reconstructing road accidents since 1969, the aim being to find out more in order to further improve safety. They put the developments through their paces again in crash tests.

What happens before a detected potential head-to-tail collision

Approx. 200-0 m	Approx. 2.6 s before the accident	Approx. 1.6 s before the accident	Approx. 0.6 s before the accident
DISTRONIC PLUS Automatic proximity control with visual and audible warnings if the gap measured by sensors narrows too quickly. Automatic braking to standstill.	PRE-SAFE® Brake and BAS PLUS Visual and audible collision warning from the PRE-SAFE® Brake as well as braking assistance in line with the situation in hand from BAS PLUS as soon as the driver hits the brakes. PRE-SAFE® functions are activated in the interior as and when required.	PRE-SAFE® Brake Autonomous partial braking after three audible warnings if the driver fails to react. Activation of PRE-SAFE® functions in the interior	PRE-SAFE® Brake Autonomous emergency braking with maximum braking power if the driver has still failed to react.

Our Innovations.

Already on the road. Equipped with intelligent assistance systems, Daimler vehicles offer an exceptional level of safety.

Daimler's integral safety concept covers all aspects of the vehicle and its occupants. When developing safety systems, the company can count on a wealth of data gathered in over 40 years of accident research. These include active safety systems to prevent danger as well as systems designed to mitigate the consequences of accidents. It is now hard to imagine vehicles without many of these Daimler-developed systems. But Daimler goes a step further still: Road safety requires a holistic approach. The company's commitment therefore ranges from educating very young road users in road safety at an early stage, to intensive training for passenger car and commercial vehicle drivers, to the provision of comprehensive information for rescue services to enable even faster rescue, and "built-in" protection for other road users – because on the road, nobody is alone.

Camera lens – the infrared camera of Night View Assist conveys the scenario in front of the vehicle to a display on the dashboard.

Integrated safety philosophy.

A holistic approach. The aim of Daimler's integral safety philosophy is to protect and assist road users in all situations.

Daimler takes a holistic approach to safety. It is about all aspects of driving – about everything that is important for the safety of the occupants and other road users. Daimler's integral safety concept is therefore based on four distinct phases.

Prevention: avoiding danger, providing timely warning and assisting. Active safety technologies help prevent accidents. Systems such as ESP® and Brake Assist have been playing a major part in enhancing road safety for a number of years. Continuous further development and new active safety systems, specially developed to prevent dangerous situations, are making motoring increasingly safer: Lane Keeping Assist systems for passenger cars and trucks help to prevent one of the most frequent causes of accidents, namely the vehicle leaving its lane. The ATTENTION ASSIST drowsiness detection system for passenger cars can provide warnings if the driver shows signs of fatigue. Proximity control systems for passenger cars and commercial vehicles help the driver to remain the desired distance behind the vehicle in front. Special light systems maximize visibility at any time of day or night and in any weather. If the vehicle performs an emergency stop, the adaptive brake lights for passenger cars and vans start flashing quickly to warn following traffic.

Reaction: PRE-SAFE® anticipatory occupant protection for passenger cars. By using the sensors of safety systems such as ESP® and Brake Assist, PRE-SAFE® can detect an imminent accident and prepare the occupants for the impact. PRE-SAFE® is a key anticipatory occupant protection concept and represents a synergy of active and passive safety. In commercial vehicles a host of safety systems react with split-second swiftness: anti-lock braking system, acceleration skid control, all-round disc brakes, electronically-regulated braking system, high-pressure braking system, Lane Keeping Assist, stability control, proximity control and the second-generation advanced emergency braking system, which now also protects when stationary obstacles are encountered.

Protection: mitigating the consequences of accidents. If an accident is unavoidable, the impact should at least be made as soft as possible for all those involved. To achieve this, Daimler conducts a whole series of different crash tests which go far beyond the legal requirements. In addition, the company can count on the data gathered during 40 years of accident research when developing its safety systems. Thanks to airbags, inertia-reel seat belts, belt tensioners, and belt force limiters, Daimler passenger cars can provide a high level of safety. Used in commercial vehicles, the same technologies and accident tests help to further enhance driver safety. Here developments such as underride guards also help to protect other road users.

Rescue: enabling fast rescue, preventing follow-up accidents and carrying out repairs using genuine parts. In this phase, the priorities are to prevent further damage and to rescue the occupants quickly, following an accident. Depending on the type and severity of the accident, the supply of fuel to the engine can be shut off and the hazard warning lights can be switched on to warn the traffic behind and prevent follow-up accidents. If the front airbags have been deployed, the front side windows can be opened slightly to ventilate the interior. The doors can be unlocked automatically to enable faster rescue of injured occupants. If the occupants are unable to free themselves, Daimler assists the rescuers by providing emergency rescue guidelines for passenger cars and commercial vehicles, which are available to fire brigades and rescue services. What makes these guidelines particularly useful is that they facilitate the rescue of the occupants of all truck models, regardless of which company built the vehicle. They can be downloaded from the Internet whenever needed and show how to rescue the occupants quickly and safely. The rescue guidelines include detailed descriptions of how to stabilize vehicles involved in an accident or how to tilt the truck's cab forwards, for example. If the vehicle survives the accident, no compromises should be made when repairing it. An authorized dealer or workshop is the first port of call for repairs as this is the only way to ensure that the same high level of safety is regained. This is the best way to ensure that the airbag deploys correctly if the vehicle suffers another accident and that ESP® and ABS function perfectly once again.

Driving safely with the Safety Van. Its numerous innovative safety features will help reduce the accident figures of this vehicle class by half in future.

Prevention.
The driver is decisive for us. High-performance systems assist and warn the driver in his responsibilities and expand his vision.

Reaction.
Accident avoidance is the foremost objective. PRE-SAFE® systems can detect critical situations in good time, warn the driver and react in order to mitigate accidents and their consequences.

Protection.
Innovative vehicle concepts and intelligent protection systems have been helping to protect adequately in the event of an accident for over 50 years now.

Rescue.
The issue of safety is far from over after an accident has occurred. Now it is a matter of enabling rapid rescue and preventing the situation from getting worse as well as avoiding consequential damage.

Our integral safety concept is adapted to real-life traffic and accident situations. The individual components of the vehicle safety systems are networked and adjusted to each other in our passenger cars and commercial vehicles.

Passive safety.

Protected area. It all started with the invention of the crumple zone by Béla Barényi. Today, the modified form of his patented idea still forms the basis for safe vehicle interiors.

Seat belts and airbags are the cornerstones of passive safety. These systems have changed a great deal over the years. Today's sophisticated and effective restraint systems offer a vehicle's occupants protection in line with the situation in hand.

The results are convincing: In the current Mercedes-Benz E-Class launched in 2009, the crumple zone protects the occupants even more effectively than before, in the event of a frontal impact. The front deformation zone acts on four independent levels, meaning that the forces can be distributed over a wide area and dissipated uniformly in the event of an impact. Likewise, the increased use of high-strength steel alloys helps the bodyshell to withstand high impact loads while the passenger cell remains stable. Around 72 percent of all the bodyshell panels are made from these sophisticated high-tech steel grades. Adaptive airbags, belt tensioners, belt force limiters, and NECK-PRO crash-responsive head restraints afford the car occupants additional protection if the worst comes to the worst. Furthermore, the unique PRE-SAFE® anticipatory occupant protection system is fitted as standard. If the system detects a critical situation that could lead to an accident, it instinctively activates preventive occupant protection measures, allowing the seat belts and airbags to deploy with maximum effect should an impact occur. Similarly, the sunroof and side windows are closed if high transverse dynamics are detected. These measures prevent occupants from being thrown out of and objects from entering the vehicle. Over 55 years ago, the Mercedes-Benz "Ponton" (three-box-body) model series W 120 was the world's first car to feature a crash-stable floor assembly – a first step towards enhancing safety in the event of a frontal or side impact. The legendary W 111 series "Fintail" model dating back to 1959 was the first standard production car on the road equipped with integrated crumple zones and a high-strength passenger cell. Trailblazing features here included interior appointments designed so as to reduce injury hazards in accidents: Hard and sharp-edged controls had disappeared and been replaced in the W 111 by recessed door handles, a dashboard that yielded on impact, cushioned window moldings, window winders and armrests, as well as a steering wheel with a large impact plate.

Deliberate crashes. Béla Barényi's successors have continued to further develop the concepts devised by their mentor based on the latest development and calculation methods and the use of state-of-the-art bodyshell materials. During the course of its many years of development to date, the current Mercedes-Benz E-Class, for example, has come through more than 5,000 realistic crash-test simulations and over 150 real-life crash tests. As well as passing around 40 different tests in order to achieve the prescribed ratings and gain worldwide approval, this model had to take part in nine exceptionally demanding in-house crash tests, some of which go far beyond the statutory requirements.

