

BMW at the Consumer Electronics Show (CES) 2015 in Las Vegas. Contents.



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1. BMW innovations at CES 2015 in Las Vegas.

Short version.

BMW was quick to realise the importance of communication between vehicles, drivers and the environment and is today one of the world's leading carmakers in the field of automotive connectivity. With BMW ConnectedDrive it offers both driver assistance systems and digital services aimed at enhancing safety and comfort. At the Consumer Electronics Show 2015 (CES, 6 – 9 January, Las Vegas), BMW will confirm and consolidate its status as a leading innovator in this field and as a premium mobility provider when it presents applications for new digital devices. It will also present new driver assistance systems and intelligent lighting technology at CES that will help to bring "Vision Zero" – the vision of accident-free personal mobility – a further step closer to reality.

Calendar and trip planning in one – the mobility planner.

The BMW i3 already offers an innovative and unique intermodal routing system for urban navigation, incorporating various modes of transport – including local public transport. Even when drivers leave their BMW i3, the smartwatch or smartphone can display a list of possible public transport connections that will get them to their destination on time, or that will navigate them back to their vehicle. In Las Vegas, BMW Group Forschung und Technik – the Group's R&D arm – are presenting a further enhanced version of this navigation service from BMW i Connected Mobility. A carfinder app is also integrated, which identifies the vehicle's precise parking spot even in large multistorey car parks. The application registers the vehicle's position and relays it to the BMW backend servers. This position data can then be used to navigate the driver back to the vehicle. In addition to the smartphone and smartwatch, BMW i Connected Mobility also integrates a further device: the smart home TV. The internet-enabled TV is used as an input and display device and mobility centre.

BMW i Connected Mobility is able to detect – e.g. from the user's digital calendar – if two appointments are in different geographical locations. The app calculates the time required to get from one location to the other and produces a precise and always up-to-the-minute mobility itinerary consisting of multiple individual trip modules. The system learns to select the types of transport the user prefers, thereby optimising the recommendations it provides. The mobility planner, supported by the smartwatch or smartphone, navigates users promptly and punctually to their destination. The same route

information that is available on the smart home TV – including directions for navigation on foot to a car park or the nearest bus stop – can also be made available on mobile devices, for use en route. Using the mobility planner, the smart TV (or smartphone or smartwatch) can even provide a reminder function, letting the user know when to set off in order to arrive at the next appointment punctually. And because all devices are synchronised with the BMW backend, seamless connectivity between them is ensured at all times.

With the BMW i Remote App for Android, BMW is the first vehicle manufacturer in the world to offer – in the BMW i3 – smartwatch control of vehicle functions as a standard feature. And with BMW i Connected Mobility, further possibilities are being opened up – for example a research application has been developed where the smartwatch also allows the BMW i3's doors to be unlocked by gesture control. If desired, the doors can also be automatically opened and closed when the user, wearing the smartwatch, is approaching or moving away from the vehicle. This is an application that can significantly enhance comfort and convenience not only in the private sphere but also when using the BMW car-sharing programme DriveNow.

360-degree collision avoidance – the next stage in “Vision Zero”.

Collision avoidance is a vital feature for moving towards accident-free personal mobility. The BMW Group has been working to implement this vision for many years. Assistance systems like Active Cruise Control with Stop & Go function, which detects and responds to preceding vehicles, are already fitted in current BMW models. These radar- and camera-based systems provide warnings and can also brake the vehicle to a standstill, if necessary. In the new research vehicle – a BMW i3 – an innovative laser sensor system scans the entire area around the vehicle. In a potential collision situation, the system warns the driver and if necessary automatically initiates centimetre-accurate braking.

Fully automated parking in multistorey car parks – quick and safe, even without a driver.

Four laser scanners monitor the entire area around the research vehicle, producing a precise image of its environment. A fully automated Remote Valet Parking Assistant integrates this information with the digital plan of a car park, and then uses this data to drive the BMW i3 autonomously, quickly and safely to a vacant space and park it there. When the driver is ready to set off again, he can summon the vehicle, for example by a voice command directed at the smartwatch, and the BMW i3 will return promptly to the car park exit, ready for departure.

Extended control options with touch control and non-contact gesture recognition.

The rapid proliferation of smartphones and tablet computers has made direct inputting of data on touch-sensitive interfaces a familiar feature of everyday life. A similar user experience in future BMW models will be offered by a touchscreen Control Display. The Control Display and the proven iDrive Controller will then have equal status. In a further development, it will also be possible in future models to conveniently perform various functions – such as inputting one's home address in the navigation system – by performing a directed gesture in the area between the gear lever and the instrument panel.

Touch Command – extended control options in the rear.

Touch Command is an example of how quickly BMW responds to new developments in the consumer electronics sector. The system uses a standard Samsung tablet computer as a control interface for infotainment and comfort functions, allowing the latest devices with new, intelligent functionality to be seamlessly integrated into the vehicle. The tablet connects wirelessly to the onboard electronics, allowing this interface to be used conveniently in the rear of the vehicle as well, for example to control the rear seat entertainment system. All the main functions appear on the tablet display, without interfering with the monitor displays.

Better parking with ParkNow.

Personal mobility in cities requires intelligent solutions. ParkNow helps with parking problems by offering convenient PC- or smartphone-app-based assistance when searching for vacant parking spaces in multistorey car parks. It will soon be possible to use this app with full functionality from inside the vehicle as well, and to operate it intuitively with the iDrive Controller. The app will be integrated into the vehicle using the innovative A4A (Apps for Automotive) interface. Also, thanks to its cooperation with Parkmobile, ParkNow will soon be offering additional functions. For example, the ParkNow app will offer users a convenient means of payment at parking meters or ticket machines in public car parks. A reminder function warns the driver when the allotted parking time is running out, helping drivers to avoid parking fines.

The BMW Group multifunctional credit card.

The new-generation BMW Group MasterCard credit cards will make it possible to simplify use of the DriveNow fleet even further. The card is fitted with a chip that supports Near Field Communication (NFC – a wireless standard for short-range data transmission). The credit card then becomes not just a means of cashless payment but also a remote key. As soon as the card is held near to the sensor in the windscreen, the system identifies the user and unlocks the vehicle.

