Vehicle Station Gateway

Vehicles will be electronically integrated into the IT infrastructure with the risk of unauthorized access. ISO (International Standardization Organization) is going to establish a joint working group standardizing the Vehicle Station Gateway (VSG). The VSG should provide security and safety functionality in order to allow only authorized access to the in-vehicle networks (IVN). CIA is committed to submitting its CIA 447 application profile for add-on devices for special-purpose cars.

ARE SAFETY RELATED. They transmit commands to brake the car or commands that just switch the direction indicator on – also a safety function. Therefore, unauthorized access to the in-vehicle networks should be avoided. However, the “doors” are widely open. For example, the CAN-based diagnostic interface, standardized by the International Standardization Organization (ISO 14229-1 and ISO 15675-4), is such an unprotected entrance. Not much (not to say no) security is provided to avoid unauthorized access. Everybody can access any ECU, if they have the knowledge. Using the provided write functions, thieves even can bypass the engine immobilizer.

Another standardized entry point is the CIA 447 gateway for special-purpose car add-on devices. Of course, the carmakers provide the CIA 447 compliant ECUs just for selected customers: taxis, police cars, ambulances, and handicapped drivers. And there are more backdoors into the in-vehicle networks, especially via the entertainment ECUs. Usually, display systems have the chance to get in. Up to now, the OEMs have closed their eyes to this issue. In a head-in-the-sand way they hope that the hackers will not see them. That’s a common mistake. There are several websites promoting that “hacking a car is fun”. And it is! With the support of search engines, you can easily find detailed information about how to access the in-vehicle networks via the CAN-based diagnostic interface. Those websites suggest for example to clear the error lists in the ECUs in order to keep the bills for maintenance as small as possible.

ISO joint task force

ISO is going to establish a joint working group of different technical committees to standardize a so-called Vehicle Station Gateway (VSG). It is intended to close the open doors to the safety related in-vehicle networks. This means the OEMs try to gain back the power to control the access to the car’s electronic. However, there is no common agreement and understanding, where the firewall should be: in the car or in the infrastructure. This might be also a political problem or in other words a business case. Money makes the world go around. This has not changed. It is true also in times of Ethernet and sophisticated electronics.

The ISO standardization activities are going to harmonize and hopefully limit the access to the safety-related parts of in-vehicle networks. The group will discuss access to the IVNs by means of in-vehicle add-on modules including nomadic devices as well as by means of infrastructure equipment, for example traffic management systems. One thing is clear: The OEMs, the car manufacturers, like to keep the complete control of the IVNs in their hands.

Already existing use-cases

Any use-case needs to be discussed and evaluated. You may like it or not. That doesn’t matter. If it is technically possible, it will be done. Legally or not is another question. Just as the ISO experts were discussing the VSG topic, the USA Today newspaper wrote about a research project, in which an iPhone app supports parents in observing their kids when they start driving on their own. The University of North Carolina Highway Safety Research Center (HSRC) and the Center for the Study of Young Drivers have developed a smartphone app that provides guidance to parents when their teens start to drive. The Time-to-drive app aims to encourage parents and teens to achieve certain goals in overall driving time and driving in various situations. In addition, many US states require a record of supervised experience when a teen driver in the learner stage applies for a provisional license. The app enables parents to keep an accurate, printable log of driving time and conditions. The teen’s smartphone communicates via Bluetooth with a device connected to the CAN-based diagnostic interface. The smartphone may send information to the parents about location and driving style (braking, acceleration, etc.).

There is also the Cellcontrol device by Scosche that plugs into a car’s on-board diagnostic system and keeps drivers from texting, e-mailing or making phone calls while the car is moving. This device communicates via Bluetooth with the app installed on the smartphone. Insurance companies therefore appreciate and praise the use of this app.

This and other apps force car manufacturers to provide smartphone apps, which provide access to data available in the IVNs. GM’s daughter, Opel, was the first OEM providing selected CAN data directly for the iPhone. The OPC PowerApp software allows displaying and analyzing data from the in-vehicle networks on a smartphone. This deep look into the car’s electronics is available for Astra OPC and other cars by the German GM daughter. The necessary sending equipment is installed behind the interior panels. The data comes from the different CAN networks in the vehicle. The carmaker is giving car enthusiasts the chance to receive selected, performance-related data. The fun offered by this iPhone app does not end when the engine is switched off. Up to sixty different data, including engine boost pressure, throttle position, lateral acceleration or engine torque, are readily available giving car enthusiasts the chance to receive selected, performance-related data. The fun offered by this iPhone app does not end when the engine is switched off. Up to sixty different data, including engine boost pressure, throttle position, lateral acceleration or engine torque, are readily available in real-time on the smartphone. They can also be stored and later compared with friends. A lap-time recorder connected to GPS data appeals to racing fans, for example those who use the legendary Nürburg-ring track and want to analyze and improve their performances on the Nordschleife stretch. This way, braking points and section speeds can be analyzed. In addition the G-forces can be measured in specific curves. The black box or smartphone controller is directly connected to one of the in-vehicle CAN networks and transmits its data with a frequency of 30 Hz to the iPhone, which is equivalent to real-time. In this sense, the mobile phone acts as an additional instrument inside the cabin, recording all the data. Seven different display modes are available complete with the OPC logo and colors. They also provide an analog instrument, a G-force meter, a digital display, an over/under-steer indicator, a bar chart, a line graph and a map.

