Volkswagen

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"The two inventions of the century, the car and the computer, are gradually converging. We need to design future mobility to be even more intelligent and networked."

Prof. Dr. Martin Winterkorn, CEO Volkswagen AG

Contents

To the point

Key aspects

To the point

CES Asia 2015 – Car and computer merge

Gesture control and networking for a new age of mobility

Golf R Touch: cockpit concept solves future challenges

Connected Golf: perfect compatibility with MirrorLink™, Apple™ and Google™

Intelligent Charge: e-Golf automatically docks above inductive charging plate

Trained Parking: future Park Assist drives into garage semi-automatically

Ten key facts about Volkswagen innovations at CES:

1. Golf R Touch offers intuitive operation of high-tech infotainment.
2. Gesture control of Golf R Touch revolutionizes user operation.
3. Volkswagen will introduce MirrorLink™, CarPlay™ (Apple) and Android Auto™ (Google) in the vehicle.
4. Media Control integrates tablets and smartwatches into the Volkswagen infotainment system.
5. Regular Routes is ideal for daily drives.
6. Inductive charging will be an important component of electric mobility.
7. e-Station Guide shows the way to the perfect charging station.
8. Digital Key makes the smartphone a car key.
9. Trained Parking via smartwatch enables semi-automated parking.
10. Volkswagen will be offering the first app for controlling vehicle functions via smartwatch in 2015.

- **Wolfsburg / Shanghai, May 2015.** "The two inventions of the century, the car and the computer, are gradually converging. We need to design future mobility to be even more intelligent and networked." Prof. Dr. Martin Winterkorn, CEO of Volkswagen AG, points out that the automotive industry found

itself in the midst of historical turning point at the beginning of the 21st century. The car and the computer were merging. Volkswagen has been instrumental in driving this development. That is because the car – which operates intuitively, is networked systematically, reacts intelligently and offers significantly greater convenience – gives new innovative impetus to mobile life, making it more communicative, safer and fascinating. This is why Volkswagen is demonstrating – with an entire fleet of vehicles at the 2015 Consumer Electronics Show in Shanghai (CES Asia; May 25 – 27) – just how much the car and computer are already becoming intertwined today and will continue to grow together in the future. The main focus here is on four aspects. First, computer-driven drive systems. Second, app and smartphone integration. Third, intuitive vehicle operation. Fourth, autonomous and semi-autonomous driving.

- First – computer-controlled drive systems. Electric mobility is coming into its own. Pure electric cars and plug-in hybrid vehicles are continually increasing their presence. The high production volume models have now arrived, and Volkswagen is setting the pace with best-sellers like the Golf. Driven exclusively by electric motors (as in the e-Golf), or by an alliance of a high-tech gasoline engine and electric motor (as in the Golf GTE plug-in hybrid). The e-Golf and Golf GTE are the protagonists of a new mobility. These cars would be inconceivable without on-board electronics with computers that control such functions as battery charging and, in the case of the hybrid models, switching between the different drive sources. At CES Asia, Volkswagen is showing, among other things, how electric cars will be able to automatically dock to inductive charging stations and output signals that indicate the battery charge state using the vehicle's exterior lights. Everything computer-driven, of course.

- Second – app and smartphone integration. It has now been eight years since Apple introduced its first generation iPhone in San Francisco. Competitors followed, and the rest is history. The fact is that smartphones have irreversibly changed the way we communicate and our everyday lives. It has long been normal practice to have phones automatically connected to a car's hands-free telephone system via Bluetooth and to have the smartphones stream their media libraries into car infotainment and sound systems. But now Volkswagen is taking a significant step forward. Last year, the second generation "modular infotainment platform" (MIB II) was introduced. Along with the new radio and radio-navigation systems, MirrorLink™ was also made available for the first time; it is used to integrate the apps and operating layout of numerous Android smartphones into cars (including Samsung, HTC, LG and Sony). Later this year, the MIB II will be making its debut in China as well. At the same time as MirrorLink™ is introduced, two other interfaces will also be launched under the App Connect label, first in Europe and the USA: CarPlay™ (Apple) and Android Auto (Google). This will result in app integration for the key operating systems. App Connect will significantly expand the range of today's Volkswagen online services.
- Third – intuitive operation. In the future, the mobile computer, i.e. the car, will not only merge with the mobile world; it will also integrate people into its operating concept more ideally than ever. Here, Volkswagen is following a consistent strategy of implementing user operation by touchscreen. Today, and in the future, the car will be adapted more than ever to people by recognizing their movements – via control based on proximity sensors and gesture recognition. Today, the latest infotainment systems by Volkswagen can already detect the approach of a hand with proximity sensors. Thanks to proximity sensors, the display automatically switches over from a purely informative level to a more varied menu with optimally sized controls. In the next revolutionary step – implemented in the Golf R Touch

concept vehicle – the infotainment unit will precisely detect hand gestures via camera and understand them. Gesture control will make it possible to control, in real space, displays and controls in virtual space without having to touch a touchscreen. This benefits convenience and safety, because it further reduces driver distractions while operating controls. At this point, it is clear that the car and computer can no longer be viewed as separate from one another. The car and computer are one.

- Fourth – autonomous and semi-autonomous driving. Clearly, cars of the future will need to be able to drive certain route segments autonomously if necessary. Either fully autonomously or semi-autonomously, and this will be introduced step by step. Even today, Park Assist by Volkswagen enables semi-automated parking and exiting from parking spaces. The car executes the entire steering process for the parking maneuver fully independently. At CES Asia, Volkswagen is presenting another evolutionary stage of Park Assist: Trained Parking. Here, the car scans a frequently driven path to a parking space via camera, and from that point on it executes the path semi-automatically by computer control. In another evolutionary stage, it will be possible to have the car parked without the driver even needing to be present in the vehicle. The driver would maintain control over the car via smartwatch.

