Validation of Sustainable Mobility Concepts
Reliable, mobile data storage solutions to reach the next level of ADAS and AD
Bernhard Kockoth

In recent years, the automotive industry has focused on the development of advanced driver assistant systems (ADAS), autonomous driving (AD), and e-mobility. With regard to changing external circumstances such as growing eco-awareness or the changing use of public transports, new developments are now dealing with mobility automation projects: "Robotaxis, autonomous shuttles, self-driving delivery vans, automated trucks, and self charging e-vehicles (EV) will play a crucial role in the next years", says Bernhard Kockoth, Advanced Development Lead at ViGEM. However, in order to bring future mobility concepts safely on-to the road, unprecedented amounts of data must first be collected and securely stored by using reliable high-end data logging systems.

Data storage devices in mobile use

ViGEM, the German expert for mobile data logging and data transfer solutions, supports OEMs and Tier1s in the validation of automated and autonomous driving for more than ten years. Its Car Communication Analyzer (CCA) product lines enable the collection of raw sen-sor data, Lidar, radar, and camera data as well as all kinds of communication data from in vehicle networks with data recording rates up to 25 Gbit/s and storage capacities up to 64 TB. This makes them ideally suited for another rapidly evolving technical aspect of modern mobility: the increasing use of artificial intelligence (AI), for example in connected driving.

In order to develop and validate such innovative functions, data loggers are installed in the trunk of prototypes and test-vehicles (Img 1) for mobile data collection.

For example, the CCA 9010 series of data loggers use removable data storage devices with capacities ranging from 16 to 64 TeraBytes (Img 2). They can be operated in all climate zones due to their broad range of operating temperatures. The continuous write bandwidth goes up to 32 Gbit/s. A typical vehicle mix of low, mid and high data rate sources can be recorded continuously with up to 25 Gbit/s.

When testing new functions, dozens of vehicles are sent out on the road in field operational tests (FOT) in real-world conditions. During these test drives, the CCA data loggers capture every single bit of the vehicle networks and sensors: whether this happens in the dusty and hot environment of Death Valley, on the icy roads at the polar circle, or in metropolitan are as such as Berlin, London, and New York. Data loggers are designed to consume as little power as possible to preserve the available range and power of electric vehicles.

The amount of raw data to be recorded has increased

exponentially in recent years. For example, 20 years ago, the total data volume per vehicle was 25 Megabit/s, today it is 25 Gi-gabit/s and more! (See Img 3) This rapid increase in data rates is mainly due to the development of automotive Ethernet and high-resolution LVDS cameras. Today, in an 8-hours' drive often more than 80 TB have been collected.

Data storage modules enable global operation

For long-term operations and reliable results, it is necessary that the devices have a robust design and work continuously without data loss. To enable a mobile use in such long-term projects and to deal with large thermal differences as well as high demands on shock and vibration, ViGEM has equipped its CCA removable data storage devices with a robust metal housing reliably protecting the high quality, internal electronics. With experience of almost 15 years in this field, the German supplier continuously additionally validates the selected SSDs to ensure a constantly high product quality.

Thanks to their robust design and high quality electronics, the removable data storage devices can be used in many different project specific applications like global field operational tests, precise data harvesting for ground truth mapping, new sensor evaluation, training of AI algorithms, or the documentation of all bit accurate inputs needed for automated vehicles.

For the rotating use of data storage devices between test vehicles and data centers worldwide, ViGEM has developed the sophisticated concept of mobile data handling. It ensures the time and cost efficient utilisation of test vehicle fleets and a longterm, easy to handle reuse of the storage modules. Instead of high speed cable based data transfer, the German measurement specialist relies on high-capacity removable data storage devices that can hold many TeraBytes of data. To bring all collected data from the vehicle into the hands of the developers, the data storage module can be swapped out in seconds. Vehicles can continue the driving, while the recorded data gets shipped to an ingest point for upload. Without losing valuable testdrive time due to data transfers, test fleets can thus be utilised al-most 24/7, which holds significant potential for cost savings (Img 4).

