

The ideal Tool Chain for LIN and CAN

From design to hardware and software integration

Vector Informatik – the networking specialist based in Stuttgart, Germany – has actively participated in the development of the LIN standard since 1999. Today Vector is an Associate Member of the LIN Consortium and a leading LIN expert offering a complete tool chain for all LIN projects as well as a variety of supplemental services.

By Oliver Falkner

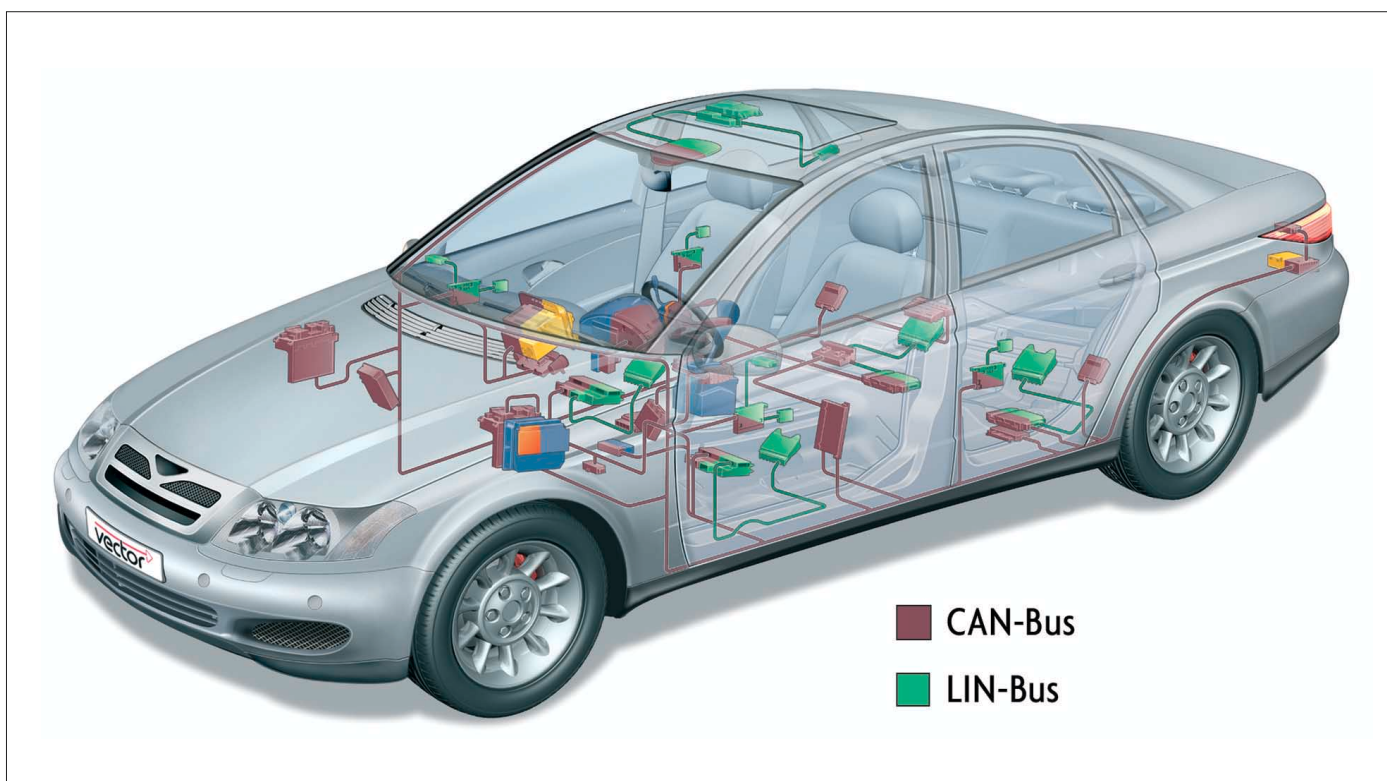
Since all of Vector's LIN tools also support the networking development process for CAN, their universal multi-bus capability allows the user to develop, simulate, and analyze communication across buses very easily. The advantage here is that the same kinds of functions can be used in the same way for both LIN and CAN. The LIN-specific functions also have the familiar and user-friendly look and feel of Vector tools.