Evolution of the restraint systems. Seat belts and airbags are restraint systems that have established themselves on a worldwide scale. These systems have changed a great deal over the years. Today's sophisticated and effective restraint systems offer the occupants even greater protection in line with the situation in hand. To make this possible, computers that use various sensors determine the likely accident severity as well as ascertaining the front passenger's individual data. If the sensor system detects a small front passenger, it initially only triggers the first airbag stage, depending on the predicted impact severity, meaning that less air is injected into the airbag. If the system senses a larger front passenger, however, both airbag stages are triggered. The engineers have also further improved the crash sensors. By way of example, the Mercedes-Benz S-Class is fitted with a total of eleven sensors which provide data regarding the type and severity of an impact at an early stage and are able to differentiate between a frontal impact, side impact, rear impact, and rollover. Like the further developed restraint systems – seat belts, airbags, and head restraints – extensive innovations covering practically every aspect of the body structure and the passenger cell provide invaluable assistance in critical situations.

Ultra-high-strength materials. Key aspects of the safety concept include intelligent design and meticulous material selection. More so than ever before, high-strength and ultra-high-strength steel alloys are used because they offer maximum strength whilst minimizing weight. Around 72 percent of all the bodyshell panels for the current Mercedes-Benz E-Class, for example, are made from these grades of steel – a new record in passenger car development.

An important lever for enhanced safety in future is the use of carbon fiber-reinforced plastics. In 2010 Daimler and Toray, the world's largest carbon fiber manufacturer, entered on an agreement for the development of lightweight components. The use of carbon fiber-reinforced plastics (CFRP) can partly compensate for weight gain due to additional safety and comfort features and alternative drive systems. CFRP parts can help further increase the rigidity of the body, while also drastically increasing the stability of the passenger compartment. Vehicle occupants are thus given additional protection in an accident, while comfort is also enhanced; these developments therefore contribute to the core brand values of Mercedes-Benz.

Safety Trucks from Mitsubishi Fuso (left) and Freightliner (right): These Daimler brands likewise prioritize vehicle safety.

Passive safety.

Robust backbone. Today the passenger cell is a strengthened structure which can offer the passengers a highly robust survival space, even in severe impacts, regardless of whether the collision is head-on, from the rear or from the side, and even if the vehicle rolls over. The use of high-strength steel grades and thicker panels plays as important a role here as the installation of additional load-bearing members. New features which are crucial with respect to both occupant safety and body stiffness include the full-length floor side members, which have been further reinforced with additional sections on their insides and thus stabilize the whole floor structure. The engineers have also incorporated sturdy aluminum transverse sections – known as transmission tunnel braces – into the floor assembly. They brace the floor assembly and channel the impact forces into the floor structure at an early stage following a side-on collision.

Safety at the rear. Multi-piece side members and a robust, flexible cross-member made from ultra-high-strength steel form the key components of the rear-end structure for the new Mercedes-Benz E-Class. The rear side members are continuous, closed box sections with carefully graduated material thicknesses. These are able to absorb high forces and, therefore, make a decisive contribution to occupant safety in the event of a rear impact. The current Mercedes-Benz E-Class, for example, also meets the world's most stringent crash regulations where rear impacts are concerned.

Action areas for safety systems are derived principally from the intensive accident research carried out since 1969. The development of NECK-PRO head restraints for passenger cars, for example, is likewise based on analyses of real-life accidents. NECK-PRO reduces the risk of whiplash injuries in the event of a rear impact. These injuries, caused by the sudden jolting movement of the head and the resulting strain on the cervical vertebrae, are one of the most common types of accident injury in Europe.

NECK-PRO is a sensor-controlled, crash-responsive head restraint which is activated when a rear impact is detected. If the sensors detect a collision of a certain predefined severity, they activate preloaded springs inside the head restraint. These springs then help to push the padded areas of the head restraints forwards and upwards to support the heads of the front passengers at an early stage and help to prevent overbending of the cervical vertebrae.

Daimler believes its responsibilities go beyond occupant protection, where the airbag, for example, is a milestone in passive safety development (functional principle at left). Protection of other road users is another important aspect of the comprehensive safety concept. To protect the most vulnerable road users – pedestrians and cyclists – safety engineers are constantly developing new, trend-setting technologies (right).

Protection for the most vulnerable

Protection of other road users is a high priority for the safety engineers. They have been developing technology that provides greater protection to those who need it most in an accident – pedestrians and cyclists – for many years. Many of these initiatives and measures serve as models and have been copied by other car manufacturers. Smooth-surfaced bodies, energy-absorbing bumpers and hoods, laminated-glass windscreens, folding exterior mirrors, rounded door handles and recessed windscreen wipers, as well as underride guards for trucks, are just some of the features that have long offered other road users a high degree of protection. Active safety innovations such as Brake Assist for passenger cars, trucks, and buses also play a vital role as they are designed to prevent accidents involving pedestrians or to reduce the impact severity. The use of Brake Assist, for example, has reduced the rate of serious accidents involving collisions between pedestrians and vehicles fitted with this equipment by 13 percent. But here, too, development continues.

Passive safety.

New era in passenger-car safety. Following almost seven decades of intensive and successful safety development – resulting in the introduction of the crumple zone, airbag, belt tensioner, sidebag, belt force limiter, windowbag and other technical milestones – the potential of active safety seemed to have been largely exhausted. New concepts were needed to further enhance the level of occupant safety. This is why, in 2002, Daimler continued its efforts by ushering in a new era in vehicle safety with PRE-SAFE®, the anticipatory occupant protection system for passenger cars. If the system detects potentially critical driving situations, it prepares the occupants and the vehicle for a possible accident. Just as animals react instinctively and search for cover when they are in danger, PRE-SAFE® activates protective measures for the car occupants as a precaution. PRE-SAFE® is able to recognize an impending accident because it offers an intelligent synergy of active and passive safety features. It is networked to Brake Assist and the Electronic Stability Program (ESP®), for example, whose sensors recognize potentially dangerous driving situations and then transmit this information to the electronic control units within milliseconds. Analyses performed during crash tests show just how important and effective anticipatory occupant protection can be. In the case of belt tensioning, for example, the measures taken mean that the driver and front passenger are held in their seats in the best possible position, thus reducing the load exerted on the head and neck area. These tests showed that the head was subjected to around 30 percent less stress, while the engineers recorded a reduction of around 40 percent in the neck area.

Future potential. Following the introduction of several successful passive safety systems, the safety engineers see additional potential in the virtual protective zone, particularly in the phase leading up to an accident. This is because the longer the time between detection of a possible accident, or a situation which could lead to an accident, and the impact itself, the more safety systems are able to improve occupant safety. By way of example, possible options include non-reversible restraint systems which deploy before the accident – but only when the accident is no longer avoidable.

Another strategic objective is the further individualization of the protection systems. For instance, adaptive belt force limiters are already available for the driver and front-seat passenger. They adapt themselves in line with the current requirements and can thus effectively reduce the load exerted on the occupants. Further forms of individualization include integrated child seats and automatic child seat recognition. For the smallest passengers – babies in rear-facing child seats – the front-passenger airbag in particular can be a danger. Automatic child seat recognition adapts the way in which the restraint systems are deployed accordingly. The front-passenger airbag is deactivated, whilst the side protection systems and belt tensioners of course remain active. Future systems will further enhance protection considerably for lighter and heavier passengers.

Another important aspect involves persuading drivers and passengers to accept and use protection systems rather than viewing them as a hindrance. This is why comfort and convenience aspects also always play an important role. Daimler likewise attaches great importance to harmonizing the trend towards eco-friendly lightweight designs with safety aspects.

Deliberate crashes: the engineers had the buses driven against a wall during development of Front Collision Guard. The system absorbs impact energy, and the load exerted on the occupants is lower than the specified level.

Unique safety system for buses and coaches

Front Collision Guard (FCG) is a unique passive safety system designed to protect the driver and tour guide aboard a bus or coach in the event of a frontal impact. FCG is fitted as standard in the latest generation of Mercedes-Benz Travego and Setra TopClass 400 touring coaches. Front Collision Guard comprises a complex safety system. Its components include a transverse profile for the protection of other road users, which can prevent a car, for example, from driving underneath the bus. The frame behind this profile consists of crash elements which absorb energy in a predetermined manner in the event of an impact. In addition, the driver's area – including the steering, pedals, and seat – is mounted on a solid frame section that can slide rearwards in its entirety if there is a severe frontal impact and, therefore, is more effective at preserving the protective space for the driver. As well as testing the effect of the Front Collision Guard system using computer simulations, the developers have also put it through its paces in several crash tests under real-life conditions. FCG complies with future statutory standards for bus and coach pendulum impact tests. Together with Active Brake Assist, which can reduce the collision speed dramatically in the event of an unavoidable frontal collision, FCG provides the driver and tour guide with an unparalleled high standard of safety.

