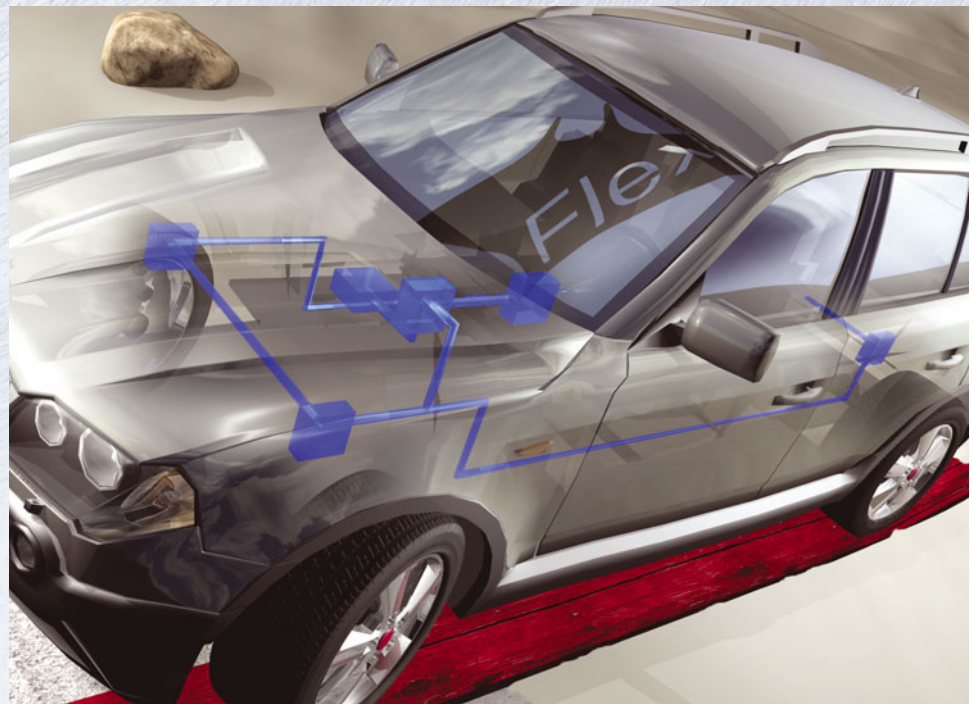


The FlexRay bus gains ground. The standardization of the protocol and database description for the FlexRay communication network have mostly been accomplished. In 2006, the first vehicle with FlexRay on board will hit the streets. With its continuous offerings, Vector Informatik supports FlexRay developers in all phases of development.



Broadly drawn-up – highly-specialized

Specially designed for the requirements of the new bus system and carefully adjusted to fulfill customer requirements, Vector Informatik GmbH supports all development phases with sophisticated tools and the appropriate embedded software components (Figure 1).

In contrast to CAN networks, time-based bus arbitration with its requirement for a predefined communications schedule demands an expanded development approach. The highest priority is the disposition of messages to the individual send slots (scheduling) early in the development process. Scheduling influences not just the performance of the system but also its expandability. For this task, the development engineer is supported by the DaVinci Network Designer for FlexRay (Figure 2).

The network designer has an extensive schedule function, with which, for example, the time parameters of the cycle, the number of slots, and the breakdown into the static and dynamic segment are defined. Then the user distributes the messages to the time slots using drag and drop in a tabular view of the schedule with different resolution levels. A plausibility check that infers a value corridor for the next input point

from the previous parameters avoids input errors. The DaVinci Network Designer for FlexRay is currently the only design tool that saves FIBEX databases. FIBEX is an ASAM-compliant database format that contains the structure description as well as signal, message, and schedule information for a FlexRay communication network.