General smartwatch integration

- The Volkswagen Car-Net app e-Remote will be made available in first countries, including for a wide variety of smartwatches, in 2015. Drivers of an e-up!, e-Golf, Golf GTE or the future Passat GTE can use e-Remote to control various vehicle functions; so far this has been done via smartphone. Starting in November, smartwatches will also be incorporated into this remote control of electric and plug-in hybrid modules. A smartwatch can be used to check the status of doors (locked or not), the parking lights (on/off) and the last parked position (address). This app also reminds the driver when the parking

meter will expire. It will also be possible to start or stop air conditioning of the interior and charging of the battery. The range of app functions will gradually be enlarged. The app will be offered for the Apple Watch and all watches with the "Android Wear" operating systems (e.g. Asus, LG, Motorola and Sony) and "Samsung Tizen" (Samsung).

Volkswagen highlights at 2015 CES Asia:

Golf R Touch

- Volkswagen is equipping its show car in Shanghai with the controls of tomorrow. The high-performance of its computers, the brilliance of today's displays and the recognition of precise human gestures are merging into a new interface generation here. In the Golf R Touch concept vehicle, Volkswagen is presenting an infotainment system that incorporates gesture control as a consistent next development step that is based on current thinking in the area of intuitive control. All it takes is a hand movement in the space in front of the infotainment display of the Golf to make human and machine interact as one. Volkswagen is thereby extending touchscreen operation into a third dimension.
- The development team for the Golf R Touch pursued the goal of developing an interior and infotainment concept that would fulfill seemingly contradictory requirements. Despite the continually growing complexity and numbers of functions, this concept was intended to reduce driver distractions while attaining a maximum of personalization and intuitive operation in the car. A vehicle was created in which nearly all controls are implemented via touchscreens and sensor switches. Therefore, the Golf R Touch is equipped with three displays: the 12.8-inch high-resolution touchscreen of the infotainment system, a Control Center (8.0-inch with touch feedback) arranged beneath it to control vehicle, climate control and media functions as well as an Active Info Display (digitalized instruments, 12.3-inch).

The layouts of the central touch screen and the Active Info Display can be customized rapidly, just as on a smartphone or tablet home screen today. The same is true of the entire color staging in the interior.

Connected Golf

- At the 2015 CES Asia, Volkswagen is showing maximum networking of the car of today in the form of the Connected Golf. This e-Golf, which is equipped with the latest generation infotainment system, incorporates an enormous range of apps, smartphones and tablets via Volkswagen Car-Net, App Connect and Media Control. Consider the example of Volkswagen Car-Net: products and applications integrated here include aspects such as networked navigation and a wide variety of services for the areas of security, service and electric mobility. The ability to access services via a call center is a high priority in China; it can be called to inquire about navigation destinations, arrange service appointments or request help in certain situations. Consider the example of App Connect: Volkswagen is one of the first carmakers to integrate the vast majority of smartphone operating systems in models in the Connected Golf. The three underlying software interfaces of App Connect are Mirror Link™, Android Auto™ (Google) and CarPlay™ (Apple). Via these interfaces, the driver is able to use the many different apps of a smartphone over the infotainment system. Consider the example of Media Control: this app enables the integration of tablets and smartwatches (as well as smartphones) into the infotainment system. Media Control uses a special app that creates a rear seat entertainment system of a new era.

- Regular Routes, meanwhile, is the name of a function by which the navigation system automatically detects – i.e. without needing to be activated by the driver – traffic disturbances on the daily commute to work, for instance, and it autonomously suggests an available alternative route. All of these innovations being shown in the Connected Golf in Shanghai are either

already in production or will soon appear on initial markets. Meanwhile, another topic of interest to future production cars is a Parking Guide – a technology for localizing potentially available parking spaces.

e-Golf Intelligent Charge

- This year, Volkswagen launched one of the world's most innovative electric cars in large-scale production for first Chinese metropolises such as Hong Kong: the e-Golf – a zero-emission vehicle with a range of up to 83 miles, optimal all-round characteristics and high-tech equipment. In Shanghai, Volkswagen is now presenting Intelligent Charge in the e-Golf; it illustrates how electric cars will be used even more conveniently in the future. A key theme here: over the mid-term it will be possible to offer inductive charging as an alternative to cable-based charging. In this type of charging, the car is parked over a charging plate. In the future, it will be possible to see in just seconds whether the battery is still being charged, or whether it is already fully charged by looking at the vehicle's exterior lights. The e-Station Guide will not only assist the electric car drivers in finding a desired charging station. They will also be informed about their location and charging equipment as well as payment options. As an additional function, the Digital Key – an electronic vehicle key – is implemented in this Golf. This feature lets third parties use a smartphone or smartwatch to temporarily and safely gain access to the vehicle and to start or stop the engine.

e-Golf Perfect Parking

- Park Assist from Volkswagen automatically guides the car into parallel and perpendicular parking spaces (in reverse) and can also automatically exit parallel parking spaces. First Volkswagen models will also be able to automatically park into perpendicular parking spaces in a forward direction. When parking or exiting a parking space, the system assists the driver by autonomously

making optimal movements of the steering wheel to stay on the ideal line. At CES, Volkswagen is now introducing an advanced evolutionary stage of Park Assist known as Trained Parking. Here the car (an e-Golf) uses a camera – mounted in the base of the rear-view mirror – to scan a frequently used path into a parking space, and from then on the parking process is executed semi-automatically and highly precisely by sensors and computer. In the future, it will of course also be possible to semi-automatically park above a station for inductive charging. In another evolutionary stage, plans call for the driver no longer needing to stay in the car during parking. The driver would just monitor the operation of parking or exiting a parking space with a smartwatch as a "remote control" device.