Active safety: Radar-based systems.

Keeping distance. Assistance systems incorporating radar technology prevent head-to-tail collisions.

This combination of state-of-the-art radar and brake technology offers the greatest safety potential on expressways, where around 36 percent of all head-to-tail collisions could be prevented.

Head-to-tail collisions are among the most frequent and severe types of road accidents. Assistance systems equipped with radar demonstrably prevent this type of collision. DISTRONIC PLUS proximity control, Brake Assist PLUS, and the PRE-SAFE® Brake for passenger cars as well as Active Brake Assist and proximity control for trucks and touring coaches already greatly enhance safety. DISTRONIC PLUS, proximity control for passenger cars, assists the driver in maintaining a programmed speed and the necessary safety distance to the vehicle in front and, depending on the traffic situation, can brake the vehicle to a standstill. If the system detects that the gap to the vehicle in front is narrowing too quickly, it gives the driver an audible warning and, at the same time, automatically calculates the brake pressure required to prevent a collision in this situation. So the system helps the driver to deal with the danger in the correct manner. When a potential accident situation is recognized, help is at hand courtesy of two short-range radar sensors behind the front bumper and a long-range radar in the radiator grille. If the sensors detect that the distance to the vehicle in front is insufficient or if the gap narrows too quickly, Brake Assist PLUS is activated. If the vehicle in front is too close, a red warning symbol lights up on the instrument cluster. If the vehicle in front being monitored by the radar brakes abruptly, heightening the risk of a head-to-tail collision, a warning tone also sounds. This is the clear and unmistakable prompt for the driver to brake. The driver is assisted here by Brake Assist PLUS: As soon as the first warning tone sounds, the system automatically determines the brake pressure required in this situation to prevent the collision. Depending on the road speed and distance, it therefore allows controlled, targeted braking and, if necessary, can provide full braking power.

The next milestone in the democratization of automotive safety technology: With the introduction of the new-generation B-Class, and of the A-Class a short time later, Mercedes-Benz is set to become the world's first manufacturer to install a radar-based collision warning system with Adaptive Brake Assist in compact-class vehicles. Unlike systems already on the market for this vehicle category, the new Brake Assist does not merely help keep minor damage in city traffic to a minimum; rather, this innovative system sets out to prevent typical tail-end collisions in all traffic situations. The Group expects to bring about a significant reduction in accident statistics by this means. This is borne out by test results: In a trial involving 110 drivers in the driving simulator, the accident rate in three typical situations fell from 44 to eleven percent thanks to the combination of collision warning and Adaptive Brake Assist.

Life savers. Analyses carried out by the Mercedes-Benz accident research team indicate that in Germany alone, DISTRONIC PLUS proximity control and Brake Assist Plus could together prevent a fifth of all head-to-tail collisions involving passenger cars on average – if all passenger cars were equipped with this technology. In another quarter of these collisions, systems such as the PRE-SAFE® Brake could help bring about a substantial reduction in accident severity, since it allows the car to be braked automatically if the risk of a head-to-tail collision is acute. This combination of state-of-the-art radar and brake technology offers the greatest safety potential on expressways, where around 36 percent of all head-to-tail crashes could be prevented.

Automatic emergency braking. Support is provided by Brake Assist PLUS if the driver gives the braking command – by forcefully stepping on the brake pedal. The PRE-SAFE® Brake for passenger cars goes a step further and brakes the vehicle if an acute risk of a head-to-tail collision is detected and the driver fails to react to the warnings. Around 1.6 seconds before the calculated impact point – after three audible warning signals – the system initiates partial braking autonomously and decelerates the car with around 40 percent of the maximum braking power (approx. 4 m / s²). If the driver fails to react, even after automatic partial braking, the PRE-SAFE® Brake activates the maximum braking power around 0.6 seconds before what is now deemed an unavoidable collision. This emergency braking can greatly reduce the severity of the impact. Daimler engineers were able to gauge the impact of this "virtual protective zone" on occupant protection by conducting realistic tests: On average, autonomous PRE-SAFE® emergency braking reduces the impact speed by more than 20 km / h, thus substantially reducing the forces exerted on the occupants.

Mercedes-Benz E-Class, assistance systems.

Radar in assistance systems

Daimler purposely uses radar to monitor the area around the vehicle in many of its assistance systems, since radar offers a number of advantages over other types of sensor. For instance, the distance to a vehicle in front and the relative speed can be measured separately and directly. Both measurements are compared continuously and checked for their plausibility, thus lessening the likelihood of faults and ensuring better controllability. What's more, radar can be used in almost all weather conditions and offers the option of concealing the sensors in the vehicle.

Within a model series, the radar-based systems in Daimler's passenger cars use the same sensors. Here the short-range radar sensors have a particular wide angle – a beam width of 80 degrees. They have a range of around 30 meters and operate at a frequency of 24 gigahertz. In the new E-Class and the model year 2010 S-Class, the DISTRONIC PLUS system uses a newly developed sensor for the long-range radar with a frequency of 77 gigahertz. The extended range is now 200 meters. In addition, the sensor system now also has medium-range detection capability, allowing monitoring of the area up to around 60 meters ahead of the car with a 60-degree beam width. This new technology enables even more precise monitoring of the traffic situation in front of the car and even better detection of dynamic events such as a car in front swerving suddenly. This technology will also be used in vehicles such as buses, trucks, and vans in future.

Active safety: Radar-based systems.

In the commercial vehicle area, too, Daimler continues to work with determination on reducing the high risk of head-to-tail collisions: Active Brake Assist for trucks and touring coaches can prevent a large percentage of these accidents. It initiates emergency braking if a collision with a vehicle in front appears to be unavoidable. The advanced emergency braking system (Active Brake Assist) is based on the same radar system as Telligent proximity control: It uses this system's three radar beams, which detect moving obstacles in front of the vehicle, and continuously calculates the difference in speed between the two vehicles. If the situation does not change and the system determines that an accident is unavoidable, the driver first receives a visual and then an audible warning. This is followed by slight braking, which the passengers in the bus also feel, giving them the opportunity to brace themselves. If the driver does not react, the system applies full braking power. The advanced emergency braking system Active Brake Assist has proven its effectiveness in practice in over 14,000 trucks and more than a billion kilometers covered on the roads in Europe. Since September 2010, this second generation of the pioneering safety system has been available for the heavy-duty Actros truck. The Active Brake Assist 2 system can now detect stationary obstacles such as the end of a traffic tailback, and can initiate a braking intervention autonomously if the driver fails to react. Active Brake Assist 2 is based on a new scanning radar system, which scans the lane from 1 to 150 meters in front of the truck, constantly calculating the distance and speed difference between the truck and a vehicle traveling ahead or a stationary obstacle. Thanks to radar technology, Active Brake Assist 2 – as up to now – is insusceptible to weather and light conditions. In addition, it is active over the entire speed range from 8 km / h to 89 km / h, the speed at which the limiter sets in. Although the advanced emergency braking system cannot always prevent accidents, application of the brakes with full power significantly reduces the collision speed and, therefore, the severity of the accident.

Optimum visibility in all directions. A further Daimler assistance system is designed to address another problem area highlighted by accident statistics: lane changes. Every year, around 9,500 serious road accidents in Germany are caused by motorists who fail to take heed of the traffic behind when changing lanes or cut across in front of another vehicle too soon after overtaking. Blind Spot Assist can help drivers to change lanes safely: It uses short-range radar sensors housed on both sides of the rear bumper to monitor the areas directly adjacent to and behind the car. If the system detects another vehicle driving in the next lane in the blind spot, it warns the driver by illuminating a red warning signal in the glass of the exterior mirror. If the driver fails to see this and indicates to change lanes in spite of the warning, the red warning signal starts flashing and an additional warning tone sounds. The Active Blind Spot Assist system, used for instance in the new C-Class, goes a step further. If the driver ignores the system's warning signals and starts to move over to change lanes, a braking intervention at the wheels on the opposite side generates a yaw movement acting against the collision course. Recently the Active Blind Spot Assist system was awarded the "Yellow Angel" by a specialist jury of the ADAC, the world's largest automobile association, hailing the system as a ground-breaking innovation.

