Today, there are many signs that electromobility will assert itself during the next ten years, including in Germany. In coming to such an assessment, we must not be deceived by the current situation in Germany, as a look at other countries or other parts of the world shows. For example, in Norway, approximately a third of newly registered vehicles are electric – thanks to massive state support. In the Netherlands, the corresponding value is still as high as ten percent. The other western industrialized nations have barely started, with a share of one percent, and with Germany bringing up the rear at 0.7 percent.

**CHINA AND ASIA IN THE FAST LANE**

By contrast, the level of activity in Asia and the breathtaking speed of the changes taking place there are highly impressive. In 2016, 500,000 electric vehicles were registered in China, of which 115,000 were buses. In the field of electromobility, China wants to present itself as a driver of innovation and world leader. In effect, Asia is characterized by increasing levels of urbanization and, according to UN forecasts, the number of megacities worldwide with more than 10 million inhabitants will grow from 28 in 2015 to 41 in 2030. Most of these will be located in Asia, China and India. The desire for mobility in these countries will not decline; at the same time, however, the cities cannot put up with even more vehicle-generated air pollution.

Another aspect of electromobility is taxi drones for personal transport and developments in this field make such solutions a realistic vision for the future. The state transport authorities in Dubai (RTA) want to launch regular test operation of autonomous air taxis in the fourth quarter of 2017. Interestingly, the German start-up E-Volo has been awarded the contract for this ahead of its Chinese competitor. Promoters of an initiative in Switzerland are
all conceivable requirements. These include not only pricing, cost optimization and billing processes but also, and most importantly, the consideration of intelligent grid functionalities. How much energy is currently available and under what conditions? Should the vehicle be charged immediately at the highest possible charging capacity or is it better to wait for a more economical time? The next version, which is planned for the end of 2018, will include further features, for example inductive charging systems with radio interface, energy feedback into the supply grid and the temporary emergency supply of households, as well as pantograph charging with wireless broadband communication.

TABLE: SUPPORT FOR INDUCTIVE CHARGING

Inductive, wireless charging has the potential to significantly increase the comfort and convenience of electromobility. Charging operations start simply without the need to laboriously connect a cable. Alongside ISO/IEC 15118, which covers the field of communication, ISO 61980 defines the infrastructure requirements and ISO 19363 the vehicle-side prerequisites. Despite this, technological challenges persist. These range from real-time wireless broadband communication through the detailed positioning of the vehicle and the identification of the ideal coil frequency and the geometry and location of the coils, and on to the detection of foreign bodies or living beings in the area of the coil. As yet there is almost no detailed experience to allow us to answer these questions. As a result, it is hard for standardization boards to define binding specifications. The STILLE
project, which is supported by the German Federal Ministry for Economic Affairs and Energy (BMWi), has the aim of constructing, measuring and evaluating the systems and technologies that are to be agreed on in the standard and making the results available to the various boards. The companies that are taking part in STILLE have an international presence and most of them actively contribute to standardization. The vehicle manufacturers’ and infrastructure providers’ aim for Germany is to bring an interoperable infrastructure for inductive charging to the market in 2020.

ELECTRIC BUSES AS FORERUNNERS

While general progress in the field of electromobility depends on many constraints and circumstances and proceeds with the corresponding caution, the decision-makers in niche sectors such as urban transport can act more flexibly and swiftly. These are, practically speaking, closed “ecosystems” because the vehicles are all equipped identically with regard to charging technology. Vehicles, batteries and charging systems can therefore be optimally harmonized for the intended area of use.

In the case of electric buses, it is necessary to choose between charging the vehicles in the depot (depot charging) and opportunity charging via a pantograph. While overnight depot charging is less spectacular, fast charging at selected stops, such as terminals or interchanges, is worthy of closer examination. When extended, the pantograph on the roof contacts a charging rail in the charging system and charges as much energy as possible in just a short time.

A number of urban transport companies in European cities are already running buses of this sort in test operation. The spectrum ranges from two buses in Copenhagen through to a fleet of 43 buses in Eindhoven. Solutions offering 300, 450 or 600 kW are possible for fast charging systems operating at voltages of 600 to 800 V. The 600-kW system describes with the corresponding caution, the decision-makers happen.

Even though cable-based charging was originally planned for the depot, pantographs are now also being used here. On the one hand, problems were caused by cable breakages due to buses driving over trailing cables. On the other, the bus drivers in the depot frequently forgot to connect the charging cable since, as a result of their driving experience, they were used to charging at the press of a button. This meant buses were often left immobile. The uniform operating concept should now ensure that this can no longer happen.

EINDHOVEN THE PIONEER

Those responsible for the large-scale project in Eindhoven have been able to gather considerable experience. To ensure that sufficient energy is available for all 43 buses at all times, fast charging equipment has also been installed in the depot. Depending on the situation, low- or high-capacity charging is possible here. To permit the uninterrupted use of the charging infrastructure, the Dutch infrastructure manufacturer Heliox developed charging stations with dual-connection for the depot. Thanks to a special DC switch mechanism, a bus can connect to the system even while the bus next to it is still being charged.

Vehicle and infrastructure manufactures as well as service providers who typically only produce or supply small series do not generally want to have to get to grips with all the details of standardization, charging communications and electronics development themselves. Despite this, they still need to meet the high standards of the automotive industry. For them, the best option is to make use of existing solutions with the corresponding embedded software.

Vector Informatik has already developed charging control units with CCS type 2 plugs that are ready for series production and are suitable for urban buses, postal and logistics companies and similar users of small pools of electric commercial vehicles. Vector’s charging control unit (Figure 2) supports DIN SPEC 70121 and ISO/IEC 15118. The control pilot signal corresponds to IEC standard 61851. The tried-and-tested Qualcomm QCA7005 chip is used for powerline communication (PLC). For backend communication, the control unit uses a bidirectional HTTPS-based connection. Consequently, the ECU makes use of proven protocols and technologies to ensure the secure transfer of sensitive data. Because both the hardware and the MICROSAR.V2G
CONCLUSION

So far, electromobility has played a fairly subdued role in the public consciousness. Despite this, the participants and experts at the Vector E-Mobility Engineering Day all agreed that this situation is the equivalent of the calm before the storm. It is only a question of time before the final technical obstacles are overcome. Standardization work for the necessary technological extensions for vehicles and infrastructure is proceeding at full speed.

Even small series manufacturers are now able to call on proven technical embedded solutions and existing control units. We shall therefore just have to wait and see how long it takes before we in Germany can look up from our electric cars and see the first autonomous air taxis driving overhead, or whether we will have to travel to Asia to see such a sight.

More information on the E-Mobility solution from Vector
www.vector.com/e-mobility

Figure 3: The MICROSA.V2G embedded basic software for smart charging communication in accordance with DIN SPEC 70121 and ISO/IEC 15118.

software (Figure 3) come from Vector Informatik, it is easy to meet customer-specific requirements.

Another very important topic in connection with electromobility is cyber security, for example during billing processes at public charging installations. A great deal of specialist knowledge and experience is needed in order to master the details of establishing secure connections using TLS or the secure exchange of certificate data – in particular the secret private key. That is why it makes sense to opt for external solutions when dealing with embedded systems for charging in accordance with ISO/IEC 15118. Vector Informatik’s security concept is based, among other things, on a hardware security module (HSM) that optimally protects control units against external access. In contrast to a software-based security concept with secure hardware extension (SHE), this HSM approach permits asymmetric encryption. This means that neither party makes use of permanently installed keys but that both negotiate new keys at runtime on every transaction. This vastly improves security.

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