Golf R Touch:

Gesture control provides ideal human interaction

Golf R Touch shows how gesture control will revolutionize operation of the automobile

A systematic car: touchscreen and ingenious sensors are key to the future

Five key facts about the Golf R Touch:

1. Infotainment with new gesture control will revolutionize user operation in every vehicle segment.
2. Golf R Touch offers nearly switch-free operation.
3. Active Info Display enables personalized instruments.
4. Screen with touch feedback (to control climate control, media library and vehicle functions) is safer and more convenient.
5. The driver can configure a completely personalized cockpit when it comes to its controls, lighting, graphics and sound.

Wolfsburg / Shanghai, May 2015. In Shanghai, Volkswagen is presenting the first compact vehicle with gesture control that is fully equipped with the controls of tomorrow. In this car, the high-performance of its computer, the brilliance of today's displays and the recognition of precise human gestures are merging into an entirely new interface generation. A simple hand motion in the space in front of the central infotainment display of the Golf to make human and machine interact as one via gesture control. Following a consistent strategy, Volkswagen is thereby extending its concept of intuitive control beyond the level of the touchscreen and into the third dimension. The fact that it is Volkswagen that is attaining this new level of control is anything but a coincidence. It is the logical conclusion of an intelligent strategy.

Volkswagen operating philosophy

Intuitive operation. Volkswagen has always striven for clearly organized controls and information that are intuitive. No less applies to the future of interfaces. At the end of the past century, it was already evident that the density of information in the car would grow exponentially. In this context, a comprehensive user operation strategy had to be developed, which would not overload the driver in the future. Even more, the operating systems of tomorrow should enable more fun than ever from media libraries, facts, news and communication in the automobile. Those were the requirements for the future. Operation of even highly complex infotainment devices and their menus would therefore have to be clearly organized and remain easy to understand while still projecting an extremely high quality image. To achieve this goal, Volkswagen brought together an interdisciplinary team of designers, ergonomics specialists and electronics specialists. They developed systems with direct interaction. Consequently, Volkswagen has preferred the touchscreen for years now; indirect controls are not found in a Volkswagen. As a result, the brand has long been an industry model in terms of its user interfaces. And it will remain so in the future, as Volkswagen is demonstrating with the Golf R Touch at the 2015 CES in Shanghai.

Switch-free operation. The development team for the Golf R Touch pursued the goal of developing an interior and infotainment concept that would fulfill seemingly contradictory requirements. Despite continually growing complexity and numbers of functions, this concept was intended to reduce driver distractions while attaining a maximum of personalization and intuitive operation in the car. A vehicle was created in which nearly all controls are implemented via touchscreens and touchpads – a nearly switch-free cockpit. The Golf R Touch is equipped with three displays: the 12.8-inch touchscreen of the infotainment system (resolution: 2,560 x 1,700 pixels), a Control Center (8.0-inch with touch feedback) located beneath it for vehicle, climate control and media functions (resolution: 800 x 480

pixels) and an Active Info Display (digitalized instruments) in 12.3-inch format (resolution: 1,920 x 720 pixels).

A highlight in the Golf R Touch is its new controls. Take the roof module, for example: when a hand approaches, it shows a symbol on the screen like magic. When the user touches its surface, a related menu is shown simultaneously on the 12.8-inch touchscreen of the infotainment system with various settings such as “open/close the sunroof”. The key aspect is that important roof functions can now be directly accessed and controlled by a gesture in the space in front of the control panel. For instance, a swiping motion towards the windshield is used to close the sunroof, while a swiping motion away from the windshield opens it. Seat adjustment operates equally intelligently. As soon as a person's hand moves laterally at the driver's seat or front passenger's seat, the proximity detection system for the seat controls recognizes this. On the large touchscreen, helpful tips and information on user control are now displayed. Naturally, the seats can be fully controlled via touchscreen.

Infotainment system – touchscreen with gesture control

Controls include touch slider. As mentioned, gesture control is integrated into the operation of the 12.8-inch touchscreen on the center console. And Volkswagen is also calling the technology being presented in Shanghai "gesture control". In addition, the system has high-resolution proximity sensors. A similar form of these sensors is already being used in the Golf and other models today. Beneath the infotainment display there is a touch slider; in the Golf R Touch it replaces the classic rotary knob control. The slider, which is equipped with a guide rail for the finger plus LED illumination and proximity sensors, is used to intuitively and precisely adjust such settings as the volume of the sound system. Ingenious: the slider can recognize the number of fingers being used. When one finger is used, the audio volume is controlled; with two fingers the navigation volume, and with three fingers the telephone volume. In addition, the

color scheme of the ambient lighting and the infotainment unit, bass and treble adjustment and balance and fader are also set by slider.

Look and feel of the touchscreen. More than ever, the screen of the infotainment system is becoming the central control point of the cockpit. The clean integration of the display in the center console has an extremely high-end look. Contributing to this high-end look is the fact that there are hardly any real pushbuttons. This gives the center console a decidedly clean and well organized appearance. Thanks to the proximity sensors, there is also a very clear information mode and an intuitive operating mode with optimally sized controls. The information density is controlled intelligently via the proximity sensors; in addition, the innovative gesture control is used to activate and operate other menu levels at lightning speed.

