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Mercedes-Benz Future Truck 2025: Autonomous driving in long-distance truck operations with the "Highway Pilot"

Press Information

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World premiere for the traffic system of tomorrow – more efficient, safer, networked – and autonomous

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Stuttgart/Magdeburg – From a vision to reality – the Mercedes-Benz Future Truck 2025 gives an exciting and realistic outlook on the long-distance truck of tomorrow. In ten years trucks will be able to drive autonomously on the motorways and highways of Europe. Their drivers will no longer be "truckers", but rather "transport managers" in an attractive mobile workplace offering scope for new professional skills. Transport efficiency will increase, traffic will be safer for all road users and CO_2-emissions will be further reduced. Connectivity is the basis for a technical quantum leap. The necessary parameters must be put in place to make it reality. To this end all those involved are engaged in a dialogue - that is the vision of Daimler Trucks, the worldwide technological leader in the commercial vehicle business.

Revolution on the motorways: more efficiency and safety

The technology of tomorrow is already a reality at Daimler Trucks. The Mercedes-Benz Future Truck 2025 constitutes a revolution in efficiency and safety, a revolution for road traffic and its infrastructure, for professional driving and for the road transport sector. This is not a new truck, but rather the transport system of the future – developed as part of the Shaping Future Transportation initiative by Daimler Trucks to conserve resources, reduce emissions of all kinds and at the same time ensure the highest possible level of traffic safety. The exciting capabilities of the Future Truck 2025 are demonstrated by the world premiere of this near-series study, as it operates at regular speeds of up to 80 km/h in realistic traffic situations on a section of the A14 autobahn. Mercedes-Benz will unveil the complete study of the Future Truck 2025 at the International Commercial Vehicle Show (IAA) in September.

Transport and traffic – today and in the future

Is there a danger of gridlock in the future? Nobody can be certain. But experts agree on one contributing factor: forecasts for the future development of goods traffic in Europe suggest that it will increase considerably. There is also agreement on a second aspect: the main burden of this will fall on road transport, as a transfer to other means of transport only appears possible to a limited extent.

Figures already available now carry a clear message. In its latest study carried out in 2012, Eurostat, the statistical office of the European Union, puts a figure of around 76 percent on road goods traffic as a proportion of total goods traffic in the EU. In the six most heavily populated EU member states the proportion varies from 66 percent in Germany to 96 percent in Spain.

In its recently published "2030 traffic forecast", the German ministry of transport expects a future increase in the truck transport volume by 39 percent in Germany alone. In their "World Transport Reports" scenario, the experts at the independent Swiss business consultancy ProgTrans expect an increase in goods traffic in the EU by around 20 percent between the crisis year of 2008 and the year 2025. Other sources such as the Ifmo study predict an annual two percent increase in the EU given dynamic economic development. This adds up to a 50 percent increase in the next 20 years, doubling the current level of demand for transport by the year 2050. Within this period, even an annual growth of only 0.7 percent means an increase in transport volume by just under 30 percent.

Investment in the transport infrastructure is however regressive, as the statistics show: while it amounted to 1.5 percent of the EU's gross domestic product in 1970, the figure has roughly halved in the meantime. In recent years the network of motorways and long-distance highways in the large nations of the EU has hardly grown. We are all familiar with the results: the roads are over-congested,

especially in the densely populated regions of Western Europe. In Germany alone, the length of traffic tailbacks on motorways and major highways totalled just under 600,000 km, and drivers spent a total of 230,000 hours standing in tailbacks. On working days many busy sections of motorway have to cope with between 150,000 and 200,000 vehicles per day, more than 20,000 of which are trucks.

Transport businesses suffering from cost pressure and a shortage of drivers

The overloaded infrastructure is just part of the future scenario. It is exacerbated by increasing cost pressure on businesses in the road goods transport sector. Fuel prices and toll fees are tending to increase, and trucks are becoming more expensive owing to new and increasingly stringent legal requirements: This is shown by the introduction of the Euro VI emission standard early this year. Moreover, an electronic stability programme will become mandatory this year, followed next year by AEBS (Advanced Emergency Braking System) and LDWS (Lane Departure Warning System).