The new Mercedes-Benz Actros with second-generation emergency braking system. Active Brake Assist 2 now detects stationary obstacles, too, such as vehicles at the end of a traffic tailback. If the system detects an imminent head-to-tail collision and the driver fails to react, the system brakes automatically – although this will not always prevent an accident, it can greatly mitigate its consequences.

Safe lane changes: The Active Blind Spot Assist system for passenger cars uses short-range radar sensors to "survey" the areas directly alongside and behind the car. It emits warning signals to make the driver aware of vehicles detected in the blind spot and initiates corrective intervention if a dangerous change of lane is attempted.

Active safety: Camera-based systems.

A glance over the shoulder. Camera-based assistance systems help drivers to take on board the vast amount of information recorded whilst driving, enabling them to react in plenty of time.

The purpose of the "awareness enhancers" is to improve the naturally limited vision of the human driver. Where two eyes cannot see everything, cameras monitor all the important goings-on around the vehicle. And when visibility is not the best, assistance systems can cast light on the situation.

Four eyes see more than two. "Awareness enhancers" are therefore an important component of the safety package for Daimler vehicles. Driving in darkness or with restricted visibility due to poor weather can cause uncertainty and, in many cases, accidents. The headlamp and Night View Assist systems for the Mercedes-Benz C- Class, E-Class, and S-Class as well as the SLK adjust the range of the headlamps automatically based on the distance to oncoming vehicles or moving vehicles in front of the car with their lights on. Speed Limit Assist systems for passenger cars can remember signposted speed limits, while Lane Keeping Assist systems for trucks, buses, and cars can provide warnings if the vehicle looks like leaving its detected lane. In addition, reversing cameras for trucks, buses, and cars make for excellent rear visibility – because what happens behind the vehicle is also crucial. In contrast to previous light systems, which merely switch between low beam and high beam, Adaptive Highbeam Assist controls the light distribution in line with the current traffic situation. A camera mounted on the inside of the windscreen monitors the traffic scenario and, thanks to an intelligent image-processing algorithm, is able to detect vehicles with their lights on as well as calculating the distance to these vehicles. Based on this information, the lights are dimmed, while the range of the controllable bi-xenon headlamps on low beam is set to as much as 300 meters and is adapted continuously in line with the current traffic situation. If the system detects that the road ahead is clear, high beam is activated automatically. Adaptive Highbeam Assist can be used at speeds above 55 km / h and, once activated, operates fully automatically. Furthermore, the new CLS 63 AMG is the first car in the world to feature LED high-performance headlamps as standard. Aside from the tried-and-tested Intelligent Light System, its five different light functions – country road, expressway, extended fog lamp function, active light system, and cornering light function – offer a host of additional safety benefits. The LED headlamps come as close as possible to the color of natural daylight, easing the strain on the eyes. Research has shown that artificial light stresses the eye less, the closer it resembles natural daylight. The driver experiences this effect particularly through daylight-like color impressions at night and the impression that there is more clarity on the road. Daimler light specialists have for the first time succeeded in combining LED technology with the innovative Adaptive Highbeam Assist; this leads to an entirely new safety feeling when driving at night. A further optional system is Night View Assist PLUS.

Turning night into day. Night View Assist is a further safety innovation that will make driving at night safer for all road users. Infrared technology greatly enhances the driver's range of vision in the dark. Two separate headlamps illuminate the road with invisible, non-reflective infrared light. A windscreen-mounted camera designed to pick up precisely this type of light records what happens in front of the car and sends the image to a display on the dashboard. A grayscale image highlights pedestrians, cyclists, and obstacles clearly at an early stage. In the further modified version, Night View Assist PLUS, persons detected are further highlighted on the display by means of a specially developed pedestrian detection function.

Camera-based awareness enhancers make the driver's job easier and therefore increase safety. Whether it be Adaptive Highbeam Assist, Active Lane Keeping Assist, Speed Limit Assist, Night View Assist PLUS or the Omnicam for buses – all offer the best possible visibility, and additional information is assured at any time of day and in any traffic situation.

Always on the right track. Around one in six serious road accidents in Germany is caused by a vehicle leaving its lane. This is why Lane Keeping Assist was developed. The system detects the lane markings in front of the vehicle by evaluating the difference in contrast between the road surface and the markings. The line taken by the car and the driver's activities are monitored at the same time. Only very specific movements indicate that the vehicle has left the detected lane unintentionally – and only then does Lane Keeping Assist intervene, by making the steering wheel vibrate to alert the driver. In trucks, the system works using audible warning signals which make the driver aware that the vehicle's course needs to be corrected. As far as commercial vehicles are concerned, around half of all accidents caused by a vehicle changing lanes unintentionally can be prevented by using a Lane Departure Warning (LDW) system.

A gentle warning. The Lane Assistant for buses shows just how intelligent and sophisticated Daimler's safety systems are. Here too, a camera in the windscreen monitors the vehicle to make sure it maintains the correct course in its lane. The main point of concern for the bus developers was coming up with a suitable form of warning for the driver. An audible warning of the kind used in trucks was out of the question, as this would inevitably unsettle the passengers. The solution: two vibration motors integrated in the driver's seat cushion, which make the driver aware of the situation when the vehicle crosses the detected lane markings unintentionally, also indicating on which side of the lane this has occurred. The system, which can be deactivated, is effective at speeds of over 70 km / h, in other words on longer-distance routes. As soon as the driver indicates, the system is deactivated automatically.

Foot off the gas? Speed Limit Assist can see what the driver sometimes misses, namely speed-limit signs. The camera in the windscreen monitors the surroundings, while the computer filters out circular surfaces and uses an algorithm to identify speed-limit signs. These are projected onto a display in the vehicle in real time, making the driver aware of the detected speed limit.

Always the right light

Country mode replaces low beam and illuminates the road verge on the driver's side more broadly and brightly than before.

Expressway mode, activated at speeds above 90 km / h, increases the driver's range of vision by up to 60 percent.

The active light function pivots the headlamps sideways by up to 15 degrees, taking into account the steering angle and the vehicle speed, thus improving illumination of the road.

The cornering light function is activated when the driver indicates or steers at speeds below 40 km / h. The headlamps illuminate the area to the side of the vehicle.

The enhanced fog lamps are activated at speeds below 70 km / h if the rear fog lamp is switched on. Illumination of the inner half of the lane is enhanced, and the degree of glare from light reflected back by the fog is reduced

Camera-based visibility enhancement

Adaptive Highbeam Assist: This system detects oncoming vehicles or moving vehicles in front with their lights on and then adjusts the headlamps so that the beam of light ends before these other vehicles. High beam, with a range of up to 300 meters, is activated and deactivated automatically.

Spotlight function: The partial LED high beam directs a spotlight at potential hazards. If the infrared camera of the Night View Assist PLUS feature detects, for instance, animals in the distance or pedestrians on the road, a spotlight is briefly shone on them beyond the area illuminated by the high-beam lights.

Driver-fitness safety.

An intelligent partner. Daimler assistance systems give vehicles extra “senses.” Rather than working independently of each other, they are networked and actively exchange data.

Technology that keeps you fit. For all their assistance systems, cars cannot drive themselves. A top-fit driver is a key requirement when it comes to preventing accidents.

Daimler is implementing a globally unique synergy of sophisticated safety technologies to give its cars extra “senses” and added “intelligence.” All of which make Mercedes-Benz models part of the “thinking” process – cars that can “see,” “sense,” and “act” autonomously. Sensor fusion is a further key concept that promises enhanced safety: The information gathered by radar sensors, cameras, and diverse vehicle systems is brought together to offer the highest possible level of protection.

Anticipatory occupant protection. PRE-SAFE® bridges the gap between active and passive safety. It is networked to Brake Assist and the Electronic Stability Program (ESP®), for example, whose sensors can recognize dangerous handling situations and then transmit this information to the electronic control units. In combination with the short-range sensors used by DISTRONIC PLUS, PRE-SAFE® – as installed in the current C-, E-, and S-Class as well as in the SLK, for example – also makes use of the information provided by the short-range radar sensors in the front bumper to tension the front seat belts at the very last moment: about 200 milliseconds prior to an impact that is deemed unavoidable.

“Continuous comparison.” A further assistance system capable of acting “instinctively” and “intelligently” is ATTENTION ASSIST, offered for the C-, E-, and S-Class as well as the SLK. This system uses various parameters to build up a profile of the person at the wheel. If the system detects that the driver is starting to become drowsy, based on deviations from this profile, it prompts the driver to take a break in due time. At the heart of this system is a high-resolution sensor which allows extremely precise monitoring of the steering wheel movements and the steering speed. Based on these data, ATTENTION ASSIST calculates an individual behavioral pattern during the first few minutes of every trip. This pattern is then continuously compared with the current steering behavior and the current driving situation, courtesy of the vehicle’s electronic control unit. In addition to the vehicle speed, lateral acceleration, and longitudinal acceleration, the system also detects steering wheel movements, use of the turn indicators and the pedals, as well as certain control inputs and external influences such as side winds or road unevenness. Observation of steering behavior has proven to be extremely meaningful, as a drowsy driver frequently makes minor steering errors that are often corrected in a characteristic manner. These data allow the system to detect typical indicators of drowsiness and warn the driver by emitting an audible signal and flashing up an unequivocal instruction on the display in the instrument cluster: “ATTENTION ASSIST. Break!”