Gesture control of the touchscreen. 3D control of gestures in the space is made possible by a 3D camera mounted in the roof module. This makes user operation easier than ever. A person logs onto the system by spreading the fingers of a hand. This prevents unintentional activation of a function with a hand movement. A control is selected using the index finger – moving it in the air, of course. A function is confirmed by a virtual button push with the index finger. The gesture input is ended by closing the fingers of the hand.

Personalization of the touchscreen. The display itself can be comprehensively personalized. As is familiar on smartphones and tablets, for instance, photos or graphics may be integrated as backgrounds in an instant, and various windows with contents such as "weather" or "media library" (also graphically personalized) are laid out on the screen. The individual window tiles can be moved or changed in size by touch. If a navigation map is active in background, for instance, it automatically adapts to the new layout. The car itself can also be represented in 3D (interior or exterior, open or closed, lights on or off, windows open or closed), and it can be rotated by touch and gestures. The Information menu provides the live status of the vehicle and if necessary explanatory animations.

Personalized ambient lighting. Last but not least, the dominant color of the display lighting – what is known as the HMI decor color – and similarly the ambient lighting can be adjusted via the touch slider. Also embedded in this color staging is opening/start-up and parking/closing of the Golf R Touch: When the car is opened, the interior comes to life with the entire cockpit and ambient lighting; when the car is parked it goes into the standby mode. The ambient lighting has a color depth of 24 bits; this enables representation of 16.7 million colors.

Instruments – Active Info Display

Instruments that can be personalized. Similar to the touch display of the infotainment system, the home screen of the 12.3-inch Active Info Display can also be individually adapted, because all of the instruments and indicators are generated digitally. Internally, the developers distinguish between the "small stage" and the "large stage". Depending on the configuration, the "small stage" might contain the tachometer on the left (with gear indicator in middle and engine temperature at bottom), a digitally-generated analog speedometer on the right (with digital indicator in middle and fuel gage at bottom) and between them the multifunction display with all conceivable menus such as traffic messages or navigation instructions. Always displayed below this and unmovable are the odometer/trip odometer and the clock. On the "large stage", the multifunction display handles such tasks as map display for the navigation system. On the left, instead of the tachometer, the display might show messages about traffic or info from the onboard computer (such as fuel economy and engine temperature). On the right, instead of the speedometer there might be a cover (with artist and song) from the media library as well as the date and outdoor temperature. Unchangeable in this case are the gear indicator at the lower left and the vehicle speed plus fuel gage at the lower right.

Center console – Control Center

Fantastic. Located beneath the 12.8-inch main screen is the 8.0-inch Control Center for climate control, media library and vehicle functions. While hard keys are generally used to control vehicle and climate control functions, in the case of the Control Center touchpads are used. They give touch feedback via special actuators. Absolute innovation: the transitions from one touch button on the touch display to another button can now truly be felt. Using a special sensor, the Control Center can even measure the force of the user’s control action. This permits functions that are activated via a pressure point just like with mechanical buttons. These refined details show how mature the overall concept is. In a Volkswagen, the controls on touch displays that lie far outside of the driver's peripheral field of vision can be felt by touch. And this reduces distractions to the driver significantly.

Front seats have bass shakers. The music aboard the Golf R Touch can also be experienced on a very elemental level. What are referred to as bass shakers – integrated in the driver and front passenger seats – make the sound waves quite noticeable. The music of the sound system is experienced more intensively on a physical level in addition to perception by the ears.

Race staging

Electronics emphasize sportiness. The "Golf R Touch" is equipped with the engine of the new Golf R in Europe with a power output of 221 kW / 300 PS. Of course, any other drive system could be installed in this Golf as well. However, since the R engine serves as the proxy here, and the car was dynamically configured accordingly, a special "race staging" function is also provided. It is activated via the large 12.8-inch touchscreen, and it simulates a wide variety of parameters – creating a sort of test drive while stationary. The engine sound is played back over the loudspeakers of the sound

system during acceleration, images of the drive itself are projected on the touchscreen, all relevant vehicle data are shown in the Active Info Display; the car boosts chassis vibrations by seat actuators, and finally the lighting is modified in the interior. Race staging illustrates how more parameters can be personalized and electronically simulated than ever before.

Connected Golf:

Volkswagen brings smartphones into the car with their apps

Volkswagen Car-Net: all conceivable apps and online services in one car

App Connect: optimally networked with MirrorLink™, CarPlay™ and Android Auto™

Five key facts about the Connected Golf:

1. In the future, Volkswagen Car-Net apps will extend beyond the car and smartphone to include control via smartwatch.
2. The latest generation of the Volkswagen infotainment systems supports MirrorLink™, CarPlay™ and Android Auto™.
3. Media Control is integrating tablets and smartwatches into infotainment system.
4. Regular Routes is perfecting daily navigation.
5. Parking Guide takes the fear out of looking for a parking space.

Wolfsburg / Shanghai, May 2015. At the 2015 CES Asia, Volkswagen is presenting the Connected Golf – the maximally networked car of today. This e-Golf, which is equipped with the latest generation infotainment system, integrates a huge range of apps, smartphones and tablets via Volkswagen Car-Net, App Connect and Media Control. The products and applications integrated here cover such aspects as networked navigation and a wide variety of services in the areas of security, service and electric mobility. A high priority in China is the ability to call services via a call center. Customers can, for example, inquire about navigation destinations, schedule service appointments or request help in certain situations. Consider the example of App Connect: Volkswagen is one of the first carmakers to integrate the majority of the most significant smartphone operating systems in its Connected Golf show car based on App Connect. The three underlying software

interfaces of App Connect are Mirror Link™, Android Auto™ (Google) and CarPlay™ (Apple). These interfaces give the driver the ability to use many different smartphone apps over the infotainment system. Consider Media Control: this app can be used to integrate tablets and smartwatches (as well as smartphones) into the infotainment system of the Connected Golf. Media Control utilizes a separate app and will become the rear seat entertainment system of the new era.