Prof. Dr.-Ing. Uwe Clausen, director of the Fraunhofer Institute for Material Flow and Logistics (IML): "The transport and logistics sector benefits today from substantial advances achieved by commercial vehicle manufacturers in the recent past. I am referring here in particular to fuel-efficient trucks whose noise levels have been reduced once again and which produce substantially less emissions than earlier generations of vehicles. Efficiency levels which would have seemed virtually impossible only a few years ago have since been attained here. For the future course of development it is important to consider vehicles in the overall context of the logistics chain and the transport system. The central aspects within these systems are data processing and communication, navigation and interaction between vehicles. The potential for increasing efficiency in the future lies not in the vehicle alone but in the interaction of vehicles, infrastructure and logistics systems."

At the same time companies are lacking professionally qualified drivers. The reasons are the demographic trend, tough requirements for obtaining a licence as a professional truck driver, modest earnings, working hours unsuited to family life and, not least, the low professional image that society gives to truckers.

The transport system of tomorrow will be networked and autonomous

As transferring road goods traffic to other means of transport is only possible to a limited extent, the only alternative is to make better use of the existing infrastructure, introduce more networked assistance and telematic systems, and make truck driving a more attractive profession. At the same time new opportunities are created by new communication technologies: Vehicle-to-Vehicle and Vehicle-to-Infrastructure, also known as V2V and V2I. It is particularly these new intelligent networking possibilities that scientists and vehicle developers consider to have considerable potential for establishing autonomous vehicles.

Prof. Dr. Sabina Jeschke, Director of the faculty of information management in mechanical engineering at RWTH: "Together with a number of remarkable breakthroughs such as the IBM computer Watson or the Google Car in the last two years, we are entering a new era in artificial intelligence – namely mass networking. Daimler's Bertha Benz journey must also be included. The "Internet of Things" plays an important role in this. It represents an expansion of the internet: the participants are no longer just people, but also things – such as the sensor system in a car, climatic data stations, process data systems in production engineering, and other systems that directly interact with the environment. Completely new forms of cooperation between technical systems are made possible on this basis – and especially when it comes to road traffic and mobility."

With its "Highway Pilot" system, the Mercedes-Benz Future Truck 2025 is an intelligently conceived and realistic response to current developments – it communicates with its environment and drives autonomously. In the future, connectivity and Big Data Management in a tailor-made vehicle and services package will be decisive factors for our customers. Connectivity is the key to increased efficiency.

The way towards this has been prepared by the already available assistance and telematic systems. Proximity Control Assist, Stop-and-Go Assist, Active Brake Assist 3, Lane Keeping Assist and three-dimensional maps for the Predictive Powertrain Control system are already in place, as are FleetBoard telematic products ranging from vehicle management and transport management to apps for the driver and operator. Daimler Trucks was the trailblazer in the development of all these systems. The next step is therefore logical: they are now being linked to each other and expanded, with cameras and sensors developed further and networked. This is rounded off perfectly by V2V and V2I communication and a digital map. In this way the truck of the future will be linked to all aspects of its environment.

Semi-autonomous driving already occurs now in day-to-day motoring: many modern cars are able to park autonomously on command. The technology finds a suitable parking space and steers the car into it, while the driver only needs to acccelerate and brake - one example is Active Park Assist from Mercedes-Benz. Stop-and-Go Assist automatically keeps the vehicle in station in e.g. tailbacks. Our customers are already confirming their acceptance of these intelligent systems to us today – by ordering our assistance systems to a major extent.

The Mercedes-Benz Future Truck 2025 – tomorrow's technology today

Autonomous driving has long been far from science fiction at Daimler. Autonomous driving with long-distance trucks will be a reality in ten years time. The Mercedes-Benz Future Truck 2025 study, which is close to reality, has already absolved this stage. It is technologically based on the 2014 Mercedes-Benz Actros. It demonstrates the future-proof concept of Europe's leading long-distance truck, which has set the standard for cost-effectiveness, safety and ease of operation since its market launch in 2011.

The Mercedes-Benz Actros - basis for the near-series study

The technological basis for the Future Truck 2025 with "Highway Pilot" is the Mercedes-Benz Actros 1845. Its engine develops 330 kW (449 hp) and a maximum torque of 2200 newton metres. Power is transferred by the fully automated 12-speed Mercedes PowerShift 3 transmission, which is standard equipment.

Its unusual semitrailer already provides a visual outlook on the near future. Mercedes-Benz presented the Aerodynamics Trailer two years ago, as a world premiere at the International Commercial Vehicle Show (IAA). Aerodynamically optimised, it is able to reduce the fuel consumption of the complete semitrailer combination by up to five percent. The overall package consisting of the Mercedes-Benz Future Truck 2025 and Mercedes-Benz Aerodynamics Trailer allows the advantages of both to be perfectly combined into the semitrailer combination of tomorrow.