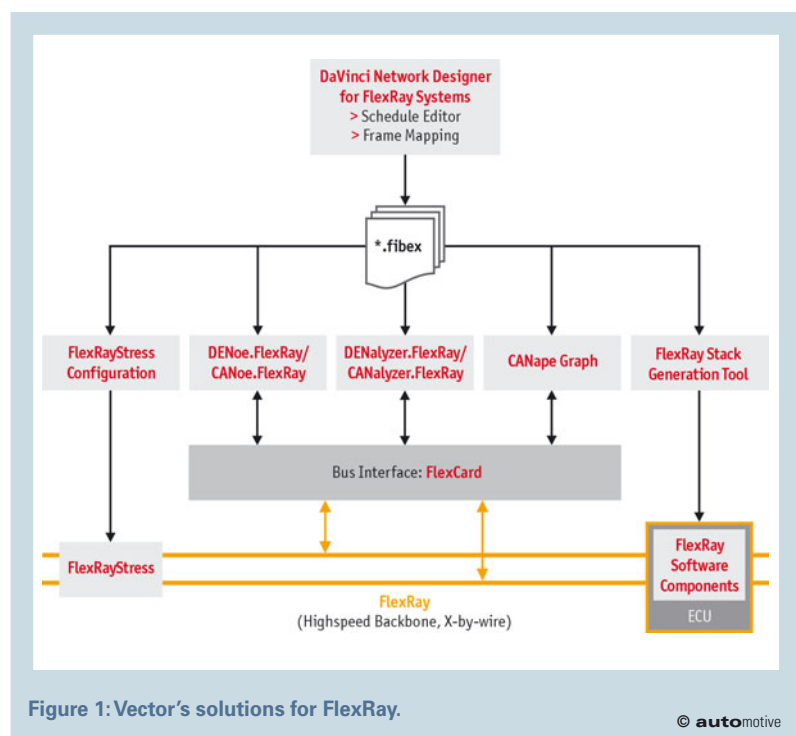


Figure 1: Vector's solutions for FlexRay.

Simulation and analysis

The most extensive Vector tool in the development process for FlexRay systems is DENoe.FlexRay. With the help of the CAPL programming language it covers several phases from integration tests and simulation of the remaining bus on through to analysis of the completed FlexRay network, including the simulation and stimulation of the network. With the new Version 5.2, developers profit from expanded functions for display, analysis, and generation of FlexRay messages. Irregularities in message transmission are highlighted visually and displayed permanently.

With the change to time-controlled communication, the applications now must synchronize their flow with the communication schedule. Therefore, in the CAPL programming language integrated into DENoe.FlexRay, there are some new notification functions that allow easy synchronization of the CAPL application with the FlexRay schedule.

The static schedule of messages to nearby time slots requires short and deterministic reaction times within the application. But even the most modern PCs with their extensive applications in the background cannot always satisfy these requirements. Therefore, Vector has separated the user interface from the real time server. The user operates the interface on, for example, a notebook which is connected to the real time server via Ethernet. The server takes over the actual processing of incoming and outgoing messages in real time without the need for keyboard and screen. The server's operating system offers an optimal software architecture with a deterministic behavior and small latencies in case of interruptions. This reduces the effect of server interruptions during processing and ensures quick response times.

AUTOSAR as goal

Vector provides software components for ECUs in series products. The Vector FlexRay-Stack with its modular architecture does not use the time-controlled process exclusi-

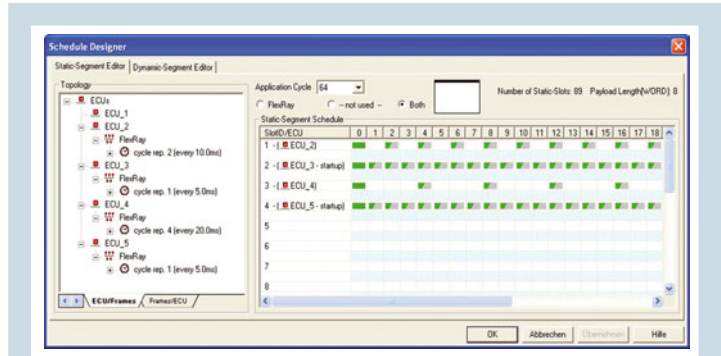


Figure 2: Design of FlexRay networks with the DaVinci Network Designer.

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vely; instead, it can also be operated with a "conventional" OSEK operating system (Figure 3).

Here the reuse of components of a CAN stack that the customer already has is in the foreground, for example the diagnostic layer or an XCP on FlexRay transport layer for an existing XCP protocol layer. The results of the active cooperation in the AUTOSAR FlexRay working group will be implemented consistently in the further development of individual components.

The heart of the Vector stack is the configuration tool GENy, with which the user configures the Vector FlexRay stack ECU-specifically based on a FIBEX file that has been read in. Anyone using the FlexRay bus for performance reasons and event controlled data transmission only, may configure the additional features receive- and transmit-interrupt and the associated callback functions via GENy.