The third generation of ViGEM data storage modules has proven itself after three years of continuous use. In addition to the high storage capacities, the robust modules also offer valuable functions such as data encryption and hot-plug capability. These features ensure maximum data security and convenient operability, such as hot plugging, i.e., allowing modules to be easily replaced during the

vehicle operation. Therefore, mobile data logging systems are an ideal solution when substantial amounts of data need to be collected or when test fleets are in operation almost 24/7 and vehicles do not return to a fixed location after each test drive.

Development of AI for ADAS

For years, connectivity has played a crucial role on the road in automated and autonomous driving. Vehicles already exchange information with the outside world, e.g., as navigation systems, lane departure warning, traffic sign recognition, and traffic light prediction. For future developments and validations in the field of ADAS and autonomous driving, OEMs will continue to need state-of-the-art logging solutions before the start of production (SOP).

Advanced AI algorithms not only work in cloud data centers but are also integrated in vehicles, for example, to help with fuel economy, battery management, passenger comfort and many other features. Most prominently in ADAS, they will help to drive an automated vehicle to its destination. With the integration of AI capable hardware also an important part of software in Electronic Control Units (ECUs) becomes non deterministic and therefore all inputs and outputs have to be monitored. This data must first be collected by test vehicle fleets of OEMs or their suppliers.

Requirements for future mobility concepts

Mobility is in a state of upheaval worldwide: ecological awareness and demands for sustainability are currently contributing to tremendous changes. In combination with new technical possibilities such as AI and connected systems, we have the opportunity, based on reliable data foundations, to develop new systems and functions which will allow us to drive more comfortably, safely, and sustainably through the future.

Data security assured by hardware encryption

Data security from the data logger to the data center is guaranteed by standard hardware encryption: Every CCA 9010 data logger uses an individual key assuring the data integrity until an authorized ViGEM copy station decrypts the removable data storage at the ingest point of the data center. The copy station reads the encrypted data and transfers it via 100G Ethernet with a transfer rate of up to 50 Gbit/s to the data center for further processing. The end-to-end data security is guaranteed by encryption according to the AES-256 and the OPAL 2.0 standard. After successful transfer, the securely erased storage modules are available for reuse in the field within a very short time.
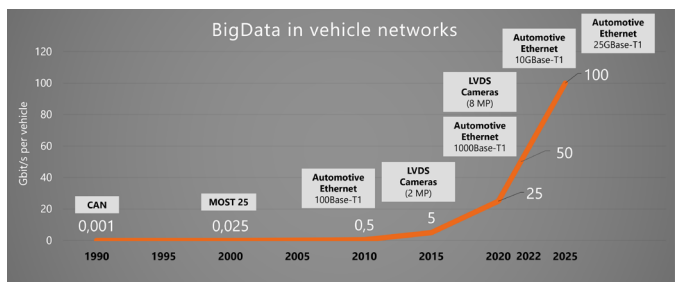
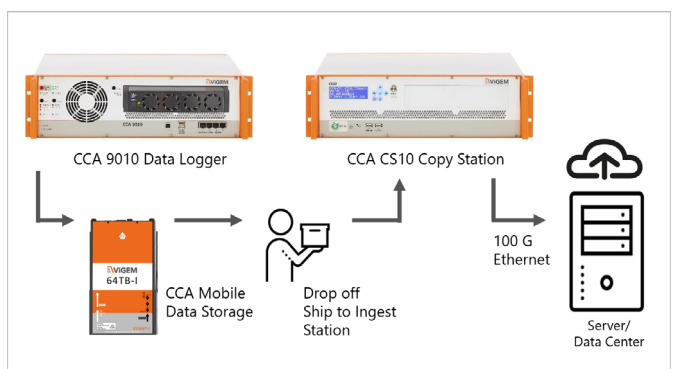Bernhard Kockoth, *Advanced Development Lead* at ViGEM GmbH

Img 1: ViGEM data logger CCA 9010 installed in the trunk of a vehicle.

Img 2: Robust removable data storage for mobile use.

Img 3: Exponential increase of environmental data.

Img 4: Mobile data handling for the efficient utilisation of test vehicle fleets.