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Press release

IAA 2017: New conceptions for mobility – Bosch business benefits from transformation of mobility

Two billion euros in sales with automated driving

September 12, 2017
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- Bosch mobility business to increase sales 7 percent in 2017
- Bosch CEO Denner: “Not just building better cars, but also rethinking mobility. Bosch is in good shape for present and future mobility.”
- Market penetration of electromobility continues to gain speed

Stuttgart and Frankfurt, Germany – In the transformation of mobility, Bosch is a driving force. With solutions for the road traffic of the future, Bosch is already growing twice as fast as the market. In 2017, the sales of the Mobility Solutions business sector are expected to increase by 7 percent to some 47 billion euros. Over the same period, global vehicle production will grow just 2.8 percent. “Our business with the automotive industry continues to grow, and will remain strong. This stands us in good stead for the mobility of the future,” says Dr. Volkmar Denner, chairman of the Bosch board of management. The business with driver assistance systems is growing especially strongly at present. These systems are the forerunners of automated driving. Market growth here is 25 percent, and at Bosch it is even higher. As early as 2019, the supplier of technology and services will generate sales of two billion euros with driver assistance systems. By the end of the year, the number of R&D associates in the company’s Mobility Solutions business sector is set to rise nearly 10 percent, to 48,000 people. Technically speaking, the path to accident-free, stress-free, and emissions-free mobility will come through automation, electrification, and connectivity. “It’s not just a case of making better cars. We need new conceptions of mobility,” the Bosch CEO adds.

Bosch solutions for accident-free, stress-free, and emissions-free traffic

Whether traffic jams, accidents, air pollution, or climate change – Bosch already has solutions and services to deal with the current and future challenges of road traffic. “If we want to remain mobile in the future, we have to change our mobility now,” Denner says. One important task right now is to improve air quality in our

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cities. Bosch wants to help do this, both by improving the combustion engine and by stepping up its efforts in the electromobility field. With a view to the current debate about driving bans and the future of combustion engines, Denner says: "For us, it's not just the one or the other. We want to keep our technological options open, and not restrict ourselves to a single path." When it comes to emissions and imissions from combustion engines, significant progress can be achieved with synthetic fuels. These are produced with the help of renewable energy, and can make combustion engines CO_2-neutral. In addition, synthetic fuels can be designed to burn practically soot-free. In this way, the cost of exhaust-gas treatment can be reduced. "Synthetic fuels can be used with existing filling stations and, most importantly, with currently existing engines. Their positive effect is thus faster than if we completely renew the infrastructure and the vehicle fleet," Denner says.

The market penetration of electromobility continues to gain speed. The new Bosch e-axle makes the electrical powertrain more efficient and cost-effective for automakers – and thus also for anyone who wants to drive electrically. For light electromobility applications, Bosch has developed a flexible and easily scalable 48-volt powertrain system based on components already tried and tested in production. Bosch already has a leading position in China, the world's largest market for electromobility. In Europe, Bosch supplies the powertrain system for the continent's largest electric-vehicle fleet, the German Post Office's Streetscooters.

With driverless parking, Bosch is paving the way for autonomous driving

At Bosch, automated driving is also taking on increasingly concrete shape. Together with Daimler, the world's biggest automotive supplier will be launching highly automated fleets of shared vehicles on urban streets at the start of the next decade. This will improve traffic flows and contribute to greater safety. According to a global survey, half of all consumers would welcome such a self-driving car that relieves drivers of tasks and steers through traffic. Bosch has already taken the first steps toward autonomous driving: from the start of 2018, cars in the Mercedes-Benz Museum parking garage in Stuttgart will look for a parking space and park themselves, without a driver. This cuts out stress, and makes more efficient use of parking space – the same amount of space can accommodate up to 20 percent more vehicles. This automated valet parking is made possible by the intelligent parking-garage infrastructure supplied by Bosch. "Bosch can do more than cars. We are using the company's entire range of technologies to put innovative mobility solutions into practice," Denner says.

As easy as using a smartphone: software updates from the Bosch cloud

This approach also applies to connectivity. Over the next five years, the market for connected mobility will grow by almost 25 percent each year. This means that global sales will rise from 47 to 140 billion euros (source: PwC). Like no other company in the automotive industry, Bosch has the sensor, software, and services expertise that this requires. Even now, 1.5 million vehicles are connected using Bosch IoT software. Vehicle connectivity makes many mobility services possible. Cars will become personal assistants. "'Just driving' was yesterday. By connecting cars with smart homes and offices, we are turning them into a third living environment," Denner says. Soon, connectivity will mean that vehicles handle repair-shop appointments digitally, using the new Bosch "software over the air" service. This will allow vehicle data to be updated securely and reliably, in the same way as smartphones are now. And it will be possible to download additional functions, such as a parking-space search engine. And by using software over the air, drivers will be able to reconfigure their cars in the future. At Bosch, connectivity extends far beyond the hood. With services such as Coup, the e-scooter sharing service that is now revolutionizing urban traffic in Berlin and Paris, Bosch is becoming a mobility services provider. Studies estimate that the mobility services market will grow by an annual 28 percent worldwide (source: McKinsey).

Related links:

www.bosch-iaa.de

Press kit IAA 2017

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Mobility Solutions is the largest Bosch Group business sector. In 2016, its sales came to 43.9 billion euros, or 60 percent of total group sales. This makes the Bosch Group one of the leading automotive suppliers. The Mobility Solutions business sector combines the group's expertise in three mobility domains – automation, electrification, and connectivity – and offers its customers integrated mobility solutions. Its main areas of activity are injection technology and powertrain peripherals for internal-combustion engines, diverse solutions for powertrain electrification, vehicle safety systems, driver-assistance and automated functions, technology for user-friendly infotainment as well as vehicle-to-vehicle and vehicle-to-infrastructure communication, repair-shop concepts, and technology and services for the automotive aftermarket. Bosch is synonymous with important automotive innovations, such as electronic engine management, the ESP® anti-skid system, and common-rail diesel technology.

The Bosch Group is a leading global supplier of technology and services. It employs roughly 390,000 associates worldwide (as of December 31, 2016). The company generated sales of 73.1 billion euros in 2016. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT company, Bosch offers innovative solutions for smart homes, smart cities, connected mobility, and connected manufacturing. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiaries and regional companies in some 60 countries. Including sales and service partners, Bosch's global manufacturing and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. At 120 locations across the globe, Bosch employs some 59,000 associates in research and development.

Additional information is available online at www.bosch.com, www.iot.bosch.com, www.bosch-press.com, www.twitter.com/BoschPresse.

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Bosch is developing the mobility of tomorrow – and is already delivering solutions today

A presentation by Dr. Volkmar Denner,

Chairman of the Board of Management,

Robert Bosch GmbH,

at the press conference on September 12, 2017

at the IAA (International Motor Show) in Frankfurt

Check against delivery.