Wireless charging of high-voltage batteries.

Optimal charging of electric vehicles and plug-in hybrid models helps to improve their sustainability. With a research application, the BMW Group is demonstrating a solution which would allow EV batteries to be charged even more conveniently in future using wireless, inductive charging. The system consists of two coils, one on the underside of the vehicle and one on the floor of the garage. Current is transmitted between the coils by means of an alternating magnetic field and without cable or contacts, at a charge rate of 3.3 kW. The battery of the BMW i8 takes about 2 hours to recharge in this way. This is similar to the charging time achieved with a wired connection. The system launches automatically, but only if the coils are correctly aligned and there is nothing in the way to obstruct the energy transfer. Incidentally, even right next to the vehicle, the amount of electromagnetic radiation released is less than that emitted by an induction hotplate on a stove in a kitchen in the home.

BMW i ChargeForward Program: intelligent charging to reduce overall running costs for EVs.

As a leading innovator in the field of electric mobility, BMW looks for opportunities to positively impact the future of mobility in ways that extend its commitment to sustainability while also focusing on total cost of vehicle ownership for the consumer. With the BMW i ChargeForward Program, it is exploring the possibilities for ensuring that recharging of the BMW i3's batteries does not create an additional burden on the grid during peak periods. This pilot project, which will be launched in the Greater San Francisco area in July 2015, will investigate the charging behaviour and driving habits of 100 BMW i3 drivers over a period of 18 months. All participants receive a financial bonus at the beginning and end of the scheme. Connected to the smart charging system, the batteries will be charged intelligently at an ideal time within the overall window the vehicle spends plugged into a domestic charging system, such as the BMW i Wallbox. The mobility requirements of individual participants are taken into account and, if desired, participants can opt out for a day at a time. A portion of the benefits for the entire network that arise from the scheme (increased reliability) is passed on to BMW i3 owners or participants in the form of bonuses. That means a reduction in total running costs for the electric vehicle. At the same time BMW i ChargeForward is exploring how batteries from used BMW EVs such as the MINI E can serve as stationary energy buffers, for example to absorb peaks in renewable energy supply. With BMW i ChargeForward, BMW i reinforcing its espousal of sustainability beyond the entire life cycle of the product and reducing overall running costs for EVs, since savings made by the electricity providers can be passed on to customers.

Over-the-air navigation map updates.

BMW ConnectedDrive features offer even greater convenience: the latest-generation Navigation system Professional now enables over-the-air updating of map data for the first time. The maps are brought up to date – at no charge to the user – via a mobile phone connection through the SIM card embedded in the car.

BMW ConnectedDrive Store also available in the USA in spring 2015.

Accessing the extensive range of digital services and features from BMW ConnectedDrive has now become even easier and more convenient. As well as being able to order them online from your home or office, customers can now also book intelligent services such as the Concierge Service and Real Time Traffic Information (RTTI) from the car via a connected SIM card – thanks to the new BMW ConnectedDrive Store. The services are ready to use within minutes. BMW is the only premium carmaker to offer this additional means of acquisition. Following its successful introduction in Belgium, Luxembourg and Germany, the BMW ConnectedDrive Store will also be launched in the USA from spring 2015.

BMW M4 Concept Iconic Lights showcases BMW laser lighting of the future and OLED rear lights.

In June 2014, BMW was the world's first manufacturer to supply to customers a standard-production vehicle with laser lighting – the BMW i8. Equipped with intelligent laser lighting and OLED-based BMW Organic Light, the BMW M4 Concept Iconic Lights model on show at CES 2015 in Las Vegas highlights BMW's position as a technology leader. The concept model combines pioneering lighting design with the latest technology.

BMW laser lights offer an impressively long beam range well in excess of other lighting systems. The light is brighter, casts a concentrated beam over a distance of up to 600 metres and is extremely efficient. Upwards of a speed of 70 km/h (43.5 mph), BMW laser lights are automatically activated on top of the broader-dispersion LED main beam. Innovations now being unveiled with BMW M4 Concept Iconic Lights are yet again helping BMW to widen its lead as a technology innovator.

In combination with BMW Selective Beam, BMW laser lighting provides optimal vision without dazzling oncoming or preceding vehicles. Extensive integration between the headlights, camera, sensors and navigation systems is allowing new, proactive light functions to be developed. For example, if the vehicle sensors detect that the clear road width ahead is reduced, the laser beams can be activated to give drivers an indication of the width of their

vehicle in relation to the road. BMW M4 Concept Iconic Lights also works with the navigation system to illuminate corners well in advance. The Dynamic Light Spot with laser technology detects people or animals on the road or at the roadside from a distance of up to 100 metres, and flashes to alert the driver.

OLED-based BMW Organic Light uses elements which are just 1.4 millimetres thick. Their semiconducting layers of organic material produce light uniformly over their entire surface. In the past, legal requirements regulating the brightness of vehicle lighting have restricted the use of OLEDs on the exterior of the vehicle. However, with BMW M4 Concept Iconic Lights, rear light clusters have been developed which for the first time include not only OLED tail lights but also OLED direction indicators. Since the OLEDs can be activated individually, this creates new possibilities for using different styles of lighting at different times, for example in different driving modes. The front and rear lights of the BMW M4 Concept Iconic Lights model preview a number of lighting functions that can potentially be used in future production vehicles. Rear light clusters featuring BMW Organic Light will already be making their debut on a future vehicle of BMW M GmbH within the next 15 months.

Key fob with display – premium door opener and innovative display functions.

An innovative ultra-modern key fob with display combines the convenience functions of a remote key – locking, unlocking and failsafe identification when starting the vehicle – with unique status displays. A 2.2-inch high-resolution LCD display shows whether the doors and windows are locked and allows the battery charge status to be checked, for example on the innovative BMW i8 plug-in hybrid sports car.