Clever navigation and parking. Regular Routes is the name of a function by which the navigation system automatically detects – i.e. without needing to be activated by the driver – traffic disturbances on the daily commute to work, for instance. In such cases it autonomously suggests an alternative route that is not congested. All of these innovations being shown in the Connected Golf in Shanghai are already in production or will soon be introduced in initial markets. Meanwhile, another theme for the future of production cars is addressed by the solution known as Parking Guide – a technology for locating potentially available parking spaces.

App Connect

One infotainment system, nearly all smartphones. In China, Volkswagen first introduced MirrorLink™ – mirroring of the smartphone on the vehicle display – with the launch of the Lamando in 2014. MirrorLink™ was developed in an industrial consortium of automotive and smartphone manufacturers (the latter including Samsung, Huawei, HTC, Sony and LG). In 2015, just one year later, Volkswagen will now be extending the range of on-board smartphone platforms by adding systems from Apple (Car Play™) and Google (Android Auto™). In the same way as MirrorLink™, they are used to display and operate apps over the touchscreen of the infotainment system. In the future, Volkswagen will manage the Car Play™, Android Auto™ and MirrorLink™ systems under the App Connect concept.

MirrorLink™. In 2014, Volkswagen put its first smartphone platform in cars: MirrorLink™. MirrorLink™ makes it possible to display contents shown on the smartphone and operate smartphone functions via the touchscreen of the infotainment system. To avoid distracting the driver, specially designed apps can be used during the drive. This is done intuitively: the user simply connects the smartphone to the car and then uses the app over the infotainment system display. MirrorLink™ makes use of an industry standard of the Car Connectivity Consortium (CCC); according to this standard, the smartphone apps are "mirrored" on the car's touchscreen, and, as mentioned, their operation is networked to the infotainment system. Since the smartphone apps are always up-to-date, MirrorLink™ does not become obsolete. Volkswagen apps available in China under MirrorLink™ are: Think Blue. Trainer, Shared Audio and Call & Remind.

- **Think Blue. Trainer:** The Think Blue. Trainer app specifically assists the driver in efficient and eco-friendly driving.
- **Shared Audio:** This app lets everyone in the vehicle stream their favorite songs from a shared play list and play them back in the car.
- **Call & Remind:** The app Call & Remind lets drivers of a Volkswagen save tasks to be performed in order to gradually process them later as the traffic situation permits.

In the future, MirrorLink™ features will not only be extended with new Volkswagen apps but also with apps from external project partners. Already available in China are Baidu Navi, Baidu Lebo, NavInfo Carlife, KaoLaFM and Fun Drive Lite. Here are some examples of functions:

- **Baidu Navi:** This app enables navigation from one place to another throughout China.
- **Baidu Lebo:** This program lets users play back podcasts, music and audio books.
- **NavInfo Carlife:** This app provides information on topics such as the weather, fuel stations and parking spaces.

- **NavInfo FunDrive Lite:** This is a navigation app optimized for MirrorLink.

Apple CarPlay™. In 2015, Volkswagen will be offering CarPlay™ by Apple – as already implemented in the Connected Golf at the CES in Shanghai. This feature will first launch in Europe and the USA. It lets everyone with an iPhone 5, 5C, 5S, 6 or 6 Plus use numerous smartphone apps over the infotainment system. Here too, the smartphone programs are "mirrored". CarPlay™, for instance, feeds the iPhone apps Telephone, News and Music into the infotainment system via a USB interface. The apps in the Volkswagen are controlled either over the touchscreen of the infotainment system or by voice control via Siri (Apple).

Android Auto™. Its name describes what it can do. Android Auto™ was developed by Google for Android smartphones. Exactly as when MirrorLink™ and CarPlay™ are used, select apps of these phones are shown on the touchscreen of the infotainment system. Volkswagen will first offer Android Auto™ in Europe and the USA starting in 2015. A USB connection serves as the interface. Many apps under Android Auto™ can be operated either by touchscreen operation or by Google Voice; the voice control is activated by pressing the relevant button on the multifunction steering wheel of the Volkswagen.

Volkswagen Car Net

Networked navigation. By integrating online services into navigation, current information is available for the navigation process. The package that is known as Guide & Inform in Europe offers services such as Online Traffic Information, Online Destination Import, My Special Destinations (integration of personalized POIs), News, Vehicle Status Report and Weather. In China, these services have been adapted to the specific wishes of customers there. Volkswagen has significantly extended the range of features for all vehicles that are equipped with a radio-navigation

system of the second generation modular infotainment platform (MIB II). An overview of Volkswagen Car-Net services:

Services integrated into navigation and infotainment systems:

- Online Traffic (online traffic messages in real time)
- Traffic situation (have traffic information and disturbances shown on a mini-map)
- Parking Lot Information (search for parking space with extended, dynamic information such as prices and total number of parking spaces)
- POI Search (search for POI via infotainment system, support via Street View images);
- POI Import (import POI from smartphone, web portal or from the internet);
- Weather (weather information, air quality and rain radar for current position and destinations)
- News (various categories of news).

