Residual bus simulation
Gateways and PC interfaces
Data logging and visualization
Functional models (HIL, Matlab/Simulink)
The modular concept of the Ixxat automotive products enables easy adjustment to your individual requirements – both in terms of functionality and costs.

Thomas Waggershauser
Product Director for Ixxat Products

Solutions for automotive test systems

Modern vehicles are equipped with a variety of electronic components and control systems – reaching from the engine control unit to air bags and electronic seat adjustment. Communication between these systems is carried out using different standards – like CAN, FlexRay, LIN or others. Knowledge about these standards is key during development and testing of new electronic components for vehicles. HMS is experienced in all important automotive communication standards and offers proven solutions for testing networked systems and components in the “Ixxat Automotive” portfolio.

The versatile HMS solutions are used in many different areas:

In test benches
- Simulation of vehicle parts via RBS
- Simple connection to the test bench via a gateway solution
- Online data logging

For driving tests
- Scalable logging solution for all important vehicle bus systems – easy to configure
- Visualization of the data/signals – quick, clearly arranged and without programming

For crash tests
- Crash-safe, compact and powerful logging solution
- Triggering upon signals and/or impact detection event
- Ring buffer for pre/post triggering

Functional models
- Communication simulation via RBS
- Extension to functional simulation via Matlab/Simulink models
- Can be combined with logging and visualization

HIL
- Communication with the device under test via residual bus simulation
- Signal stimulation/manipulation via standardized interfaces
- Connection of IOs via Ixxat gateways

In test vehicles
- Easy integration of Electronic Control Units (ECUs) from various integration levels/OEMs
- Long-term recording of data
- Online visualization and parametrization

Customized
- Platform concept which allows for fast and cost-effective adaptation
- Supports all relevant protocols and standards
- Easy interface extension and software adaptation, also on behalf of customers

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The modular concept of the Ixxat automotive products enables easy adjustment to your individual requirements – both in terms of functionality and costs.
Embedded Platforms

The basis for accessing automotive bus systems

The Ixxat FRC Embedded Platforms form the basis for manifold testing and analysis applications – both with Ixxat automotive software tools as well as with customer-specific software solutions.

The embedded platforms have a powerful processor, a real-time operating system as well as a variety of different automotive communication interfaces. They are therefore ideal for applications in which several bus systems are to be merged into a single device with its own processing power. The PC is only needed for configuration or simulation/visualization of data, as the actual intelligence – for e.g. the transport protocols – is outsourced to the embedded platform. Additionally, it is possible to implement stand-alone applications in order to, for example, combine several bus systems via a gateway in a vehicle without a control PC.

When using the Ixxat automotive tools, the required application-dependent functions can be activated on the device via runtime license.

Application areas

Test bench

In the test bench, vehicle parts such as the electronic power steering are frequently tested isolated from the vehicle. The communication interface should be installed close to the device under test, in order to minimize the interference in the bus topology. In order to become operational, most ECUs also require a simulation of the – from their view – remaining vehicle bus. The Embedded Platforms were designed for this use, both featuring a communication interface as well as a residual bus simulation in one device. Using the corresponding Ixxat tools, the platforms can be configured without own coding effort and can be placed directly at the device under test. The test bench computer is then connected with the platform across any distance.

Functional simulation

ECUs are sometimes required to respond to certain events in real time. PC’s are often either too slow or not securely chronologically defined. In these cases, the intelligent embedded platforms can be used for functional simulations. Responses are promptly indicated and then forwarded to the PC – time-uncritically.

Development platform

For most application cases, Ixxat offers the corresponding tools for platform configuration. Nevertheless, there are specific application cases where it may be necessary to create customized solutions. The open platform architecture of Ixxat’s solutions makes it possible to very quickly provide adaptations and extensions as well as fully customized solutions. If necessary, this can also be performed by the user alone using the software development kits.

Analysis

The platforms can also be used for bus communication analysis. A simple use case is the pure interface function with a corresponding analysis software on the PC. However, the strength of the intelligent devices is the pre-processing of data.

Thanks to efficient pre-processing of data, it is possible to only send selected, physical signals from different bus systems to the PC for evaluation. It is recommended to use Ethernet when connecting to the PC, since the measurement results then can be transmitted across long distances while being galvanically isolated and fail-safe. Other types of connections are also supported, such as USB or Wi-Fi.