2. **Vehicle automation – the next stage. 360-degree collision avoidance and fully automated parking in multistorey car parks.**

At CES 2014 last year, BMW demonstrated how highly automated driving using advanced control technology can cope with all driving situations right up to the vehicle's dynamic limits. Now, at CES 2015, the company is showing how new sensors can be used to move to the next stage – fully collision-free, fully automated driving. This latest milestone from the BMW Group is a further step on the road towards accident-free personal mobility in both driver-operated and fully automated, driverless vehicles.

360-degree collision avoidance is based on precise position and environment sensing. Four highly advanced laser scanners monitor the surroundings of the research vehicle (a BMW i3) and accurately identify obstacles, such as pillars in multistorey car parks. An audible signal warns the driver in a potential collision situation. As a last resort, for example if the vehicle is approaching a wall or pillar too quickly, it is also possible to initiate automatic braking, bringing the vehicle to a standstill with centimetre accuracy. If the driver steers away from the obstacle or reverses direction, braking is automatically interrupted. This function reduces strain on the driver in difficult-to-monitor driving environments for improved safety and convenience. Just like any other BMW assistance system, this research application can also be overridden by the driver at any time.

Fully automated parking in multistorey car parks – quick and safe, even without a driver.

The fully automated Remote Valet Parking Assistant in the BMW i3 research vehicle combines the information obtained by onboard laser scanners with the digital plan of a building, for example a multistorey car park. When the driver activates the fully automated Remote Valet Parking Assistant, using his smartwatch, the vehicle is driven quickly and autonomously through the various parking levels to a parking space. In the meantime, the driver can already be on the way to his next appointment. The fully automated Remote Valet Parking Assistant and its sensors accurately detect not only the physical features of the building but also any unexpected obstacles – such as incorrectly parked vehicles – and, equally accurately, will steer a course around them. When the BMW i3 reaches its final parking position, it parks and automatically locks itself. It then waits to be summoned in due course by a smartwatch voice command. On receiving such a command, the fully automated Remote Valet Parking Assistant calculates the exact time the

driver will be back at the car park, and then starts the BMW i3 so that it reaches the car park exit in time for the driver's arrival.

Navigation without GPS signals.

By integrating vehicle sensor data with the digital car park plan, BMW has made it possible to control the vehicle fully automatically without having to rely on a GPS signal. The research vehicle is equipped not only with laser sensors but also with computing modules and algorithms, allowing it to precisely determine its position in the car park, to perfectly monitor its surroundings and to navigate autonomously and fully automatically. This allows vehicles to orientate themselves and navigate without going to the expense of fitting the car park – or other facility – with special infrastructure.

Longstanding experience of vehicle automation.

BMW Active Assist is another example of the BMW Group's role as a world-leading pioneer in the development of partially automated and highly automated driving systems.

Back in October 2009, the BMW Group's precursor research project BMW Track Trainer already demonstrated a highly automated system capable of following an ideal line around the Nürburgring North Loop, the most challenging racing circuit in the world. The BMW Track Trainer then went on to demonstrate its effectiveness on the Laguna Seca, Zandvoort, Valencia, Hockenheimring and Lausitzring circuits as well. Under conditions which made extreme demands in terms of vehicle control and positioning, it allowed the research team to gather valuable practical experience.

Further important insights were provided by the BMW Emergency Stop Assistant research project. If the driver is incapacitated by a medical emergency such as a heart attack, this system is able to switch to highly automated driving mode and bring the vehicle safely to a stop at the side of the road before automatically calling for help.

In mid-2011, a BMW Group test vehicle drove automatically and with no driver intervention along a stretch of the A9 motorway, heading from Munich towards Nuremberg. Since then this research prototype, which brakes, accelerates and overtakes other vehicles entirely autonomously, while keeping pace with other traffic at speeds of up to 130 km/h (80 mph) and always observing traffic rules, has been undergoing continuous optimisation. In the meantime, approximately 20,000 kilometres (12,500 miles) of testing has been carried out. The sensing is performed by technologies that include lidar, radar, ultrasound and camera scanning.

Since January 2013, the BMW Group has been working with international automotive supplier Continental to take this project forward. The main goal of this research partnership is to get highly automated driving functions ready for implementation by 2020 or beyond.

The different degrees of vehicle automation.

All driver assistance systems enhance driving safety and convenience – but to differing degrees. Fully automated assistance systems provide the highest level of automation.

Fully automated driving functions do not need to be monitored by the driver. As demonstrated with the fully automated Remote Valet Parking Assistant, it is not even necessary for a driver to be aboard the vehicle.

Highly automated systems, the next stage down from fully automated driving, do not require continuous monitoring by the driver. They provide both longitudinal control (control of forward and reverse motion) and lateral control (control of lateral motion, by steering).

Partially automated systems, on the other hand, although able to provide longitudinal and lateral control (e.g. Traffic Jam Assist), must be monitored by the driver at all times.

In the case of assisted driving functions (e.g. ACC), the assistance system simply plays a driver-supporting role in the longitudinal or lateral control of the vehicle.

3. iDrive Controller now also with touchscreen control and non-contact gesture recognition. **Extended control options for infotainment systems.**

BMW ConnectedDrive offers an exclusive range of functions including driver assistance systems, digital services and apps. BMW's leading-edge technology is also demonstrated in the iDrive control system, which allows safe control of infotainment systems even while the vehicle is on the move. In Las Vegas, BMW is now displaying a research application that shows how it will be possible in future to control functions not only with the iDrive Controller but also by means of a touchscreen and non-contact gesture recognition.

Perfect complement: touchscreen and iDrive control system

The rapid proliferation of tablet computers and smartphones in recent years has seen a fundamental change in the way digital devices are used. In many areas, touchscreens have already replaced input devices such as the keyboard, mouse or touchpad, offering improved speed and more precise response. Users have now become used to performing intuitive finger movements across screens or using learned gestures to interact with programmes on their devices.

The BMW Group has noted this change in user habits and at CES in Las Vegas is unveiling an infotainment system that can be operated not only by the iDrive Controller/iDrive Touch Controller but also by touchscreen. The touchscreen and iDrive can each be used to control all functions. This is an important difference over existing hybrid systems that comprise a main control unit and a second interface that can only be used to operate certain functions.