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Ladies and gentlemen,

The film you've just seen is sufficient evidence that we will have to change our conception of mobility if we wish to stay mobile. The current debate about air quality and combating climate change indicates how great the pressure to act is. People's faith in the car has suffered – as has their faith in the automotive industry. For this reason, I want to focus particularly on the innovations that will solve the problems of road traffic in the short and long term. Our goal is to rethink mobility. Just four years ago, I introduced Bosch's vision of future mobility at the IAA: mobility that is electrified, automated, and connected. These three development approaches will allow us to achieve emissions-free, accident-free, and stress-free traffic for all road users in the long run. It is a bold plan – one that will revolutionize mobility as we know it today. But it is more than just an attractive vision – we know full well that the path toward the mobility of tomorrow must begin with specific action for improving traffic today. Bosch supplies the solutions that provide this.

Another way to protect the environment: coexistence of combustion engines and electric motors

So what are the urgent challenges of road traffic? Traffic jams, accidents, air pollution, climate action – we all know how many tasks we have to tackle. And yet all these problems seem to currently boil down to one thing: diesel. This is a matter that affects a company such as Bosch – not just because thousands of jobs depend on it at Bosch and elsewhere in the industry. No, what is worrying is primarily the one-sidedness of the debate, which for example ignores the fact that diesel engines consume 25 percent less fuel than gasoline engines, and thus undoubtedly contribute less to global warming. But concerns over the blind spots of this ongoing debate are mixed with the ambition of engineers. Our engineers aim to improve air quality in our cities, not just with diesel engines, but with all kinds of cars. Specifically, that means:

- We have more than 300 customer projects in which we are supporting automakers as they implement the strict Euro 6d emissions standard in real driving conditions. With diesel prototypes, we have demonstrated that we can already fall well within the limits stipulated for 2021. In other words, we can meet the legal requirements in real driving conditions, not just on the test bench.
- We are developing new solutions to reduce particulate matter, most of which comes not from exhaust, but from brake and tire wear. Our iDisc is going into production as early as next year. This carbide-coated brake disc generates up to 90 percent less brake dust.

In summary, there are many ways to combat climate change. Similarly, we see several options for the path toward alternative powertrains, from natural-gas engines to fuel cells. We are continuing to optimize the internal-combustion engine, and believe it will continue to exist side by side with electric cars for quite some time yet. How long that period of coexistence will last is still subject to debate. As far as that debate is concerned, I would like to give you an engineer's perspective. First, we must remember that electromobility is truly eco-friendly only if the electricity is not generated from fossil fuels. At the same time, combustion engines can be CO_2-neutral when powered by synthetic fuels that are produced using renewable energy. This process is still expensive, but the first pilot commercialization projects have been launched. Bosch has also been advocating this technology for many years. After all, synthetic fuels allow us to keep using existing gas stations and engines, so their positive environmental impact is more immediate than if we completely overhaul our infrastructure and vehicle fleet. Strict and consistent use of these fuels could save some 2.8 metric gigatons of CO_2 by 2050 – three times as much as Germany's total CO_2 emissions for 2016. We at Bosch are in favor of keeping our development options open, and not limiting ourselves to any one technology. I myself have set our engineers an ambitious goal: to achieve practically zero emissions in a combustion engine that breathes out what it breathes in, as it were. A combustion engine whose emissions – with the exception of CO_2 – are virtually indistinguishable from the air it takes in.

We want to achieve both this goal and electromobility, while keeping both of them affordable.

Economic clout: Bosch is growing faster than the market

In all this, we realize the short- and long-term solutions will involve not only a huge amount of technical effort, but will require considerable economic resources as well. A brief look at our ongoing operations shows that we have the necessary economic clout. Bosch Mobility Solutions will grow 7 percent this year, more than twice the rate of global automotive production. Our driver assistance systems are seeing particularly strong growth – stronger even than the current 25 percent growth in market volume. And we expect our sales in this market to surpass two billion euros as early as 2019 – twice their 2016 level. At the regional level, the current economic climate in China is especially favorable, not least for diesel commercial vehicles. Overall, our automotive business continues to see robust development – a crucial requirement for our upfront investments in the transformation of mobility. For example, we are in a position to invest about one billion euros in the construction of a new semiconductor factory in Dresden. This is the largest single investment in our company history and is aimed at producing, among other things, chips for automated and connected driving. By the end of 2017, we will have 48,000 research and development associates working on mobility solutions – some 4,000 more than at the beginning of the year. Regionally, most of these new jobs are in Asia, and mainly in software. We are strengthening our position for the mobility of the future.

Implementing the strategy: a new mindset and engineering approach

As I already said, our journey toward the future of mobility starts from solutions for the road traffic of today. Aside from climate change and air pollution, we see at least two further challenges:

- The first is that 1.2 million people around the world die in road accidents each year – that is more than 3,000 every day.

- The second is that in cities like Tokyo, cars travel at an average speed of just 15 kilometers per hour – slower than a bicycle.

Given these considerations, we believe the issue is about more than building better cars – we also have to discover ways to avoid, shift, and improve traffic flows. Especially in major cities, where total traffic volume is expected to triple by 2050, we have to think of mobility in more flexible terms than in the past. And by "flexible," I mean multimodal concepts with seamless transitions from cars to trains, trams, or bikes. This is another reason our three development approaches complement one another – we want to make transportation not only electric and automated, but connected as well. Only if all three aspects are present will transportation be as emissions-free, accident-free, and stress-free as possible.

The closer we look, the more clearly connectivity emerges as the key to the mobility of tomorrow. It not only enables brand-new models of shared mobility, but it revolutionizes individual mobility as well. For example, in the future, there will be two kinds of cars:

- One is a driverless shuttle – a simple, robust transport pod that passengers will be able to book online, quickly and easily.
- The other is a vehicle that serves as a productive space, connected over the internet to the smart home and the office. This will add value to the driving experience – time in the car will no longer need to be wasted time.

But what role will Bosch play in this transformation of mobility? The answer is again twofold:

- For one thing, we will more than ever be a supplier of automotive high-tech. For example, the "intelligence" in the car of the future will be accumulated in a few master computers – and by 2020, these computers will be a good 200 times more powerful than today's ECUs. Bosch is putting the power of the IT world on the road. In other words, we are combining powerful performance with reliability.

- For another thing, we will increasingly become a provider of mobile services. These may be shared mobility services, such as our Coup e-scooter sharing service, which we have successfully launched in Berlin and Paris. But mobile services can also mean access from the car to the smart home – another area where Bosch technology excels. And finally, we deliver entire technology and service packages for smart cities. Around the world, Bosch is currently pursuing 14 beacon projects relating to smart cities, half of them focusing on urban mobility.

All in all, one thing is clear: not only was Bosch the first company to stake out the key development approaches to the mobility of the future – electrification, automation, and connectivity – but it is also throwing its economic and technological might into these approaches. But even more importantly, in my view, we are already translating our progress into solutions ready for the market or for mass production. Let me give you a prominent example from each of our areas of focus.

Fewer accidents: automated driving starts with parking

The first of these is automated driving. This is arriving faster than expected, also in cities. We have put 3,000 engineers to work in this area, we are cooperating with international partners like Baidu in China, and we have launched a project with Daimler intended to make driverless car-sharing fleets a possibility in urban areas in the early years of the next decade. Above all, our automation efforts are succeeding particularly quickly in parking – an area where the driving itself is fairly manageable, but especially time-consuming and nerve-wracking.