Further interfaces

- -

Expansion Slots / Extensions

SDHC card slot

- I/O

Internal memory

- - 32 GB

Internal expansion slots

2 x mPCIe form factor 2 x mPCIe form factor 2 x FlexRay, CAN, CAN-FD, EtherCAT 2 x mPCIe form factor

External extensions

Wi-Fi, USB devices Wi-Fi, USB devices Wi-Fi, USB devices Wi-Fi

Others

Prepared: GSM/GPS, Bluetooth and Automotive Ethernet

General

PC connection

Ethernet 10/100 MBit/s, WLAN or USB 2.0

Plugs

Standard plug for PC, Dsub plug for fieldbus

Temp. range

-40 °C...+80 °C

Protection class

IP42, IP42, IP67

Power supply

6.36 V DC, 350 mA typ. at 12 V 6.36 V DC, 350 mA typ. at 12 V 6.36 V DC, 420 mA typ. at 12 V 6.36 V DC, 350 mA typ. at 12 V

Dimensions (mm)

142 x 113 x 40 142 x 113 x 40 182 x 113 x 50 190 x 180 x 60
The embedded platform only provides the processing power and the desired interfaces in an automotive-suitable form factor. A total solution is achieved when a corresponding configuration has been created for these devices. For this purpose, HMS offers the Automotive Configuration Tool, ACT – a powerful, yet easy to use PC software with versatile functions and possibilities.

**Residual bus simulation**

The residual bus simulation view of the ACT tool provides a simulation environment for one or more ECUs in order to test these independently of other network devices. This includes, for example, generation of the necessary communication traffic as well as automatic calculation of signal-based CRCs and alive counters. Without programming effort and supported by a configuration wizard, the user is guided through a few, logical graphical configuration steps of a residual bus simulation. The generated function module is autonomously executed on the embedded platform.

**XCPonEthernet**

With the XCPonEthernet solution, it is possible to control the residual bus simulation via a standardized protocol and to evaluate communication data. For this purpose, all signals of the CANdb and/or FIBEX file are merged in a A2L file. The A2L file can then be imported into suitable software solutions, enabling representation of all signals present on the bus and to influence all signals sent by the residual bus simulation.

**IxAdmin**

The IxAdmin is the administration tool for the connected embedded platform. With the IxAdmin tool, created configurations can be loaded on the device, updates can be performed, runtime licenses can be managed and basic settings can be made. The IxAdmin can be connected to the device via USB, Ethernet or Wi-Fi.

**Vehicle Editor**

The basis for most solutions in the automotive sector are bus descriptions in CANdb, FIBEX or AUTOSAR-XML format. The bus descriptions contain a great deal of information, but often not all required information. Using the Vehicle Editor, everything that belongs to a certain vehicle, an integration level or a test configuration can be easily combined. This data can then easily be accessed during further configuration.

**HIL signal manipulation**

Based on the FlexRay/CAN residual bus simulation and the XCPonEthernet extension, the signals sent by the RBS can be defined and manipulated. This includes, for example, on/off signal switching for a defined time/number of cycles, transmission of defined substitute values with switched-off signals and defined corrupting of CRCs and alive counters for all signals sent by the RBS. Signal manipulation control can be done via user code, the gateway or XCPonEthernet.

**Visualization and transmission**

Data processing in real time with access to all interfaces

- Up to 128 GB data recording for all interfaces with pre- and post-trigger
Like the residual bus simulation, the gateway configuration is another view of the ACT tool. The gateway is a versatile solution, which can be used alone or in conjunction with a residual bus simulation to combine different data streams with each other, regardless if physical or virtual bus systems are being addressed.

The gateway view of the ACT tool is divided into two areas: source and target. Regardless of bus system handled, messages or individual signals from the source to the target bus are always mapped in the same way via drag & drop. The created configuration can be loaded on an ixiat embedded platform and executed stand-alone.