Still veiled in secrecy

For demonstration drives on the roads, the Future Truck 2025 is still disguised – it is clad in black-and-white adhesive foil to obscure the exterior contours. In the interior, a protective shroud conceals the

cockpit from inquisitive glances. However, additional monitors already give an advance indication that this is the workplace of the combined driver and transport manager in the truck of the future. The new Actros already makes a visual distinction between the driving and living areas. In the future the cab will also include a comfortable and functional working area for autonomous driving phases.

Moreover, the coming EU length restriction for trailer and semitrailer combinations allows additional aerodynamic improvement measures. The Aerodynamics Trailer will benefit from this. As will the Future Truck 2025 in its final and spectacular version. It will celebrate its world premiere in September, at the International Commercial Vehicle Show (IAA).

Eyes front: radar sensors and a camera scan the road ahead

The technical features are decisive for the outstanding capabilities of the Mercedes-Benz Future Truck 2025 as an autonomous vehicle. A radar sensor in the lower area of the front end scans the road ahead at long and short range. The front radar sensor has a range of 250 m and scans an 18-degree segment. The short-range sensor has a range of 70 m and scans a 130-degree segment. The radar sensor is the basis for the Proximity Control Assist and Emergency Braking Assist already available today.

The area ahead of the truck is also scanned by a stereo camera located above the dash support behind the windscreen. This is currently the location of a mono-camera if the optional Lane Keeping Assist is ordered. The range of the stereo camera is 100 m, and it scans an area of 45 degrees horizontally and 27 degrees vertically.

The stereo camera of the Mercedes-Benz Future Truck 2025 identifies single- and double-lanes, pedestrians, moving and

stationary objects, all objects within the monitored area and also the condition of the road surface. The camera recognises everything that contrasts with the background, and is therefore also able to measure clearances precisely. The front stereo camera also registers the information on traffic signs.

In addition to object and distance recognition, the stereo camera recognises lane markings as a major function for autonomous track guidance.

The road surface to the left and right of the truck is monitored by radar sensors installed in the sides. They are located on the left and right, ahead of the tractor unit's rear axle. The sensors have a range of 60 m and cover an angle of 170 degrees.

Multisensor fusion: fusion of the data from all sensors

The sensors are networked (multisensor fusion), and provide a complete image of the surroundings. All moving and stationary objects in the truck's vicinity are registered. Fusion of the data from the front radar sensor, side radar sensors and front camera by a high-performance multi-core processor in the central computer provides a continuous view of the entire area in front of and beside the truck. For comparison, the human eye has a 150-degree angle of vision, but its focal area is merely a fraction of this.

The sensor system of the Mercedes-Benz Future Truck 2025 already comes from the next generation of this technology. The sensors work so precisely that they can not only recognise the road edge by the marker lines, but even identify the course of the road surface by the roadside features (e.g. guard rails or vegetation).

The sensor and camera technology is active throughout the speed range from standstill to the legally permitted maximum truck speed of 80 km/h. By intervening in the steering, it automatically keeps the

truck safely in the centre of its lane. The system also includes a three-dimensional digital map, which is already used for the assistance system Predictive Powertrain Control (PPC). This means that the truck is always fully aware of the road's course and topography.

In addition the digital map and the information from multisensor fusion are used to determine the truck's own position.

V2V – vehicle-to-vehicle communication

The "Highway Pilot" is ideally partnered with V2V and V2I networking. Every vehicle equipped with this in the near future will transmit continuous information to its surroundings, the CAM (Corporate Awareness Message). The vehicle uses this to announce its presence. The information content includes vehicle position and model, dimensions, direction of travel and speed, any acceleration and braking manoeuvres and the bend radii negotiated.

The frequency of information transfer depends on the vehicle speed and the intensity of any changes in its movement. It varies between one message per second when cruising to ten times that interval when changes are significant.

Transmission is via WLAN technology, using the standard, Europe-wide G5 frequency of 5.9 gigahertz. The basis is the ITS Vehicle Station (Intelligent Transport Systems and Services) on board the vehicle. Communication between vehicles is also standardised following an agreement between a consortium of automobile manufacturers, suppliers, public organisations and research institutions.

Predictive driving – fast reactions

The range of these continuous messages is a radius of around 500 m. The vehicles inform each other about their movements, so that they can respond to them immediately in advance. This includes e.g. reacting to vehicles joining a motorway, or when approaching the end of a traffic tailback. Each of these messages certified to prevent misuse. Transmission to this distance also works in unfavourable weather conditions.