It's something we're all familiar with: the long search for available parking spaces, which makes up nearly one-third of the traffic in our cities. Not only that: maneuvering into parking spaces and in parking garages causes one-fifth of all fender benders. We offer solutions that can help. This summer, we joined with Mercedes-Benz to debut the first live demonstration of automated

valet parking – a method of driverless parking in parking garages in which the vehicles themselves find a parking space. We arrived at the solution by taking a pragmatic approach: not only did we integrate the necessary sensors into the car, but we also distributed them throughout the parking-garage maze. This is not only a solution that reduces stress for drivers. It also frees up space for garage operators, since driverless parking makes it possible to park cars closer together, boosting space utilization by up to 20 percent. Even in this initial guise, therefore, automated driving offers multiple benefits.

Less stress: connected driving means fewer visits to the repair shop

Our “connectivity” approach is also bearing its first fruit. Here as well, we are relying on open partnerships. But like no other company in the automotive industry, we are contributing expertise in the “3 S’s” that are key to the internet of things: sensors, software, and services. Even now, 1.5 million vehicles are connected using Bosch IoT software. That’s because we have partnered with a German automaker to offer software updates over the air – a service that will become standard for future vehicle generations.

It’s something we all know from our smartphones: in a straightforward process, software is updated time and time again over the device’s lifetime. Similarly, a car’s software can be updated. So far, however, this has involved considerable effort on the part of the driver: visits to the repair shop, stress, and lost time. This is precisely what our new over-the-air software service seeks to remedy. The service has to satisfy one crucial criterion: the data must be transmitted to the car securely and reliably. To achieve this, the 150 specialists at our Escrypt subsidiary offer customized cyber-security solutions. We believe that over-the-air software will add a new diversity to driving, making it possible to customize cars to a greater degree than was ever thought possible. In the future, for instance, drivers will be able to download additional driver assistance functions for a virtually stress-free drive to their vacation destination. It is no longer only the automakers, but the drivers themselves who will be able to repeatedly reconfigure their own vehicles. This serves as

an excellent example of what connected driving offers: less stress, more possibilities.

Lower emissions: electric driving starts off small and light

Lastly, I wish to say a few words about how we are turning electrification of the powertrain into a market success. Bosch electrical powertrain components already feature in over half a million vehicles around the world. We supply the powertrain system for the German Post Office's Streetscooters, the largest electric vehicle fleet in Europe. And we are doing well in China, the world's largest market for electromobility: In 2016 alone, we won 16 major orders there, five of them for the 48-volt battery technology that makes entry-level hybrid powertrains possible.

We believe that 48-volt technology holds the key to the new trend of light electromobility: all-electric, very small, and very light vehicles. We already have the electric makeover of the legendary Schwalbe moped, and there are more and more electric rickshaws in India. Urban vehicles like these don't have to set records for range – they are short-distance specialists. Bosch has developed an entire technology package for this kind of light electromobility. At its core is the 48-volt powertrain system, which consists of battery, electric motor, and ECU. Add to that a display and an app, and of course a battery charger for recharging at power sockets. In developing this package, it was especially important that all components should be production-tested, as well as scalable for two-, three-, or four-wheelers, depending on the desired level of power. It is precisely this straightforward approach that is the secret of our modular system: it allows new mobility providers to quickly bring a vehicle to market, with no more than 12 to 18 months between start of development and market launch. This speed is unprecedented in the automotive industry. The result is lower costs – for our customers, but also for anybody who opts for electric transportation. It is yet another reason we are convinced that light electromobility will play a major role, not only in Asia, but also in Europe. We expect to see some 100 million light electric vehicles roll off the production

lines worldwide by the year 2020. Sales generated by our 48-volt system have been modest thus far, but they will at least double each year as we head into the next decade. Light electromobility is a response to the pragmatism shown by city dwellers when it comes to mobility: they want to get to their destination in a simple way, if possible without emissions and stress, and in a vehicle that fits into any parking space.

As you can see, ladies and gentlemen, we are working on creating accident-free, stress-free, and emissions-free mobility. But we're not waiting for the future to happen – we are delivering it today. Naturally, we are also doing everything in our power to make electromobility affordable in larger vehicles as well. And since people don't always need to own their own vehicle, we are making it easier to switch to shared mobility. To address these topics in further depth, I will now turn the floor over to my colleague Mr. Bulander, who will present two exhibits here at our booth …

Press release
Bosch Compact

August 2017
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The Bosch innovations on show at the IAA 2017
Solutions to make tomorrow's mobility free of accidents, stress, and emissions

- Bosch is using connectivity, automation, and electrification to solve the challenges of mobility
- Leveraging systems and components expertise for accident-free driving
- Smarter parking and autonomous parking thanks to connectivity
- Connected mobility services for stress-free and convenient journeys
- Keep a constant eye on key information thanks to new displays and display systems
- Electromobility and combustion engines for better air quality

Frankfurt and Stuttgart, Germany – Bosch is working to create technological solutions for a new era in mobility: free of accidents, stress, and emissions. The supplier of technology and services will be presenting its innovations for the mobility of tomorrow at the 67th International Motor Show (IAA) in Frankfurt. You can find Bosch at booth A03 in hall 8.

Highlights at the Bosch booth

Automated valet parking: Driverless parking saves time and reduces stress. At the Mercedes-Benz Museum parking garage in Stuttgart, Bosch has joined forces with Daimler to make automated valet parking a reality. Using a smartphone function, drivers can now automatically park their cars in their assigned spots without having to keep an eye on the maneuver. This driverless parking is made possible by the interplay between in-vehicle technology and intelligent parking-garage infrastructure supplied by Bosch. Automated valet parking is an important milestone on the road to autonomous driving.

Over-the-air software updates: Updating software and apps online is second nature to smartphone users. Now, Bosch is doing the same for cars – with over-the-air updates. Vehicle software can be kept up to date and new features added to the car – overnight, encrypted, and protected from unauthorized access. This

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allows drivers to try out and then activate features such as automated valet parking, community-based parking, and lane-keeping assistants.

Electric axle (e-axle): The e-axle is a compact, cost-optimized solution for electrical powertrains in battery-electric vehicles and hybrids. In this innovation, the electric motor, power electronics, and transmission are integrated in a compact unit which directly drives the vehicle's axle. This reduces the complexity of the electrical powertrain and, thanks to the system designed by Bosch, could potentially shorten the time taken to develop electric vehicles. There are various e-axle configurations. Its power output can be scaled between 50 and 300 kilowatts, which means the e-axle can be installed in compact cars, SUVs, and even light commercial vehicles. Its high level of efficiency is the result of two factors. First, the continuous improvement of electric motor and power electronics and, second, the reduction of the number of interfaces and components such as high-voltage cables, plugs, and cooling units. In short, the Bosch e-axle means greater range with the same battery capacity. Bosch has developed a flexible approach to e-axle manufacturing that can be implemented worldwide, thus ensuring a reliable supply everywhere.

