The all-new BMW iDrive.
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Individual, intuitive, intelligent, proactive, high-resolution and ready for the future.

The new generation of BMW iDrive takes the interaction between driver and vehicle into a digital future where many areas of life are getting increasingly smart. The new interpretation of BMW's operating system equips the vehicle to actively engage in its relationship with those on board and, in so doing, serves as a digital, intelligent and proactive partner in any situation. A natural dialogue is created with the aim of precisely tailoring all the functions controlled via BMW iDrive to the driver's needs and preferences as the situation demands.

Alongside the system's expanded capabilities, the advances made with its natural control approach and the holistic user experience design play a particularly prominent role in helping the new BMW iDrive to create an in-depth and personal relationship between the driver and their vehicle. Underpinning the unique user experience are the new BMW Operating System 8, a new generation of displays, controls and software, and extremely powerful connectivity and data processing. The new iDrive will be rolled out gradually across all vehicle classes, making its debut later this year in the BMW iX before also featuring in the BMW i4.

The ability of the BMW Intelligent Personal Assistant to adjust to the driver's individual needs and routines, as well as the situation at hand, makes it – more than ever – a central operating channel of human-machine interaction with the new BMW iDrive. The operating system is designed with a clear focus on dialogue-based interaction using natural language and touch operation via the BMW Curved Display. And then there is "Great Entrance Moments", which brings emotionality to the relationship between driver and vehicle even before the driver climbs on board. This new customer experience welcomes the driver and invites them into the vehicle with a thoroughly choreographed routine. It all starts with illumination of the area around the vehicle and its interior, before the doors unlock automatically and the cabin is prepared for the occupants. During the journey, the new My Modes use an all-encompassing interplay of various functions to conjure special moments from a combination of vehicle characteristics and the interior ambience adapted to the situation at hand.

The new BMW iDrive constantly processes a large quantity of self-generated data, information available online and data imported from the BMW Group

vehicle fleet to implement the driver's wishes in a context-related way. Paving the way for even greater personalisation is the BMW ID. This system recognises repetitive situations, learns from them and provides suggestions on how functions can be activated accordingly. Remote Software Upgrade allows the new BMW iDrive to benefit from regular over-the-air improvements, integrate additional functions and stay up to date at all times.

Added to which, the integration of apps from third-party providers is more extensive than ever. The most important applications in each individual market around the world can be absorbed seamlessly into the vehicle's operating system. The display and operation of these apps will be familiar to customers from their smartphones. They are fully embedded in a modern, digital design which employs high-resolution graphics, a striking use of form and emotionally rich colours to elevate the user experience to a new, future-focused level.

History and new interpretation.

The arrival of iDrive 20 years ago saw BMW ushering in a new era of in-car operating technology. Keen to get a grip on the constantly expanding array of functions in vehicle interiors, in 2001 BMW instigated a paradigm shift in the then new BMW 7 Series – one which enabled the hitherto inexorable march of buttons and controls through the cockpit to be checked and even reduced. In their place came a colour screen in the centre of the instrument panel (the control display) and a rotary dial on the centre console (the iDrive Controller). This multifunctional system allowed drivers to control a large number of vehicle settings, entertainment, navigation and telecommunications functions with a single operating tool. Within the space of a few years, iDrive effectively became the new industry standard and proved to be extremely future proof.

Today, 20 years later, the developers and designers focusing on user interaction and user experience have faced up to a new set of challenges. A constant stream of new functions is joining the fray, functions are gaining in complexity all the time, and operating them is becoming easier and more natural. Added to which, the BMW cars of today are intelligent and able to build a detailed picture of their surroundings and make sense of it using modern sensors and sensor fusion. They are permanently connected to the BMW Cloud and therefore benefit from the combined computing power, long-term and real-time data, machine learning, and swarm intelligence generated by the other 14 million connected vehicles.

The developers of the new BMW iDrive have carried over the car's expanded technical armoury and abilities into an all-embracing user experience design distinguished by its skilful and intelligent symbiosis of hardware and software. Looking ahead, the car will become an increasingly smart and automated device which maintains a natural dialogue with the user. This interaction will involve the user simply making iDrive aware of their wishes and requests, while the system learns how its user behaves, comes up with suggestions in real time (based on an extensive pool of detailed knowledge) and actively proposes them to the driver – who then only needs to signal their agreement. Added to which, the user-experience designers blend an array of different in-vehicle functions into a staged and curated experience. Taking the customer's wishes and the situation at hand as starting points, different senses are addressed in an orchestrated way.

What began with the introduction of a rotary dial and a digital display is now an all-encompassing, intelligent, multi-sensory experience tailored to the user at hand. That is what the new BMW iDrive represents. It brings about another paradigm shift – this time to a natural dialogue between the user and their vehicle: more intuitive, personal and inspiring, but also engaging on an emotional level.

Design approach and operating concept.