**FlexRay / CAN / CAN FD / LIN**

A bus description file can be provided for these physical bus systems. With the signal-based gateway, it is therefore possible to combine signals from different source messages into one target message. In the process, send triggers and possible default values can be freely chosen. If the source signal description and the target signal deviate from each other, an optional signal transformation could take place automatically, in order to ensure that the interpretation of the source and target signal is identical. It is also possible to adapt the cycle times of the sent messages to relieve the recipient connected to the target bus.

**Analog / Digital IO**

Different IOs are available, depending on the embedded platform used. These can be added to the gateway as a virtual bus. After configuring the data direction, the range of values, the conversion rules and the unit, the IOs can be mapped similarly to the other bus systems via drag & drop. This makes it possible to map the trigger inputs and outputs of the logger or to fill vehicle signals based on the analog inputs.

**Signal and data logger**

The logger is added to the gateway configuration as a virtual bus. Signals and messages to be recorded can be mapped on the logger bus via drag & drop, similar to the other bus systems. In addition, it is possible to define and to graphically configure trigger inputs on a signal basis. Optionally, a ring buffer can be configured to enable recording of data to the storage media which was received before the trigger event. Recording then takes place on a common time basis for all connected bus systems. Depending on the application, different SDHC card recording formats can be chosen. The logger can be used individually or in parallel to a residual bus simulation. Recordings can also be played back again later in the correct chronological order.

**Generic Ethernet**

In addition to the CAN interfaces installed in the device, the ixiat FRC Embedded Platforms have up to 16 virtual CAN on Ethernet buses. An Ixxat protocol is used here, which allows for the receipt and transmission of messages from and to 16 different IP addresses. For each virtual CAN bus, the ACT generates a CANdb bus description file, which the remote station can use to interpret the data stream, similar to a real CAN bus. Depending on the requirement, a virtual CAN channel can be evaluated by the control PC, analyzed with the Ixxat canAnalyzer or transformed to CAN again via an Ixxat CAN@net.

**EtherCAT**

The FRC-EP190 comes with an EtherCAT extension in order to combine the automotive world with the industrial world in the test bench. With the ACT tool, the signals from the vehicle or ECU can be selected, which are to be analyzed or stimulated via EtherCAT. The EtherCAT configuration can be read directly from the device.

**FDX**

The Fast Data Exchange protocol is an Ethernet-based communication interface and represents a favorable alternative to XCP on Ethernet for accessing physical signals. FDX does not require an elaborate communication stack and can therefore be quickly implemented on any target platforms. For the FDX interface, the ACT generates an XML description file that can be used for the interpretation of the data stream.

**Signal visualization**

The signal visualization is added to the gateway configuration as a virtual bus. Using the integrated web server, it allows a simple display and stimulation of all mapped signals. Any device (PC, smartphone or tablet) can be used here as a display device. The basic requirement is only a HTML5-capable web browser. HMS provides a generic HTML page for this purpose, which can be adapted by the user to own needs. The visualization device is connected via USB, Ethernet or Wi-Fi.

**User code**

In addition to the various possibilities of the standard gateway solution, it is possible to implement own, specific functions. For this purpose, the user code bus is added as a virtual bus of the gateway configuration. Signals or messages that are mapped via drag & drop from and to all other bus systems serve as an input/output for the own code. The user code application is written in standard C and may represent specific algorithms. Digital output control as well as implementation of a complex logger trigger module is therefore possible.

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**Gateway**

Like the residual bus simulation, the gateway configuration is another view of the ACT tool. The gateway is a versatile solution, which can be used alone or in conjunction with a residual bus simulation to combine different data streams with each other, regardless if physical or virtual bus systems are being addressed.

The gateway view of the ACT tool is divided into two areas: source and target. Regardless of bus system handled, messages or individual signals from the source to the target bus are always mapped in the same way via drag & drop. The created configuration can be loaded on an ixiat embedded platform and executed stand-alone.
Functional models

For some users, C code development is either too complex or there are already finished models from other projects. It is possible to integrate such models using an own API. Similar to the user code, a Matlab/Simulink model can then access the mapped signals and messages, making it possible to integrate also complex functional models.

Development tool

An Eclipse-based development environment is available for development of own, specific applications. This is either available independently or integrated in the ACT tool. Through the development environment, the user code applications can be developed to extend the gateway solution or completely separate applications can be created. This is supported by the integration into the ACT project, the convenient editor, cross-complier as well as a high-level language debugger. The applications developed in this way can be executed stand-alone on the Ixxat embedded platforms.