To take one example, the research application on show at CES offers users the choice of either scrolling through playlists or navigation addresses using the iDriveController or entering numbers directly on the touchscreen. A virtual keyboard opens up on the touchscreen as soon as the user's hand approaches. Even while entering letters, it is possible at any time to switch between the iDrive Controller, the iDrive Controller touchpad or the touchscreen. The advantages of intuitive iDrive operation can therefore be supplemented by an additional option, giving the user more choice. Regardless of whether the iDrive Controller or the touchscreen is used, both systems conform to BMW's strict standards on safe data inputting while on the move. The positioning of the displays, in all vehicles of the BMW Group, and the suitably optimised text size reflect thoughtful ergonomic design and

aid optimal data inputting – whether using the iDrive Controller or the touchscreen.

Direct data inputting with non-contact gesture recognition.

Advanced sensor technology has already made it possible to perfect the technique of gesture control. This means of control is being showcased at CES in a research application that can be used to control selected infotainment functions. That is to say, a variety of functions can be performed not only using iDrive and the touchscreen, but also through non-contact gesture control. The driver or front passenger simply performs a directed gesture in the area between the gear lever, steering wheel and Control Display.

A 3D sensor in the roof detects whether one or two fingers are being pointed, or whether the thumb and index finger are being moved towards each other. The system decodes different movements – such as tapping, finger rotations or a swiping movement to the right – and performs the desired input. A rotating movement can be used, say, to alter the volume of the radio, a finger raised to accept a phone call or a swiping movement to decline a call. Like touchscreen control and the iDrive Controller, non-contact gesture control can offer even more efficient and convenient operation of new-generation entertainment systems.

4. Touch Command. Unprecedented controllability in the rear.

Driver orientation is one of the premium hallmark qualities of every BMW. At the CES in Las Vegas, BMW is now presenting a system that has been perfectly tailored to the needs of the passengers in the rear: Touch Command. It uses a Samsung tablet computer that has a wifi connection to the vehicle and serves as a control console for both the infotainment and the comfort functions. Passengers are able to use this tablet in the usual way to make the rear of the vehicle feel like their own living room and for controlling the comfort functions to create a personal haven of wellbeing for themselves. BMW is thus demonstrating for the first time how the latest consumer electronics devices can be turned into integral components of the overall vehicle system.

World premiere: regular tablet becomes part of the vehicle.

Touch Command offers unprecedented flexibility for operating the information and entertainment systems, while also illustrating how a tablet computer can be perfectly integrated into the vehicle. The tablet is kept in a crash-proof holder and can be recharged by means of a snap-in adapter. The touchscreen itself is therefore transformed into a high-tech-looking element of the vehicle interior. A BMW app on the tablet makes it possible to control all available devices, such as the Rear-Seat Entertainment System. When it is being used, the tablet can be either left secured in its holder or removed. All functions are permanently available thanks to the wifi connection.

Smart solutions and swift integration of the very latest technology.

The BMW app provides a clearly arranged menu on the Samsung tablet, from which the various functions can be selected. The app functions as a remote control for operating the DVD player, for example, or changing the radio station. Touch Command therefore incorporates the functions that are currently controlled with the BMW iDrive Controller in the case of today's BMW Rear-Seat Entertainment System, for instance. The tablet also doubles as an additional screen and can display controls without affecting the image shown on the onboard screen in the head restraints. So the radio station can be changed using the tablet while the navigation map continues to be shown in full on the connected screens. In addition to this, comfort functions in the rear compartment, such as seat adjustment or climate control, can be operated with the greatest of ease using the tablet without the passengers having to move in their seat.

Touch Command supports the customary tablet-computer gesture control actions for changing views, for instance. It can also be used to connect to the internet in the usual way provided it has the necessary mobile network connection.

Touch Command marks the first time that a top-quality digital device and its state-of-the-art functionality have become an integral part of the car. At the same time, the system also demonstrates how swiftly BMW ConnectedDrive is able to react to the furious pace of innovation in the field of infotainment and incorporate equally smart solutions into cars.

5. **BMW i Connected Mobility.** **The next logical progression in integrated mobility.**

Not only is the BMW i3 the first ever premium electric car, but thanks to its standard built-in SIM card it also stands out for its unprecedented level of connectivity. Even today, the BMW i Remote app allows various functions of the BMW i3 to be remote controlled using either a smartphone or a smartwatch. These devices allow the intermodal route guidance started in the BMW i3 to be continued once the driver has left the vehicle. This form of navigation is perfectly tailored to the requirements of urban travel and it factors in both the local public transport options and walking time when searching for the optimum route. At the CES 2015 in Las Vegas, BMW is presenting the BMW i Connected Mobility research application as the next logical progression of this unrivalled functionality.

A direct link with the personal digital appointments calendar, the use of the latest devices such as smart TVs, smartwatches and smartphones, along with the inclusion of preferred means of transport and exact pinpointing of the vehicle's position, even in large multistorey buildings, further boosts the degree of connectivity between driver, vehicle and the outside world, while also greatly enhancing the benefit to the customer.

The TV in the home is transformed into a mobility dashboard.

BMW i Connected Mobility paves the way for a whole new form of journey planning that starts on the TV in the home rather than on the computer. The television, now turned into a smart TV by the addition of an internet connection, can show BMW i Remote functions such as the battery's state of charge or the vehicle status (e.g. doors locked or unlocked). An exact driving range map can be called up on the TV that instantly shows how far the BMW i3 can travel with its current battery charge. If desired, the application can even flash up messages while the television is being watched, notifying the user for example that the BMW i3 batteries are fully charged.

For the first time, the research application also connects to the user's stored digital appointments calendar. It synchronises with the calendar and uses the appointments and associated venues to create a personal mobility agenda based on the principle of intermodal route planning. This means that a wide variety of means of transport are taken into account for the purpose of route guidance – from the car to local public transport to walking. The vehicles in the DriveNow car-sharing fleet can also be located, booked and used via a

smartphone. Graphics showing the latest traffic reports are displayed in real time along with the possible delays, just as with the Real Time Traffic Information (RTTI) system.