The BMW iX puts its driver and passengers at centre stage. Its vehicle concept and technology are designed to meet – in an emotionally engaging way – the needs and desires of its occupants, in terms of spaciousness, functionality and luxury. The all-electric Sports Activity Vehicle was developed from the inside out with this in mind. It's the same story with the user experience for the new BMW iDrive. Here, the starting point was how not only the driver but also the front passenger experience things on board. The wishes of those travelling in the iX underpin how the user experience is designed – in all its facets and for all the senses.

Advances made in the field of digital design are likewise reflected in the design of a user interface which not only fulfils its functional role but is also extremely clear, aesthetically pleasing and rich in detail. This artistic approach creates surprising moments, with graphic presentation on the displays precisely designed, down to the last pixel. The interaction between driver and vehicle becomes a unique experience in which the boundaries between the digital and analogue worlds melt away. The user experience design for the new BMW iDrive therefore provides a new gateway into its functions.

The digital design's use of form fits in neatly with the geometric structures of the analogue elements in the new BMW design language. A prime example is the use of clear, minimalist design in both the exterior and interior of the car, which is reprised by the pure, reduced design of the digital elements of BMW iDrive. For example, the clear structures of the surfaces for the interior door trim – dominated by diagonal lines – are reflected in the graphical user interface of the BMW Curved Display. This creates a smooth connection between the user interface design and the vehicle design.

The most distinctive new addition to the physical components on board is the BMW Curved Display, which groups together the information display and control display. This curving screen offers a futuristic interpretation of the traditional driver orientation in the cockpit design of BMW models. The BMW Curved Display is angled clearly towards the driver to good ergonomic effect, making the intuitive touch control even more straightforward. The front passenger also has a full view of the displays and can also operate the system by touch control. In this new BMW Curved Display, the screen areas of the 12.3-inch information display and 14.9-inch control display merge together

into a single unit. Its high-quality display technology (200 ppi) with non-reflective glass and the slim design of the supporting structure also help to integrate the BMW Curved Display harmoniously into the cockpit area and instrument panel so it almost looks like it is floating.

The BMW Head-Up Display also uses its optimised graphics and additional design content to enhance the intuitive and focused dialogue between driver and vehicle to an even greater degree. It is now integrated flush into the surface of the instrument panel with no surround, and therefore fits invisibly into the pared-back interior design.

The “Act, Locate and Inform” principle, which ensures information is distributed clearly and screen redundancy is avoided, takes the signature BMW driver orientation of the cockpit design to a new level. The content shown by the BMW Curved Display and BMW Head-Up Display are perfectly coordinated. Pre-filtering ensures that only information relevant to the driving situation is presented to the driver – and always shown where they can absorb it as quickly and easily as possible. This is a perfect example of the BMW Group’s “Eyes on the road – Hands on the wheel” design principle at work. The driver is shown certain instructions in the Head-Up Display (Act). For example, if the route guidance function of the navigation system is activated, this is where they will see recommendations on which lane to be in or the distance to a junction where they need to turn off. Meanwhile, a detailed map extract in the display behind the steering wheel offers location-finding information (Locate). And the large map view in the right-hand area of the BMW Curved Display provides the driver and front passenger with an overall picture (Inform).

In order to forge an emotional connection through the interaction with a technologically sophisticated and complex product such as the BMW iX, other points of contact have been created beyond the carefully judged distribution of visual information. Voice control and the touch function of the BMW Curved Display were prioritised as usage options in the development of the new BMW iDrive. The number of buttons and switches has been reduced by almost half. At the same time, control clusters for relevant and frequently used basic functions are retained where customers expect to find them. The controls also serve as gateways to digital sub menus with further settings on the display, creating a seamless transition between physical and digital controls.

The control panels on the centre console and instrument panel have an all-new, strikingly clear and minimalist design. The familiar iDrive Controller is the central control element on the centre console. The Touch Controller,

designed in an extremely smart glass-effect finish for the BMW iX, is encircled by a bezel painted in Gold Bronze. The colour scheme and materials used for the centre console give it the appearance of a classy piece of furniture between the comfortable front seats. The Controller is enclosed by a sharply styled control panel with a High-gloss Black frame, a glass-effect surface and white backlit buttons. On the centre console (which features high-class materials), an aesthetically pleasing control surface with active haptic input subdivided by feeler bars is used to select the iDrive menus, My Modes and other functions. The Controller, the rocker switch for gear selection, the audio roller control and the seat adjustment buttons can also be specified in a polished crystal finish as an option.

The upgraded BMW Intelligent Personal Assistant performs the role of a digital character which can engage in natural dialogue with the driver and front passenger – similarly to a relationship between humans. It forges an extremely natural relationship between human and vehicle in which discovering new possibilities, and joy in the surprising talents of the new iDrive, play a central role. The driver is not solely dependent on finding ways to meet their own requirements. On the contrary: with the new BMW iDrive, each time they get behind the wheel they embark on a journey during which solutions are presented to them proactively, contextually and in dialogue with the vehicle.

Graphical user interface.