If necessary the continuous reports are overlaid with DEN messages (Decentralized Environmental Notification). These give a warning of unusual events, for example emergency braking, activation of the hazard warning system or switching on fog lamps.

V2I – communication between the truck and infrastructure

V2I means that all these messages and signals are also sent to external recipients such as traffic control centres. These are then able to respond flexibly, for example by changing the speed limit or opening up additional lanes. Messages can also be sent to the vehicles, for example about daytime or temporary roadworks.

If the next relay station for V2I is out of direct range, the information is relayed via other vehicles in the form of a transmission chain. If there is no WLAN network, transmission is by mobile technologies such as UMTS and GPRS.

All these data inform the driver or the onboard computer about events happening outside the range of vision in good time. The driver and vehicle are therefore aware of problems in advance, before they can become a hazard.

The Mercedes-Benz Future Truck 2025 is therefore not on the road in isolation, but constantly communicates with its environment, unnoticed by the driver. Just as it sends information about its own movements and journey to other vehicles, it receives signals showing the movements of other trucks and any other vehicles. The result is real-time communication between the networked vehicles that cannot be matched by even the most precise radio traffic reports.

In this way information about sluggish and slow-moving traffic is passed between vehicles in advance, also data on tailbacks and their length and duration, or on roadworks – the data are available to all road users. As the networked vehicles respond automatically, a steady traffic flow and efficient use of the limited infrastructure are ensured, better than even the most sophisticated traffic management systems can currently achieve. In the event of major problems, early information is provided about automatically initiated route changes to the destination or recommended diversions. In combination with autonomous driving, road traffic will develop into a self-learning system.

The average transport speed will be increased by the improved traffic flow alone, without raising the speed limit, and at the same time the smoother flow will save fuel. This benefits all parties involved in the goods transport sector: the transport operators and their drivers, dispatchers and customers.

The future as a reality: autonomous driving in practice

After joining the motorway, the driver of the Mercedes-Benz Future Truck 2025 merges with the traffic flow in the appropriate lane. The truck reaches the prescribed speed of 80 km/h. The system then prompts the driver to activate the "Highway Pilot". The driver activates it, and the vehicle switches to autonomous mode. The driver receives an acknowledgement reading "Highway Pilot active".

The Future Truck 2025 is on the road independently according to the traffic situation, as no vehicle travelling ahead is needed as a reference to guide it through the traffic – it literally acts autonomously. The Mercedes-Benz Future Truck 2025 operates independently of other road users thanks to networking, not by being daisy-chained with a lead vehicle.

If there is another vehicle travelling ahead, the truck automatically adapts to its speed within the permitted limit and maintains a set safety distance. It is therefore always possible for other vehicles, e.g. a car cutting in ahead when moving from the overtaking lane before an exit, to do so safely. Here too the safety distance is always maintained – the Future Truck 2025 adapts perfectly to its environment.

Autonomous travel: driving and working at the same time

As soon as the "Highway Pilot" system has been activated, the driver is able to pivot the driver's seat to the co-driver's side by 45 degrees, into a working or resting position. In the cockpit of the future, which has a completely newly designed centre console in the style of an office workstation, the driver is now able to use a removable tablet computer with a touchscreen for other activities such as communicating with the outside world. The new cockpit also gives the driver considerably more freedom of movement.

Networked with all other road users

Even before departure, the schedulers have used telematic systems to transmit the current transport assignment to the vehicle, where it is shown to the driver on the integrated display. The destination address is sent to the navigation application in the data cloud. The navigation computer calculates the most efficient route using real-time information from the networked vehicles on the road.

Networking between vehicles ensures that both the truck with its host computer and the driver are always informed about the route ahead. The same applies to any major events behind the truck – for example an approaching emergency vehicle where traffic is tailed back. The truck's control system is able to respond to such events and leave the traffic lane for a brief period. While on the move, the driver always has further information such as remaining driving time, range or preferred service areas along the route available.

In the Future Truck 2025 too, the driver is the boss in the cab. It must always remain possible for the driver to resume manual control. Two cameras therefore monitor the cockpit and a sensor the driver's seat.

Autonomous overtaking manoeuvres are not envisaged, they must be performed by the driver. The same applies to leaving the motorway or changing lanes where the road forks.

Before deactivation of the "Highway Pilot", the driver is given advance visual notification followed by an audible warning to resume manual control of the truck. This could become necessary if the situation changes and requires increased vigilance or resumption of control owing to e.g. roadworks or obstacles on the road. Autonomous driving is anyway a "can" function – the driver can always decide freely whether to take personal control or leave things to the technology.