Different apps gives you unprotected read and write access to the in-vehicle networks via the OBDII and car’s diagnostic interfaces

If you like to read all in-vehicle diagnostic data via the OBDII (on-board diagnostic II) interface, you can buy the full version of the OBDII app, which describes and interprets more than 18000 error codes. The lite version only understands 1853 trouble error codes. This means you can analyze the ECUs without dedicated and expensive diagnostic tools. No Internet connection is necessary. There are also several other apps available: The OBD2 app for example turns smartphones or tablet computers into so called scanners, which monitor and record the in-vehicle communication. But you may also use it to reset the “check engine” light. Ford also provides a mobile app to talk to the car. The AppLink uses the driver’s smartphone and
not, like Opel does, an additional module to be accessed by authorized garages or by the car manufacturer.

Recently, Hyundai and LG have revealed their joint activities regarding the use of smartphones to lock and unlock doors. In addition, the two companies plan also to use the smartphone to check the status of the windows and the sunroof. The Korean companies demonstrated at the Geneva Motor Show how the i30 three-door car can use smartphones as integral components to control and check the status of ECUs, which are connected to the CAN-based in-vehicle networks. The Hyundai app allows owners to remotely connect with their vehicles, checking if the windows and sunroof are open or closed, and to prepare for the next journey by checking the car’s fuel level and driving range. Using details of the car’s location, they can also plan for the next journey – or receive a useful reminder of where they parked the car. The smartphone used in Hyundai’s connectivity project can unlock the doors and automatically personalize the vehicle’s settings, including adjusting electric seat and mirror positions, altering radio station presets, menu appearance settings and other preferences.

Buick, BMW, Ford, and others announced partnerships bringing more infotainment apps into the car. They will give developers access to GPS, speed, acceleration, fuel flow, and other car data. Some of this information could be forwarded to business partners or co-workers or family members in order to report automatically the journey progress. BMW’s Glympse is such an app calculating the time of arrival. If you want to inform the entire world about where you are, you can publish this information on Facebook or other social media. Big brother is watching you.

There are also fleet management systems for commercial vehicles, which are connected to the CAN-based IVNs. For example, TX-GO by Transics is an on-board computer without display, which can do more than just provide the position of the vehicle. Due to its connection to the CAN-based tachograph, it offers a real-time, at-a-glance view on information like driving and resting times. The system is seamlessly integrated to the IVNs, thus allowing all information to be visualized in the back office. This means, the driving behavior can be observed.

Different apps give you unprotected read and write access to the in-vehicle networks via the OBDII and car’s diagnostic interfaces

Driverless cars need external information

Other examples include Google’s driverless cars. The driverless car fleet consists of ten vehicles including modified Toyota Prius, Audi TT, and Lexus models. They drive autonomously in several US states – since 2012 in Nevada, Florida, and California. Of course, you need to give some add-on electronics to the standard in-vehicle networks. Audi is the first car manufacturer with a pilotless driving license in Nevada. Automotive supplier Continental has also received Nevada’s Autonomous Vehicle Testing License, which allows the firm to test driverless vehicles on state roads.

"At Continental, we continue to invest in research and development for next generation technologies – such as our highly automated vehicle – that will drive us toward a safer, more efficient and more comfortable future," said Dr. Elmar Degenhart, chairman of the executive board of Continental. "Our strategy is clearly focused on making this type of future technology reality. It’s clear to us that automated driving will be a key element in the mobility of the future. As a system supplier, we are perfectly positioned to develop and realize series production of solutions for partially automated systems for our customers by 2016. We will be able to develop the first applications for highly and ultimately fully automated driving, even at higher speeds and in more complex driving situations, ready for production by 2020 or 2025." The car is designed to always have a driver monitoring the vehicle behind the wheel, unlike a completely driverless vehicle. The automated vehicle can accommodate multiple driving scenarios. Utilizing four short-range radar sensors (two at the front, two at the rear), one long-range radar, and one stereo camera, the vehicle is capable of cruising down an open freeway as well as negotiating heavy rush-hour traffic. Taking advantage of the supplier’s sensor fusion technology as part of the Continental safety concept, the vehicle is able to track all objects as they enter into the sensors’ field of view. The object information is then processed and passed on to the control unit (Continental Motion Domain Controller) to control the vehicle's longitudinal and lateral motion via signals to the system, the brakes and the steering system. The equipment in the highly automated vehicle differs from the customized sensors and tailor-made actuators in other automated vehicles. Although the concept of complete fully automated driving is valid, it is not yet fully viable. This highly automated vehicle, however, is an intermediate step toward fully automated driving. It brings Continental closer to achieving the company’s Vision Zero – the goal of reaching zero accidents and zero fatalities on the roadways. The automotive supplier will continue real world evaluations with this vehicle. Starting in 2016, partially automated systems may therefore be assisting drivers in "stop & go" situations on the freeway at low speeds of up to 30 km/h.