The new generation of BMW iDrive brings a new design language for the newly developed BMW Operating System 8 and therefore provides the perfect stage for its extended capabilities. Strong and eye-catching graphics, modern colours, futuristic textures and forms, bright light and the interplay of reflections create an impressive and immersive visual appearance. At the same time, the user interface has been optimised to present the right amount of information at all times in a simple and easy-to-understand way.

The information display in the driver's central visual axis impresses both with its generously sized screen surface and its striking forms, dynamic light effects, strong depth of colour and modern colour worlds. All of the displays have an extremely high graphic resolution of 200 ppi. The dials for the driving speed on the left-hand side and the rev counter / power meter on the right-hand side of the display are partitioned from the central display area by diagonal guide lines.

The extensive individualisation options available for the screens in the display area behind the steering wheel can be selected extremely quickly and easily via the function keys on the steering wheel. The two-axis operating system enables user-friendly vertical list navigation with the rotating key, as well as toggling between menus by tilting horizontally. This allows the driver to move quickly between the content and layout menus, and make changes via vertical list navigation. The driver can switch between three layout types and various different widgets according to personal preference or the driving situation at hand – by thumb control and in just a few operating steps.

The driver can choose from the media widget, a navigation map section for orientation, detailed status displays for the driver assistance systems in the Assisted View and a G-force meter, which displays longitudinal and lateral acceleration in figures and graphics. In addition, a 3D graphical range display provides a quick overview of the car's current operating range (calculated according to driving style), the minimum and maximum remaining range, and – if the navigation function is activated – the distance to the driver's pre-set destination.

In the Drive layout, drivers can use a dynamically changing area in the centre of the information display to show individually selectable information. The

Focus layout, meanwhile, has been designed for extremely dynamic driving situations. Broader needles and higher-resolution dials allow driving information to be visualised in highly detailed form. By contrast, the Gallery layout largely minimises the driving information view to clear as much space as possible for widget content. For example, information on the media source currently being accessed, the map display or the interventions and action prompts of the driver assistance systems are presented in even greater detail. In all three layouts, the driver can also activate a “calm” mode, in which only the current vehicle speed in digital form is shown in the centre of the information display. Colour-coordinated, three-dimensional animations – imbued with extra dynamism by the use of light reflections – give each of the three layouts a distinctive character.

The clear structure and new arrangement logic employed for the widgets, which provide a flawless overview of the relevant information at all times, are an immediately eye-catching feature of the large, horizontally stretched control display. The widgets line up in an unbroken ribbon on the home screen. The geometries and screens adopt the diagonal guide lines used in the information display, creating a seamless visual integration into the overall grouping. The content of the widgets is pared back to essential information and presented as a live image. Frequently used functions are shown in the widgets and can therefore be activated directly by touch. Examples in the navigation widget include a button for changing the map view or selecting the most likely destination for route guidance. The phone widget has buttons for accepting/rejecting calls and frequently selected contacts.

The driver is free to choose the widgets shown on the home screen and configure their order. As with smart devices, the user can use a long press on a widget to select it for changes and move it around via drag & drop. In this way, the respective content can be prioritised individually and changes made quickly to the way it is arranged.

At the same time, widgets can change depending on the context using seamless and fluid animations to show more or less information, as the situation demands. The standard widgets overview gives the navigation map a prominent position. If a navigation instruction is imminent during a journey – e.g. if the driver needs to turn off a road – the map section is enlarged to give the user a visual prompt and detailed orientation information.

Three views can be selected for the navigation map. In Adaptive mode, the driver can view relevant information along the route, and this is adjusted according to the driving situation. The presentation of information takes on a particularly focused form in Reduced mode. For example, here only the most

frequently used points of interest are displayed. Expanded mode shows all available information on the vehicle's current surroundings.

The newly designed media player represents a particular aesthetic highlight. Taking the "reduced to the essentials" approach a step further still and adopting a simple arrangement, the clarity of its design has a magnetic appeal. At the same time, the large open space becomes the stage for a visually pleasing show of colour. An algorithm selects the cover colour scheme of the music track currently playing and reproduces it dynamically across the display area of the media player.

Likes its predecessor, BMW Operating System 8 enables fast access by swiping downwards from the upper edge of the BMW Curved Display or tilting the iDrive Controller upwards. The fast access menu contains shortcuts to useful and frequently used functions. In addition, the user's own shortcuts can be stored and edited via the same menu (the previous-generation system used physical (numerical) buttons for this process). Radio stations, navigation destinations, phone numbers and jumps to submenus are among the preferences that can be set as a shortcut. In each case, the type of shortcut is visualised by a symbol in the digital fast access view, so the user can quickly find their way around.

BMW iDrive creates a personal relationship and natural dialogue between the user and vehicle.

Natural dialogue with the BMW Intelligent Personal Assistant.
The new generation of BMW iDrive also brings additional skills for the BMW Intelligent Personal Assistant. In order to strengthen the personal connection between the digital companion and the vehicle occupants, users can still give the BMW Intelligent Personal Assistant a name of their choice, which they then use as a prompt. The BMW Intelligent Personal Assistant has a particularly important role to play in creating a natural dialogue between the user and their vehicle, which is now an even more clearly stated aim. The personal assistant is the central interaction interface with the user – the "face" of the in-car intelligence.