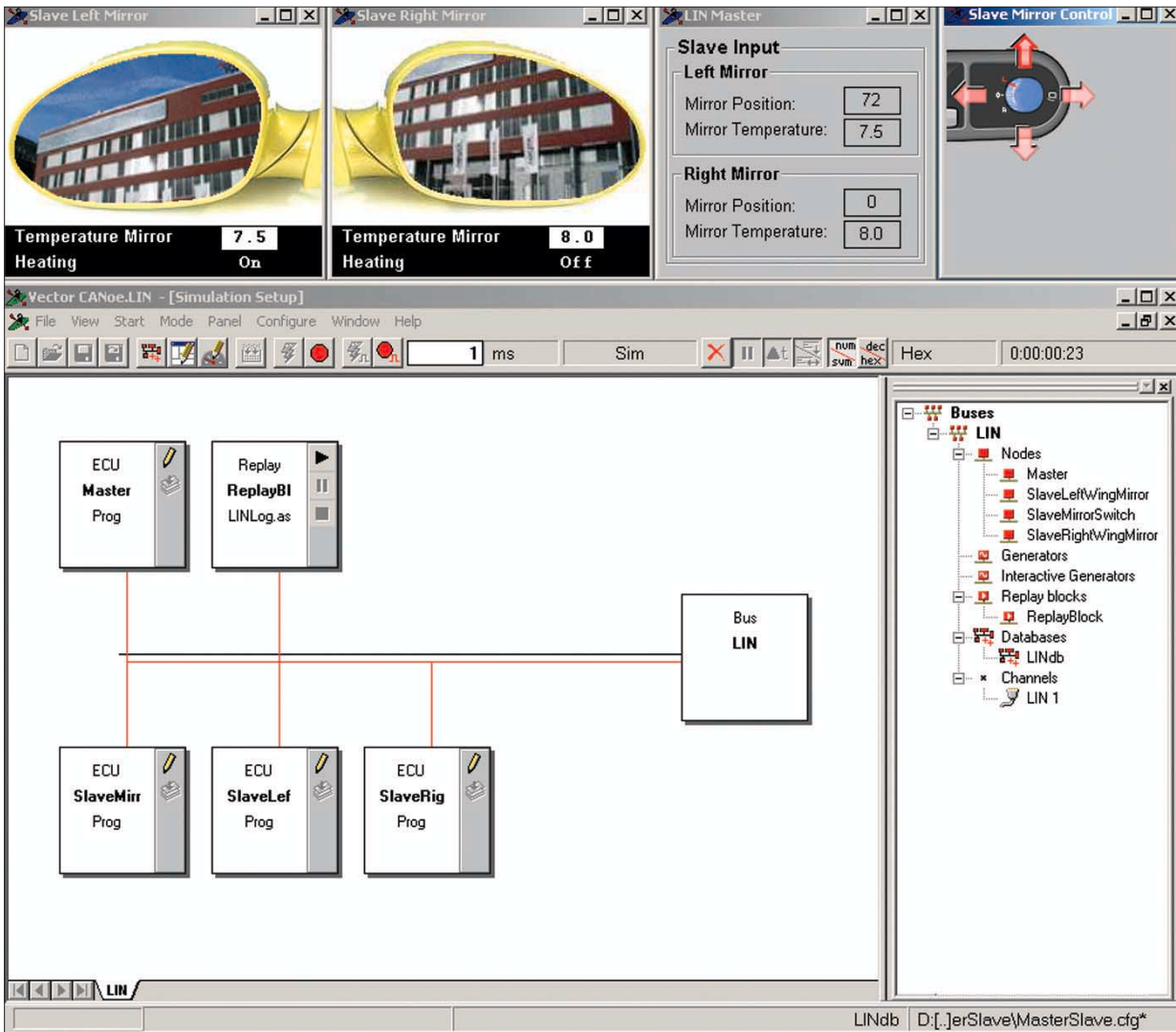
CANdb++ and CANdb++ Admin represent the backbone of all work processes: From designing the LIN communication, to managing communication data, to using the data – e.g. for simulation, configuration of ECU software, and detailed ECU tests. The network description of a LIN system is generally saved in a LDF (LIN Description File) database. The Schedule Tables are also described there. Individual fields of the LDF (e.g. signals, messages