The driver is notified in good time when approaching the relevant exit road. The driver returns the driver's seat to the driving position and assumes direct control of the truck, like the pilot of an aircraft before landing.

From driver to transport manager – premiere in the cockpit of the future

Already today, drivers are supported by comfortably equipped, climatised cabs, assistance systems such as Proximity Control Assist, Stop-and-Go Assist and fully automated transmissions.

Dr. Ing. Klaus Ruff, deputy head of prevention at the trade association for commercial transport, says it clearly: "The working day of a truck driver is demanding and stressful: the need for constant attention, monotony on long journeys, often unclear situations in dense traffic, constant noise, day and night shifts are just some of the aspects. Modern assistance systems relieve driver stress and therefore help to improve traffic safety. Despite higher traffic densities and an approx. 80 percent increase in transport volume in the road goods traffic sector, the number of road users killed or seriously injured in accidents involving trucks has been reduced by almost half. There are many indications that further development of such assistance systems and their intelligent networking will continue this positive trend in the future."

Truckers have long placed great confidence in these stress-relieving assistance systems, and use them as a matter of course. Because irregular working hours, a sedentary occupation and mental stresses take an above-average toll in this profession, subjecting truck drivers to serious health risks. Mercedes-Benz already minimises these professional risks with its excellently equipped trucks today, and is the trailblazer not only in the goods transport sector, but in the entire commercial vehicle industry, when it comes to ergonomic and comfortable cockpit design and a high level of active safety thanks to intelligent assistance and telematic systems. A technological lead that is also paving the way for autonomous driving.

In many situations autonomous driving relieves the driver of "having to" drive, especially on tiring and often monotonous long-distance routes. As the truck regulates its own speed and automatically finds the best route using a navigation app, and because the transport company, dispatcher and goods recipient are constantly informed about the location, route and expected time of arrival in real time, the driver is relieved of time pressure. Today this is a major stress factor for drivers.

Dr. Ing. Klaus Ruff: "Autonomous driving will inevitably also change the job profile of truck drivers. They will gain time for other activities than just driving the truck: office work, social interaction, relaxation periods. Autonomous driving will make the driver's working time more varied and less stressful, and help to make long-distance driving more attractive as a profession. Only time will tell whether it can solve the major current problem, the shortage of drivers."

Mobile office in the Future Truck 2025

With the Mercedes-Benz Future Truck 2025 the driver is not only relieved of monotonous chores, but also gains time for other tasks or for communication with the outside world. To do this the driver switches from "workplace steering wheel" to "workplace office". Activities might include tasks that were previously the preserve of dispatchers, or social contact with friends, family and colleagues. Owner drivers in particular can do their office work conveniently while on the move if needed, no longer working in the evenings or on weekends, and without delegation to others. The magic words are connectivity and networking. The "Highway Pilot" system is "always on" if required. Invoicing the last transport assignment or completing last month's VAT return while on the move – no longer a fantasy for the future, but reality.

Carrying out further activities will significantly change the professional profile of the truck driver. This will in turn give rise to opportunities for advancement from the purely driving role to transport manager. For the dispatchers and customers of a freight forwarding company, the driver will therefore change from a transporter and machine operator to a qualified transport manager, upgrading the entire profession. The profession of truck driver will become more attractive – autonomous driving is therefore also a compelling answer to the shortage of drivers.

Using electronic media, the driver is also able to conveniently communicate with other people. Drivers can e.g. make arrangements to meet for a break, make appointments, obtain information about the traffic situation or loading and unloading points, or attend to private matters. The many possibilities for social activities are another important benefit of autonomous driving.

One of these is the ability to reserve a parking space in a service area or truckstop while on the move. The driver will be able to take a look at the online menu in advance, reserve a washroom and order a meal for the appropriate time. An acknowledgement is sent directly to the cab, including the parking space number and time.

Much more relaxed driving will have a positive effect on the health of drivers. The stress factors involved in purely driving activities on Europe's arterial roads will be considerably reduced. The change in seating position during autonomous driving also means that the driver is no longer condemned to the same posture, but gains freedom of movement and can even perform light relaxation exercises while on the move.

With autonomous driving, the truck and its driver become a team more than ever before, an intelligent, highly capable and cost-effective combination of man and machine.