Seamless connectivity for flawless information.

Smartwatches and smartphones make it possible to easily use this mobility dashboard while on the move as well. Like the smart TV, these devices are permanently connected to the BMW ConnectedDrive Server, enabling users to access their personal, fully up-to-date mobility agenda at any time from any of their devices. The route recommendations already shown on the smart TV are also transferred. The application can furthermore be set to give the user a reminder via their smartwatch, smart TV or smartphone when it's time to leave for the next appointment. BMW i Connected Mobility also monitors for unforeseen events, such as delayed trains or traffic jams. If the traffic situation would prevent the user getting to their next appointment on time, the application prompts them to set off earlier. If the situation is particularly bad, alternative suggested routes for the journey are shown on the smartwatch and can be used directly for navigating. Route guidance on the smartwatch takes place in the form of arrow symbols, maps and navigation instructions. Alternatively, the corresponding BMW i Mobility app on the smartphone shows detailed route information.

When it comes to selecting the means of transport, the research application is adaptive and remembers the user's previous preferred means of travel: whether, for example, they would rather travel by car on a particular route, even if there are minor traffic jams, or would prefer to take the train instead in this case. BMW i Connected Mobility then applies this information the next time it plans a route.

Gesture control using smartwatch unlocks the BMW i3.

Smartwatches allow direct access to important information without having to use the connected smartphone. BMW i Connected Mobility harnesses the possibilities offered by the smartwatch for advanced BMW i Remote app functions. The car can even be programmed to recognise the driver by their smartwatch. It unlocks the doors as the driver approaches and locks them again when the driver leaves the vehicle, in each case in response to a specific gesture. This type of functionality could complement the use of smartcards as a means of identification for car-sharing services such as DriveNow and offer even greater ease of use.

Sensor system memorises the exact vehicle position.

Whereas navigation instructions used to end at the address of the multistorey car park, a vehicle is now capable for the first time of using its system of

sensors to automatically detect a change of storey in large car parks and thereby ascertain exactly where it has been parked, for example. BMW i Connected Mobility uploads this information to the cloud, where it can be accessed wirelessly by the smartwatch via the BMW server. If the smartwatch's positioning function is activated, the user's location data can be used together with the data from the BMW backend to navigate the user straight back to their vehicle, with the help of maps, arrows and distance information. This same function could also make the DriveNow car-sharing service more convenient and flexible to use.

6. **ParkNow with extended functions.** **Finding, reserving and paying for parking made even easier.**

With its premium ParkNow service, BMW i has devised an exceptionally customer-friendly and convenient solution to the problem of parking in urban centres – for drivers of all makes of car. ParkNow covers both on-street and off-street parking.

The all-encompassing approach optimises all key steps in the process. If the customer is interested in an off-street parking space, for example, it can be easily found, booked and paid for, all with ParkNow. The booking can be made either in advance from a PC or smartphone or, in the near future, even en route by means of the navigation system. The multistorey car parks in the ParkNow network can be filtered by price, distance or availability of services such as charging stations or car washes. Once the selection has been made in the navigation system, the driver is directed straight to the selected car park and an electronic ticket is generated that grants access to the reserved space. Tedious searching for a free parking space and the pollution caused in the process are therefore a thing of the past.

Added convenience right down to the finer details.

If parking on the street, there is no longer any need to hunt around for change, walk to the parking meter and carefully position the ticket in the car. All the customer has to do is enter the number of the parking zone in the ParkNow app or the navigation system and the parking process starts. The customer also receives notification before the parking time expires and can extend the parking time while away from the vehicle if necessary. Payment takes place automatically.

With ParkNow LongTerm, meanwhile, BMW i additionally offers the possibility of renting a long-term parking space with charging facilities close to home or the workplace.

Collaborations with car park operators are spurring on the international expansion of the network. ParkNow has real-time access to 4,200 multistorey car parks offering 5.6 million parking spaces in hundreds of cities across North America. In addition to this, there are 2.8 million on-street parking spaces in more than 200 cities in the USA alone.

7. **New BMW credit card also functions as a key.** **Platform for new mobile services.**

At the 2015 Consumer Electronics Show (CES), BMW and MasterCard have jointly presented a contactless MasterCard credit card that can be used to hire, unlock and operate a BMW or MINI vehicle from the DriveNow car-sharing fleet. BMW and MasterCard are continuing to cooperate on the development and introduction of this new smart mobility solution.

DriveNow, the car-sharing service by BMW and Sixt, is a premium mobility service from the BMW Group and one of the biggest car-sharing operators in the world, with more than 2,800 vehicles and more than 350,000 users in the USA, the United Kingdom, Germany and Austria. One reason for DriveNow's success is simple access to the car fleet: all that is required is a smartphone app or PC and an ID card.

New functions for the BMW Group credit card.

DriveNow is designed to meet short-notice, short-term mobility needs in the city. It is targeted both at local residents who want flexible, on-demand mobility and visitors who, following a flight or train journey, want to be able to use a car with the minimum of hassle.

Following a one-off registration, customers can reserve BMW and MINI vehicles from the DriveNow fleet simply by using a smartphone app or computer. They can then access a DriveNow vehicle by identifying themselves with an ID card or the smartphone app. Billing is automatic and by the minute, based on a fixed scale of charges. The DriveNow smartphone app also provides users with directions to the vehicle they have reserved.

The new generation of BMW Group MasterCard credit cards will offer a further way of accessing any vehicle in the fleet. The card is fitted with a chip that supports NFC (Near Field Communication – a wireless standard for short-range data transmission). The credit card then becomes not just a means of cashless payment but also a remote key. As soon as the card is held near to the sensor in the windscreen, the system identifies the user and unlocks the vehicle. Since the user's identity was already checked when the credit card was issued, identification with an additional ID card or the smartphone is no longer required.

