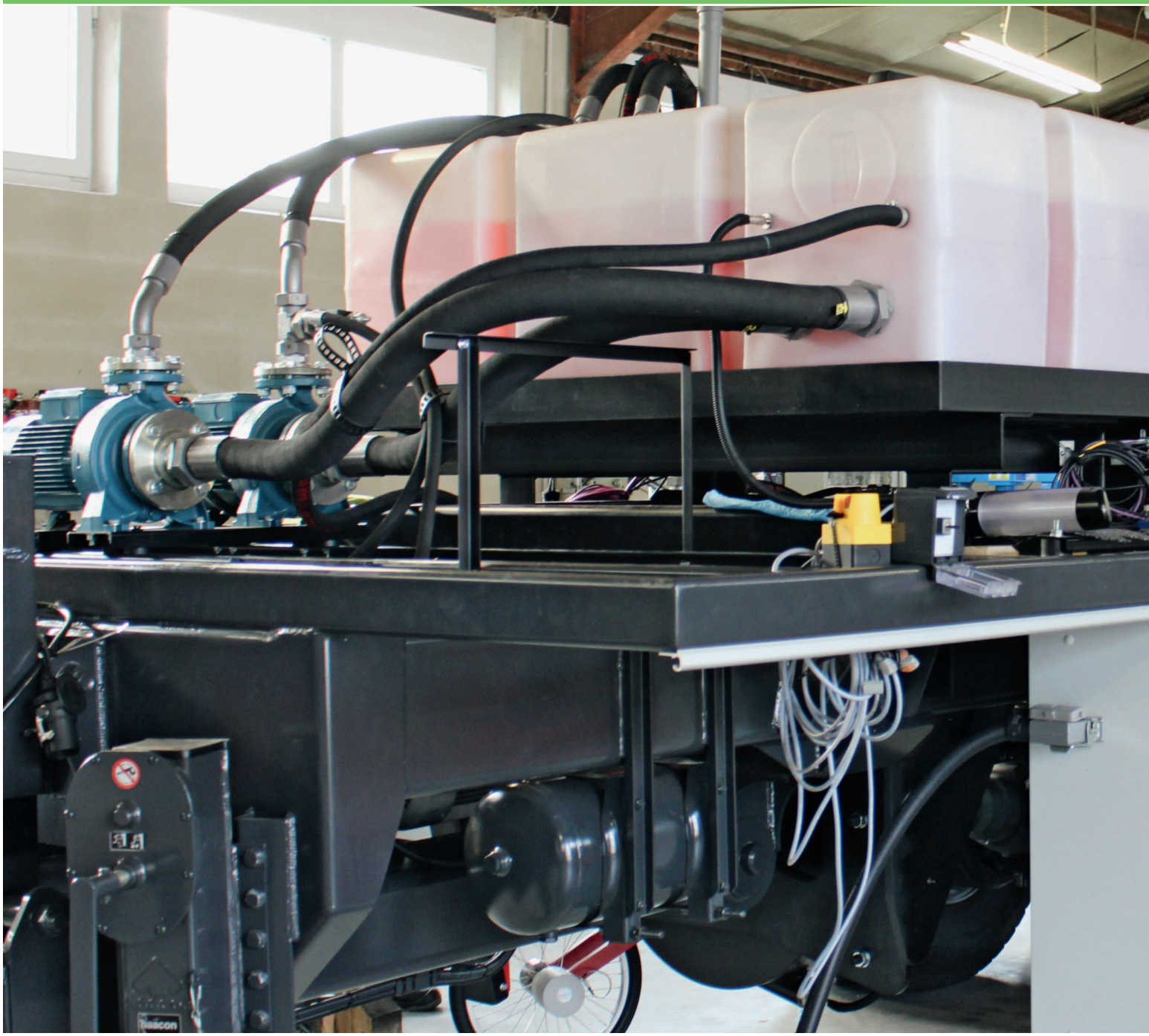
Agricultural equipment

High-speed bus for precision braking



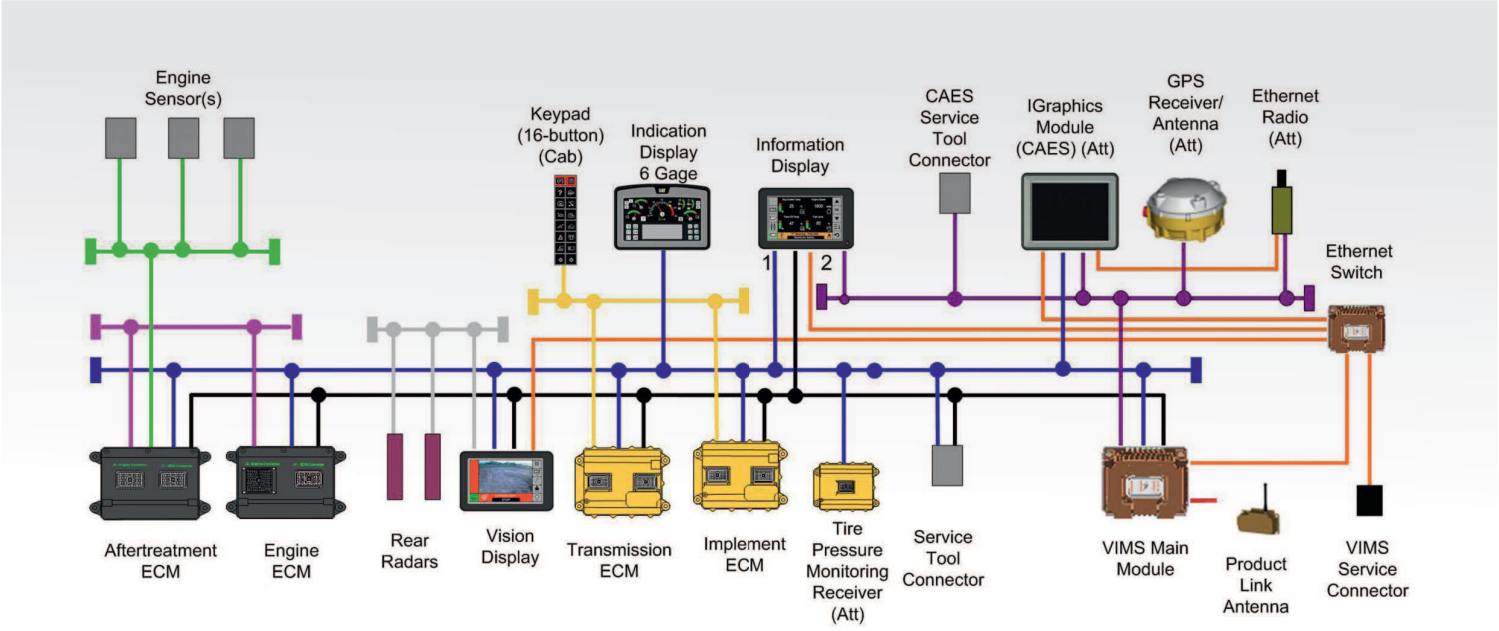
Today's agricultural equipment is so heavily automated, the cab of a modern tractor might almost be mistaken for a high-tech control room. The volumes of data being processed demand a level of performance that traditional bus systems are no longer able to offer. For its newly developed load car, enders was looking for a communication protocol able to meet the special demands of agricultural equipment – and they found it.

Nearly every automobile manufacturer is tinkering with some form of self-driving technology, and the first rounds of real-world testing have made headlines throughout the industry. For agricultural vehicles, on the other hand, autonomous driving technology is already a well-established reality. As a modern tractor moves across the field, it is often steered by the implement it is towing – requiring the driver to do no more than supervise the process. A potato harvester, for example, detects the ridges in the field with integrated sensors and sends commands to the tractor so that it follows them automatically without any steering on the part of the driver.

The harvester also calculates how fast it needs to move in order to optimize its capacity utilization and passes this information on to the tractor. The speed of the entire assembly is automatically adjusted according to the implement's current rate of production [1]. This is all made possible by a standard called Tractor Implement Management (TIM) developed by the Agricultural Industry Electronics Foundation (AEF).

High-performance fieldbus essential