Additional highlights at the Bosch booth

Leveraging systems and components expertise for accident-free driving

Automated driving: Automated driving makes roads safer. Increasing automation can lower accident rates even further – by up to one-third in Germany alone. Making automated driving reality calls for profound understanding of all vehicle systems. Bosch has this expertise, and manufactures most of the key components itself – including radar, video, and ultrasonic sensors, braking control systems, electrical power-steering units, display instruments, and connectivity solutions inside and outside the vehicle. From the start of the next decade, there is a possibility that highly automated freeway driving (SAE level 3) will be permitted for cars featuring Bosch technology. In addition, Bosch is working with Daimler to make fully automated driving (SAE level 4) and driverless mobility (SAE level 5) possible in towns and cities. Their objectives include the development and start of production of an autonomous driving system for robocabs starting in the early 2020s.

Braking system: Bosch has developed the second generation of its vacuum-independent, electromechanical brake booster. Like the first-generation unit, the new iBooster meets all the requirements of a cutting-edge braking system. This second-generation brake booster has been designed to be even more compact, and also generates brake pressure even faster. The iBooster is suitable for all powertrains – in particular in hybrid and electric vehicles. In combination with the

ESP electronic stability program, the electromechanical brake booster supplies the braking-system redundancy needed for automated driving. If one of the two components fails, the other can safely decelerate and stop the self-driving car – without the driver having to intervene.

Electric steering: One key technology for automated driving is fail-operational, electric power steering. In the rare event of a malfunction, the Bosch system is capable of retaining 50 percent of the electric steering functionality in conventional and autonomous vehicles. Thanks to this technology, automakers can meet fail-operational requirements – some of which have been stipulated in the United States by the National Highway Traffic Safety Administration (NHTSA) and the U.S. Department of Transportation in its Federal Automated Vehicles Policy.

Predictive road condition services: Surface grip, or friction coefficient, depends on whether the road surface is dry, wet, or icy. Drivers have to modify their driving style to avoid critical situations. Bosch is developing a cloud-based road condition service that will allow self-driving vehicles to determine how road surface will develop over the course of a journey. The service uses the sensors of the ESP electronic stability program to collect information on road-surface characteristics. Aided by data from weather stations and road sensors in the infrastructure, the map calculates current friction coefficients and forecasts upcoming ones. This Bosch service then supplies connected vehicles with friction-coefficient maps via the cloud in real time – in turn enhancing the safety and robustness of automated driving functions.

Smarter parking and autonomous parking thanks to connectivity

Finding a parking space: Bosch community-based parking simplifies the search for a suitable space. Using the ultrasonic sensors of their parking assist system, cars identify and measure the gaps between parked cars as they drive past them. This information is transferred in real time to a digital parking-space map, which drivers can use to find the nearest vacant spaces. In cooperation with Mercedes-Benz and other automakers, Bosch is testing this service in cities in Germany and elsewhere in Europe. Bosch plans to supplement its community-based parking service with a function that will allow parking fees to be paid digitally.

Gaming app: The Parkineers app is designed to make finding a parking space easier. It is simple for users of this gaming app to share information on parking restrictions, such as resident-only spaces or temporary bans on parking. App users are part of a community: they can make their avatars visible to all, make it clear which areas likely have vacant parking spaces, and digitalize the parking situation in their neighborhood. Parkineers is currently available for iOS and Android users in Germany.

Home Zone park pilot: Stress-free parking in a private garage or an assigned underground parking space: the Home Zone park pilot takes on this recurring maneuver, including the approach (up to 100 meters) to the parking space. All drivers have to do is teach the vehicle the maneuver once in a dummy run, then save it. From then on, their car will park itself independently in the preset parking space, without drivers having to keep an eye on the maneuver. For orientation, the Home Zone park pilot relies on ultrasonic sensors, stereo video cameras, and radar sensors which recognize the objects detected during the dummy run and consequently guide the car safely to its parking space.

More protection for car occupants and cyclists

Occupant protection: Vehicle safety and occupant protection can be further improved by intelligently connecting surround and contact sensors with passive safety systems as well as braking and steering units. If the surround sensors detect a potential collision, the passive safety systems (such as airbags and seat-belt pretensioners) can be deployed more quickly. In addition, the restraining effect of these systems can be tailored precisely to the specific scenario. This helps to mitigate the consequences of an accident.

Cyclist protection: Cyclists and pedestrians are the most vulnerable road users. In the interest of reducing accidents involving cyclists, the radar or video sensor in Bosch's new automatic emergency-braking system can recognize cyclists – even if they suddenly cut in front of a car. If the system detects an imminent collision, it automatically triggers emergency braking. Ideally, this will mitigate the consequences of an accident – or even prevent it altogether. Starting in 2018, the rating criteria of the consumer-protection organization Euro NCAP will include automatic emergency braking that recognizes cyclists.

Antilock braking system for pedelecs: Bosch is launching the first production-ready antilock braking system for e-bikes – and thus equipping bicycles with automotive technology. The e-bike ABS prevents the front wheel from locking up. This works on all surfaces, which means the e-cyclist can continue steering and stay in control while decelerating to a stop. A further feature prevents the rear wheel from lifting if the rider brakes too hard on a surface with good grip.

New mobility services for stress-free and convenient journeys

Demonstration car for connected mobility services: Bosch's show car features smart mobility services that will soon make driving less stressful and more convenient. They include community-based parking, preventive vehicle diagnostics, and Perfectly Keyless. The technology at the heart of it all is the Bosch Automotive Cloud Suite. It coordinates the seamless interplay of all mobility services in the cloud.

Perfectly Keyless: Bosch's Perfectly Keyless turns the smartphone into a car key. Thanks to this new vehicle-access system, drivers can open, start, and lock their vehicle without the bother of searching for keys. The Perfectly Keyless system automatically identifies the unique digital security key on a user's smartphone. Only when it detects the user is less than two meters away will it unlock the door. Moreover, the vehicle will not start until the access system has located the smartphone inside the vehicle. Car owners can use the app to grant vehicle access to other app users.

Predictive vehicle diagnostics: Nothing is more annoying than when a car breaks down on vacation. During regular drives, predictive diagnosis uses data and information from the cloud to analyze the condition of key components. If the data indicates that components are worn, the driver is notified before a defect occurs and receives a recommendation for the next visit to the repair shop. Predictive diagnostics prevents situations where the car unexpectedly breaks down.

mySPIN smartphone integration: Using a smartphone's navigation, streaming services, or a calendar even while driving a car or riding a motorcycle? mySPIN, the Bosch integration solution for smartphones, makes all this possible, hands-free. It simply integrates the smartphone and its apps into the vehicle's infotainment system. It will soon be possible to integrate and display data from the cloud in real time. This data can warn drivers of hazards such as a sudden traffic jam.

Driving app: The new Bosch smartphone driving app offers more convenience and entertainment for drivers whose vehicle is not equipped with a sophisticated infotainment system. The app brings together all the features of an infotainment system, including phone calls, text messaging, navigation, and other assistance innovations. Thanks to integrated voice control, drivers can use the app safely and conveniently.

