CAN and open protocols in commercial vehicles

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In mid-June in Stuttgart, more than 100 users met for the second Vector symposium "The use of CAN and open protocols in commercial vehicles." Among the numerous sensors and ECUs in a vehicle there is, according to the statement of a contributor, a large field in which networking with CAN, SAE J1939, CANopen, and LIN and FlexRay is the focal point.

Fig. 2: Vector user symposium on the topic "The use of CAN and open protocols in commercial vehicles"

Global unification

Wolfgang Appel, who is responsible worldwide as Lead engineer for E/E (electric/electronic) architectures for DaimlerChrysler trucks, demonstrated how important a uniform E/E architecture is for the company. For a broad spectrum of vehicles on all international markets with various requirements and existing standards, numerous technical, economic, and market-specific particularities must be overcome.

The main goal is, based on the new vehicle-spanning architecture, to use as many components as possible with the same interface, geometry, and mechanics. In particular, standardization thus extends from network topology to communication to standard software and network management.

In the future, the CAN bus will continue to serve as the basis for networking onboard electronics; for simple applications, it is complemented by LIN. On the protocol side, SAE J1939 is the standard. A gateway will handle the incorporation of proprietary messages and the mapping of the previous IES (a Daimler Chrysler proprietary higher layer protocol) from DaimlerChrysler to SAE J1939 requirements. With the increase in electronic functions in commercial vehicles, there is an urgent need to act to increase the reliable bit-rates for SAE J1939 to 500 Kbit/s or even better, to 1 Mbit/s.

How the design of a vehicle architecture actually looks is determined by numerous parameters, e.g. reliability, modularity, costs, compatibility, competitive advantages, safety, etc. An important criterion for the E/E architecture is how fast new, intelligent functions can be integrated into a vehicle.

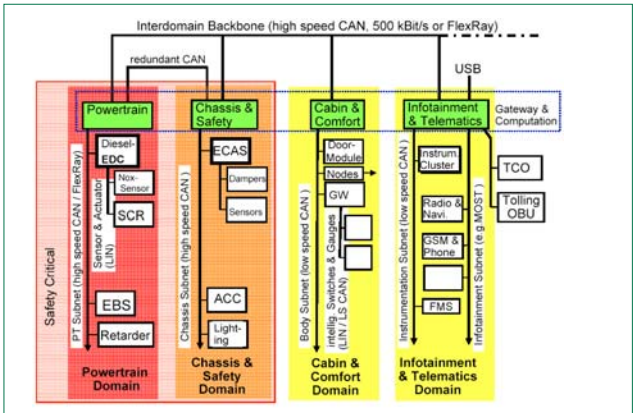

Fig. 1: SAE J1939-conforming, decentral CAN network architecture

Standardization and specific solutions

Joachim Lassmann highlighted the situation from the point of view of a large automotive supplier of motor and drive controllers, fuel-injection systems, combination devices, ready-to-install cockpits, etc. He heads the product management department for electronic network solutions for commercial vehicles at Siemens VDO. Networks reduce the cabling effort required in the vehicle and they offer greater reliability, safety, and diagnostic opportunities. Thus especially for the commercial vehicle sector, there are essential advantages since availability is the uppermost priority there.

Tool-based code generation

With the majority of E/E architectures in commercial vehicles, CAN with SAE J1939 has prevailed. However, many options still cannot be incorporated into the network using J1939. For higher integration, there is still clearly a need for wider-reaching standardization. This applies globally as well as within individual vehicle brands. Even among the manufacturers there are different architectures for the individual vehicle types. With SAE J1939, the on-board networks are divided into various classes: Class A for body train, Class B for instrumentation train, Class C for power train, and Class D for infotainment train. All domains in the current architectures are connected with a "central body control unit." In future decentral architectures, one domain head computer will control the individual sub areas. The head computers will then communicate with one another via an interdomain backbone, based, for example, on high-