Lower fuel consumption and emissions – more efficiency and safety

At the same time fuel consumption and emissions are significantly reduced during autonomous driving, thanks to the more homogeneous traffic flow. Transport times will become more predictable. The major assemblies of the trucks concerned will also be subjected to less wear thanks to a consistent driving style. The new activities carried out by the driver or transport manager during journeys will also revolutionise the freight forwarding sector, making it a dynamic and self-learning system.

The advances in efficiency already in place with the new generation of Mercedes-Benz trucks, thanks to e.g. Euro VI and assistance and telematic systems such as Predictive Powertrain Control, improve the effectiveness of the "Highway Pilot" system even further. Already today a fuel saving of up to 15 percent is possible with FleetBoard operational analysis and FleetBoard Eco Support. This means that the Mercedes-Benz Future Truck 2025 is arriving at just the right time: After all, the European Commission has just recently presented its strategy for the reduction of fuel consumption and CO_2 emissions. The Mercedes-Benz Future Truck 2025 is a convincing answer to this.

V2I communication and an "always on" internet connection will open up new possibilities for companies to address the increasing cost pressure. For example, the driver and truck are always connected to their headquarters if required. This allows perfect route and trip planning, e.g. in conjunction with telematic services such as FleetBoard. It also opens the door for anticipatory diagnostic and maintenance work. Software updates can e.g. be conveniently transferred en route, making a visit to the workshop unnecessary.

And not least, traffic flows on long-distance routes that are predictable for all road users mean more safety for all those involved. Already today, assistance systems regulate vehicle speeds and are able to automatically initiate emergency braking to prevent accidents. Both have proved their worth for a number of years. Autonomous driving stands for system perfection by fusion of the assistance systems: machines make fewer mistakes than people, their attention never lapses, and they do not react emotionally or depending on mood and fitness level, but rather predictably.

In the future, accidents caused by human error will therefore be substantially a thing of the past. Safety regulations such as speed limits or safety gaps between vehicles will always be strictly adhered to. Anticipatory driving, a recurring theme in driver training courses, means programmed safety and cost-effectiveness for the Mercedes-Benz Future Truck 2025.

This will continue the positive trend in accident statistics. While the volume of road goods traffic has increased, the number of road users injured or killed in accidents involving trucks continues to decline. In Germany, for example, the volume of road goods transport has increased by around 80 percent in the last 20 years. In contrast the number of seriously injured has fallen by more than 40 percent, and fatalities even by over 50 percent. It is very noticeable that the figures began to decline rapidly from 2000 – as trucks started to be equipped with assistance systems for which Mercedes-Benz was above all the driving force.

Conditions necessary for autonomous driving

The stages leading from manual to autonomous driving must be flanked by legal provisions. The technical preconditions are now being demonstrated for the first time with the Mercedes-Benz Future Truck 2025, however legislation needs to be adapted to this new dimension in driving. A further development of the 1968 Vienna Convention on Road Traffic, which almost all European countries have signed and implemented, is already under way. The Convention is intended to make road traffic safer by standardising the regulations, and one of its core principles is this: the driver must have control of the vehicle at all times, and under all circumstances.

On the basis of the Vienna Convention on Road Traffic, UN/ECE Regulation R 79 for steering systems only permits corrective steering intervention, but not automatic steering at speeds over 10 km/h. This allowance is a precondition for Parking and Stop-and-Go Assist.

The Vienna Convention came about at a time when autonomous driving was still in the realms of science fiction. The USA was never a signatory to the Vienna Convention on Road Traffic. In several federal states it has therefore been possible to formulate regulations at least for trial operation of autonomous vehicles on public roads.

A committee of United Nations experts has recently supplemented the Vienna Convention on Road Traffic, providing the basis for legalisation of autonomous driving. Corresponding systems will be permitted in the future, as long as they can be deactivated or overruled by the driver at any time. This is part of the standard programming for the "Highway Pilot" in the Mercedes-Benz Future Truck 2025.

Data security must also be ensured in technical and legal terms. This concerns external access to the individual vehicle, and also the transfer of data for V2V and V2I or internet communication.

In addition to operating permission it will be necessary to clarify other legal aspects such as liability for traffic infringements and accidents, which can never be completely eliminated. The same applies to insurance and product liability aspects. How new working models and professional profiles are to be reconciled with the current, rigid regulations on driving and resting times also remains to be defined.

