Openness

On the application layer, the data transfer method utilizes the XCP-on-Ethernet protocol (ASAM standard), which is widely accepted in the automotive industry. Consequently, ES400 modules are easily integrated in partner applications. The Ethernet transport and network layer uses the UDP/IP protocol. The XCP (Universal Measurement and Calibration) protocol provides transmission of measurement and/or stimulation data to and from different Ethernet modules within a highly precise and predictable time frame. A PC application that does not have to meet hard real-time requirements will synchronize itself with the modules by means of the time stamps.

Integration of ES400 modules with IAV Drive Recorders

Starting in October 2006, IAV GmbH will offer the integration – based on the open XCP-on-Ethernet interface of the ES400 product family – of its IAV Drive Recorders with the ES411 A/D Module with Sensor Power Supply and the ES420 Thermo Module. The configuration is accomplished by downloading an ASAM standard A2L file into the IAV Drive Recorder. The file describes all of the measured variables to be captured by the connected ES400 measuring chain, and the bus signals to be measured are selected by simple Drag & Drop. The A2L description file can be easily generated by means of a stand-alone configuration tool from ETAS.

For data acquisition, an off-the-shelf PC or drive recorder can therefore be directly connected to an ES400 measuring chain. On one hand, due to the cyclical data transfer behavior, using an off-the-shelf PC enables the efficient acquisition of high data volumes. Using a real-time capable master, such as a rapid prototyping or an auto calibration system, on the other hand, enables access to a variety of I/O signal types, even in the presence of extremely short cycle times.

The integration of the ES400 represents an ideal extension of IAV’s vehicle bus-oriented endurance measurement technology through the addition of the powerful sensor signal measuring modules by ETAS. The user benefits by gaining access to ES400 measurement data for endurance measuring captured in vehicle or on the test bench, with the virtual absence of extra cabling efforts. Connecting the Ethernet cable of the ES400 measuring chain to the IAV Drive Recorder is all that is required.

Virtual Prototyping – The New INTECRIOR PC-Connector

Function prototyping on the Windows PC

The new PC-Connector for INTECRIOR enables developers to create virtual prototypes and test them on the PC without additional hardware. Function developers can use system models already in early project phases in order to validate new functions using Model-in-the-Loop technologies.

Creating synergies between development domains

While INTECRIOR does not offer a complete virtual world, the new PC-Connector allows function developers to create virtual prototypes of automotive electronic systems and test them on the PC. A virtual prototype of this kind comprises:

- **Automotive embedded software**
  - application software (functions for control and monitoring)
  - OSEK operating system
- **Plant model**
- **Driver**
- **Vehicle**
- **Environment**

The PC-Connector for INTECRIOR thus enables collaboration in very early development phases between function developers on one hand and system developers and simulation experts on the other. Without virtual prototyping, these domains often do not come into contact until very late in the process, e.g., during HIL (Hardware-in-the-Loop) testing. With virtual prototyping, developers can use system models (such as chassis or engine models) in early stages of the process as well, and thus validate their functions through Model-in-the-Loop (ML) technology.

Target-close prototyping

In INTECRIOR, models can be created using a variety of different tools or a combination thereof (MATLAB®/Simulink®, ASCET, C code). With the new PC-Connector, developers can now work within their familiar tool environment and execute their virtual prototype directly at their desks on a standard Windows PC under target-close conditions. Already in the function design phase, developers can thus validate the functional architecture and verify the electronic architecture against the plant model. Moreover, they can do all of this under target-close conditions. In short:

- **Function prototyping on the Windows PC**
- **Target-close prototyping**

For developers and simulation experts on one hand and system developers on the other, they can do all of this under target-close conditions.
Virtual prototyping offers new opportunities for early phases of vehicle development, such as precalibration in the office, detailed analysis of function behavior, and control over the execution speed of a prototype, as the following three examples illustrate.

1. Saving time and money through precalibration

With INTECRIO, developers can now move some of the necessary development steps from the test bench to the lab or to their desks and validate, optimize, and precalibrate functions against a plant model right there. In addition, a virtual testing environment on the PC also offers developers the advantage of being able to minimize the execution time of experiments (given the available computational power and the complexity of the model) and thus test a larger amount of functions or data variants in a shorter amount of time (Figure bottom).

2. Detailed analysis using highly elaborate simulation models

The option of validating a new function based on elaborate plant simulations also allows developers to conduct a detailed analysis of its behavior. This is particularly valuable because an in-depth analysis is often not possible in the real-world environment, or only possible by spending a lot of time and effort.

3. Slow-motion and time-lapse simulations

With the INTECRIO PC-Connector, users can dynamically influence simulation time by defining a scaling factor. Scaling factors < 1 allow users to accelerate the simulation, while scaling factors > 1 result in a "slow motion" effect (Figure top). Users can, e.g., quickly find the relevant parts of a simulation and then examine them by switching to the slow motion option.

Advantages of virtual prototyping

Virtual prototyping enables developers to validate functions and software in the context of a simulated world at their PC workspace, without any dedicated hardware, and not restricted by real-time requirements.

By supporting RTA-VIRTUAL-OSEK, a complete OSEK operating system for the PC, the PC-Connector for INTECRIO offers conditions that later exist on the vehicle ECU. These include task and process oriented scheduling and buffered message communication between individual OS processes. At the same time, the INTECRIO PC-Connector takes advantage of the flexibility and short turn-around times of testing on the PC, which offers ample room for experimentation due to fewer constraints in terms of timing, memory consumption, etc. than exist on the target ECU.

Virtual prototyping is the process of using a virtual prototype, in lieu of a physical prototype, for testing and evaluation of specific characteristics of a product design.*

Virtual prototyping and rapid prototyping

In INTECRIO, the function model is strictly separated from the OS configuration, the hardware configuration, and the instrumentation. Given this separation, fewer model variants have to be created, and the optimum re-use of software prototypes, experiments, and data sets can be ensured across teams, target platforms, and development phases. Being able to reuse virtual prototyping models in rapid prototyping will lead to considerable synergies. To summarize the advantages of using both virtual and rapid prototyping:

2006.2