<table>
<thead>
<tr>
<th>Solution</th>
<th>FlexRay/CAN RBS</th>
<th>Gateway</th>
<th>Development tool</th>
<th>Data logger</th>
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<tbody>
<tr>
<td>Description</td>
<td>Residual bus simulation for FlexRay and CAN based systems on Ixxat Embedded Platforms</td>
<td>Universal application for message/signal conversion on the Ixxat Embedded Platform</td>
<td>Development environment for the implementation of specific requirements on Ixxat Embedded Platforms</td>
<td>Application for configuration of the embedded platform as data logger</td>
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<tr>
<td>Functions</td>
<td>Generation of FlexRay and CAN messages as well as reaction to messages received</td>
<td>Message or signal conversion between all bus systems on target hardware</td>
<td>Eclipse-based development environment for Linux User Mode</td>
<td>Message/signal conversion from all systems/I/Os to the memory</td>
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<td>Provision of two cold starter nodes for starting up a FlexRay system</td>
<td>Support of FDX &amp; EtherCAT</td>
<td>Cross compiler for Ixxat Embedded Platforms</td>
<td>Pre- and posttrigger</td>
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<td>PC controlled and stand alone operation</td>
<td>Easy allocation of signals from the source to the target bus via drag &amp; drop</td>
<td>Remote debugging via Ethernet or USB</td>
<td>Graphical configuration of trigger conditions</td>
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<td>Easy configuration based on data of the bus description files</td>
<td>Optional automatic signal conversion</td>
<td>High-level code debugging API</td>
<td>Drag &amp; drop assignment of signals from source to destination bus</td>
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<td>Signal manipulation for all signals transmitted by the RBS</td>
<td>Matlab/Simulink support</td>
<td>for connecting your own application to the Ixxat residual bus simulation</td>
<td>Plausibility and consistency check of the configuration</td>
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<td>Simulation via XCPonETHERNET and commercial third-party software</td>
<td>Automatic plausibility and consistency check of the configuration</td>
<td>Signal visualization on HTM/L-capable devices (e.g. tablet or PC)</td>
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Data logger for CAN

Powerful and versatile tool for development, test and maintenance of CAN, CANopen, CAN-FD, SAE J1939 and LIN systems

The canAnalyser is based on a modular concept which makes it open and expandable. The standard version of canAnalyser has functions that cover many application areas such as:

- Transmission of single messages, signals and message sequences
- Reception and interpretation of messages and signals
- Display of statistic data
- Signal management with databases – Editing via editor or import (CANdb, FibEX, DIM)
- FibEX and CANdb file export

The canAnalyser is based on the VCI driver and can be used with all Ixxat interfaces. Additional functions are provided by optional modules, such as the protocol-specific display of messages in CANopen or J1939 systems. Customized functions can be added by using the open .NET programming interface.

More information can be found at www. ixxat.com/canAnalyser

Cost-effective logging solution for CAN, CAN FD, LIN and FlexRay (optional)

The Ixxat data logger for CAN is based on the powerful FRC platform and can be easily configured with the free version of the ACT tool.

- Simultaneous recording of up to 8 CAN channels (4 x CAN FD), LIN and 4 digital inputs (optional FlexRay)
- Recording of all connected bus systems with a uniform time base
- Easy configuration via drag & drop of messages/signals or complete buses – with support of CANdb, DBC and Fibex files
- Graphical trigger configuration with pre- and post trigger (ring buffer)
- Fast boot time
- Recording on SD card, USB stick or USB hard disk (CSV, MDF4 or binary)
- Data visualization via Web-socket with HTM/L-capable devices (tablet/PC) using USB, LAN or WLAN
- Easy upgrade from data logger to gateway

Can be downloaded from the Ixxat website for free.
PC Interfaces

for analysis and control of CAN, CAN-FD, FlexRay and LIN systems

Ixcat PC interfaces are used in a wide range of applications, either in test benches to connect devices to be tested to a test computer or as control interface in production systems.