Retrofit eCall: Starting in 2018, the automatic eCall emergency call system will be standard equipment in all new motor vehicles. Bosch has developed the retrofit eCall solution for vehicles that do not have eCall as a standard feature. Powered by the vehicle's cigarette lighter, this sensor device uses acceleration sensors and intelligent algorithms to detect whether a vehicle has been involved in an accident. In an emergency, a special smartphone app transmits data to a service center. This allows emergency services to respond even more quickly, thus increasing the chance of saving lives. Available in China, Germany, and the United States, this digital guardian angel has already helped a lot of drivers and passengers who found themselves in precarious situations.

Keep a constant eye on key information thanks to new displays and display systems

The connected show car: Bosch is using its show car to demonstrate how new user interfaces ensure better security, less stress, and fewer distractions when driving. This interface between people and vehicles provides drivers with relevant information as needed, and is an alert companion in every situation. In addition, the show car is always online, and connected to its surroundings as well as the owner's smart home. This connectivity allows drivers to reserve the nearest e-bike or close the windows at home if it starts to rain – tapping or swiping the screen is all it takes.

Anti-glare instrument cluster: Bosch is launching the world's first optically bonded instrument cluster featuring full-HD resolution. Its screen reflects more than four times less light, allowing for better resolution from all angles – even in direct sunlight and in the dark. The secret lies in a new manufacturing processes that uses a thin layer of fluid to bond the screen with the glass. Thanks to the high-contrast screen, all information displayed is crystal-clear. This instrument cluster is popular among motorcyclists due to its robustness and enhanced resistance to dust and dirt.

Head units with new technologies: Drivers can use a head unit to manage all information and entertainment in the vehicle. At the IAA 2017, Bosch is presenting head units that – thanks to new processors – are up to five times more powerful and boast up to seven times better graphic performance.

Efficiency in the cockpit: The cockpits of today's vehicles comprise a whole array of screens, displays, switches, and buttons. Each screen is typically operated by its own control unit. When space becomes scarce in a compact vehicle – or when new vehicle and operating concepts call for all information to be displayed on just one large central screen – it is essential to have maximum functionality and the fewest possible components. This is why Bosch has combined the functions of an instrument cluster with those of an infotainment system, with just one arithmetic logic unit (ALU) controlling all the information from behind the scenes. Owing to this convergence of different display systems, it is becoming easier to provide more functions in the tiniest of spaces. Complexity is also reduced, and there is more freedom to display information on different screens in the cockpit.

Electromobility and combustion engines for better air quality

48-volt drive system for light electric vehicles: Especially for urban mobility, Bosch has developed an integrated 48-volt drive system including motor, control unit, battery, charger, display, and app. Bosch is thus making urban mobility efficient. On top of that, rapid acceleration from a standstill makes for a "wow" factor. Whether two, three, or four wheels, this system is available for all classes

of light electric vehicles. As it is made up of off-the-shelf automotive components, manufacturers will have the benefit of production-tested parts and minimal development expense. This gives both established OEMs and new players in the market the opportunity to launch vehicles within 12 to 18 months.

48-volt battery: Along with a boost recuperation machine and a DC-DC converter, the 48-volt battery is the main component in the 48-volt system. This battery stores recovered braking energy, subsequently delivering it to the electric motor and supplying the vehicle's electrical system. The battery's low mounting height of just 90 millimeters means there are more placement options – it can go under a seat or the spare-wheel well, for instance. Passive cooling allows for a compact design, helps optimize costs, and, as an additional convenience factor, makes the battery almost silent. Bosch expects the strongest market growth to be in Europe and China. It has already procured a considerable number of production projects in China. The company's main advantages over its Asian competitors are the calibration engineering it carries out on the spot and its considerable local manufacturing expertise.

Port fuel direct injection: The best of both worlds. With port fuel direct injection, Bosch combines the benefits of gasoline direct injection with those of gasoline port injection. Gasoline port injection's main strength is low friction losses during part-load operation, while gasoline direct injection exhibits a higher knock limit at nearly full load. Port fuel direct injection blends these two systems to exploit the strengths of each. In practice, the result is better fuel efficiency and lower particulate levels – during both part-load and full-load operation.

Needle-closing control for diesel engines: The new needle-closing control (NCC) technology can precisely measure and control the duration of fuel injection in real driving conditions – accurate to just a few millionths of a second. To achieve this, a sensor is integrated into a solenoid-valve injector and paired with a cutting-edge, intelligent control software application. This establishes a feedback control loop that ensures significantly more precise injection throughout the injector's service life. Complex injection configurations thus become possible, in turn helping to further reduce vehicle noise, fuel consumption, and emissions in real driving conditions. NCC also opens up new possibilities for online diagnosis of the injection system in the future.

Vehicle control unit (VCU): Modern vehicles have as many as 100 standalone control units. A vehicle control unit, or VCU, can substantially reduce the number of such units. This frees up valuable installation space, reduces vehicle weight, and simplifies communication among control units. Acting as a central computer for the powertrain, the VCU in an electric vehicle coordinates powertrain

components such as the inverter and transmission as well as systems that manage the battery and motor. A VCU can even handle specific functions if it is used as a domain computer. Functions might include operational and gear-shift strategies, torque coordination, high-voltage and 48-volt coordination, recharging control, diagnosis, monitoring, thermal management, and much more.

Press photographs: #1147919, #1152554, #1138672, #1068271, #1068270, #1068269, #1105501, #452462, #693521, #1152547, #1143652, #1152548, #1152549, #1152553, #454300, #710763, #1057879, #1057878, #1143660, #1138662, #1152552

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domain solutions from a single source. The Bosch Group's strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiaries and regional companies in some 60 countries. Including sales and service partners, Bosch's global manufacturing and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. At 120 locations across the globe, Bosch employs some 59,000 associates in research and development.

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Press release

August 2017
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Carbon-neutral cars: synthetic fuels turn CO_2 into a raw material

Bosch study highlights considerable potential for reducing CO_2 emissions

- Achieving climate targets calls for more than electromobility
- Bosch CEO Denner: “Combustion engine can become a carbon-neutral powertrain”
- Synthetic fuels can be added to conventional fuels, and thus play a direct role in reducing the CO_2 emissions of the existing vehicle fleet
- If used as planned in cars, synthetic fuels have the potential to save 2.8 gigatons of CO_2 in Europe by 2050

Gerlingen, Germany – Up until recently, a carbon-neutral combustion engine was the stuff of dreams. Now it may soon become reality. The secret lies in synthetic, or carbon-neutral, fuels, whose manufacturing process captures CO_2. In this way, this greenhouse gas becomes a raw material, from which gasoline, diesel, and substitute natural gas can be produced with the help of electricity from renewable sources. “Synthetic fuels can make gasoline- and diesel-powered cars carbon-neutral, and thus make a significant contribution to limiting global warming,” says Dr. Volkmar Denner, chairman of the board of management of Robert Bosch GmbH. Bosch experts have put an exact figure on the contribution that could be made solely by the European car fleet: by 2050, the use of synthetic fuels as a scheduled supplement to electrification could save up to 2.8 gigatons of CO_2, or 2,800,000,000,000 kilograms[1]. That is three times Germany’s carbon-dioxide emissions in 2016.