In communication between people, a great deal of information is conveyed non-verbally. In keeping with the updated brief for the new BMW iDrive, the BMW Intelligent Personal Assistant has been upgraded with a particular focus on how it is presented visually. This new visualisation approach features spheres of light in differing sizes and brightness levels, giving the assistant more space and new ways of expressing itself. This visual image also gives it a "face" with a clearly visible point of focus and identifiable states of activity.

To also enable non-verbal communication with the vehicle occupants in future, the user experience designers gave the BMW Intelligent Personal Assistant a visual form that also allows it to display gestures. This was based on studies with test persons who were asked to answer selected questions non-verbally. Their movements were recorded and patterns were established in how certain moods and activities were expressed. These patterns were carried over to the new geometry of the BMW Intelligent Personal Assistant's visual image with the help of insights from animation theory, as used in the making of animated films. Using an extensive requirements and evaluation catalogue, a visualisation form was chosen from a selection of over 100 design approaches. It has a trustworthy and appealing aura and displays the dynamism required to be able to express different emotions and states of mind non-verbally and in a human-like manner.

The character of the BMW Intelligent Personal Assistant is being constantly developed and elaborated, and is evident in both the use of dialogue and now also the new gestures. The Intelligent Personal Assistant is a confident, reliable and expert companion who answers questions in a light-hearted

manner but also precisely. The BMW Intelligent Personal Assistant has a generally positive disposition, communicates on equal terms and can actively bring composure to a situation when necessary, without overstepping its role.

Advances have also been made in the functionality of the BMW Intelligent Personal Assistant. An expanded pool of underlying data and information has not only made the digital assistant more intelligent, it has also enabled it to act according to context. It can take into account the situation in the vehicle and its surroundings when considering when and how it will communicate with those on board. And the BMW Intelligent Personal Assistant can also access an even higher number of functions in the vehicle. It can control functions such as climate control, ambient lighting, audio playback, opening and closing of the side windows, shading of the panoramic glass roof, switching between My Modes, the driver assistance systems and many more besides. The BMW Intelligent Personal Assistant also plays the role of vehicle expert and answers questions on operating functions, Check Control messages, driving history and vehicle characteristics. It also has access to information on points of interest such as restaurants, parking, shops and cultural institutions.

The personal assistant follows the shy tech principle of design in terms of how and where it is visible. When it is spoken to, it appears in a fluid animation fitted to the relevant screen area and spreads out engagingly over the displays, without concealing relevant information. The BMW Intelligent Personal Assistant can distinguish who is talking to it. If the driver is actively engaged, the Intelligent Personal Assistant's visual image appears in the right-hand area of the information display or in the BMW Head-Up Display and signals its readiness to accept spoken instructions. If prompted by the front passenger, the assistant's image appears in the right-hand area of the BMW Curved Display, where it is easy to view for the front passenger. A widget designed specially for the BMW Intelligent Personal Assistant enables rapid access to other settings and suggestions. For example, it may provide the user with tips on possible voice commands or unused vehicle functions which may be helpful to the driver. Its interplay with the vehicle's intelligence systems allows the personal assistant to manage complex tasks. The assistant can therefore not only operate a function on behalf of the driver, but also save them having to think about how to activate a particular function.

The BMW Intelligent Personal Assistant will also learn new functions and new forms of expression as the ongoing development of BMW iDrive continues. These new features are regularly imported into the vehicle by means of Remote Software Upgrade.

Greater personalisation using the BMW ID.
When interacting with the BMW Intelligent Personal Assistant and using the new BMW iDrive in general, customers benefit from increasing personalisation of the user experience based on the BMW ID. In future, it will be possible to securely store even more personalised settings in the BMW ID and transfer them between vehicles. A PIN code can be created or the BMW ID associated with a particular key to prevent other vehicle users from accessing personal data. Simply scanning a QR code is all it takes to create a new BMW ID on a smartphone. If the user already has the My BMW App, the existing BMW ID will be automatically imported into the car when the QR code is scanned.

This method can be used to transfer the BMW ID effortlessly and securely into vehicles with BMW Operating System 8 or BMW Operating System 7. Once the BMW ID has been loaded, the driver will receive a personal greeting which will include the customised profile image that can be uploaded in the My BMW App. At the same time, personal settings for seat and steering wheel position, exterior mirrors, navigation system, driver assistance functions, display layouts, shortcuts and favourites as well as infotainment system settings will be imported automatically. Even personalised suggestions from the BMW Intelligent Personal Assistant are stored in the BMW ID, together with individually selected wake words and privacy settings. Once the BMW ID has been activated with the associated key or by selecting the BMW ID in the vehicle, the personal settings are instantly adopted.

