

Current Challenges in Automotive Networking

The vision of cross-platform use of ECUs, universal communication capability, interchangeability and reusability of software modules beyond vehicle and OEM boundaries is fast approaching reality. Until production maturity is reached, however, automotive OEMs and suppliers still need to overcome a number of challenges. Two presentations, one by Volkswagen and the other by Bosch, given at the Vector Congress in October 2006 serve to explain this.



The topic of AUTOSAR was a common thread throughout the two-day event sponsored by the specialist in developing automotive electronics, Vector. For the over 350 participants meeting in Stuttgart, the themes of diagnostics, testing, quality and distributed systems were of primary importance. There was general agreement that the cited visions and future goals could only be achieved by comprehensive standardization. The well-worn road will continue to be traveled, where the relative importance of software will continue to grow compared to mechatronics and hardware. That is because in the future crucial innovations, specific functions and brand-typical properties will be firmly based in the software area. Mechatronic systems on the other hand will be responsible for basic functions and emergency back-up systems for example. This continued growth of electronic systems in the automobile must however be achieved without increasing the number of control

modules. That assures stable networks and components essential to achieving reusability of total system solutions across vehicle lines that have different Electrical/Electronic infrastructures. The global challenges lie in attaining quality improvements with simultaneous cost reduction, creating new business models for handling software as an independent product with regard to issues of utilization rights, pricing, product liability, etc., and realizing a professional organization with a high level of process maturity.

Activities at Volkswagen and Audi

The current network architecture in Volkswagen vehicles is based on a total of seven CAN buses plus LIN sub-networks and the K-line. Currently the focus in standardization work and development efforts at VW is on standardizing the diagnostic exchange format per ASAM/ODX, working together with other leading automotive OEMs

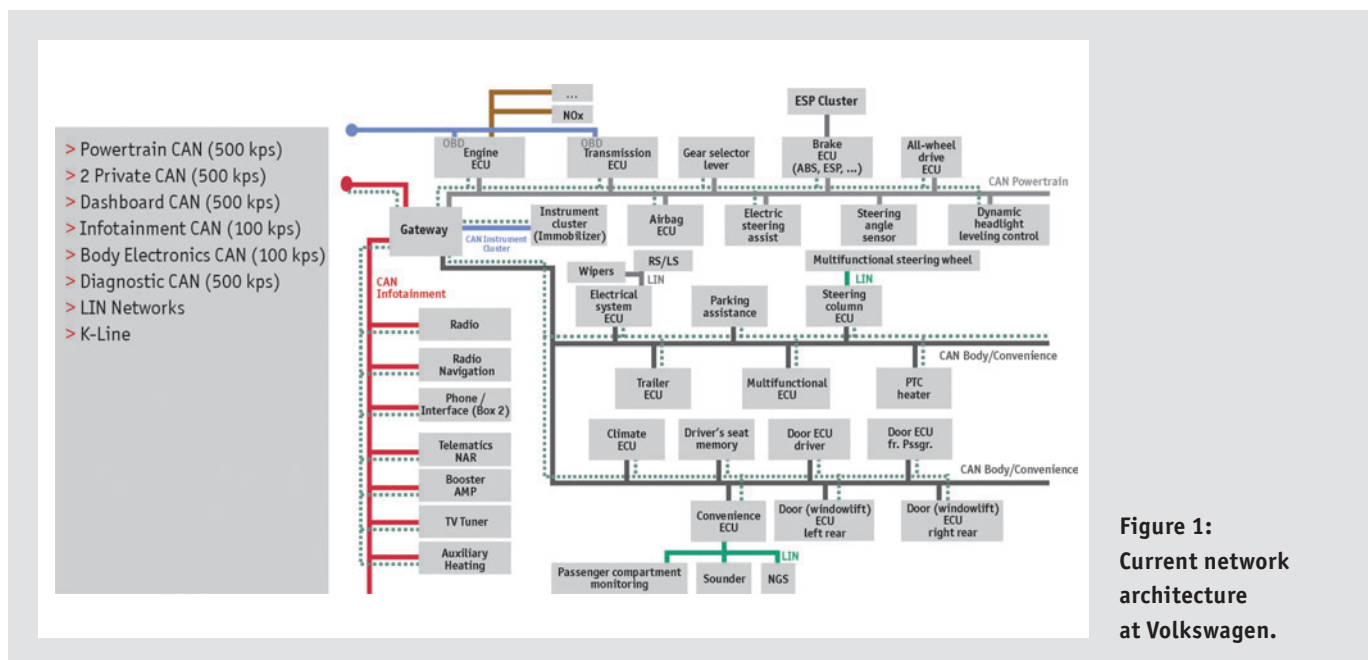


Figure 1: Current network architecture at Volkswagen.

in the HIS (Herstellerinitiative Software) interest group, developing and introducing AUTOSAR-conformant software components and utilizing the FlexRay and MOST bus systems.

ODX has already proven its capabilities in a future-oriented joint project. The new generations of the Sprinter and Crafter vans from DaimlerChrysler and Volkswagen are similar from the networking architecture perspective. An ODX converter processes the ODX diagnostic data generated by the Vector Tool CANdela by DC and uses it to prepare the diagnostic data for VW.

In introducing AUTOSAR, VW and Audi are taking the approach of gentle migration and are converting ECUs gradually, ECU by ECU. Initially there will be different “next generation” development levels of the standard software core, in which both AUTOSAR and VW modules are implemented simultaneously. Adaptation work is focusing on hardware-related areas such as the communication driver, I/O driver and memory driver as well as associated abstraction modules. After the last migration step, steps will be taken to thoroughly separate the application layer from the underlying layers, such that it only accesses other system components via the AUTOSAR Runtime Environment (RTE).