Low-soot combustion reduces cost of exhaust-gas treatment

A look beyond Europe’s borders shows how urgent it is to further reduce traffic emissions: if the climate targets set by the Paris conference are to be achieved, CO_2 emissions from traffic worldwide will have to be reduced 50 percent over the

[1] Roadmap zum defossilisierten Antrieb; Dipl.-Ing. Ulrich Schulmeister, Dipl.-Ing. Steffen Eppler: VDA – Technischer Kongress 2017

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next four decades, and by at least 85 percent in the advanced economies[2]. "Achieving our future climate targets calls for other intelligent solutions apart from electromobility," Denner says. After all, even if all cars were to drive electrically one day, aircraft, ships, and even trucks will still run mainly on fuel. Carbon-neutral combustion engines that run on synthetic fuels are thus a very promising path to explore – also for passenger cars. In addition, synthetic fuels can be designed to burn practically soot-free. In this way, the cost of exhaust-gas treatment can be reduced.

One further crucial advantage is that the existing filling-station network can continue to be used. The same applies to the existing combustion-engine expertise. Moreover, even though electric cars will become significantly less expensive in the years ahead, the development of these fuels may be worthwhile. Bosch has calculated that, up to a lifetime mileage of 160,000 kilometers, the total cost of ownership of a hybrid running on synthetic fuel could be less than that of a long-range electric car, depending on the type of renewable energy used.

A new lease on life for filling stations and old vehicles

Technically speaking, it is already possible to manufacture synthetic fuels. If the electricity used is generated from renewables (and thus CO_2-free), such fuels are carbon-neutral and very versatile. The hydrogen (H_2) that is initially produced can be used to power fuel cells, while the fuels created following further processing can be used to run combustion engines or aircraft turbines. Pilot projects to commercialize synthetic diesel, gasoline, and gas are currently underway in Norway and Germany. In addition, because synthetic fuels are compatible with the existing infrastructure and engine generation, achieving a high degree of market penetration would take far less time than electrifying the existing vehicle fleet. Nor will anything change for the drivers of older vehicles, as even classic cars will still run on synthetic gasoline – in terms of chemical structure and fundamental properties, it is still gasoline.

Q&A – More about synthetic fuels

What needs to happen before synthetic fuels become established?

Despite everything, considerable efforts are still needed before synthetic fuels can become established. The processing facilities are still expensive, and there are only a few test plants. The German Ministry for Economic Affairs and Energy is thus supporting synthetic fuels as part of its "Alternative energies in

[2] https://ec.europa.eu/clima/citizens/eu_en

transportation" initiative. The widespread use of these fuels will also be helped by the increasing availability of, and thus falling prices for, electricity from renewables.

How are synthetic fuels made?
Synthetic fuels are made solely with the help of renewable energy. In a first stage, hydrogen is produced from water. Carbon is added to this to produce a liquid fuel. This carbon can be recycled from industrial processes or even captured from the air using filters. Combining CO_2 and H_2 then results in the synthetic fuel, which can be gasoline, diesel, gas, or even kerosene.

How expensive will the fuel be?
At the moment, producing synthetic fuels is a complex and expensive process. However, a production ramp-up and favorable electricity prices could mean that synthetic fuels become significantly cheaper. Present studies suggest that the fuel itself (excluding any excise duties) could cost between 1.00 and 1.40 euros a liter in the long run.

What's the difference between synthetic fuels and biofuels?
Synthetic fuels do not mean a choice between fuel tank and dinner plate, as biofuels do. And if renewable energy is used, synthetic fuels can be produced without the volume limitations that can be expected in the case of biofuels because of factors such as the amount of land available.

Press photographs: #1152429; #1152423

More information:

The Bosch innovations on show at the IAA 2017

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Press release

The “start-up” powertrain for electric cars: the Bosch e-axle offers greater range

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- New development: more efficient and affordable than other electrical powertrains
- All-in-one principle speeds up automakers’ development times
- Bosch board of management member Dr. Rolf Bulander: “Economically speaking, the e-axle may turn out to be a major coup”

Gerlingen, Germany – It’s now common knowledge that a more powerful battery will increase an electric car’s range. But can a new powertrain have a comparable impact? In the case of the Bosch electric axle drive, or e-axle, the answer is a definite yes. What’s so special about it is that Bosch has combined three powertrain components into one unit. The motor, power electronics, and transmission form one compact unit that directly drives the car’s axle. This makes the powertrain not only far more efficient, but more affordable as well. “With its e-axle, Bosch is applying the all-in-one principle to the powertrain,” says Dr. Rolf Bulander, member of the board of management of Robert Bosch GmbH and chairman of the Mobility Solutions business sector. It is precisely for this reason that the new powertrain is a potentially huge business opportunity for Bosch. The components are very flexible, which means the e-axle can be installed in hybrids and electric cars, compact cars, SUVs, and even light trucks – a huge market.

A powertrain that also speeds up development times

“Economically speaking, the e-axle may turn out to be a major coup for Bosch,” Bulander says. The novel electrical powertrain is playing a key role in the company’s drive to be the global mass-market leader for electromobility from 2020. On the world’s roads, there are already well over 500,000 electric and hybrid cars fitted with Bosch components. Bosch thus has many years of experience in the manufacture of electric motors, axle drives, and power electronics. The expertise it has gathered in the process is now bearing fruit in its newly developed electric axle. With this component alone, Bosch is hoping to generate sales running into

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the billions. "The e-axle is the 'start-up' powertrain for electric cars – also at established automakers. It allows them to save valuable development time and to get their electric vehicles to market considerably faster," Bulander says. As Bosch customizes the powertrain to each automaker's requirements, customers no longer have the time-consuming task of developing new components. Samples of the electric axle have already been tested with customers. The start of mass production is planned for 2019. Bosch already has a flexible, globally applicable manufacturing concept for this component. The concept guarantees that each customer will get a customized solution that can be quickly integrated into its manufacturing operations.

Up to 6,000 Newton meters of torque and 300 kilowatts of power

The e-axle's USP is its high level of versatility, which means it can be adapted to many types of vehicles. "Instead of reams of specifications, a few parameters are enough for Bosch to customize the e-axle," says Dr. Mathias Pilin, the executive vice president for electromobility. All the customer has to do is state what performance, torque, and installation space they require, and Bosch then optimizes the rest of the powertrain to fit these parameters. In this way, a complete, customized powertrain can be delivered directly to an automaker's assembly line. This is a further reason why the Bosch electric axle is the next logical step for powertrain engineering.

The powertrain can deliver between 50 and 300 kilowatts, and is therefore also capable of powering large vehicles such as SUVs completely electrically. Torque at the vehicle axle can range from 1,000 to 6,000 Newton meters. When installed in hybrid and electric vehicles, front- and rear-axle drive is possible. An electric axle delivering 150 kilowatts weighs roughly 90 kilograms, and thus far less than the combined individual components used so far. Compared with competing products, the distinguishing feature of the Bosch electric axle is an especially high peak performance combined with a high level of continuous performance. In other words, the electrical powertrain can accelerate better and maintain a high speed for a longer period. To achieve this, Bosch has not only redesigned the system as a whole, but also improved the motor and power electronics components.