The new credit card again demonstrates that the BMW Group is a premium mobility provider capable of reaching new target groups with new and innovative services.

8. Inductive charging. Power transfer without cables or wires.

Powered by high-voltage EV batteries, the first premium all-electric vehicle – the BMW i3 – and the BMW i8 plug-in hybrid sports car can be driven with zero tailpipe emissions. As a fast and simple solution for battery charging via a hardwired connection, BMW i offers the Wallbox. At CES, BMW will present an alternative solution: in a BMW i8 it will demonstrate a research application for inductive – i.e. wireless – battery charging.

Contact-free power transfer between coils.

Inductive charging provides reliable, wear-free and user-friendly EV battery charging using a magnetic field, without the need for a hard-wired connection between the vehicle and the power source. The system comprises a primary and a secondary coil. The primary coil is fitted in a base pad underneath the vehicle, for example on or embedded in the garage floor. The secondary coil is integrated in the underside of the BMW i8. As soon as the vehicle is positioned over the base pad and the charging process begins, an alternating magnetic field is generated which transmits electricity between the coils. The electricity is transmitted without cables or contacts across a gap of several centimetres, at a charge rate of 3.3 kW. The high-voltage battery of the BMW i8 can be fully recharged in less than two hours using this system – which is approximately the same amount of time required with a wired connection. Future inductive charging systems with a higher charge rate of 7 kW will also allow the larger batteries of all-electric vehicles, such as the BMW i3, to be fully recharged overnight. In typical accessible areas immediately next to the vehicle, the electromagnetic field strength during inductive charging is well below the existing regulatory limits. The electromagnetic radiation is less than that emitted by an induction hotplate on a kitchen stove.

Trouble-free inductive charging even in snow or in the wet.

The key requirement for an optimal charging process is the correct relative positioning of the two coils. A parking assistant ensures that the BMW i8 is parked so that its secondary coil, which is located centrally between the front wheels on the underside of the vehicle, is positioned precisely over the primary coil in the base pad. The system launches the charging process automatically, but only if the coils are correctly aligned and there is no obstruction to the power transfer – for example due to foreign objects situated

between the vehicle and base pad. Since all the system's electric components are protected, inductive charging is possible even in rain or snow.

Automatic control for additional convenience.

Inductive charging offers important convenience benefits for drivers of electric or plug-in hybrid vehicles: they no longer have to connect a cable to a charging station, for example. At the same time, charging begins automatically and is continuously monitored. This ensures the BMW always offers an optimal range for zero-tailpipe-emission electric driving.

Just as when charging the vehicle with the BMW i Wallbox, inductive charging can also be activated and monitored using a smartphone app. Amongst other things the app shows the current charging status, remaining time to complete a full charge and potential driving range.

9. **The BMW i ChargeForward Program.** **Intelligent, proactive charging to reduce overall running costs of electric vehicles.**

The BMW Group is a leading innovator in the field of electric mobility and battery charging technology. Jointly with Californian energy provider Pacific Gas and Electric Utility Service (PG&E), BMW i will launch an 18-month pilot project under the name BMW i ChargeForward, starting in July 2015. The project will research and develop a system for smart charging of electric vehicles. Starting in January 2015, BMW i3 owners from the Greater San Francisco area will be able to apply to be one of the 100 participants in this project. The information obtained about the participants' charging habits will offer valuable pointers as to how to provide a dependable supply of battery charging energy and how to use it as efficiently as possible. The aim of the project is to reduce grid load at peak times and to make greater use of renewable energy through staggered charging of the vehicles, while giving priority to the individual mobility requirements of the BMW i3 drivers. Participants in this scheme will receive bonuses worth over 1,500 US dollars in total. The BMW i ChargeForward Program will also explore the possibilities for reuse of ex-EV batteries as local energy buffers.

Optimised charging improves sustainability.

As more and more electric vehicles take to the road, the demands on energy providers increase as well. Providers have to ensure that the necessary supplies are available to allow a growing number of customers to replenish their high-voltage batteries at domestic charging stations, such as the high-performance BMW i Wallbox. When connected to the Wallbox, the BMW i3 can be charged in approx. 3.5 hours (7 kW at 240 V). The aim of BMW i ChargeForward is to boost the efficiency of the power grid and thus lower the overall running costs for EVs while at the same time driving forward the integration of renewable forms of energy – advantages that will prove beneficial particularly in the light of the steadily growing number of EVs on the roads.

The two cornerstones of the BMW i ChargeForward Program.

In addition to researching EV customers' driving and charging habits, the field trial will also explore the possibilities for reusing ex-EV batteries as stationary electric storage systems, buffering electricity that can then be fed back to the grid during periods of high demand.

The BMW i3 drivers participating in the field trial in the Greater San Francisco area will sign an agreement to say that BMW may control the timings of battery charging when drivers connect their car to the grid at home or at a public charging station. Earlier trials with EVs have shown that the timing is flexible when it comes to vehicle charging, whereby the mobility requirements of drivers are given top priority. The BMW i ChargeForward intelligent charging system takes into account the charging requirements and preferences of individual participants based on the BMW i Remote smartphone app. With the aim of smoothing grid load as much as possible, the system can then decide exactly when to start charging in each individual case. The information is supplied from the BMW servers wirelessly to the energy management system in the BMW i3. If a user connects his vehicle to the charging station in the evening but does not plan to use the car until the next morning, the BMW i ChargeForward system can exploit the financial benefits of this flexibility and pass them on to the customer.

The system can be deactivated at any time to ensure that the electric mobility requirements of participants are optimally met. Should BMW i3 owners need their vehicle earlier than planned, they can use a free ChargeForward smartphone app to opt out of the pilot project at short notice. The charging process can then be manually launched. How often participants in the pilot project make use of this opt-out will provide further valuable input for use in developing an intelligent charging strategy.

Storing “intermittent” renewable energy.