Driving can be tiring – but it doesn’t have to be. Daimler coined the phrase “driver-fitness safety” more than 15 years ago as part of the company’s comprehensive safety philosophy and as a key factor in preventing accidents. Driver-fitness safety means maintaining and, in some cases, improving the driver’s physical and mental fitness and capabilities by designing and constructing vehicles with the necessary equipment. After all, drivers need to be fit in order to react quickly and correctly in critical situations on the road. Driver-fitness safety begins with the interior dimensions and also includes all aspects of suspension, climate, and seating comfort, as well as low noise levels and the development of intelligent assistance systems that deal with certain tasks whilst driving. The decisive factor is perfect interaction of all the measures, which have one common aim: to make life easier for the driver by maintaining fitness and alertness. The outstanding results achieved during a seven-week road test conducted by the Daimler research department in Berlin, for example, show that an intelligent overall vehicle design is the best way to ensure a high level of driver-fitness safety. A Mercedes-Benz S-Class car was compared with two competitor models. The average heart rate of the test drivers – a typical indicator of stress – was up to six percent lower among the Mercedes-Benz S-Class drivers than for their counterparts in the competitor models.

Everything at a glance. Key components of any intelligent vehicle design include a clear arrangement of the controls and easy-to-navigate menus, since they ensure that the driver has fewer distractions to worry about, meaning a higher level of safety whilst driving. The control and display systems in Daimler vehicles have proven their worth in tests conducted on the expressway and in the driving simulator. By way of example, the duration of typical control interventions in the Mercedes-Benz C-Class was reduced considerably – it was around 40 percent lower than the average control time in comparable vehicles. The average time spent looking at the controls was likewise reduced substantially.

Detecting stress factors in order to avoid them. Daimler engineers have developed various methods that enable objective assessment of the level of driver-fitness safety provided by a vehicle. These chiefly involve physiological measurements of typical stress indicators – above all the driver’s heart rate, which is a reliable way of continuously measuring stress. Reasons for an increased heart rate can include stress due to increased traffic volume as well as bad weather conditions and poor visibility. Interior noise, insufficient ventilation and poor suspension comfort also have a negative effect. In order to evaluate and continuously improve these aspects, on-board computers in test cars and measuring equipment connected up to the drivers record all variables that give an

Driving safety training: practice makes perfect

However, no matter how helpful driver-fitness safety, operating safety and assistance systems are, when it comes to preventing accidents, it is still a person who sits behind the wheel. Assistance systems should assist drivers rather than act as their guardians. Professional driving safety training is therefore a further key factor in the quest to prevent accidents for passenger car and commercial vehicle drivers. This is why Daimler attaches such a high priority to basic and advanced driver training. With some 65,000 participants per year, Mercedes-Benz Driver Training has long been the largest training facility of its kind for truck drivers. And over 15,000 bus and coach drivers have already taken part in safety training courses. Passenger car drivers, meanwhile, can attend a number of courses, ranging from winter training and special training for women to off-road training, ECO training and professional driver training. Customers who opt to buy a Sprinter, Vito or Viano model receive a voucher for special driving safety training tailored for their vehicle. As well as preparing drivers for dangerous situations and showing how critical driving situations can be mastered, driver training also teaches drivers how to detect risks in plenty of time and even prevent them entirely.

Driver-fitness safety.

Technology that keeps you fit. For all their assistance systems, cars cannot drive themselves. A top-fit driver is a key requirement when it comes to preventing accidents.

indication as to the drivers' physical condition. Decisive is the perfect interplay of all measures, all with the common goal of relieving the burden on the driver and maintaining fitness and alertness. These results provide an objective picture of the influence of the vehicle technology on drivers' behavior and, therefore, their capabilities. By monitoring driver performance with the help of the Global Positioning System (GPS), the experts can also determine the section of the route on which stress is at its highest when evaluating all the data. The results of the tests yield crucial findings in terms of how to further develop driver-fitness safety and assistance systems.

But while heart rate provides an indication of the degree of driver stress, it cannot indicate its type. Stress can actually be positive and, therefore, does not necessarily impair the driver's ability to act. This is why the experts gather additional information about emotional factors such as mood, tension, and motivation in far-reaching psychological interviews – both before and after the test drive – as well as conducting online surveys to gauge well-being whilst driving. To this end, the test drivers answer questions about their current mood, which are displayed at certain intervals during the drive. This procedure allows the experts to determine whether the stressful situation that has led to an increased heart rate is perceived positively (eustress) or negatively (distress).

Mind Lab – a look inside. Another supplementary means of producing a comprehensive driver profile is the recording of brainwaves by means of EEG (electroencephalography) in various simulated driving situations. Measurements based on neuro-physiological methodology conducted on board of a mobile research laboratory – called the Mind Lab – allow an insight into cognitive, unconscious behavior that cannot be influenced by the driver. This is the only way to ensure dedicated and objective measurement of the driver's neuronal activities in certain situations and conditions. The resulting evaluations yield findings that provide crucial indications of the extent to which assistance systems can be honed in order to provide the driver with the best possible level of assistance.

In the mobile research laboratory Mind Lab, scientists investigate patterns of driver behavior in order to further improve assistance systems.

MobileKids.

The MobileKids road safety initiative. In our eyes, safety is not just restricted to technology and the vehicles. This is why it is natural for Daimler to become involved in road safety initiatives. One of these is MobileKids, which provides ad-free state-of-the-art road safety education.

Children are particularly vulnerable road users. Between the ages of six and ten, they are slowly but surely developing into independent road users: going to school, visiting friends in the afternoon or engaging in sport. For this reason, it is important to make girls and boys aware of possible dangers in an age-appropriate manner and to train them to behave cautiously in road traffic for safety reasons.

Daimler launched this initiative back in 2001 in cooperation with international road safety experts, with the objective of making children learn how to behave adequately and cautiously in road traffic. MobileKids adopts a holistic approach: Not only does MobileKids offer children customized material, it also helps parents and other adults, such as teachers, in their close environment in order to protect and prepare their children even better to face the dangers in road traffic.