Q&A – Additional information about the Bosch electric axle

What makes the electric axle more efficient than previous electrical powertrains?

Highly efficient individual components are the basis for a high level of overall efficiency. In this respect, Bosch has the benefit of years of experience in the market. In addition, efficiency losses are minimized by reducing interfaces and components such as high-voltage cables, plugs, and cooling units. One of Bosch's strengths is its ability to combine individual components to form systems, to use the interactions in the system, and in this way to arrive at an overall optimum. In the case of the e-axle, this relates not only to efficiency, but also to things such as acoustics and electromagnetic compatibility.

When will the e-axle be available in the market?

Bosch has had electric axle drives in the market since 2012 (in the Peugeot 3008 and Fiat 500e, for example), but the power electronics was not fully integrated into them. With the new generation of the electric axle, Bosch is in the development phase, and is in contact with automakers from around the world. More precisely, samples of the electric axle are ready for use, and are currently being tested. Start of production is planned for 2019 at the latest.

What vehicles can it be used in?

The Bosch electric axle is designed so that it can be adapted to many types of vehicles. When installed in hybrid and electric vehicles, front- and rear-axle drive is possible. This applies to any vehicles up to a total weight of 7.5 metric tons, and thus to light trucks as well as passenger cars.

Why is the e-axle less expensive than the powertrains used up to now for electric cars?

Since the e-axle combines power electronics, electric motor, and transmission in a single component, fewer parts are needed. For example, the new electric powertrain does completely without thick and expensive copper cables linking the components. In addition, the cooling system can be simplified, and there is no need for bearings for rotating components. This reduces the powertrain's cost while increasing its efficiency. Placing the transmission close to the motor saves valuable installation space, which is always an important factor in the auto industry.

How deeply is Bosch involved in electromobility?

On the world's roads, there are already well over 500,000 electric and hybrid cars fitted with Bosch components. In its efforts to make a breakthrough in electromo-

bility possible alone, the company invests 400 million euros annually. The company has already won more than 30 electromobility-related orders from international automakers.

Press photographs: #1156595, #1152529, #1152530

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Press release

August 2017
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No more lost keys
Bosch's Perfectly Keyless turns the smartphone into a car key

- Use a smartphone to unlock the car, ignite the engine, and lock the car again
- Digital key can be passed on to other users
- Personalized vehicle settings for each driver
- Digital key management for vehicle fleets and vehicle-sharing providers

Stuttgart, Germany – It's a scene most of us will be familiar with: in the mad morning rush, the car key is nowhere to be found. And anyone who has ever had both hands full with shopping bags will have wished that an "open sesame" was all it took to open their car door. By turning the smartphone into a car key, Bosch will be putting an end to this irksome hunt for the key. "Perfectly Keyless, our digital vehicle access system, means that drivers will be able to do without traditional car keys. It's a great example of stress-free connected mobility," says Harald Kröger, president of the Bosch Automotive Electronics division. As drivers approach their vehicles, their smartphones are identified by the on-board sensors. "Once this identification has happened, the vehicle is unlocked without any need for a physical key. Similarly, no key is needed to start the engine or to lock the car again at the end of a journey," Kröger says. Vehicle owners can also use an app to give other drivers permission to use their vehicles. In a secure process that is protected against unauthorized access, an additional virtual key will then be sent via the cloud to other smartphones. This will allow the providers of car-sharing services and the operators of vehicle fleets to manage access and keys flexibly.

A stress-free, keyless journey
Perfectly Keyless is a digital car key. To use it, drivers download an app onto their smartphones, and connect their cars to the app. Once they have done this, the smartphone generates a one-off security key that fits their respective vehicle's digital lock. Perfectly Keyless uses a wireless connection to the on-board sensors to measure how far away the smartphone is, and to identify the security

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key. Once the distance between driver and vehicle is less than two meters, the car door is unlocked. Hunting for the car key is no longer necessary. As soon as the vehicle has been unlocked, any predetermined individual settings, such as those for the rear-view mirror and seat position, are activated. And if Perfectly Keyless detects that the smartphone is in the vehicle, a touch of the start-stop button is enough to start the engine. When the driver gets out of the car at the end of the journey, the system continues to keep a virtual eye on the smartphone. Once driver and phone have moved more than two meters away from the car, it is automatically locked securely. The system sends an acknowledgment to the driver's smartphone.

Individual key management

Car owners can use Perfectly Keyless to make their cars available to others, such as family members and friends. Instead of handing over the key personally, parents can simply use the app to grant their children access to the family car. The system generates a further individual security key, and sends it via the cloud to the smartphone. So that each user's settings can be personalized, each key is unique. The Perfectly Keyless system also works for entire vehicle fleets. Users can be granted and blocked access digitally, subject to geographical and time limits if so desired. This allows fleet operators such as car hire companies, providers of car-sharing services, and businesses in general to manage their vehicle keys digitally, using an app and the cloud.

Additional questions and answers

For Perfectly Keyless to work, what hardware does my car need to have?

Automakers will have to install proximity sensors and a control unit as fixed features in their vehicles. These sensors measure how far away the driver's smartphone is from the car. They also register what direction the driver is approaching from. The control unit administers the digital security key and ensures that smartphone, cloud, and vehicle systems communicate smoothly.

What if a user loses their smartphone?

If the smartphone is lost, and the app with it, the digital key can be deactivated online. This blocks access to the vehicle, both for authorized persons and third parties. A new smartphone can be connected with the vehicle at any time, and a new unique security key generated. In the interim period, the conventional vehicle key will work as usual.

How does Perfectly Keyless differ from the keyless entry systems already in the market?

Today's keyless entry systems still feature a physical key fitted with a chip, which drivers still have with them in their pocket or handbag. The first app-based digital access systems are now being used by sharing services to cut out the complicated task of keeping track of car keys. To get in or to drive off, users request access by smartphone before each journey. With Perfectly Keyless, simply having a smartphone in one's pocket is enough. The vehicle access system automatically unlocks the vehicle as soon as the driver and smartphone come close. There is no need for a key, chipcard, or swipe of the smartphone touchscreen.

Which mobile operating systems does Perfectly Keyless work with?
The systems supports devices using any of the common operating systems.

Press photos: #1152553 #1156699 #1156701

Further information:
Video about Perfectly Keyless on YouTube.
Additional details about Perfectly Keyless at www.bosch-mobility-solutions.com.
The Bosch innovations on show at the IAA 2017

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Press release

Emergency braking in two blinks of an eye
Bosch launches new driver assistance systems for more safety in the urban jungle

August 28, 2017
PI 9778 CC joe/BT

- Predictive emergency braking systems protect pedestrians and cyclists
- “Driver assistance systems are the next step along the path toward accident-free driving,” says Bosch board of management member Dr. Dirk Hoheisel
- Half of all new vehicles in Germany have at least one driver assistance system
- Radar sensors allow an over-the-shoulder view that prevents accidents when opening the car door

Stuttgart, Germany – Another narrow escape: a cyclist appears as if out of nowhere and suddenly crosses the road. Distracted by the search for somewhere to park, the driver is powerless to avert what appears to be an inevitable disaster. Yet Bosch’s new emergency braking system with cyclist detection prevents any serious consequences, automatically bringing the car to a full stop from 40 kph. Everyone makes it through the incident, shaken but unharmed. As soon as the emergency braking system’s radar or video sensor detects an imminent collision, the Bosch iBooster initiates full braking in just 190 milliseconds – less time than it takes to blink twice. “Driver assistance systems are the next step along the path toward accident-free driving,” says Bosch board of management member Dr. Dirk Hoheisel. “These electronic assistants are always vigilant and, in emergencies, they respond more quickly than people can. They provide support just where drivers need it – in busy city traffic.” Emergency braking systems are one of the most useful assistance systems, particularly when it comes to responding to cyclists and pedestrians, the most vulnerable of road users.