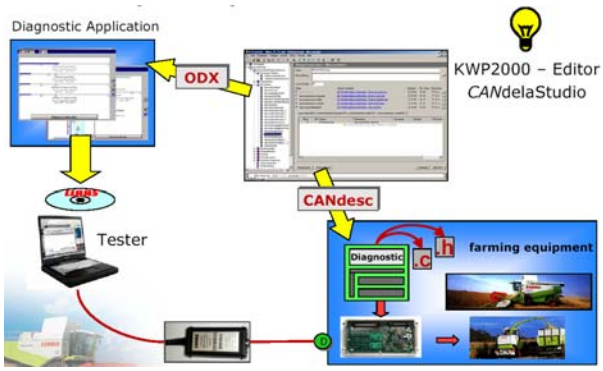

Fig. 3: The diagnostic-development process at Claas

speed CAN or FlexRay. In order to implement individual additional functions via software, Siemens VDO provides a tool-based code generation with standardized PLC programming via function plan in accordance with IEC 61131-3. Thus with generally-usable hardware, it is possible to reconcile high flexibility, short development times, reduction of development costs, and the required quality. In the future, many intelligent vehicle functions will be a part of standard equipment that today could only be implemented with great effort.

Electronic despite environmental odds

Norbert Schlingmann is project director for development of diagnostic systems at Claas Self-Propelled Harvesters. He demonstrated the challenges with which manufacturers in the agricultural sector are confronted. Harvesters, combines, crop choppers, etc. are subjected permanently to heat, cold, humidity, dust, and dirt; in other words, everything that is anything but ideal for electronics and cabling. The trend in vehicle electronics is thus essentially directed towards decentral control units with shorter lines and fewer connectors. In a combine, there are approximately 350 connectors with 3,000 individual contacts and 3,000 meters of copper wire. Each connection is a potential source of error.

Vehicle availability

Since the availability of agricultural machines at harvest time is of paramount importance, Claas agricultural machines are equipped with a high-performance diagnostic system. If a combine stops dead in the field, service technicians usually repair it on location. In a combine there are up to four CAN buses, to which the (laptop-based) diagnostic computer is connected to CAN according to SAE J1939. In order to concentrate entirely on the rationalization of harvesting processes, when it comes to software development, Claas relies on proven software components from Vector Informatik.

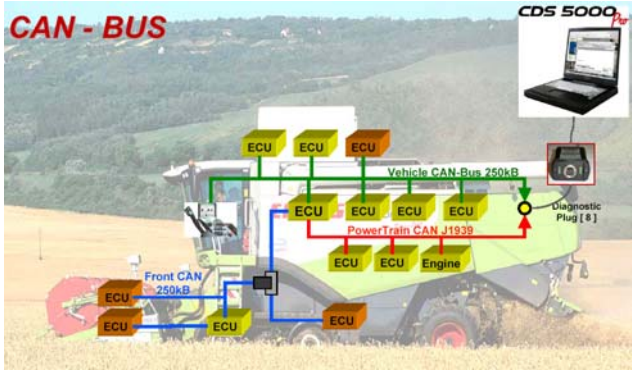

Fig. 4: Diagnosis via CAN in agrarian technology

Continuous tool chain

Thus a rational and simultaneous development of the diagnostic system parallel to the ECU software is guaranteed. CANdela-Studio's KWP 2000 editor handles the collection of all necessary test information. With an eye to maximum efficiency, the Claas development department places value on the uniform collection and management of variables and data types. Several development departments across Europe thus have access to the consistent and redundancy-free database of the error memory.

The data collected in CANdela is exported in ODX format for the creation of diagnostic software and at the same time, it forms the basis for the creation of actual applications with CANdesc or CANgen.

The use of a chain of tools that are continuously and optimally attuned to one another more than pays for itself. The data for all development areas is stored uniformly in a single database, which avoids many typical problems from the get-go. At the same time, a high degree of reusability of software functions is possible, and finally identical diagnostic specifications can be used within the entire Claas group.

Thanks to the early presence of an ECU capable of diagnosis, the uniform implementation of the diagnostic protocol across all ECUs of a harvester and the assurance of the consistency of the diagnostic data across the various program states and variants produces great potential savings.

Conclusion

There is a clear trend in the commercial vehicle sector towards globally-uniform E/E architectures with reusable hardware, software, and networks. Future vehicles will distinguish themselves through their safety, comfort, and reliability. Combined with cost reductions in the global, modular, and scalable OEM product portfolio, this is especially relevant for the commercial vehicle and capital equipment sector.

For vehicle networks, CAN with SAE J1939 plays a central role, complemented by LIN and FlexRay. In addition, CANopen is proving itself as the domain of commercial vehicle superstructures and it works via gateways with J1939 without a problem. High-performance software tools and custom-tailored embedded software components are becoming ever more indispensable throughout the entire development process. Just as important as a tool chain that is seamless and optimally-attuned to the requirements are services and consultation from corresponding specialists.

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