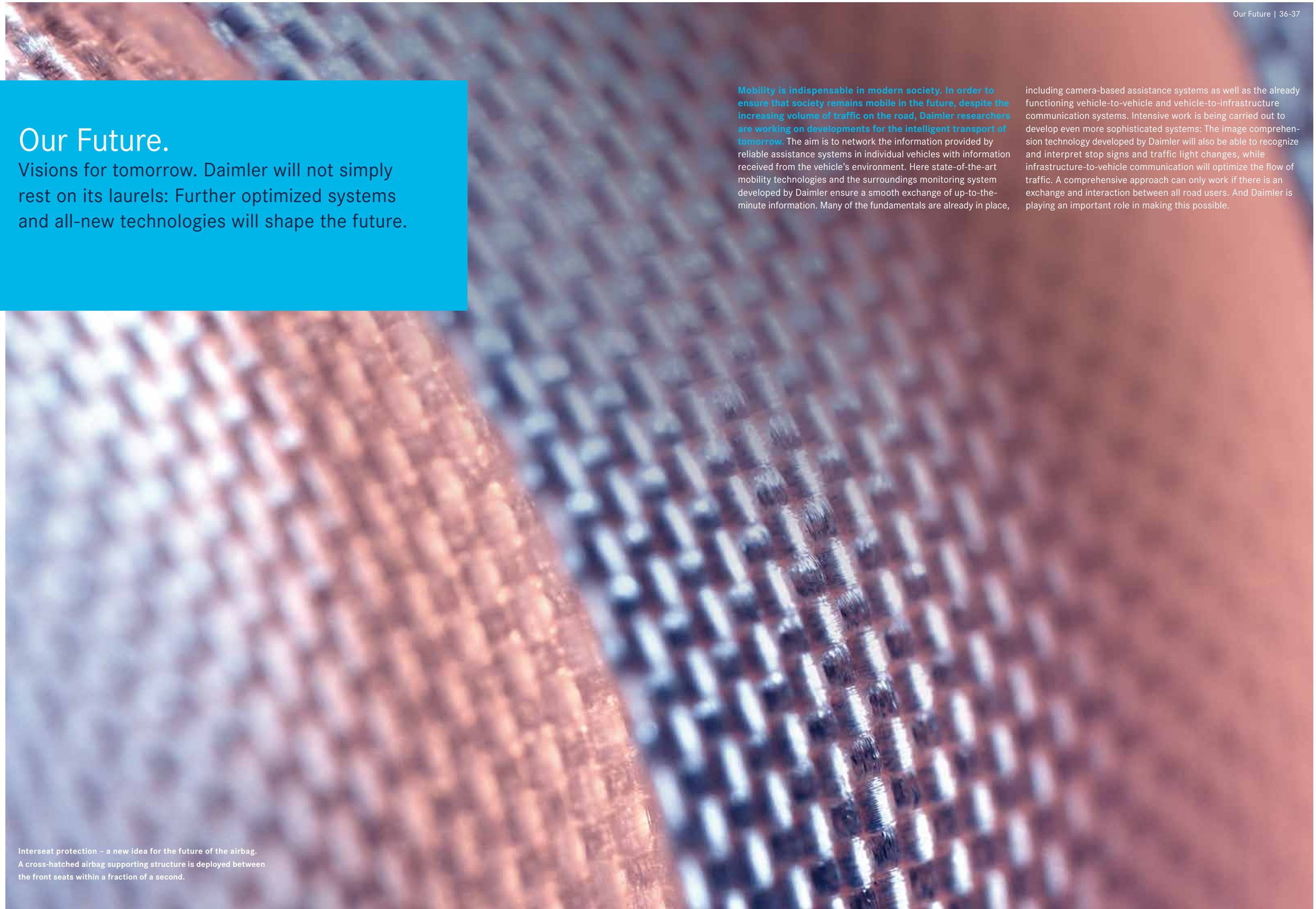
To this end, MobileKids invites primary schools to implement "MobileKids school days." Teachers receive teaching material free of charge and can participate with their school classes in the MobileKids school contest. On the Internet-based MobileKids Safety Map, parents, teachers, and children have the possibility to look up and mark critical locations on their daily route to and from school or kindergarten. This way they can exercise familiar or new routes in a virtual manner and learn to recognize critical spots. And in the MobileKids Online magazine, parents, teachers, and children learn all about safe, sustainable mobility. In addition, there are learning games appropriate for the six-to-ten years' age group available on the Internet website.

With MobileKids we are making children fit for traffic. MobileKids includes valuable information concerning road safety training, combining real and virtual traffic education, for instance through the Safety Map.

Our Future.

Visions for tomorrow. Daimler will not simply rest on its laurels: Further optimized systems and all-new technologies will shape the future.

Mobility is indispensable in modern society. In order to ensure that society remains mobile in the future, despite the increasing volume of traffic on the road, Daimler researchers are working on developments for the intelligent transport of tomorrow. The aim is to network the information provided by reliable assistance systems in individual vehicles with information received from the vehicle's environment. Here state-of-the-art mobility technologies and the surroundings monitoring system developed by Daimler ensure a smooth exchange of up-to-the-minute information. Many of the fundamentals are already in place, including camera-based assistance systems as well as the already functioning vehicle-to-vehicle and vehicle-to-infrastructure communication systems. Intensive work is being carried out to develop even more sophisticated systems: The image comprehension technology developed by Daimler will also be able to recognize and interpret stop signs and traffic light changes, while infrastructure-to-vehicle communication will optimize the flow of traffic. A comprehensive approach can only work if there is an exchange and interaction between all road users. And Daimler is playing an important role in making this possible.



Interseat protection – a new idea for the future of the airbag. A cross-hatched airbag supporting structure is deployed between the front seats within a fraction of a second.

ESF vehicles.

ESF vehicle 2009. Experimental safety vehicles highlight new, at times unconventional ways to further improve vehicle safety.

The Experimental Safety Vehicle program (German acronym ESF) originated in the early 1970s, following the dramatic development of accident frequency in the USA. Between 1970 and 1974 Daimler-Benz AG, as the company was then known, took part in this program with a total of 24 vehicles and test cars. In these vehicles, the company developed practically all the major systems for improving passive and active safety. The result was a series of innovations that are now considered must-haves for practically all passenger cars. The current ESF 2009 follows this tradition and highlights new, unconventional approaches for enhancing vehicle safety. The use of highly precise information regarding the traffic environment provided by radar sensors and the networking of vehicles using new communication technologies point the way ahead. The focus of developments for the ESF 2009 is on improving the perceptual safety of other road users by employing innovative lighting technologies as well as enhancing the visibility of one's own vehicle. The ESF 2009 also shows how information about an imminent, unavoidable accident can be used to develop further potential in terms of occupant safety and the protection of other road users. One part of this concept is the utilization of the initial impact and the distribution of energy in several pulses. The ESF 2009 provides a detailed insight into the current development projects dealing with the the matter of vehicle safety at Mercedes-Benz.

Six aspects represent the extensive technological approach in the ESF 2009:

New passive safety. Conventional restraint systems are reactive. The build-up of force and the associated conversion of energy only take place within the restraint system after the occupant has moved a required distance within a certain time. An occupant protection system which absorbs the initial impact, such as "side impact" in the case of the ESF 2009, uses the early information about the unavoidable impact for preparatory energy conversion on the occupant. PRE-SAFE® pulse systems accelerate the occupant in the direction of movement caused by the impact energy in real time during the accident. To do this, the cushions of the multi-contour seat are used with modified inflation characteristics. The reversible, pulse-like inflation of the cushion causes the occupant to move towards the center of the vehicle and thus in the direction of the impact. The contact between the door and the occupant therefore occurs significantly later, with a lower intrusion speed. Simulations prove that rib intrusion is 30 percent lower on average.

Braking bag doubles braking power. Present-day emergency braking systems such as that used in the current E-Class brake the vehicle after various warnings if a frontal impact is imminent, up to full brake application to a standstill if necessary – at the slip limit. To offer additional protection potential, a system has to increase the deceleration energy beyond that which the wheel brake can provide. To this end, Mercedes-Benz has developed the concept of the braking bag and extended the front underbody paneling of the standard production S-Class so as to include a special airbag. When the airbag is activated, it expands and rests against the top side of the front subframe. The bottom side features a friction lining to optimize deceleration. If the braking bag is activated when there is an imminent frontal impact, this leads to a doubling of the braking effect compared to a normal wheel brake. A positive side-effect: Because the vehicle lifts under emergency braking, the brake dive movement is compensated for and crash compatibility is improved.

First-generation Mercedes-Benz experimental safety vehicles: ESF 13 from 1972 (left) and ESF 22 based on the S-Class (model series 116) from 1973 (right).

The current ESF 2009 adopts new, unconventional approaches to enhance vehicle safety, such as the PRE-SAFE® Pulse occupant protection system and the braking bag.

ESF vehicles.

SIDE REFLECT improves visibility at the side of the vehicle in darkness. SIDE REFLECT allows better detection of broken-down, unlit vehicles on country roads or traffic that suddenly crosses the vehicle's path at junctions. Diffused light at the side increases reflection properties so that other road users see the vehicle much sooner. One option is to affix a reflector strip to the tires as on bicycles. In addition, the ESF 2009 is equipped with reflective-effect door seals. Here the outer sections of the door seals are coated with a special film which fits in perfectly with the design of the vehicle. It emphasizes the vehicle's contours and makes it more easily visible at night.

New light functions via LED pixel headlamps. Advances in camera technology and image processing now also allow drivers to detect potential dangers on the road. An indication on the display is one way of warning the driver. The "danger light" function in the ESF 2009 shows how the driver can be made aware of a hazard directly in the road space. For this, the car has main headlamps from an electronically addressable LED array with 96 pixels arranged in four rows. Each of these pixels is dimmable in 256 stages and can be switched on within milliseconds. As well as providing the "danger light," this LED array can be used to create adaptive light functions such as the active light function and partial high beam. The headlamp with upstream image processing can also be used to illuminate pedestrians up to the waistline without dazzling, or to project a "light indicator" onto the road. The first series-production vehicles featuring this innovative light function will already be available in 2011.

Pressurized vehicle components absorb impact energy. Inflatable structures are used to specifically change the properties of small and lightweight structures in the vehicle in the event of an accident. To achieve this, these elements are inflated by a gas generator. The cross section of these structures is enlarged into previously unused areas of the vehicle body, allowing the space required for the window within the side door to be used if required.