and nodes) can be edited and supplemented in that database. Of course they can then be used directly in CANoe/DENoe or CANalyzer/DENalyzer for model creation, simulation or analysis.

The LIN Schedule Editor and LIN Schedule Generator are expansions of the CANdb++ Editor and are included with the CANoe.LIN and DENoe.LIN tools. It is very easy to generate and edit Send Tables using these two tools. A LIN Schedule Viewer is included with CANalyzer.LIN/DENalyzer.LIN.

The central Schedule Tables which describe the message traffic between the Master and Slaves are set up in CANoe/DENoe using the Schedule Editor. The user can choose between a graphic view and a text-based view for table editing and management. Editing by drag-and-drop, automatic analysis of send intervals and graphic highlighting of faulty configurations are key user-friendly features. To shorten the time needed to manually create the Schedule Tables the user just needs to define in the Schedule Generator, which messages occur in the table and the requirements for minimum and maximum cycle times of a Slave. The tables are then automatically generated; nevertheless they may be modi-





Complete simulation of mirror control with CANoe.LIN.

fied and even automatically expanded at any time.

► Analysis and Simulation with LIN

With the .LIN option the CANoe/DENoe and CANalyzer/DENalyzer software tools give you a complete package for developing LIN networks, which satisfy all LIN specification requirements from Version 1.1 to 2.0. The .LIN option is seamlessly integrated into a familiar and trusted programming environment and offers functionalities the user is accustomed to, e.g. the Interactive Generator block, multi-bus filter and user programmability.

CANoe/DENoe and CANalyzer/DENalyzer offer features specifically for LIN such as the simulation of a LIN Master with user-configurable baudrate

and any desired number of Slaves as well as operation with or without a LIN Description File. CANoe.LIN and CANalyzer.LIN permit gateway operation with precise time-correlated analysis of LIN and CAN networks. CANoe.LIN/DENoe.LIN also offers CAPL simulation capability with LIN.

The interactive LIN Master provides the user with all Schedule Tables defined in the system. A table can be imported by simple selection. The LIN Slave Tester allows the user to automatically test a Slave node against the LIN specification based on the LDF used.

► Hardware Interfaces for Device Development

Of course Vector also has powerful, user-friendly and adaptive hardware in-

terfaces for the development, simulation, testing, and maintenance of LIN: the XL-Interface product line:

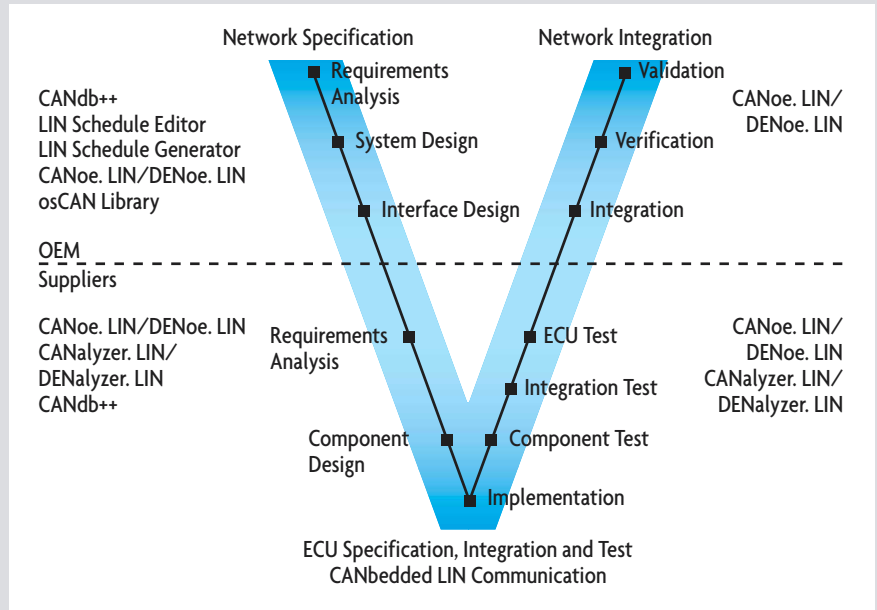
- CANcardXL – in its compact PC-card package (Type II) this is a flexible interface for use in notebook, desktop computers or PDAs.
- CANcaseXL – a compact and robust USB 2.0 interface for notebook or desktop computers.
- CANboardXL – a compact and standardized PCI interface for any standard PC.
- CANboardXL compact – the interface for industrial PCs in compact PCI/PXI format.