The TIM standard currently defines ISOBUS as the communication infrastructure for exchanging commands between tractor and implement. This allows implements to control certain tractor functions, such as the power take-off, linkage system, driving speed, steering angle and hydraulic valves. The advantages for the farmer are clear. Intelligent equipment automatically finds the most efficient way to complete its tasks, leaving considerably less work for the driver [2].



Typical machine system architecture[3]: Various components communicate with different protocols, which requires extensive cabling. Since POWERLINK handles everything with a single protocol, cabling is simplified immensely.

Faced with ever-increasing requirements, the CAN-based ISOBUS system has reached the limits of its potential. The situation is not made any easier by the fact that a growing number of manufacturers are installing distributed electric drive technology in heavy equipment and agricultural vehicles. To alleviate the performance bottleneck, the AEF is currently working on a high-speed ISOBUS based on standard Ethernet.

The full scope of the challenge facing mobile equipment, however, extends beyond the matter of bus performance. A typical system architecture in these applications may involve up to 30 control devices, multiple operator terminals and over 100 sensors, all communicating on seven different fieldbus networks. This requires over 3,000 meters of cable, weighing in at over 100 kilograms. A reduction in cabling alone would yield huge rewards in productivity, reliability, serviceability and fuel consumption.

POWERLINK ideal as high-speed backbone

The demands that vehicles and mobile equipment place on a fieldbus are not substantially different from those of industrial machinery. The fundamentals are maximum bandwidth, real-time capability with sub-millisecond precision, multi-master architectures and free choice of topology. Then there are features like hot plugging and transmission of safety-relevant signals up to SIL 3 / PL e.