A warm welcome from vehicle to driver: Great Entrance Moments.
Besides producing a more personal relationship between driver and vehicle, BMW iDrive also creates unique experiences staged in an intelligent, all-inclusive way that appeals to virtually all the senses. “Great Entrance Moments” is the name given to the user experience from the point when the driver first approaches the vehicle until the journey commences. All steps are orchestrated by the vehicle to optimum effect and blended into an inspiring overall experience.

Ultra-wideband (UWB) radio technology is key to enabling all of this. It allows precision location pinpointing between vehicle and the key or smartphone, meaning that the car knows exactly where the driver is approaching from and how far away they are to within a few centimetres. As soon as the distance drops below three metres, the vehicle starts to wake up and indicates this with a gradually intensifying, dynamic lighting effect using the headlights and rear lights. A soft, subdued light comes on in the cabin. The vehicle shows the customer the way to the entrance area, which is lit up by a light carpet in the vicinity of the driver’s door featuring geometric forms inspired by the elements of the graphical user interface. At the same time, the door handles and boot

lid handle are illuminated to make it easier for the customer to take hold of them.

Once the driver moves to within one-and-a-half metres, the vehicle unlocks no matter whether they are carrying their UWB key or a smartphone with BMW Digital Key Plus. The vehicle also now indicates that it is getting ready to drive by folding out the exterior mirrors. Opening a door activates the seat's entry assistance feature along with the surface and steering wheel heating. The interior light illuminates the area from the entrance to the centre console. The entire BMW Curved Display is taken up by a BMW-style welcome animation that shows the system is starting up.

The personal settings from the BMW profile are loaded and a connection is established with the driver's smartphone while they are still getting into the car. If a phone call is in progress, it will be seamlessly transferred to the vehicle's microphone and speakers. At the end of the animated sequence, information on the vehicle's state of charge is shown on the information display. Meanwhile, the control display shows a welcome window with a personal greeting, suggestions on activating / setting up services or information on vehicle functions or available upgrades. When the start/stop button is pressed, the characteristic BMW sound can be heard, the headlights are aligned as required and the light in the cabin dims. "Great Entrance Moments" guides the customer to their car, facilitates entry, welcomes them and makes sure they are perfectly prepared for the journey ahead.

BMW iDrive provides optimum support for the driver and uses intelligence to delight.

BMW iDrive is perfectly in tune with the driver and their task of driving. The screens for both the Head-Up Display and the BMW Curved Display bending around the driver interact according to the principle of “act, locate and inform”, ensuring that the driver is always shown the right information in the right place at the right time. The information content displayed is reduced or increased to suit the situation. The driver receives optimum support, all decision-relevant information appears in their line of sight when looking at the road and they are not distracted from what is happening ahead by additional or superfluous information.

An all-encompassing driving experience for the senses: My Modes.
The new My Modes feature ensures an all-encompassing user experience geared towards the driver’s personal preferences, creating unique moments for both the driver and their passengers. When designing My Modes, consideration was given to a multitude of functions relevant to the driving situation in order to maximise the functionality and emotional impact of the user experience in the situation at hand. My Modes are designed to stimulate multiple senses, from sight to hearing to touch. They can be selected very easily by voice command or by using a dedicated button on the centre console. This will replace the Driving Experience Control switch in future and offer an extended range of functions.

The initial version of My Modes will neatly combine up to ten different parameters in the vehicle, whose settings are activated with a single command. These parameters include the previous driving experience mode functions, such as drive system and transmission control, steering characteristics and chassis settings. The activated configuration is indicated by variations in the artwork specially developed for My Modes, the style and layout of the displays, and a change in the display colour, which adapts to the experience setting in the same way as the ambient lighting. Switching between My Modes produces acoustic changes, too, including adjustment of the engine/motor sound.

Efficient Mode is clearly focused on sustainable driving and configures the vehicle to keep consumption as low as possible. The driver is given tips by the intelligent Efficiency Trainer. The design of the displays in this mode was inspired by flowing water with sunlight reflecting in it. The interior ambience is

made as calm as possible: a pleasant blue shade sets the tone for the lighting mood and the noise from the engine/motor is reduced. This all has the effect of immersing the driver in a uniquely relaxing environment.

Sport Mode, by contrast, allows the driver to revel in the sense of driving pleasure. Vehicle characteristics such as acceleration and handling are configured for a sporty drive. The power unit's sound is clearly audible and provides distinct acoustic feedback when accelerating. Thrilling Orange becomes the dominant colour for the interior lighting, while the displays take on a pared-back, more focused appearance to help the driver concentrate fully on the road.

Personal Mode offers customers an array of options for creating their own My Mode. The vehicle characteristics are set to a balanced configuration. The customer can choose various lighting and colour settings and display layouts, and also select other settings to create their personal ideal driving experience.

The new BMW iDrive system will be launched with these Efficient, Sport and Personal Modes. Further modes will be added as part of the ongoing development of BMW iDrive in the future. This will also include modes that do not revolve primarily around the driver or the task of driving. Additional functions will be integrated into the modes and the options for configuring functions extended. These enhancements will be imported into vehicles via over-the-air updates.