With their powerful 32 bit micro-controllers operating at 64 MHz and their flexible hardware design these interfaces are well-equipped for all applications. Two independent channels for

The LIN product tool kit from Vector

- CANdb++ – Design environment for network design with the LIN Schedule Editor and LIN Schedule Generator
- CANoe.LIN/DENoe.LIN – The comprehensive development tool extending from simulation to testing and ECU diagnostics
- CANalyzer.LIN/DENalyzer.LIN – The analysis tool
- CANcardXL, CANcaseXL and CANboardXL – The hardware interfaces to connect to the LIN and CAN busses
- CANbedded LIN Communication – Drivers and components for ECU development
- CANoe osCAN Library for LIN – Emulation of ECU applications with CANoe

Vector offers LIN training courses and workshops as part of its training program.



Vectors LIN and CAN Products in the Development Process.

(All Pictures: Vector Informatik GmbH)

ning program. These are held either in Vector's own class rooms or at the customer site (for more information go to www.lin-solutions.com).

Additionally Vector can design special development and test environments for a customer's specific LIN projects.

LIN and/or CAN 2.0B permit multi-bus operation, and it is also possible to achieve time synchronization of multiple cards via an external connection. The time stamp operates with 10 microsecond accuracy and one microsecond resolution. The XL cards are simply integrated into the hardware by plug and play and may be combined in any desired layout of connection cables (LINcabs) and piggyback boards (LIN-piggies) available from Vector. Important card functions include:

- Simulation of multiple Slaves and a Master,
- Master/Slave operation with switchable terminating resistor,
- Master simulation with Schedule Table execution in the device,
- Detection of communication errors,
- Generation of errors.

Software Components for acceleration of development

Within the CANbedded product area Vector offers standardized software components for the LIN Master and Slave ECUs. In their development pro-

perties that are essential for motor vehicle ECUs were emphasized. These are: Runtime efficiency, low ROM and RAM requirements, generic basis for source code, and automatic generation of parameter settings and configurations.

It is easy to adapt the LIN drivers to a special LIN node whose description is available in either LDF or NCF format. Vector offers a Generator Tool for this purpose. With this tool node information may be supplemented by ECU-specific parameters, the LIN driver is configured according to ECU requirements, and the source code is optimized. For Master ECUs multiple nodes are integrated thereby supporting connections to multiple LIN busses. LIN drivers from Vector permit quick development of ECUs that are conformant to LIN specification 1.2, 1.3 or 2.0, whereby the LIN-API specification is also supported. They are easy to integrate with other CANbedded components from Vector. As a result it is possible to implement CAN-LIN gateways quickly.

In a multi-day training course that specifically addresses the needs of LIN

users the participant is taught – in addition to protocol fundamentals – how to analyze and simulate LIN networks. This course also teaches the user how to implement LIN drivers from Vector. Clients may also contract to have our CANoe User Development team create simulations and test environments for a wide variety of tasks in the LIN area. *sr*



Oliver Falkner
(Graduate Engineer)

is Senior Product Management Engineer for the Networks and Distributed product line at Vector Informatik.

► E-Mail: oliver.falkner@vector-informatik.de