Dynamic assignment of the bandwidth

For access to ECU-internal values, the calibration engineer needs a special measurement and calibration protocol: XCP on FlexRay. This protocol uses the universal, bus-independent XCP protocol layer; for FlexRay only a new transport layer is required. Especially for FlexRay, the specification defines a dynamic assignment of the bandwidth available for XCP. Thus the still-free bandwidth is identified and assigned dynamically and very efficiently to the current calibration data traffic.

For the ASAM working group for the standardization of XCP on FlexRay, Vector contributed the fundamentals and is continuing to actively contribute its extensive XCP expertise. At the beginning of 2006, the optimized draft will probably become the official ASAM specification.

In the BMW X5 mentioned above, the four ECUs for damping control were applied with CANape Graph and Vector embedded software components via XCP on FlexRay. Currently CANape Graph is the only MCD tool that has an XCP on FlexRay interface and a management function for the XCP bandwidth.

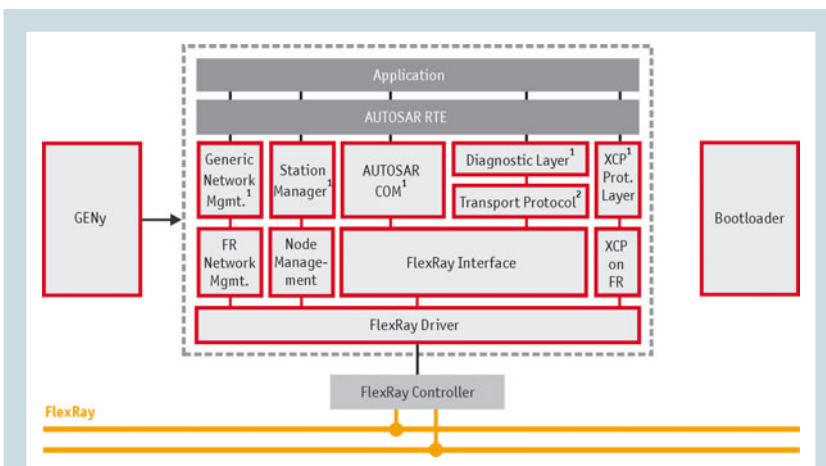


Figure 3: Architecture of the stand-alone FlexRay stack.

- 1 Re-use of components already applied in CAN
- 2 AUTOSAR Transport Protocol

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Resistance on the network

Discover and simulate errors and test the behavior of ECUs with purposeful interference — FlexRayStress by Vector allows this. This handy interference instrument offers various functions: for an oscilloscope, bit-precise triggers can be generated any place in the cycle and frame. In node mode, FlexRayStress is connected to the bus like a normal FlexRay node and can interrupt other nodes' messages. In coupler mode, the interrupting instrument divides the FlexRay bus into two parts and can thus change or delay temporarily any messages that are sent from one part to the other deterministically at defined bit locations. It is also possible to stress the bus capacitatively or with resistances in order to simulate short-circuits, high transition resistance or other loads.

But that's not all

Although the original goal of the FlexRay consortium to establish a standard data bus for security-relevant applications such as X-by-wire systems will only be realized in the medium term, the application possibilities for the fast, deterministic FlexRay are already many and varied. They range from the substitution of one or several CAN buses on through to a communication backbone with CAN or LIN as sub bus structures. These tasks conceal numerous new challenges, but also great potential for further optimization

of networking in electronic systems.

Vector's portfolio is multifunctional and covers numerous aspects of the development of FlexRay networks. The continuous connection of all tools to FIBEX and the multibus capability ease and speed up development. With FlexRay basic training, the Vector-Academy provides developers with the knowledge for quick implementation of their plans.

Next year, the third generation of the FlexCard interface hardware will be available. With the Bosch-IP "E-Ray," it supports the current FlexRay protocol version V2.1 and offers optimized and higher-performance analysis possibilities.

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Dr. rer. nat. Carsten Böke is Senior Software Development Engineer for the "Tools for Networks and Distributed Systems" product line.



.....
Dipl.-Ing. Dirk Grossmann is Team Leader for the "Software and Integration Factory" product line.



.....
Dipl.-Ing. Roel Schuermans is Senior Product Management Engineer for the "Measurement & Calibration" product line.