Services available via smartphone and/or web portal:

- Vehicle Status (status of doors, lids/flaps and lights)
- Car Finder (localizes the car via smartphone app)
- Vehicle Trip Statistics (vehicle fuel consumption data)
- Door Lock and Unlock (vehicle can be locked and unlocked by smartphone)
- Honking & Flashing (for initiating honking and flashing via smartphone)
- Event information (information / tips on events from different sources)
- POI Search (search for POI via smartphone)
- POI Sharing (share POI with friends)
- Rating Communities (rate a POI or call up ratings).
- Geofencing (virtual fence)
- Speed Alert (speed alarm)

- Vehicle Tracking and Tracing (localizes a stolen vehicle)
- Vehicle Health Report (vehicle status report)

Support services. Volkswagen drivers in China can use numerous services to optimize their personal safety that can be accessed via a call center. An SOS button and a road service button, for example, can be used to immediately request help. In addition, a lot of important information about the car can be accessed. The overall concept is implemented by a control unit integrated in the vehicle. The following call center services are available in China:

Services linked directly to the vehicle:

- Info call (phone contact for sending POIs to the car)
- Automatic Crash Notification (makes automatic phone call to service center in emergency)
- Manual Emergency Call (enables manual phone call to service center in emergency)
- Roadside Assistance (send vehicle data and location to service center at push of a button)
- Maintenance Scheduling (manual phone contact to schedule a service appointment, or if necessary automatic reporting by the vehicle. Vehicle data are transmitted online)

e-Remote / e-Remote SmartTV. Other apps that have already been implemented are the Volkswagen Car-Net solutions of the e-Remote app. They were specially developed for use in electric and plug-in hybrid models. Therefore the app is offered for the e-up!, e-Golf and Golf GTE. e-Remote lets users adjust settings and make inquiries via smartphone. In Shanghai, Volkswagen is also showing that in the future it will also be possible to control e-Remote via smartwatches – such as the Apple Watch, watches based on Android Wear or the Samsung Gear S. Specifically, the app contains the following functions:

- Programming of departure time
- Climate control

- Battery charging
- Query vehicle data
- Query vehicle status

In addition, an app is being prepared that lets users call up e-Remote services via a television (“SmartTV”).

Media Control

Rear seat entertainment via tablet and smartwatch. Until now, control of infotainment functions was reserved for just the driver and front passenger. Media Control – a new infotainment extension via app – now lets you conveniently control all main functions via a tablet or smartphone, even from the rear seats. Media Control will be the rear seat entertainment system of the future. Now it is no longer necessary to buy any expensive hardware, rather rear seat passengers can simply connect their devices to the infotainment system via the Wi-Fi hotspot. Controllable functionalities – which can all be accessed in the Connected Golf at the CES Asia – include the radio, all media sources (e.g. USB, CD or DVD, hard drive, online song search) as well as navigation.

The Media menu shows such information as the artist, album name and cover. In the radio, it is possible to modify station selection from station icons and lists, the station search and display of RDS information as well as frequencies. In the Navigation menu, along with standard functions, it is also possible to make a Baidu address search on the Internet then send it as a destination input. In addition, guests in the rear seating area are able to send calendar events and address book entries to the infotainment system as navigation destinations. The volume control can be adjusted in any context, just as the balance and fader settings can be. The tablet can be used to select from the available audio sources, to access the media library and to control basic operating functions such as start, stop, pause, forward and back. To optimize operating convenience, and to make it easy to watch movies, Volkswagen offers a device-specific tablet

bracket as an accessory that also supplies electricity to the device. One innovation that Volkswagen is showing at the CES in Shanghai is how, in the future, it will be possible to use a smartwatch to control the infotainment system. This means that Volkswagen drivers will essentially carry the media library on their wrists.

Navigation that thinks ahead

Regular Routes. Navigation systems provide detailed information on the traffic situation, warn the driver of traffic jams and suggest alternative routes. On many daily drives, however, the navigation system is not even used, because the routes are simply so familiar. Typical examples of such routes are the daily commute to work, a drive to the supermarket or to kindergarten. Therefore, Volkswagen will now be extending its systems to include Regular Routes functionality. Here, the navigation system "memorizes" regularly driven routes and scans them for traffic disturbances – even when navigation is inactive. If there are points of traffic congestion, a detour is recommended.

Before heading out, the driver can choose to have regularly driven routes automatically recommended. This simplifies destination input considerably. Regular Routes is also networked with the rest of the vehicle electronics. For instance, the car uses information about the predicted route to clean the diesel particulate filter along a suitable route segment or to integrate information about descents and inclines as well as acceleration and braking operations into the operating and charging strategy of plug-in hybrid models.

Parking Guide. To find a parking space in a public space with a high rate of success – that is precisely what Parking Guide will achieve in the near future. It is all based on the familiar digital street maps that are used in all navigation devices and on the servers of Internet services for route calculation. With Parking Guide, the information shown on such a digital map is extended to include potential parking spaces along the streets. What is ingenious about this is the way in which the data are acquired: with the help of ultrasonic sensors which are installed in every vehicle with a parking assistant. While driving past parking spaces in areas that have been mapped accordingly, it recognizes whether parking spaces are available. Each individual car individually computes the occupation rate of a parking area where it is located, and it transmits the data online to what is known as a backend – a computing center. There,

the information from many vehicles is collected anonymously, and it is converted into a digital pattern. This yields a digital map which provides information on parking area occupation rates – and indeed individually according to the street section and time of day.