Where mobile applications differ are the heightened requirements for harsh operating conditions, such as extended temperature range, moisture resistance and ESD protection. That's why support for the BroadR-Reach standard is also essential. With its single twisted pair construction, it plays a decisive role in the reduction of cabling weight. Each and every one of these requirements is met by POWERLINK, making it the ideal solution for mobile automation[4].

Load car demonstrates POWERLINK's potential

With its newly designed load car for tractor testing, Bavaria-based development service provider enders has demonstrated what a mobile automation solution featuring POWERLINK might look like. 'Tangible development results' is the enders promise – referring to the fully functional prototypes the company develops and builds from the ground up to customer specifications. "Our many years of working with leading manufacturers of agricultural equipment and commercial vehicles has earned us valuable expertise in this field," says Thomas Rogalski, who heads the company's embedded systems business unit.

For a tractor manufacturer, enders recently developed a new generation of load cars, which are used to simulate complex load scenarios during testing. While the previous generation was restricted to manual adjustment of fixed load settings, the new load car offers seamless and automated load adjustment to simulate the behavior of towed implements in real time. This is made possible by a 500 kilowatt eddy current brake, which is mounted along with a complete infrastructure on a self-contained towed vehicle. The data generated during testing can be used to optimize all aspects of tractor performance.

User interface with full access to all systems

"When selecting the fieldbus, one of our main concerns was to ensure that the technician in the cab has access to all of the relevant measurement and control parameters provided by the load car," explains Rogalski. Other considerations included the direct integration of safety-relevant data, such as the E-stop signal, as well as the flexibility to position additional sensors wherever they are needed.

POWERLINK will also make it easy to integrate the backup camera enders plans to add. The camera's data packets, which are sent in the protocol's asynchronous phase,

Gunnar Gubisch from B&R (2nd row from left) with the enders team. Not even the rainy weather could dampen the team's spirits upon seeing the load car in action.

can be displayed as a video stream on the same display using mapp Technology. There is no need for an extra display or extra cabling. As this example clearly demonstrates, a single high-performance fieldbus like POWERLINK can drastically reduce the number of devices and amount of cabling required in mobile applications. ←

Thomas Rogalski
enders

"What brought us to POWERLINK is its openness and its ability to integrate both safety-relevant and asynchronous data."

Sources:

1 Horstmann, Jan: Moderne Kommunikationssysteme in der Landtechnik. In: Frerichs, Ludger (pub.): Jahrbuch Agrartechnik 2013. Braunschweig: Institut für mobile Maschinen und Nutzfahrzeuge, 2014. – p. 1–7; http://www.digibib.tu-bs.de/?docid=0055002, (retrieved 2016-02-21)

2 ISOBUS in Functionalities; www.aef-online.org/AEF_handfan_EN_10-15_lr, (retrieved 2016-02-23)

3 Caterpillar, VeCo12_5_HeavyDutyVehicle_2_Weck_Lecture; Typical Machine System Architecture; http://www.vector.com/portal/medien/cmc/events/commercial-events/VectorCongress 2012/VeCo12 5 HeavyDutyVehicle 2 Weck, (retrieved 2016-02-23)

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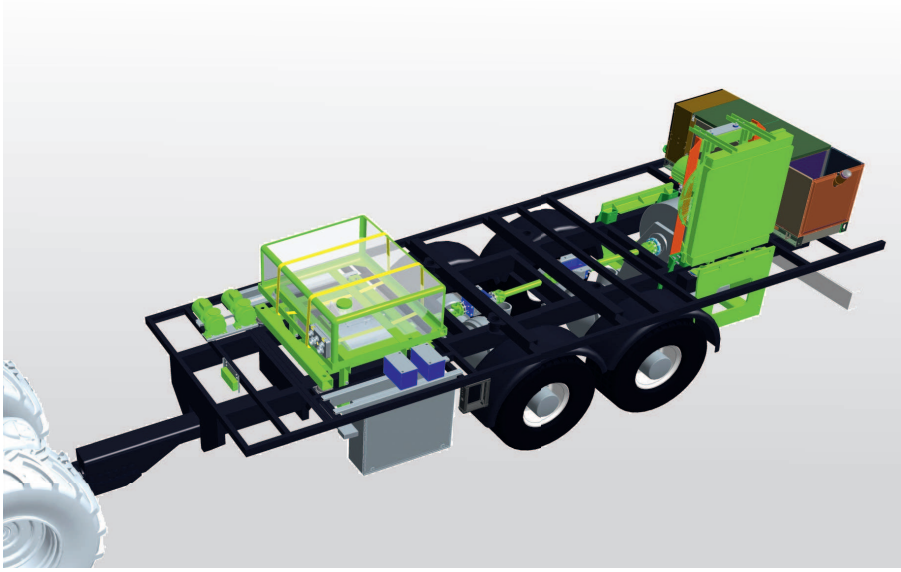

For communication with the load car, enders relies on POWERLINK. (Source: enders)