

# Data flow transparency

Rapid developments continue to challenge electronic control units in the automotive industry. This fact must be taken into account by Hardware-in-the-Loop systems.

To solve this challenge for Hardware-in-the-Loop (HiL) systems, Micronova has designed the software feature Bus Tracing for its Novasim simulators. With the help of this feature, all communication buses connected with the system can be monitored and recorded.

Less and less frequently, modern ECUs send or receive required information via dedicated analog or digital lines. Instead, the sensor itself or another ECU puts the information on one or several buses, from where the data can be picked up accordingly. Therefore, the precise knowledge of the data on the buses is essential as this data determines the operating status of the ECU. Depending on the test case, the ECU of the simulator needs to be set to the proper mode of operation at the start of each test. In most cases this is achieved by an appropriate calibration of the bus signals. Only after the testing engineer has set the targeted output mode at the ECU can the errors be entered and the system checked for its error response.

The Bus Tracing feature provides the architecture required to monitor bus data. Based on the existing hardware, data can be collected from different networks, transmitted to the control computer, processed there, and displayed on the user interface. The structure is illustrated in Figure 1.

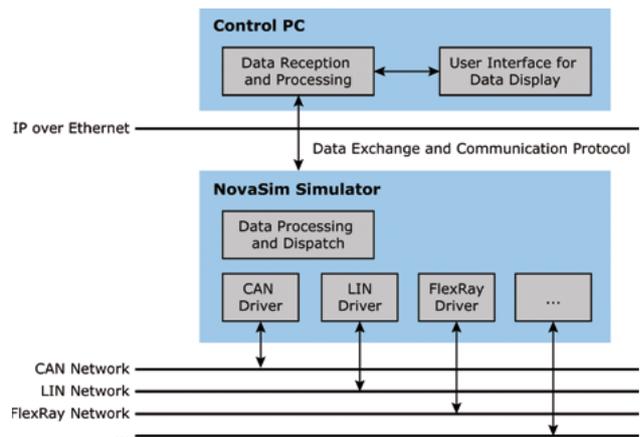


Figure 1: Structure of the Bus Tracing architecture

## Data acquisition

The testing engineer can monitor and record the data of each network used by Novasim on the user interface (see Figure 2). Currently, the solution supports the networks CAN, LIN, and Flexray. The HiL simulator provides the recorded data with a time stamp that is accurate to the millisecond for

HW Timestamp	SW Timestamp	Channel	Direction	Type	ID	Name	Length	Data
8653,9740000	8653,974	CAN1	Rx	Normal	5	MSG_5	100	10 17 D3 55 1A A...
8653,9740000	8653,974	CAN0	Rx	Normal	5	MSG_5	156	AE D8 64 17 B0 B...
8653,9760000	8653,976	CAN0	Rx	Event	6	MSG_6	42	2F 79 44 CF 98 6...
8653,9740000	8653,974	CAN1	Tx	Normal	6	MSG_6	106	E8 AA 21 39 6F 7...
8653,9760000	8653,976	CAN0	Tx	Normal	7	MSG_7	126	1D 92 6C 98 98 F...
8653,9710000	8653,971	CAN1	Rx	Normal	7	MSG_7	129	56 FC 44 B0 D9 8...
8653,9740000	8653,974	CAN1	Tx	Event	8	MSG_8	101	5F B4 D7 36 37 8...
8653,9730000	8653,973	CAN0	Tx	Event	8	MSG_8	67	6B UD 1U BD 41 F...
8653,9760000	8653,976	CAN0	Tx	Event	9	MSG_9	47	34 C6 60 14 27 5...
8653,9670000	8653,967	CAN1	Tx	Normal	9	MSG_9	117	B8 CD CF 63 CA 6...

HW Timestamp	SW Timestamp	Name	Data	Channel	ID
8653,9740000	8653,974	MSG_6	E8 AA 21 39 6F 7F A...	CAN1	6
		ID_6Signal_1	57628 (0xE11C)		
8653,9760000	8653,976	MSG_7	1D 92 6C 98 98 FC D...	CAN0	7
		ID_7Signal_1	92 (0x5C)		
		ID_7Signal_2	45574 (0xB206)		
8653,9730000	8653,973	MSG_8	6B 0D 10 BD 41 FD 2...	CAN0	8
		ID_8Signal_1	35359 (0x8A1F)		
		ID_8Signal_2	11767 (0x2DF7)		
		Strom	20,53 A (0xB25C)		
		Spannung	13,9 V (0x956B)		
		Temperatur	24,5 °C (0xFB90)		

Figure 2: User interface of the Novasim Bus Tracing

## Fibex: XML-based file format

The "Fieldbus Exchange Format" (Fibex) is an ASAM-defined and XML-based file format. It contains the information necessary for the description of the communication process on message-oriented communication buses. The information includes the topology, configuration parameters, schedules, frames, and signals as well as their coding on the bit level. It is used for the description of CAN and Flexray communication.

the purpose of a time-related tracing among the records. For some hardware devices, the hardware generates even more accurate time stamps. Each simulator supports up to fifty data channels. The implemented protocol for the communication with the simulator also allows to query the number and type of bus connections installed in the simulator and to display them on the user interface.

## Display and analysis

The traced data is displayed on the user interface along with the identifier, time stamp (software time stamp and hardware time stamp, if any), channel, direction (the Novasim simulator may be sender or receiver), and raw value. In addition, it is possible to display the interpreted data, i.e. the corresponding physical and logical variables. The rule of interpretation is stored in bus description files for each data channel. The format used for the description files of CAN and Flexray is Fibex 3.X, and that of LIN are Intermediate Data Files (IDF).

In order not to lose track in case of high data traffic a filtering system based on messages (ID) and/or buses is included. For the filtering process based on message IDs there are numerous options available including range filters. Furthermore, the user has the advantage of sorting the displayed messages by channel, message ID, and time stamp. The configurations (IP and channel configuration, filter configuration) can be stored and do not need to be re-created in later applications. In order to analyze the recorded communication at a later date, there is an additional option to save the trace in a file (Vector ASCII Logfile format).

Through its compatibility with the HiL simulator, the Bus Tracing feature provides a convenient way to monitor the data traffic on the existing bus systems. By using the existing bus connection no additional hardware is necessary and costs are saved. ◀

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