Cost and performance considerations play a key role in decision-making processes for future network technologies. Volkswagen is trimming its large number of CAN networks: LIN and CAN-C are re-

placing CAN-B. With regard to acceptable bus load, the CAN bus has already reached its maximum in some instances. Therefore, beginning in 2008, time-triggered FlexRay will assume certain challenging networking tasks in distributed systems. In 2009 FlexRay will be used in an extended application with more than three bus nodes. MOST has been transporting data in multimedia applications since 2003 on the Audi A8, and since 2006 on Volkswagen models too. Additional implementations are planned [1].

Suppliers: Generating customer utility instead of maintaining variety

AUTOSAR also simultaneously represents an opportunity and a challenge for Tier-1 suppliers such as Bosch [2]. For suppliers the benefits of a global de-facto AUTOSAR standard lie in the use of standard platforms; this limits the number of versions and facilitates cost-effective mass production. Suppliers can devote their energies entirely to generating customer utility and do not need to employ their development resources in numerous interface modifications.

In implementation seemingly contrary requirements sometimes need to be satisfied. For example, on the one hand product lines should demonstrate unique competitive advantages, but at the same time they should fit trouble-free into different system environments. System modeling and system design must be kept separate in integrating the devices in a network of ECUs and bus systems. This can only be achieved by very close cooperation with

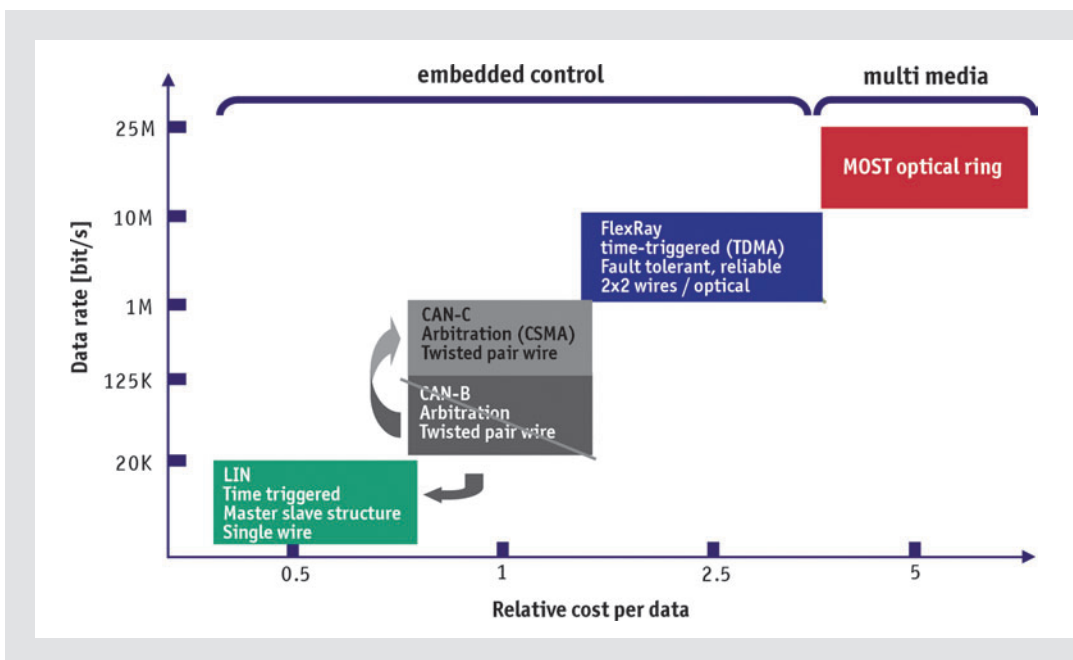


Figure 2: Future network technologies at Volkswagen.

OEMs in design and evaluation of E/E infrastructures. Migration of today's software architecture to AUTOSAR demands much innovative work by the supplier in adapting development processes, methods, tools and ways of thinking.

In the development process efforts must be directed toward creating unambiguous definitions of interfaces, completing unfinished work and delivering results; precise software specifications that prescribe the depth of detail and development levels are essential. All in all what is required are professional techniques of project and quality management, project risk assessment and a high maturity level among all partners.

Summary and outlook

Key goals of cross-OEM standardization efforts are quality improvement, cost reduction and efficient management of the continuously growing software share in the value-creating process. The path toward attaining these goals at OEMs and suppliers necessarily involves developing and introducing system components that conform to AUTOSAR, HIS, etc. and facilitate reusability across OEM boundaries. Simultaneously, powerful bus systems such as FlexRay will reduce the application field of CAN.

At the Vector Congress it was made clear that to master the rising complexities involved in development, administration, data exchange and process management, it is increasingly becoming necessary to turn to massive software support. Vector supports vehicle OEMs and suppliers in networking the described systems with a universal tool chain and software components, wherein continuous advanced development of the tools is always oriented toward the latest specifications of standards.

Literature references:

- [1] Lange, K. (Volkswagen AG): "The challenge of networking and software – Implementation of new standards", Vector Congress 2006.
- [2] Schnelle, Dr. K.-P. (Robert Bosch GmbH): "AUTOSAR – Examples of a system architecture from the perspective of an automotive supplier", Vector Congress 2006.