More protection where most needed

In Germany, bicycles are involved in one-fourth of all accidents resulting in personal injury. According to the German Federal Statistics Office, 393 people

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were killed in such accidents in 2016 alone – roughly 12 percent of the country's total road fatalities. Some two-thirds of these accidents involve a car. Equipping every car in Germany with an emergency braking system that can detect cyclists would prevent almost half (43 percent) the bicycle/motor vehicle accidents that result in personal injury, or at least mitigate their severity. "An emergency braking assistant may reduce braking distance by the few crucial centimeters that can mean the difference between life and death," says Gerhard Steiger, president of Bosch's Chassis Systems Control division. The European New Car Assessment Program, or Euro NCAP, has also recognized the importance of emergency braking systems for road safety. Starting in 2018, the consumer protection association's star rating system will include emergency braking with cyclist detection. Emergency braking systems with pedestrian detection have been part of the rating system since 2016.

Electronic assistants growing in popularity

In light of rising volumes of road traffic, driver assistance systems offer the full package – and hold the key to increased road safety. They keep cars in their lanes, warn of obstacles in the blind spot when changing lanes, provide support for pulling into and out of parking spots, and help maintain following distance, to name just a few examples. Bosch is constantly honing the technology behind these driver assistance systems: sensors supply increasingly precise images of the car's surroundings, and their interaction with actuators, such as braking and steering, is steadily becoming faster and more efficient. In this way, driver assistance systems are not only preparing the path toward automated driving, but are already delivering stress-free and relaxed driving. No wonder, then, that the spread of electronic assistants is picking up. A Bosch survey found that half of all new cars (52 percent) in Germany have at least one driver assistance system on board. The trend is toward consolidating multiple assistance functions on one sensor, as demonstrated by car exit warning, a new function developed by Bosch.

Radar offers a constant over-the-shoulder view

Bosch's rear mid-range radar sensors, which monitor lane changes on the freeway, can also keep city drivers from making a dangerous mistake: after parallel parking at the curb, drivers often get out of their cars right away – without looking over their shoulder. This has led to countless cyclists getting painfully up close and personal with car doors as they are knocked unceremoniously to the pavement. But Bosch's car exit warning can help. It is active for all car doors and warns the occupants – even several minutes after the ignition has been turned off – before they carelessly get out of the vehicle. Mounted to the left and right of the rear of the car, the Bosch sensors monitor traffic. Within a 20-meter radius, the sensors can detect other road users who are approaching from the rear, or

who are already to the side or rear of the car, and promptly warn the driver before they open their door.

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Press release

September 2017
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Cars as easy to update as a smartphone
Bosch is securely updating cars over the air

- Over-the-air software updates will soon be a standard feature
- Fewer recalls and visits to the repair shop mean wireless software updates save time
- New and improved functions are relayed directly to the car
- New encryption technologies make over-the-air updates secure

Stuttgart, Germany – In the future, car owners will be able to enhance their car's security, intelligence, and performance without getting up from the sofa. In the future, updating their car's software will be as simple as updating apps on their smartphones today. A swipe of the smartphone will be enough to automatically update vehicle software or to download new functions directly from the cloud – without any need to visit the repair shop. "In a few years from now, automatic software updates will be possible in every new car," says Dr. Markus Heyn, a member of the Bosch board of management. "Wireless over-the-air updates are extremely convenient for drivers. In addition, Bosch is making these online updates secure and fast," Heyn continues. Bosch has developed all the features required for these wireless updates in-house. They range from the control units and in-car communication infrastructure to modern encryption technologies and the Bosch IoT cloud.

A new standard – simple and secure

More electronics, more functions, more software: the car is turning into a smartphone on wheels. Keeping vehicle software up to date is thus becoming increasingly important. New functions can provide extra convenience, even after the vehicle has been bought. Over-the-air software updates will therefore soon be a standard feature. Today's vehicles feature as many as 100 control units. Even compact cars have between 30 and 50. Their software governs nearly every function in the vehicle. In addition, more and more vehicles are now

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connected – with the internet, other cars, and the infrastructure. This means a greater risk of weak links in vehicle software, as well as of manipulation. In this context, software updates over the cloud offer a solution that keeps cars constantly up to date, and thus also secure. “Cars are driven for 15 years or more. Over-the-air software updates are Bosch’s contribution to keeping vehicle software constantly up to date, without having to visit the repair shop,” Heyn says. In addition, the cloud updates mean that ever more functions can be added, with ever greater scope. If the necessary hardware is already installed, a new software function can be tried out and subsequently downloaded. In this way, lane-keeping or park-assist functions can be added, for example. And it is not just drivers that benefit from over-the-air software updates: in 2015, 15 percent of recalls in the automotive industry in the U.S. had to do with software errors. Four years previously, this figure was only 5 percent, according to a U.S. study based on data from the National Highway Traffic Safety Association (NHTSA). “For automakers and their customers alike, such repair-shop visits are a huge waste of time and money, and online updates can significantly reduce this,” Heyn says.

Updates directly from the cloud

Secure, fast, and simple – that’s how over-the-air software updates work. On the driver’s smartphone or the car’s infotainment system, the online security updates are started and any new functions that need to be downloaded are selected. This information is sent to the cloud, which acts like a kind of app store, holding the updates in readiness and starting the process of downloading software to the vehicle. The data can either be downloaded in the background while the car is moving, or overnight when it is parked in its garage. As soon as the vehicle is in a secure condition (once it has parked, for example), the software updates are installed on the appropriate control units, where they are immediately activated.

Security on all levels

Security and the smooth interaction of automotive electronics, cloud, and software are decisive for over-the-air updates. Data security is ensured by the latest encryption technologies developed at the Bosch subsidiary Escrypt. A complex security architecture with end-to-end encryption protects the data transmission against unauthorized access. At the car-cloud interfaces, secure protocols and filters act like a firewall to ward off any hacking attempts. To ensure that over-the air software updates are not just secure, but also fast and reliable, Bosch uses fast update technologies such as delta and compression mechanisms. These accelerate the update process and reduce cost, since the data volume for the transmission remains low. One further security measure is to transmit the updates in sequences. If problems occur, the update process can be stopped and adjusted. The technology at the heart of these over-the air updates

is the Bosch Automotive Cloud Suite. Its software elements enable all functions needed for over-the-air updates – by drivers, automakers, and even by vehicles themselves.

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Further information:
You can find more information about over-the-air updates here.
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