Automated driving on German Autobahn (read on)

Pilotless parking – not only a dream any more

External access to the IVNs is also necessary for less challenging use-cases: In Ingolstadt (Germany), the hometown of Audi, a parking garage provides automatic parking for prototype cars. The parking assistant that helps to steer various Audi models such as the Audi A4 and Audi A6 into a parking space has been in production for some time, and technologies for ‘piloted parking’ are now being developed. At the entrance the driver stops, leaves the car, locks it, and uses his smartphone to send a ‘park’ signal to the garage’s computer. This computer controls the parking process. It communicates via WLAN with the car’s IVNs and calls up the principal data, from which it learns the car’s size. The computer then locates the nearest suitable parking space and transmits a schematic route map to the car. This ‘digital thread’ operates the Audi’s electromechanical steering as it moves through the garage at a speed of five to ten kilometers an hour. The aim of the project is to execute the parking function reliably without the car having to be upgraded technically. The Audi therefore uses existing series-production sensors to identify its position. The computer algorithms compile a complete picture of the surrounding area and compare it to the garage’s route map. If there is the slightest risk of a collision, the car comes to a standstill. The same applies if WLAN contact with the computer is lost. The computer monitors the car’s movements with laser scanners. When the driver calls the garage parking computer by smartphone and instructs it to send the car to the exit point – assuming that he hasn’t already asked for it to be returned at a specific time, his car re-appears and the parking fee is debited automatically. The next applications of the ‘Audi connect’ technology are already under development: automated car wash and refueling systems as well as recharging points for the e-tron models. Although the systems in the cars are already functional, more has to be done about the problems of the infrastructure.

Outside the garage, the Audi parking assistant will drive us toward a safer, more efficient and more comfortable future,” said Dr. Elmar Degenhart, chairman of the executive board of Continental. "At Continental, we continue to invest in research and development for next generation technologies – such as our highly automated vehicle – that will drive us toward a safer, more efficient and more comfortable future," said Dr. Elmar Degenhart, chairman of the executive board of Continental. "Our strategy is clearly focused on making this type of future technology reality. It’s clear to us that automated driving will be a key element in the mobility of the future. As a system supplier, we are perfectly positioned to develop and realize series production of solutions for partially automated systems for our customers by 2016. We will be able to develop the first applications for highly and ultimately fully automated driving, even at higher speeds and in more complex driving situations, ready for production by 2020 or 2025." The car is designed to always have a driver monitoring the vehicle behind the wheel, unlike a completely driverless vehicle. The automated vehicle can accommodate multiple driving scenarios. Utilizing four short-range radar sensors (two at the front, two at the rear), one long-range radar, and one stereo camera, the vehicle is capable of cruising down an open freeway as well as negotiating heavy rush-hour traffic. Taking advantage of the supplier’s sensor fusion technology as part of the Continental safety concept, the vehicle is able to track all objects as they enter into the sensors’ field of view. The object information is then processed and passed on to the control unit (Continental Motion Domain Controller) to control the vehicle’s longitudinal and lateral motion via signals to the system, the brakes and the steering system. The equipment in the highly automated vehicle differs from the customized sensors and tailor-made actuators in other automated vehicles. Although the concept of complete fully automated driving is valid, it is not yet fully viable. This highly automated vehicle, however, is an intermediate step toward fully automated driving. It brings Continental closer to achieving the company’s Vision Zero – the goal of reaching zero accidents and zero fatalities on the roadways. The automotive supplier will continue real world evaluations with this vehicle. Starting in 2016, partially automated systems may therefore be assisting drivers in "stop & go" situations on the freeway at low speeds of up to 30 km/h.

In-vehicle add-on devices

The CIA 447 application profile for car add-on devices has been implemented by several carmakers: Audi, BMW, Daimler, Opel/Vauxhall, and Volkswagen (VW). They offer it especially for police cars. At the IAA motor show in Muenster (Germany), the German police and CIA organized a joint one-day conference introducing this CANopen profile and its application options for police cars. About 100 people participated in this event. In the exhibition, there was a special area for presenting the cars. Vauxhall showed the one-box concept from the British police also based on a CIA 447 network – this is so-to-say the British way. Daimler has outsourced the CIA 447 network design to its partners Haensch and Cars, a Daimler-daughter company. VW also equips police cars by means of its Volkswagen R daughter company. However, all OEMs provide a CIA 447 compliant gateway to the in-vehicle networks. During this event VW introduced its so-called special-purpose car assistant strategy. Starting this autumn, the company will provide its Golf VI platform with this assistant, which includes a CIA 447 gateway to the in-vehicle networks. The CANopen network can be used for after-market applications.