People who use Parking Guide get information on parking areas for which the probability is high that it has available parking spaces (specific parking spaces are not shown). In addition, "parking routes" can be calculated for driving along the streets with the highest parking availability. A benefit: While routes are generally calculated according to criteria such as "fastest" or "shortest," the Parking Guide considers community data that is used to customize the navigation process.

e-Golf Intelligent Charge:

Inductive charging will revolutionize driving of electric cars

e-Golf automatically docks to an inductive charging plate in the floor

Headlights and tail lights indicate whether the car is being charged

Five key facts about the e-Golf Intelligent Charge:

1. Inductive charging is easier than conventional refueling today.
2. A charging plate automatically establishes a connection to the car.
3. Charge Check indicates the charge state using the vehicle's exterior lights.
4. e-Station Guide shows the way to the ideal charging station.
5. Digital Key turns a smartphone and smartwatch into a car key.

Wolfsburg / Shanghai, May 2015. Volkswagen launched one of the world's first high production volume electric cars on the market in the new e-Golf – a zero-emission vehicle with a range of up to 83 miles, optimal all-round characteristics and high-tech equipment. In Shanghai, Volkswagen is now showing, based on the e-Golf Intelligent Charge, how it will be possible to use electric cars more conveniently in the future. A core theme in this regard is inductive charging which will simplify the use of electric cars significantly. Over the mid-term, inductive charging will become established as an alternative to cable-based charging. The car is simply parked over a charging plate. In the future, users will be able to tell whether the battery is being charged by a quick look at the light signatures of the LED headlights and tail lights. Via e-Station Guide, drivers of electric cars will now also not only be able to find a desired charging station, but also get information on their locations and equipment as well as payment options. The Digital Key – an electronic car key – is also implemented in this Golf. It gives third parties temporary and

secure access to the car and enables starting or stopping of the engine via smartphone or smartwatch.

Wireless charging

Park and charge. Over the mid-term, it will be even easier and more convenient to charge the batteries with the market launch of inductive charging systems for electric and plug-in hybrid vehicles. In cable-based charging, it is necessary to use a separate charging plug to connect the car to an electrical outlet, but with inductive charging all the driver needs to do is park the car above what is known as a charging plate. Volkswagen is showing how this works with an e-Golf at CES. As soon as the control and communications unit of the charging plate in the pavement has established communications with the vehicle over a communications channel, contactless energy transmission can begin via an electromagnetic field between two coils (one in the floor of the parking space and one in the e-Golf). Beforehand, a "power lift" moves the charging plate integrated in the parking space into proximity with the underbody of the Golf. This results in just a minimal air gap between the two coils, so that – in contrast to fixed floor systems without a "power lift" – greater energy efficiency is achieved, and the electromagnetic limits (EMC values) can be satisfied without any problems.

Safe and simple. Inductive charging with a "power lift" is also considered exceptionally safe and easy. A separate menu on the navigation system display enables automatic and precise parking of the car over the charge plate. The car is positioned either with the help of a front camera using special markings around the charging plate or based on an electronic guide beam emitted by the charging plate. In both methods, the attained precision is remarkable (less than ± two inches in driving direction, less than ± four inches perpendicular to driving direction). The driver can use a smartphone app as an alternative. In this case, the car is essentially remote controlled. During the entire automated positioning process, all the

driver needs to do is press a soft key. Once the e-Golf is positioned above the charging plate, communication is established between the car and the system, and finally energy transfer occurs (with an efficiency of 93 percent). The start of the energy transfer is visually indicated to the driver via a special flashing sequence of the headlights and tail lights.

Charge Check

Charge state indicator. Today, on all Volkswagen vehicles with an electric or plug-in hybrid drive system, the status of battery charging is indicated in the instruments, and as an alternative it can be read from LEDs near the charging socket. While the instruments show a charge level, the LED indicators show a color-graded interval for the charge state. This interval is now simultaneously shown on the exterior lights of an e-Golf in the Charge Check being presented in Shanghai. The goal: The driver should basically be able to see from any visual angle – around the car from any perspective – whether the battery is still charging or is fully charged. To output the charge state signal at the front of the car, Volkswagen uses the position lights and the LED daytime running lights of the Golf with its C signature that is typical of the electric models, and at the rear all of the LED tail lights and (in the car being shown in Shanghai) the third brake light in the roof spoiler are used. The light indicator is activated when the charge plug is connected and after activating central locking (when the charge plug is active). The charge state is then briefly displayed for 5 to 10 seconds.

Light signals. If the battery is fully charged, the lighting is continuous over the mentioned time period. If the charging process is still actively taking place, the LEDs pulse at a long interval. If an active departure time has been set, the LEDs flash at a short interval. If the LEDs do not output any of the three named signals – despite the charge plug being connected or the car being parked over an inductive charging plate – then the charging process is inactive. Possible reasons: no electrical supply voltage present, gear selector

lever is not in the "P" position, car is not parked exactly over the charging plate (for inductive charging), or a fault exists in the charging system.

e-Station Guide

Route to the ideal charging station. For drivers of electric cars, it is important to have charging stations precisely shown and described as points of interest (POIs) on digital street maps. If a mapped charging station is difficult to access, does not support the required plug systems, is defective or does not exist at all, this would lead to an unnecessary waste of time. A function like the new e-Station Guide can prevent this from happening. Technical background: The electric vehicles can very accurately evaluate all of the relevant parameters of a charging station and make the results accessible to other Volkswagen customers via the cloud. In this process, it is important to reliably evaluate the information on each station based on a representative sample of data sets. If sufficient information exists on the charging station, it can be considered validated. Naturally, this also applies to other POIs. Over the long term, this will significantly improve the quality of the digital street maps.