Autonomous driving: Daimler as an innovator

The leadership of Mercedes-Benz and Daimler in the field of assistance and telematic systems, and on the way to autonomous driving, is recognised. For example, Daimler was recently cited as the most innovative company in the categories of "Vehicle concepts" and "Safety systems" in a study by the Center of Automotive Management and the business consultants Pricewaterhouse Coopers. The market research company Frost & Sullivan sees Daimler as one of the leaders in the development of car-to-car communication. In their study the researchers expect more than 40 percent of all vehicles to be equipped with car-to-car communication by 2030 – a precondition for perfecting autonomous driving.

In view of the specific operating parameters, road goods traffic occupies a special position where autonomous driving is concerned. The almost identical speed of trucks, Europe-wide goods traffic covering long distances, long periods of time spent in the vehicle and other activities associated with road goods transport make the truck ideal for the introduction of autonomous driving. This is assisted by the heavily structured, junction-free environment provided by motorways and long-distance highways, whose users are clearly defined.

Autonomous driving is not being viewed and developed in isolation by Mercedes-Benz Trucks. Daimler AG is conducting research and development in different areas of this field, and from different points of view. Numerous examples confirm the company's leading role. One of these is the Mercedes-Benz S-Class S 500 Intelligent Drive. Last year this car autonomously covered the legendary, approx. 100 km Bertha Benz route from Mannheim to Pforzheim, with a combination of inter-city and urban traffic. A pioneering step 125 years after the first long-distance journey by automobile.

Daimler had the project management role in simTD, a large-scale trial of V2V and V2I communication involving around 120 vehicles in the greater Frankfurt area. This was successfully concluded last year.

Daimler is also working on highly precise vehicle location. GPS data currently achieve a precision within decimetres, which is already amazing in itself. For exact autonomous driving it is however necessary to achieve a precision within centimetres, recalculated every one tenth of a second. Continuous updating of the necessary three-dimensional maps is also required. The vehicles themselves can take part in this with V2I communication, by immediately reporting even the smallest changes on their route.

During the development of the Future Truck 2025 with the "Highway Pilot" system, the engineers at Mercedes-Benz Trucks are in constant dialogue with their colleagues in the passenger car sector. They work hand in hand, and are active in the same committees and advisory bodies. The systems and platforms for communication and sensor systems are anyway uniform. However, the developers take their own sector-specific approach where necessary, owing to the very different requirements for passenger car and goods traffic.

Autonomous driving: already a reality tomorrow

One of the most interesting questions on the subject of autonomous driving is the time horizon envisaged for its realisation. In purely technical terms, turning it into reality on the roads is already feasible within around five years. This time window corresponds to passenger car development cycles, where a possible start in 2020 is envisaged. Owing to the more complex factors for heavy commercial vehicles, the time horizon will however be rather longer – realistically an implementation is possible within ten years, also in view of the legal considerations that still remain to be clarified.

This short time period means this: Truck drivers currently aged around 50 will become familiar with autonomous driving during their professional lives. For all younger drivers it will one day become a day-to-day part of professional life – giving them the opportunity to work as transport managers.

The introduction of autonomous driving will not happen digitally from one day to the next, as development is continuously in progress: evolutionary stages are necessary to revolutionise goods traffic on the roads. In the coming years, in the same way as developments so far, new and improved assistance systems will prepare the clearly defined path to autonomous driving.

Mercedes-Benz Trucks: leading the way in assistance and safety systems

Mercedes-Benz has traditionally taken the lead in new safety and assistance systems, and in improving the driver-friendliness of commercial vehicles. The matter at hand is no less than the improvement of human capabilities by technical means. Know-how obtained by decades of development work is the basis for revolutionary developments like automated driving. It builds on the available assistance systems as a logical further development, and consolidates their capabilities.

As early as 1981, Mercedes-Benz was the first manufacturer to introduce the anti-lock braking system ABS for trucks. A few years later this was followed by acceleration skid control ASR. With the introduction of the first Actros series in 1986, Mercedes-Benz once again set new standards with the Electronic Braking System EBS including disc brakes all-round, a fast-responding high-pressure braking system and roll control.

In 2000 these were followed by Proximity Control Assist and Lane Keeping Assist as further revolutionary safety systems. Only one year later came the debut of stability control – the Electronic Stability Program ESP for trucks.

In 2002 the second generation of the Actros introduced the hill holder as a starting aid and Brake Assist. In 2006 Active Brake Assist ABA ushered in a new era for safety systems: For the first time, a truck was able to brake automatically when approaching a slower-moving vehicle ahead. Between 2009 and 2012 the functions of Active Brake Assist were gradually extended. Today the new Mercedes-Benz Actros with ABA 3 automatically initiates emergency braking if there is a danger of a rear-end collision with a moving or stationary obstacle ahead. In 2011, together with the new Actros,

Mercedes-Benz also introduced the drowsiness detection system Attention Assist. As an extension of Proximity Control Assist, Stop-and-Go Assist now relieves the driver of tedious starting and stopping in e.g. tailbacks.