Navigation, parking and charging with BMW Maps.
The BMW Maps navigation system was rolled out in 2020 for models with BMW Operating System 7. This first ever cloud-based system enables routes to be calculated significantly faster and more dynamically by combining real-time information with forecasting models. This means that, on longer journeys, the estimated time of arrival isn't just calculated based on the current traffic situation. Instead, probability models are used as a basis for also factoring in the traffic situations on the upcoming sections of the route in 15-minute intervals, all the way to the destination. This allows arrival times to be calculated with leading levels of accuracy – by both automotive and smartphone standards. The data pool for this is provided by the HERE map, enriched by the knowledge gathered through the swarm intelligence of the BMW Group's entire connected fleet (over 14 million vehicles worldwide).

As well as incorporating real-time data, machine learning algorithms are also employed in the BMW Cloud that compute probabilistic models for the occurrence of certain traffic phenomena based on long-term data sets. The

Cloud also contains additional contextual information on points of interest, such as ratings, opening times and images.

With the arrival of the new BMW Operating System 8, the digital services for navigation, parking and charging are fully integrated into the cloud-based BMW Maps system in a user-friendly way. The intelligent functions of BMW Maps are also being expanded further.

One of the key functions here is “Learning Navigation”, meaning that BMW Maps uses the habits associated with the individual BMW ID as the basis for learning and anticipating the destination the driver is likely to head for next. This saves drivers the trouble of entering the destination again for regular journeys, especially the daily commute to work, when they nevertheless wish to be alerted to delays or hazards along their route. Information on the current traffic situation for the journey ahead and the estimated driving time are sent to the My BMW App in good time prior to departure. An individually configurable Traffic Widget in the car likewise shows the predicted destination with the accompanying traffic information. If the driver wants to find an alternative route, pressing a direct-access button activates the fastest route to the destination at the present time. All of the learned destinations can be viewed from the vehicle and in the My BMW App, and deleted if desired.

There is a choice of three different views for the navigation map, allowing its appearance to be customised as required. The “adaptive” view shows relevant information along the route that is tailored to the specific driving situation and user habits. If, for example, the vehicle is running low on fuel or the high-voltage battery charge is low, filling stations or charging stations in the vicinity will automatically be shown on the map. The information becomes more focused in the “reduced” view, which only displays the four most popular points of interest categories and omits detailed information about the surrounding area. Meanwhile, in the “expanded” view all available local information can be seen on the map, including points of interest such as filling stations, charging and parking facilities, restaurants and other catering establishments, as well as the traffic situation on side roads and the current parking situation.

Shortly before reaching the destination, the system will ask the driver whether it should help them search for a parking space and if they prefer to park on the road or in a car park close to the destination. The route currently being followed is adapted accordingly. For roadside parking, a parking search route is calculated based on a probability analysis. This guides the driver to their destination along a route offering a very good chance of finding a free space.

This same logic has been extended to charging, enabling the vehicle to suggest car parks with additional charging facilities in the immediate vicinity – a particularly helpful feature for purely battery-electric vehicles in urban areas.

Intelligent automation of climate control.
The introduction of the new-generation BMW iDrive brings a reduction in the number of controls in the cockpit. Control of the air conditioning system will also be incorporated into the BMW Curved Display in future, as customers should seldom need to adjust any of the climate control settings. To make this possible, all temperature and comfort functions will now be intelligently controlled together. Each further adjustment made to the settings by voice command or from the menu in the control display is registered by the system and stored in the user profile for the BMW ID so that users do not have to keep making the same adjustments.

The ideal pre-set configuration has been programmed based on the evaluation of more than 440 million customer journeys across all model classes and regions of the world. Besides fan speed (airflow) and air distribution, the intelligent automatic climate control also regulates the steering wheel and surface heating as well as the seat heating and ventilation in order to ensure optimum levels of thermal comfort. These additional comfort functions are controlled automatically to suit the specific situation and independently for the driver and front passenger. To make operation of the air conditioning system as energy efficient as possible, the automatic climate control considers a host of other factors, too, such as the number of occupants, where they are sitting and the intensity and direction of the sunlight. This means BMW's intelligent climate control system is arguably interconnected to a higher degree than any other air conditioning system in the automotive industry.

The air conditioning is operated centrally by specifying a target temperature for each climate zone. Based on the individual user settings in the air conditioning menu, the intelligent climate control automatically regulates the airflow and operates all the additional features available itself. Consequently, there is no longer any need for manual operation of additional functions such as the seat heating. The current temperature settings for the driver and front passenger side are shown at the bottom of the control display, where they can be adjusted by touch control or voice command. Voice commands can also be used to communicate various requirements directly. Saying, "My feet are cold," for instance, will result in the temperature in the footwell being increased. The system even recognises which seat the request came from, allowing it to adjust settings selectively. Integrating the air conditioning readouts and controls into the control display allows additional information to

be shown to the user that illustrates what the system is doing. This is the case, for example, with the blue / red animation next to the set temperature for visualising the cooling and heating processes. The animation disappears once the target temperature has been reached.