Vehicle communication broadens the horizon. Systems that monitor the surroundings are not capable of detecting and locating objects and vehicles which are concealed behind crests or hills, around bends or behind buildings at inner city junctions. In this case, car-2-x communication offers the option of obtaining information from far beyond the visible monitoring range by spontaneously linking vehicles to one another (car-2-car) or linking the vehicle with the infrastructure (car-2-I). The potential offered by car-2-x communication for active safety is due in part to the possibilities of sensor data fusion. The additionally acquired data from car-2-x communication can improve the quality of conventional environmental sensors. Thanks to automatically generated warning messages in particular, car-2-x communication plays an important part in preventing accidents as it signals accident spots, broken-down vehicles, obstacles on the road, the ends of traffic tailbacks, road works or approaching emergency vehicles, at an early stage. Car-2-x communication also plays an important role in enhancing overall road safety.

One of the main focal points when developing the ESF 2009 was enhancing perceptual safety. SIDE REFLECT is one of the innovations that help to do this.

ESF 2009: Innovations for even greater safety

Night View Assist PLUS	Interactive vehicle communication	HYBRID battery shield
Intelligent Light System	Spotlight function	HYBRID battery fuse
DISTRONIC PLUS	PRE-SAFE® Pulse	Braking Bag
Speed Limit Assist	PRE-SAFE® 360°	Brake Assist PLUS
Lane Keeping Assist	Size-adaptive (front) airbag	PRE-SAFE® brake
Attention Assist	Beltbag	PRE-SAFE® structure
Automatic Child Seat Recognition	INTER-SEAT PROTECTION	Child protection system rear seat camera
Adaptive Brake Lights	SIDE REFLECT	

Project future.

Looking ahead. Our researchers and developers are already thinking about the future of safe motoring.

Vehicle-to-vehicle and vehicle-to-infrastructure communications help to provide assistance systems with the information that they need to evaluate the situation. The more accurate the internal and external information that the system can evaluate, the greater the options for initiating suitable measures in plenty of time before an accident actually occurs. One example of this is the level of occupant protection provided by non-reversible restraint systems deployed before an unavoidable accident.

Safe vehicles alone are no guarantee of safe transport. For Daimler, the challenge for the future is to work together with other vehicle manufacturers as well as telecommunications and traffic management specialists. A comprehensive approach is needed to shape the mobility of the future. The vision for future transport is to use sophisticated communication systems to link information from the vehicle environment with innovative driver assistance functions. One of the main requirements for ensuring road safety and mobility in the future is providing shared, real-time, and comprehensive information about the flow of traffic and hazardous situations, for all road users. Working together with specialists from the automotive, telecommunications and traffic management sectors under the umbrella of the "AKTIV" research initiative, Daimler uses the synergies of the different disciplines to enhance the safety and efficiency of road traffic. The cornerstones of this initiative are active safety, traffic management, and vehicle-to-vehicle as well as vehicle-to-infrastructure communications. Future transport will be shaped by the exchange of information, not only from "public" to "private" partners, but also in the other direction. This means that rather than just being communicated on gantries and variable message signs, all traffic-related information will also be sent directly to the vehicle.

Communication in all directions. Important sources of information include virtual traffic control systems. Working independently of infrastructure equipment – hence the "virtual" tag – they are positioned at important points on the road, such as at road works, and send information directly to driver assistance systems. A central information platform is the hub for strategy and traffic situation-based information. Here data and information from various sources are gathered, conditioned, and provided for the applications. In the traffic system of the future, traffic lights will be integrated into the new information concepts as "cooperative light signal systems." This means that traffic lights will be controlled in line with the current situations, thus reducing both noise and harmful emissions. Cooperative vehicle infrastructure technologies designed to ensure dynamic navigation and inform the driver are being developed for "Adaptive Navigation." Their input is via radio, DAB (digital audio broadcasting) and – in a new approach – via WLAN and the mobile phone networks.

Communication in all directions: Vehicle-to-vehicle and vehicle-to-infrastructure communications will ensure that everyone is made aware of hazardous situations at all times via radio, DAB (digital audio broadcasting) and the mobile phone network.

Mobile danger warning systems. The system of information also works the other way around: In vehicle-to-vehicle and vehicle-to-infrastructure communications (car-2-x communications), each individual vehicle plays the role of a danger warning system. Successful tests conducted by Daimler using ad-hoc networks as part of the "NOW – Network on Wheels" project have shown just how much potential this system offers. Thanks to warning messages, vehicles behind were able to prepare for dangerous situations such as black ice, fog or obstacles on the road in good time, while the drivers were able to adapt their driving accordingly. Daimler is also adopting this approach in the "Safe, Intelligent Mobility – Test Area Germany (simTD)" research project. simTD aims to develop a technology for communication between vehicles by radio and with an "intelligent" traffic infrastructure.

Information determines actions. Alongside the information gathered from the monitoring of the surroundings by the vehicle assistance systems, all the information received by the vehicle forms the basis for a comprehensive evaluation of the situation. And this is needed at junctions in particular. Junctions often involve areas that cannot be seen and are therefore accident blackspots. Around one-third of all serious road accidents in Germany occur at junctions. When it comes to comprehensive risk estimation, therefore, the vehicle can never receive too much information. Since the situation at junctions is extremely complex, a high degree of awareness and clarity is required. This means that the requirements for monitoring the surroundings and evaluating the situation are correspondingly high. The aim of the "AKTIV" initiative is to develop an assistance system for detecting movements of inner city traffic, which helps the driver when crossing or turning at a junction.

System decision as an emergency brake. Onboard sensors, cooperative communication, the integration of positioning maps and digital maps as well as a comprehensive situation analysis form the basis of the assistance system. Here an anticipatory sensory system is designed to help detect vehicles, pedestrians, and cyclists ahead of an imminent accident and to initiate effective protective measures.

Project future.

The future begins today. “Intelligent” video-based assistance systems that employ artificial intelligence are already used in some sectors. They make the driver aware of detected imminent dangers and initiate measures for preventing accidents or mitigating their consequences. The Daimler-developed image recognition system for monitoring the surroundings is one such system. It is based on a stereo camera on the inside of the windscreen, which provides high-performance computers with information about the lie of the road as well as about vehicles driving or crossing in front and vehicles parked at the side of the road. It can also detect pedestrians, cyclists, and vehicles approaching from the side. In this case, as well as “seeing” the sources of danger, the assistance system can predict how the object will behave in the seconds to follow, based on its movement, its distance, and its speed. Tests have shown that the early warning system reliably detects pedestrians crossing the road from a distance of 30 meters, for example. The risk of a collision with a cyclist approaching quickly from the side is detected a full two to three seconds before an imminent collision. This innovative technology is based on the idea of identifying relevant pixels and then monitoring them for a certain period. A cyclist riding up ahead is located, for example, and perceived by the system as a series of individual moving pixels. The stereo camera tracks their movement and, based on the information received, the computer predicts the likely direction of the object’s movement.

See, understand, act. “Image comprehension” is the term experts use to describe this process. It indicates that as well as involving the recording of images, the focus is on understanding, interpreting and assessing that which is perceived. In the Mercedes-Benz E-Class and the S-Class (model year 2010), the intelligent video-based Speed Limit Assist system can already detect speed limit signs within milliseconds – whether they be at the side of the road or on overhead gantries – and indicate the detected speed limits on the display in the cockpit. In future, such a system will be able to inform drivers of stop signs, priority signs, and expected traffic light changes, for example, in addition to the current speed limits. These systems operate on a similar principle: The camera identifies objects, then the image-processing program analyzes their significance in real time and initiates the necessary measures instantaneously. In the case of traffic light detection, for example, circular objects in the colors red, yellow, and green are perceived. The size of the recorded traffic light discs provides information about their distance from the vehicle.

Many small successes combine to produce one resounding success. However, the first priority for the researchers when developing each new safety system is reliability. Systems build on one another and complement each other. A typical vehicle today has 50 or more control units. The automobile is already a mobile computer of sorts. And the brief for the Daimler developers is – and will continue to be – “error-free software.” The driver must be able to trust the technology: The more extensive it becomes, the more reliable it has to be. Daimler is working intensively towards the future – on the safety of its own vehicles and on the success of the entire traffic system; one does not work without the other.

For the traffic systems of the future, an infrastructure with flexible, intelligent traffic management systems and sophisticated safety and information systems in individual vehicles go hand in hand. All the components together, perfectly in tune and integrated into the existing infrastructure network, constitute the foundation of future mobility.

The Mercedes-Benz C-, E-, and S-Class as well as the SLK already feature camera-based safety systems: The image recognition system based on artificial intelligence identifies and interprets speed limit signs. In future, the system will also be able to detect pedestrians, cyclists or other vehicles, predict their likely next movements, and initiate appropriate measures.