In parallel with its assistance and safety systems, Mercedes-Benz Trucks has also continuously set trends for simplified operation and driver-friendliness, making for improved cost-effectiveness. In 1985 the electropneumatic gearshift EPS revolutionised operation of the transmission: nudging a shift lever knob and briefly operating the clutch was enough to change gear. By 1996 this stage was in turn made redundant by the introduction of the fully-automated transmission. From 2008 the fully-automated gearshift was developed further in the form of the PowerShift transmissions, and perfected in subsequent years. The current Mercedes PowerShift 3 in the new Actros has different transmission modes, and can therefore be individualised to suit different operating profiles. The EcoRoll mode puts the transmission into neutral in defined situations on slight downhill gradients, and reengages the gear when appropriate.

The current masterstroke in assistance systems is Predictive Powertrain Control (PPC). This technology networks the three-dimensional GPS data of the route with the current vehicle data and powertrain, predictively regulating the gearshifts according to the topography, and allowing fuel savings of up to five percent.

Systematic implementation of further technical developments – we do what we promise

A look back at the spectacular technical workshops shows how systematically Daimler Trucks develops new assistance, safety and operating systems, and makes them a practical reality. During the technology days in 1999 and 2005, Mercedes-Benz used driving demonstrations and studies to present numerous innovations which almost without exception entered series production in the following

years. As early as 1999, these included ESP, Lane Keeping Assist and distance control. Examples six years later included the emergency braking system Active Brake Assist, Stop-and-Go Assist for automatic starting and stopping in a traffic tailback, or predictive cruise control now known as Predicitive Powertrain Control (PPC). There are other systems still under development and test which will make operation of the truck of tomorrow even more cost-effective and safe.

Autonomous driving – commercial vehicles as the vanguard

Heavy commercial vehicles are the vanguard on the road to autonomous driving. Their advantages: Many operations take place within company sites, off the public road network. One research project in 1999 that was not yet mature enough for series production was "Promote Chauffeur", an early attempt on the way to autonomous driving: an "electronic drawbar" coupled two truck/trailer combinations. The lead vehicle was steered, while the second vehicle followed it and was fed with all the data from the lead vehicle. Its steering, acceleration and braking followed the lead vehicles, and depending on speed it maintained a distance of between six and 15 metres.

The coupling system was electronic on the basis of early sensors, data transfer and vehicle control systems. The trucks were connected by radio, and their onboard computers communicated with each other. Two video cameras in the following vehicle kept a constant eye on a distinctive pattern of infrared lamps on the rear of the lead vehicle. Daimler researchers using a 7.5-tonne demonstration vehicle already showed in 1994 that trucks can be electronically coupled.

Already in those years, autonomous driving was about to achieve a first breakthrough away from the public roads: in enclosed areas, semi or fully automated trucks with or without drivers became conceivable for transporting containers, bulk commodities or hazardous materials. The idea already became a reality in 2001: since then, two Mercedes-Benz vehicles have carried out on-site transport duties in a company based in Ulm. Guided by transponders, they cover a defined stretch between the warehouse and plant at a speed of 5 km/h. On a large scale, these trucks are similar to the driverless transport systems encountered in e.g. automobile production. Autonomous vehicles are now also a familiar sight in container ports – though not on the public roads. This spectacular next step is now being taken with the Mercedes-Benz Future Truck 2025.

The answer: Mercedes-Benz Future Truck 2025

The Future Truck 2025 with the "Highway Pilot" system is the answer to the challenges of the future. The answer to increasing traffic, inadequate infrastructures, increasing cost pressure and a shortage of drivers.

On the basis of the current Mercedes-Benz Actros, further developments of its numerous assistance and telematic systems and V2V/V2I communication, a new era in road goods transport and communication is being ushered in. In the future traffic will flow more smoothly, predictably and safely. Traffic systems will become more flexible, with better use of the infrastructure. Avoidance of human error at the wheel will reduce hazards and accidents. Transport operators will operate more cost-effectively and flexibly. Truck drivers will be able to assume different tasks as transport managers. More than ever before, they will form an independent and highly effective unit with their truck. This answer is not just a vision, as it is already too real.

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