Technology and connectivity.

BMW Operating System 8.

BMW Operating System 8 is the most powerful and extensive technology stack ever created by BMW. It forms the basis for the eighth generation and new interpretation of BMW iDrive.

Over the course of development in recent years, there has been a huge increase in the software scopes for the overall iDrive system. Today, the BMW Operating System handles a wide array of tasks that extend far beyond a conventional display and operating concept. These range from integrating telematics and connected services to data processing and preparation, connecting to devices and deep integration of third-party apps or projected modes, as well as seamless integration of cloud-based services like BMW Maps. On top of this, the Remote Software Upgrade facility added functionality that calls for a software stack offering a whole new level of modularity and flexibility.

The BMW Group has been developing the central control unit and software integration platform entirely on Linux and in-house since 2013. Having complete control over software is crucial for creating a stable, upgradeable, high-quality system that distinguishes the brand. In the past, the BMW display and operating system has been overhauled on average every three years, a cycle that is roughly half as long as the complete product development cycle for a vehicle. In the era of fast-paced digital development, it is no longer enough to completely update a model's digital features every three years, and this resulted in a fundamental change of approach in 2018.

The arrival of Remote Software Upgrade means the vehicle is now designed and conceived as a digital platform. So, when a new-generation BMW Operating System is launched, the development work is far from finished. Instead, it acts as the basis for ongoing development during the product life cycle. The interaction between the digital software platform and hardware and the ability to think of this holistically from the moment development starts are vital here, as this is the only way of enabling dynamic development on a functional level. The digital and functional vision aimed for at the end of the life cycle dictates what is required of the necessary hardware in the development phase.

This integrated interaction between hardware and software, the technical possibilities offered by Remote Software Upgrade and the company's agile development processes underpin its ability to make new functions accessible to the customer in a matter of a few months or even weeks. BMW Operating System 8 will not be making its debut until the launch of the BMW iX, yet the developers are already busy working on the functions for the months and years thereafter.

Always up to date: Remote Software Upgrade.
Since the introduction of BMW Operating System 7 in 2018, BMW drivers have been able to keep their vehicle up to date with the latest software at all times by means of the Remote Software Upgrade facility. New functions can be imported quickly and easily over the air, either using the car's built-in SIM card or via the My BMW App. The installation files are prepared in the background while the vehicle is on the move. Once this is done, installation can be launched by the customer. The actual installation seldom takes longer than 20 minutes, even for major upgrades.

Remote Software Upgrade has a crucial role to play in the new BMW Operating System 8 too, offering the same functionality as in the past with some important enhancements. Consequently, Remote Software Upgrade for BMW Operating System 8 will also offer the possibility of performing extremely complex and large software updates in areas such as driving assistance and partial automation. In view of this, the upgrade process has been further refined, partly because the installation procedure for such complex functions can last up to 30 minutes.

BMW Operating System 8 will additionally allow customers to schedule the installation of a Remote Software Upgrade. For this, the vehicle must first be securely parked in accordance with the instructions. The installation can then be carried out automatically at a pre-set time – meaning it can be done overnight too – without the customer having to start the installation manually from the vehicle.

The BMW Group is one of the key players in the field of over-the-air function upgrades. By 2020 it was already carrying out the largest upgrade campaigns of any European carmaker. Just recently, in late February 2021, a Remote Software Upgrade was simultaneously made available for over one million vehicles worldwide. And the BMW Group has set itself the goal of having the largest over-the-air upgradeable fleet of any manufacturer in the world by the end of 2021. By that time, a total of over 2.5 million vehicles from the BMW brand will be able to receive Remote Software Upgrades.

Over-the-air retrofitting: Functions on Demand.
Ever since Functions on Demand was launched, vehicle functions that used to be only offered as factory-fitted optional extras have also been available to purchase later from the BMW ConnectedDrive Store. BMW owners can then have them installed in their car over the air. As of August 2019, selected functions, including High Beam Assistant and Active Cruise Control with Stop&Go function, could be added to vehicles fitted with BMW Operating System 7 and Remote Software Upgrade by selecting them in the store and downloading them straight to the car. Further functions have been regularly added to the range ever since, which is now available for more than 20 different models in the BMW ConnectedDrive markets.

Functions on Demand offers customers the flexibility they need to subsequently adapt the specification of their BMW to changing requirements and preferences. Since this new business line was first launched, Functions on Demand has become increasingly in demand and has been very warmly received by customers. The optional functions available for retrofitting over the air already account for over ten per cent of the BMW ConnectedDrive Store's revenue.

And in future, the new BMW Operating System 8 will make it possible to acquire even more vehicle functions for over-the-air installation at a later stage. What is more, the new way in which the technology is implemented will open up scope for making the product offering more flexible. Customers will be able to decide whether they wish to buy a function outright or simply book it for a period of three years, twelve months or even just one month.