As the pioneers of road safety, we are continuing along the Road to Accident-free Driving. From the first crumple zone to the vehicle as a thinking partner: Daimler has invariably been at the forefront of developments in vehicle and road safety.

Our brands.

Mercedes-Benz Cars

Mercedes-Benz · smart · MAYBACH

Daimler Trucks

Mercedes-Benz · FREIGHTLINER · FUSO · WESTERN STAR · Thomas BUILT BUSES · BHARATBENZ

Mercedes-Benz Vans

Mercedes-Benz

Daimler Buses

Mercedes-Benz · SETRA · orion

Daimler Financial Services

Mercedes-Benz Bank · Mercedes-Benz Financial · Daimler Truck Financial

Daimler, an overview. Company founders Gottlieb Daimler and Carl Benz wrote history with the invention of the automobile in 1886. 125 years later, in the anniversary year of 2011, Daimler AG is one of the most successful automotive manufacturers in the world. With its divisions Mercedes-Benz Cars, Daimler Trucks, Mercedes-Benz Vans, Daimler Buses, and Daimler Financial Services, this carmaker is one of the leading producers of premium cars and is the largest manufacturer of commercial vehicles with a global reach. Daimler Financial Services offers an extensive financing portfolio with financing, leasing, insurances, and fleet management.

Daimler passenger cars.
Fuel consumption, CO_2 emissions and Energy efficiency categories[1,2].

	Fuel consumption						CO_2 emissions		Energy efficiency category	
	urban		extra-urban		combined		combined			
	[l/100 km], [kWh/100 km] and [kg H_2/100 km] acc. to Directive 80/1268/EWG						[g/km]			
Vehicles	maximal	minimal	maximal	minimal	maximal	minimal	maximal	minimal	maximal	minimal
smart										
smart	6.4	3.3	4.4	3.3	5.2	3.3	119	86	E	B
Mercedes-Benz Cars										
A-class	9.8	5.4	6.3	3.9	7.6	4.5	178	118	F	B
B-class	8.3	5.3	5.0	3.8	6.2	4.4	145	114	C	A
C-class	18.6	5.6	8.5	3.7	12.2	4.4	285	117	G	A
E-class	13.9	5.9	7.8	4.0	10.0	4.7	234	123	F	A
CLS-class	13.9	6.4	7.6	4.4	9.9	5.1	231	134	F	A
S-class	21.8	7.0	9.9	5.0	14.3	5.7	334	149	G	A
CL-class	21.8	13.5	9.9	7.2	14.3	9.5	334	224	G	E
SLK-class	12.0	6.1	6.2	4.1	8.4	4.9	195	128	E	A
SL-class	21.5	9.3	9.6	5.4	14.0	6.8	333	159	C	G
SLS AMG	19.9	19.9	9.3	9.3	13.2	13.2	308	308	G	G
ML-class	15.7	7.0	9.6	5.4	11.8	6.0	276	158	F	A
R-class	18.8	11.0	10.2	6.9	13.4	8.4	311	222	G	C
GLK-class	11.0	6.4	7.4	5.0	8.7	5.6	220	145	E	A
GL-class	19.0	11.1	10.8	7.5	13.8	8.9	322	235	G	C
G-class	21.6	13.6	12.6	9.8	15.9	11.2	372	295	F	G
Maybach	23.6	22.6	11.3	10.7	15.8	15.0	368	350	G	G
Mercedes-Benz Vans										
Viano	16.5	8.7	9.5	6.3	12.1	7.1	284	187	G	C
Vito	16.5	8.4	9.5	6.1	12.1	7.0	284	182	G	C
Sprinter	21.5	9.2	13.3	6.5	16.2	7.5	314	197	F	B
Electric vehicles					kWh/100 km					
smart electric drive					< 14		0		A+	
A-class E-CELL					17.5		0		A+	
Electric vehicle with fuel cell					kg H_2/100 km					
B-class F-CELL					0.97		0		A+	

[1] The figures for fuel consumption and CO_2 emissions shown were obtained in accordance with the prescribed measuring process (Directive 80/1268/EEC in the currently applicable version). The figures are not based on an individual vehicle and do not constitute part of the product offer; they are provided solely for purposes of comparison between different vehicle models.
Further information on the official fuel consumption and the official, specific CO_2 emissions for new passenger cars can be found in the publication "Leitfaden über den Kraftstoffverbrauch und die CO_2-Emissionen neuer Personenkraftwagen" [Fuel consumption and CO_2 emissions in new passenger cars], which is available free of charge from showrooms and from Deutsche Automobil Treuhand GmbH.

[2] The above table shows the fuel consumption and CO_2 emission levels plus the energy efficiency category of all model series available in Germany at the time of printing. For each vehicle class, the highest and lowest values are indicated for the models available in the german market. Further details on specific types of vehicle are available on the Internet. Fuel consumption levels in real driving operation can deviate from the test values in accordance with individual driving style.

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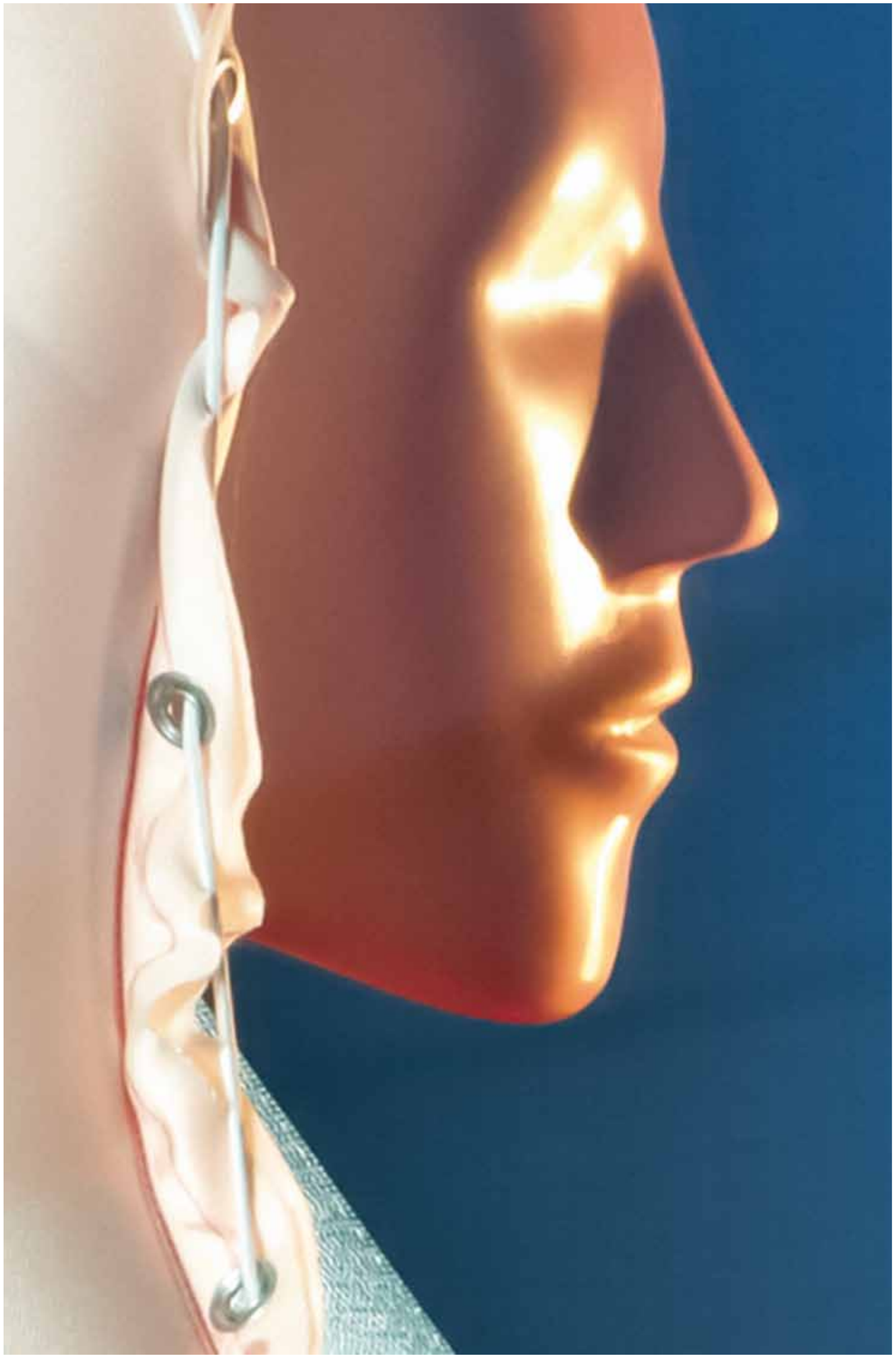

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