In the electric car, information from charge management, the drivetrain and steering system are evaluated and compared to local information of the navigation system. Special algorithms are used to evaluate steering movements and the drive system to rate the accessibility of a charging station. If a vehicle would need to perform difficult maneuvers before charging, this information can be combined with the location of the charge plug on the car (front, rear, left or right), and a conclusion can be reached on whether this type of charge station would be difficult to access for vehicles of the specific model. On the other hand, accessibility is considered good if a car can maneuver to a stop with minimal steering movements and gear shifts. Meanwhile, battery management can acquire important information on the actual charging process. It can accurately log whether the charging power listed for the station is actually

available. It is also possible to evaluate the charging power curve over a specific period of time to analyze it in order to determine whether irregularities occur in the amount of charging power it supplies. And finally, e-Station Guide can be used to communicate which plugs are compatible and which payment cards are accepted.

Digital Key

Smartphone and smartwatch as car key. Today, the e-Remote app can already be used – such as in the e-Golf – to access data and perform functions such as starting heating and cooling or battery charging. Volkswagen is now introducing another app in the e-Golf Intelligent Charge which was developed for operating the car: Digital Key. A smartphone is actually used as a digital key that can be used to lock or unlock the e-Golf (separately for the rear hatch), open or close all windows and start or stop the engine. Moreover, not only can all of this be done with a smartphone, but also with a smartwatch. In addition, the Digital Key can also be transferred to other smartphones and smartwatches. In this way, the app makes it possible to have third parties unload the car, for instance, or perform maintenance without having to have the real car key in their hands. Afterwards, the temporary access to the car can simply be deactivated.

e-Golf Trained Parking parks semi-automatically:

Future version of Park Assist will move the car nearly autonomously

CES highlight: Volkswagen is showing innovative leap of the parking assistant

Trained Parking: future Park Assist drives into garage semi-automatically

Five key facts about the e-Golf research vehicle:

1. Trained Parking uses a camera to scan the path driven during parking.
2. Parking situations "learned" in this way can later be executed nearly autonomously by the car.
3. Trained Parking utilizes sensors and a camera that come from systems already being used in production cars today.
4. The combination of Trained Parking and inductive charging offers a considerable gain in convenience.
5. Additional expansion stages in conjunction with smartphone and smartwatch control are possible.

Wolfsburg / Shanghai, May 2015. Park Assist by Volkswagen automatically guides the car into parallel and perpendicular parking spaces (in reverse) and can also exit parallel parking spaces. First Volkswagen models will also be able to automatically park in perpendicular spaces in a forward direction. The system assists the driver by autonomously performing optimal steering wheel movements to park or exit from a space on an ideal line. At the CES in Shanghai, Volkswagen is now presenting another evolutionary stage of Park Assist. It is known as Trained Parking. In this process, the car – in this case an e-Golf – scans a frequently driven path to a parking space by camera (production system from the modular transverse matrix), saves it and later executes the maneuver semi-automated.

- **Park Assist 1.** The first generation of Park Assist made its debut in 2007; it assisted the driver by performing automated steering for parking in reverse into spaces parallel to the road – an innovation.
- **Park Assist 2.** The second generation, presented in 2010, made it possible to automatically steer into parking spaces that are perpendicular to the street for the first time; the parallel parking spaces could also be smaller (a space length of the car's length plus 31.5 inches sufficed). In addition, it was now possible to assist in exiting from parallel parking spaces.
- **Park Assist 3.** The third generation of Park Assist, presented in 2014 in Europe, offered the innovative feature of semi-automatic parking in perpendicular spaces in a forward direction as well. Due to its high functional versatility, Park Assist 3 can optimally assist the driver, especially in difficult traffic situations, because it accelerates and simplifies the parking process.
- **Mode of operation.** After it is activated by pressing the Park Assist button, the driver only needs to control the accelerator pedal, brakes and gear shifting (including clutch for manual transmissions), while Park Assist automatically guides the car into the parking space. The system autonomously recognizes the type of parking space and initiates the relevant maneuver; the driver is simultaneously informed and given instructions via the multifunction display. The driver can use the activation button for Park Assist to manually select the specific desired parking space from the automatically detected parking spaces.

Trained Parking. In 2015, Volkswagen is now presenting a vehicle that semi-automatically executes a frequently recurring parking process including the driving approach. This future generation of Park Assist is still in development. But it is already clear that it will represent a tremendous innovative leap forward. And this is how the system works: as described above, the driver parks at his or her parking space or in the garage and models a parking maneuver. The system saves this maneuver in a training set. Now, as soon as the car

drives into the surroundings of the "trained parking space" it offers the driver its assistance. And the driver can have the system drive the trained route to the saved parking location. Here, the car utilizes sensors from the modular transverse matrix already installed in production cars today.

In another innovation stage, it will be possible to combine this functional flow with another feature that was developed at the same time: remote controlled parking. Here, the driver can exit the car on the way to the trained destination parking space and have the car drive into the space semi-automatically while the driver monitors the process via remote control or smartphone. This even enables automatic exiting from a parking space on the trained path.

Automatic inductive charging. As noted in the section on the e-Golf Intelligent Charge, automated parking will also make it very easy to perform inductive charging. The car is positioned either with the help of a front camera using special markings around the charging plate or based on an electronic guide beam emitted by the charging plate. In both methods, the attained precision is remarkable (less than ± two inches in driving direction, less than ± four inches perpendicular to driving direction). The driver can use a smartphone app as an alternative. In this case, the car is essentially remote controlled. During the entire automated positioning process, all the driver needs to do is press a soft key. As soon as the e-Golf is positioned above the charging plate, the system automatically initiates communication between the car and the system, and the energy transfer begins.