Spreading out EV charging as much as possible in order to avoid sudden load peaks helps to improve grid stability. It also allows more renewable electricity – for example wind or solar power – to be integrated into the power grid, for example by storing it in stationary energy storage systems based on used EV batteries, in this case batteries from the MINI E field trial. Optimised use of the power grid and a greater proportion of renewable energy are predicted to reduce costs for the electricity providers, who would be able to pass these savings on to their customers in the form of lower electricity prices. In this way, BMW i would be reinforcing its commitment to sustainability while reducing overall running costs for electric vehicles.

10. Over-the-air updates. **Convenient wireless updating of navigation maps.**

BMW, the world's leading provider of online-based in-car services, is strengthening its lead by bringing out yet more innovative applications. The Navigation system Professional has represented the ultimate in convenience and information en route to the destination ever since it was launched. When paired with the latest generation of this system, BMW ConnectedDrive enables regular automatic navigation updates. With the help of the vehicle's built-in SIM card, the data is transmitted over the air via the mobile phone network, with no licensing fees or transmission costs for the end user.

Up-to-date navigation maps for optimum functions.

The sophisticated BMW navigation systems are fast, easy to use and reliable. Besides the vehicle data and the route planning algorithms, up-to-date map material is of vital importance here. Updated navigation maps keep the system informed of new roads and modified traffic layouts. This data can be factored in for effective route planning in the same way as information such as altered town boundaries can be transmitted to the electrical system to assist with anticipatory energy management.

To allow the navigation system to access the very latest map material at all times, BMW ConnectedDrive is taking a different approach with the generation of the Navigation system Professional that is now available. With this system, the navigation maps now update automatically, putting an end to the problem of outdated datasets.

The new map data is simply transmitted straight to the vehicle over the mobile phone network using the vehicle's built-in SIM card, thereby dispensing with the need for manual installation via an external data device.

Regular updating without registration or additional costs.

The system updates itself at regular intervals several times a year, whenever a new map version becomes available. Update progress is shown in the Control Display, while installation couldn't be simpler as it all takes place automatically. In this way, the most up-to-date map software is provided without delay to ensure flawless navigation. All navigation functions continue to be fully available while the update is in progress. There is no need to either register or log in to a portal for the automatic update.

This cutting-edge solution is included as part of the Navigation system Professional, and customers do not have to pay either licensing costs or data transmission charges. Besides automatic map updates, the ultra-fast transmission of very detailed data over the air using a SIM card embedded in the vehicle also paves the way for transferring the Real Time Traffic Information (RTTI) used to optimise route calculations.

11. The new BMW ConnectedDrive Store. Extreme flexibility when booking digital services and features.

At BMW, connectivity between driver, vehicle and environment is about to get even simpler, even more personalised and even more flexible. The extensive range of digital services and features available under the umbrella of BMW ConnectedDrive can be booked and updated via the internet on your home computer or directly from the car – thanks to the BMW ConnectedDrive Store. The services are ready to use in the car in a matter of minutes. BMW is the only premium manufacturer to offer this convenient route to accessing online-based services. Following the successful launch of the BMW ConnectedDrive Store in Belgium and Luxembourg in early summer and in Germany in October of last year, it will also be available in the USA from spring 2015.

Booking services as and when needed.

BMW was one of the first car manufacturers to recognise the significance of mobile communications, integrating them into its vehicles through BMW ConnectedDrive. With the launch of the BMW ConnectedDrive Store, this extensive range of connectivity solutions can now be ordered online via the “My BMW ConnectedDrive” customer portal. Moreover, services and apps are accessible directly from the car via the BMW ConnectedDrive menu. For example, RTTI (Real Time Traffic Information) can be uploaded if you happen to be stuck in a traffic jam and cannot rely on radio traffic news that may be inaccurate or incorrect.

As simple to use as the smartphone App Store.

In the car, the store has its own menu option under ConnectedDrive or BMW Online, which can be selected via the iDrive Controller. It is as easy to use as the well-known smartphone stores and displays all the services that are available and already booked. As soon as the password set up in the customer portal is entered, services and features can be directly accessed, also for flexible periods, and are ready to use in the car within a short space of time.

All BMWs in the USA with embedded SIM card.

All you need to use the BMW ConnectedDrive Store is a connection via a SIM card built into the vehicle. In the USA this is standard on all vehicles. The embedded SIM card is also required for the Intelligent Emergency Call service, which in the event of an accident establishes contact with a BMW Call Centre. The Call Centre agent will speak to the vehicle occupants in their

native language if they happen to be abroad and will organise rapid and extensive assistance. Thanks to automatic data transmission, the Intelligent Emergency Call system can also assess the severity of the accident. This allows crucial information to be conveyed to the rescue services even if the occupants are not responding to questions from the Call Centre agent.

Intelligent Emergency Call can also be triggered manually to help other road users, for example to provide first aid at an accident site. Here, too, the system makes for greatly enhanced safety.

Following its successful introduction in Belgium, Luxembourg and Germany, the BMW ConnectedDrive Store is to be launched in the USA in spring 2015.

12. BMW M4 Concept Iconic Lights – bright ideas for more driving pleasure. BMW laser lighting and BMW Organic Light with OLED technology.

At CES 2015 in Las Vegas, BMW is providing further evidence that it is a world leader in the development of laser lighting. Having already supplied its first models with laser lighting to customers, it is now presenting further laser functions for vehicles of the future.

Laser lighting is now able to offer its impressively long beam range of up to 600 metres in combination with the BMW Selective Beam function (anti-dazzle High-Beam Assistant). At CES, BMW is unveiling ways in which laser lighting, extensively integrated with assistance systems and vehicle sensors, can be used to implement new intelligent lighting functions for enhanced safety and comfort. For example, it can work with the navigation system to illuminate corners well in advance, while a laser-based Dynamic Light Spot can provide early warning of people or animals at night from a distance of up to 100 metres.

The BMW M4 Concept Iconic Lights model, with exterior paintwork in Cool White metallic, features a new interpretation of the typical BMW twin round headlights. On the move, the laser technology can be identified by the fine blue strips inside the lights. Meanwhile, the rear light clusters of the BMW M4 Concept Iconic Lights model are based on OLEDs (organic light-emitting diodes), which produce light from wafer-thin semiconducting layers of organic material. For the first time, both the tail lights and rear direction indicators feature OLED technology. The illuminated surfaces are positioned to produce a three-dimensional effect. OLEDs also take up less room on account of their thin size.