Easy integration into customer applications

Powerful drivers for Windows, Linux and real-time operating systems are included with the PC interfaces, enabling an easy integration. A uniform programming interface for all CAN interfaces allows quick switching between cards without adaptation of the customer application. Thus, it is easy to select the the best CAN interface depending on application, performance requirements or costs.

Windows

The “Virtual Communication Interface” (VCI) driver for Windows is designed as a system server and allows simultaneous access by several applications to one or more CAN controllers of one or more PC interfaces. The driver supports 32 and 64 bit Windows operating systems and includes a simple CAN bus monitor “canAnalysys Mini”.

User interfaces:
- C, Java and LabView API
- DASYLab (includes Ixxat driver)

Linux & Real-time OS

For use of the CAN interfaces with Linux, QNX, RTX, Irrtime and VxWorks Ixxat provides the universal “Embedded Communication Interface” driver (ECI) free of charge. The ECI driver has a C-based application interface.

Sae J1939 and CANopen

For use of the CAN interfaces with CANopen or J1939, HMS offers driver APIs that provide all protocol specific functions and thus enable quick and easy development of PC-based control and configuration applications.

Repeater, Bridges & Gateways

for test back-ups and system extension

Ixcat repeaters, bridges and gateways are used in many application areas, for system extension, protection and control of noise.

CAN repeaters

Ixcat CAN repeaters are specially designed for use in an industrial environment, meeting the highest demands in terms of robustness, temperature range and safety. Users can benefit from significantly improved system reliability along with cost-savings thanks to simpler wiring. The CAN repeaters are used to establish a physical coupling of two or more segments of a CAN bus system. They can be used to implement tree or star topologies as well as for long drop lines. In addition, network segments can be electrically decoupled using a galvanically isolated repeater.

CAN bridges and gateways

The use of Ixxat bridges and gateways opens up a large number of possibilities. For example, CAN systems can be implemented with a larger system expansion or systems can be coupled using different communication technologies, like Bluetooth or Ethernet.

CAN bridges can link two or more CAN networks that employ different CAN bit rates or protocols. Translation and filter rules can also be used. As an extension to the CAN bridges, CAN gateways allow access to CAN networks using other communication systems, e.g. Bluetooth or Ethernet.
Third-party products

Ixxat Automotive products from HMS are used in various third-party products

CanEasy

CanEasy is a software-based residual bus simulation and analysis tool for CAN and LIN, which supports all VCI driver based interfaces from Ixxat. In conjunction with the FRC devices, FlexRay data can be easily stored and displayed. With CanEasy, residual bus simulations can be configured quickly, automatically and flexibly, also offering add-ons for XCP and diagnostic functionality. In addition, an integrated development environment is available for VBA or .NET. Sophisticated and clear user interfaces can be easily designed by using rich panels.

A free trial version is available at www.caneasy.de

hibento app

The hibento app allows easy visualization and manipulation of CAN and FlexRay data, provided by the Ixxat FRC Embedded Platforms via WLAN. The app supports DBC and Fibex description files and displays the data within graphical instruments, as trace, and as scope.

A free demo version is available on request.

Customized solutions

The three solution levels

Level 1:
Software adaptation of an existing Ixxat product

For a customer project, CAN signals in a vehicle had to be converted to digital frequencies. This was necessary in order to adapt a new CAN-based engine technology for commercial vehicles to our customer’s solution. In the first approach, the customer had selected the standard CANio250 in the PCB version. During consultation it was concluded that the requirements could not be mapped with the standard firmware of the device. Based on the CANio ADK (application development kit), a customized firmware was developed which is programmed into the devices before delivery to the customer.

Level 2:
Hardware adaptation for an existing Ixxat product

Specific device requirements from a customer were met by customizing the FRC-EP170 motherboard with regards to interface compilation and pin assignment. The housing color and design was also modified according to the customer’s specification.

Level 3:
Completely customized product

After having provided the display device AZG 2000 to ZF Friedrichshafen AG for several years, HMS created the successor device AZG3000 through a customization project. Downward compatibility was very important, and HMS managed to represent the functional range of the AZG2000 model also in the new AZG3000 device.

More products can be found at www.ixxat.com/automotive
Work with HMS.
The number one choice for industrial communication and IIoT.

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