Fast, reliable data transmission using 5G mobile technology.
The BMW iX will be the first premium model available worldwide that is equipped with 5G mobile technology. 5G offers extremely high data bandwidth and low latency – meaning fast data transmission – and also expands the possibilities for connectivity between the vehicle and its environment. It forms the basis for real-time reception and transmission of large volumes of data and sensor system information to the BMW Cloud. Together with the quality of service offered by the 5G network, this will bring about significant enhancements and innovations in the areas of entertainment, infotainment, automated driving and road safety. The high data transmission rates will additionally enable a far greater degree of cloudification. This involves moving vehicle functions requiring a lot of computing power to the BMW Cloud, where the combined performance of an entire computing centre is available for processing vast quantities of data and complex tasks. The computed data is sent back to the vehicle within a few milliseconds courtesy of 5G.

The new vehicle generation's on-board network and antennae have been designed to enable full 5G performance. The new BMW Operating System 8 has also been prepared for making optimum use of the data speeds offered by 5G. Besides the integration of further cloud-based functions, this also encompasses data transmission via the four exterior antennae to the occupants' various smart devices for e.g. HD-quality streaming.

BMW Digital Key Plus with ultra-wideband radio technology.
BMW has been pioneering the use of smartphones as digital vehicle keys since 2018, during which time it has been relentlessly driving the development of the BMW Digital Key. For instance, the premium carmaker has now devised a convenient and secure way of unlocking and starting the vehicle without the user even having to take their Apple iPhone out of their pocket.

The upcoming BMW Digital Key Plus version is based on the ultra-wideband (UWB) technology already integrated into the vehicle and, for example, the iPhone's U1 chip. UWB is a digital radio technology for short-range high-bandwidth applications that offers exceptionally precise location identification combined with maximum security. The high precision of UWB has the additional benefit of ruling out the possibility of relay attacks, where the radio signal is disrupted or intercepted.

Apple and the BMW Group have been working closely together with the Car Connectivity Consortium (CCC) to develop the Digital Key Release 3.0 specification for UWB, which will serve as a global standard for the automotive industry. The BMW Digital Key Plus will be first introduced for the all-electric BMW iX. The new generation of remote-control keys will likewise feature UWB technology, resulting in the same high standards of convenience and security.

More apps, greater diversity: optimised third-party integration.
The new-generation BMW iDrive offers new opportunities for seamlessly incorporating customers' habits and preferences into the operating system. The system's higher degree of flexibility will additionally make in-car use of third-party apps even simpler and more convenient in future. BMW Operating System 8 again ensures full integration of Apple CarPlay and Android Auto, while the new BMW iDrive will also enable extensive integration of the Alibaba and Tencent services for customers in China.

The control display's large screen is ideal for clearly presenting all available apps in the system's menu. The user's favourite apps can be launched very quickly and easily either via the main menu or the toolbar. The increased

integration of app functions into the information display and even the BMW Head-Up Display also results in seamless transition throughout the screen grouping.

And music streaming and communications apps are now deeply integrated within BMW Operating System 8. They are displayed as original sources in the main menu, enabling customers to make full use of their apps' functions while driving their car.

Centralised network architecture and Gigabit Ethernet.
A multitude of extremely powerful sensors – coupled with over 30 antennae and the on-board network's highly centralised architecture, in which complex software functions are concentrated in a handful of high-performance central computers – convert the new generation of vehicles (starting with the BMW iX) into digital top performers on wheels. The technology toolkit being deployed for the first time paves the way for new, highly complex vehicle functions and redefines standards for connectivity, data processing and intelligence.

When all vehicle functions are active and operating at full load, data for processing flows through the car's network at a rate of up to 30 Gbit per second, meaning the volume is between ten and 20 times higher than in the current model generation. This is all made possible by the first ever use of Gigabit Ethernet technology in a BMW.

The growth in the volume of data is largely down to the vehicle's improved sensor technology comprising in excess of 40 individual sensors, and is needed for the driving assistance systems. Consequently, the data needs to be processed and evaluated instantaneously so that the functions can react in real time. To give an idea of its capabilities, the network aboard the BMW iX can transmit the data stored on an entire DVD in a little over a second.

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The BMW Group

With its four brands BMW, MINI, Rolls-Royce and BMW Motorrad, the BMW Group is the world's leading premium manufacturer of automobiles and motorcycles and also provides premium financial and mobility services. The BMW Group production network comprises 31 production and assembly facilities in 15 countries; the company has a global sales network in more than 140 countries.

In 2020, the BMW Group sold over 2.3 million passenger vehicles and more than 169,000 motorcycles worldwide. The profit before tax in the financial year 2020 was € 5.222 billion on revenues amounting to € 98.990 billion. As of 31 December 2020, the BMW Group had a workforce of 120,726 employees.

The success of the BMW Group has always been based on long-term thinking and responsible action. The company set the course for the future at an early stage and consistently makes sustainability and efficient resource management central to its strategic direction, from the supply chain through production to the end of the use phase of all products.

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