Shining example of innovative technology: anti-dazzle laser lighting and laser projection.

BMW laser lighting sets new standards in terms of beam range and brightness. Inside the laser headlights, the “coherent” monochromatic blue laser light is converted into harmless white light. A special optical system directs the rays from the high-performance diodes onto a phosphor plate inside the light, which converts the beam into a very bright white light that is similar to natural daylight and pleasant to the eye. Despite consuming 30 percent less energy, the parallel light beam is ten times more intense than that produced by halogen, xenon or LED light sources. BMW laser lighting also has a beam range of up to 600 metres, more than twice that of conventional

headlights, for increased safety in the dark. The camera-based BMW Selective Beam system, which is controlled by dynamic actuators, prevents oncoming or preceding vehicles being dazzled and allows the laser high beam to be left on at all times.

Extensive integration of the innovative laser lighting with other vehicle systems allows a variety of intelligent lighting functions to be implemented. Integration with the navigation system, for example, allows the proactive Adaptive Headlight control system to illuminate corners even before the steering wheel is turned. Laser lighting also adds a new dimension to the Night Vision system's Dynamic Light Spot function. In pitch-dark conditions, people and animals can be detected from a distance of up to 100 metres, by infrared camera, and "spotlighted" by the laser-based Dynamic Light Spot. This is a longer range than that of any other system. Also, if the vehicle detects reduced clear road width ahead, the laser headlights can be used to provide "narrow clearance" lighting. A laser projection function indicates the exact width of the vehicle in relation to the road to allow safe passage through the narrow space. BMW M4 Concept Iconic Lights also showcases a further "visionary" system: "High Power Laser" diodes. This system projects driver information directly onto the road in front of the vehicle, allowing drivers to concentrate optimally on the traffic even in pitch darkness.

OLED rear light cluster with three-dimensional effect.

Organic light-emitting diodes – OLEDs – are an innovative, efficient, sustainable light source that forms the basis for the BMW Organic Light system. OLEDs have a low power consumption, which helps to further reduce vehicle CO₂ emissions. Another sustainable feature of this technology is the fact that no expensive rare earth metals are required in the production process. Unlike ordinary LEDs, which are a point light source, OLEDs produce light uniformly over their entire surface. The OLED elements are very thin, with a thickness of just 1.4 millimetres. Also, the individual modules can be activated separately, generating new possibilities for creating different lighting effects at the rear light clusters.

Different lighting effects in different driving modes.

In the past, rigorous legal requirements regulating the brightness of vehicle lighting have limited the number of lighting functions that it was possible to implement with OLED technology. On the BMW M4 Concept Iconic Lights model, BMW Organic Light is used in the tail lights and rear direction indicators. By activating the OLED segments individually, it is possible to create different rear lighting effects in different driving modes. Whereas normally the L-shape is wide and uniformly illuminated, in Sport mode a different-shaped light pattern can be used by activating only some of the

OLED segments. The rear light then appears as a narrow, focused and sharply defined “strip” of light.

New technologies create new design options.

Lighting is an important design element in modern vehicles. From the front, all vehicles of the BMW core brand are instantly identifiable by the combination of their twin round headlights and the hallmark kidney grille. At night, the four glowing corona rings form a distinctive signature. The BMW M4 Concept Iconic Lights model presents a new interpretation of the twin circular headlight theme. The headlights feature laser technology which is attractively highlighted by fine blue LED strips when the vehicle is on the move. Thanks to the new laser technology it was also possible to give the headlights a flat and sharply sculpted design.

The L-shaped rear light clusters are just as distinctive in terms of styling as the front lights. The “L” shape is a typical design hallmark that accentuates the width of the rear and gives the vehicle a striking and powerful look that always stands out from the crowd, whether at night or during the daytime. On current models, LED-powered light strips and other light elements emphasise the L-shape at night and make the brand identity more easily recognisable in the dark. BMW first presented a rear light cluster with OLED elements on the BMW Vision Future Luxury concept model, which made its world debut in Beijing in April 2014. BMW M4 Concept Iconic Lights displays its own version of this design. Its M-style OLED rear light cluster marks a new evolution of the typical BMW L-shaped lighting design which, with the BMW 7 Series launch, was reinforced with a distinctive “glowing” effect. OLED technology makes it possible to create a new, more three-dimensional and at the same time very sharply defined appearance.

13. Key fob with display. Premium door opener and “info centre”.

At the CES, BMW is presenting a new ultra-modern key fob with display for the pioneering BMW i8 plug-in-hybrid sports car. Its technically sophisticated design featuring a novel three-dimensional glass surface and aluminium clasps perfectly matches its state-of-the-art functionality. Besides all the convenience functions of a remote key – unlocking, locking and failsafe identification of the key for starting the vehicle – this premium key fob also shows vehicle status displays on a 2.2-inch LCD screen. The display provides information on the fuel level, for instance, or the battery electric range. Swiping the touchscreen with the same gestures used to control a smartphone opens up submenus, which show whether the doors and windows are locked or a service is due, for example.

Touchscreen for controlling functions.

The key fob with display is therefore capable of showing the sort of status information that can be accessed on a smartphone with the BMW i Remote app. However, the data is transmitted to this premium key fob by means of the same radio signal used to lock or unlock the vehicle. The information can be updated if the vehicle is within radio range of the key.

The new key fob combines a compact format with optimum usability and legibility. The display boasts the same crystal-clear resolution as today's smartphones, while a lithium-ion battery provides the power. The key can be recharged inside the vehicle inductively (contact-free) by placing it in a special charging tray, or by using the micro USB port. Smart energy management ensures the key functions can be used for at least three months without charging.

A key fob with display was already included as part of the specification of the one-off BMW i8 Concours d'Elegance Edition 2014 model that was auctioned in Pebble Beach. The innovative premium key fob will be available as an option for the BMW i8 from autumn 2015.