



# Universal Real-Time Platform

SCALEXIO now also for rapid control prototyping



Function developers of mechatronic systems from a wide range of industries are now entering the SCALEXIO era. Frank Mertens, lead product manager for rapid prototyping systems at dSPACE, explains what this is all about.





*Mr. Mertens, the name SCALEXIO is well-known with regard to hardware-in-the-loop (HIL) simulation. It is now used for the first time in the context of rapid control prototyping (RCP). What can you tell us about this?*

Indeed, our users know the SCALEXIO product line mainly as HIL test systems. With its innovative technology, SCALEXIO has made a name for itself in this application area since 2011, has seen many new developments over the years, and has achieved a very high level of maturity. During this time, many function developers from the RCP environment wanted to use the technology and its strengths in control, validation, and data acquisition tasks for closed-loop real-time applications. We have now met this demand.

*Why was it not possible for function developers to use SCALEXIO for RCP before?*

Generally, they were able to use it, and some have. But in the first years, we focused on HIL requirements. For example, many of the I/O boards used for HIL applications have particular functional properties as well

as special signal conditioning and integrated fault simulation. This requires a certain board size. In the course of further optimizations and with the introduction of the compact SCALEXIO LabBox as well as the associated compact boards, we have released new components and features over the last years. They are very well suited for HIL testing, but also particularly for RCP applications. Today, we have reached a considerable degree of coverage, so we now officially position the system in the RCP sector.

*What is so special about the SCALEXIO technology that the RCP users can look forward to it?*

Let us have a look at the entire SCALEXIO system. While each component is very powerful itself, their interaction even increases the system's performance. I used to play volleyball, and it's the same principle: Having the best players alone does not make for a winning team. When we designed the system architecture, we therefore not only used the latest, most powerful technology. We also optimized their interaction. For example, we use a state-

of-the-art Intel® Core™ i7 processor. The high processing power enables it to compute even sophisticated and complex applications very fast. But for this to work, the operating system must contribute its part, for example, by reacting promptly and reliably when switching between tasks. Add the I/O, and even the strongest processing power is not enough if the bandwidth is insufficient or if high latencies or considerable temporal fluctuations, called jitter, occur. Since dSPACE has always been a top player in real-time systems and has long-standing experience in the field, we did not settle for the status quo but developed innovative technology like an intelligent I/O network that has already passed the litmus test in HIL applications: IOCNET. In addition to an exceptional latency behavior, its bandwidth allows for an outstanding handling of large data streams, for example, when capturing comprehensive data or connecting to modern vehicle networks. The SCALEXIO system, with all its capabilities, prepares the user for current and future applications. In the automotive industry, this includes the development of

**SCALEXIO systems provide high computing power and bandwidth at low latencies and jitter.**



advanced driver assistance systems, highly automated driving, electromobility, and the growing interconnection of vehicles.

#### *What I/O interfaces does SCALEXIO support already?*

Since we are no longer at the beginning of development, we already support a high number of I/O boards for processing analog and digital signals as well as buses and Ethernet for many different industries. Several years ago, we introduced the first boards that can be used with SCALEXIO LabBox. At dSPACE, we are continuously developing further boards at full throttle and will continue to do so in the next years.

#### *And what about particular I/O requests?*

Here, SCALEXIO gives us the flexibility we need. If we do not already cover the requests with our standard portfolio, SCALEXIO makes it possible to integrate PCIe I/O cards from third-party suppliers in the system in a clean and cost-effective manner. dSPACE offers the relevant support and qualification of the I/O cards. The cards also have to pass compatibility tests so we can ensure consistent system performance and reliability despite the high flexibility. Not all suppliers do this as consistently as

we do, and users might learn a “painful” lesson or two when using other products. In everything we do, we want to give our users continuously high real-time performance and system availability. Moreover, SCALEXIO provides additional options for customization with the freely programmable FPGA boards in combination with I/O plug-on modules.

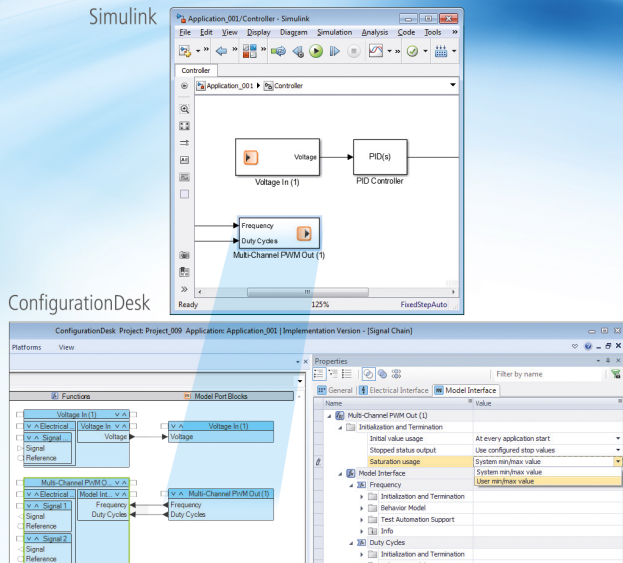
#### *Doesn't new hardware for modular RCP systems also require new software?*

Yes and no. The largest part, such as the experiment software ControlDesk, the test automation software Auto-

mationDesk, and the Simulink® application models, is hardware-independent. This is different for the hardware-dependent implementation software. When we introduced SCALEXIO, we also launched dSPACE ConfigurationDesk, which replaces the Real-Time Interface (RTI) software. ConfigurationDesk gives users entirely new ways to display I/O interfaces in a clear overview and configure them quickly at a central location. It also lets them separate an application model, for example, in Simulink, almost completely from I/O-specific settings and modelings. This answers the need for reusabil-

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SCALEXIO is based on a state-of-the-art, innovative technology for the optimum setup of modular real-time systems – be it for rapid control prototyping or hardware-in-the-loop applications.

ity, seamless transitions, and the “golden model” approach. The openness of the software due to Functional Mock-up Interface (FMI) support is certainly another plus.

*Will SCALEXIO replace today's modular systems, which are based on a peripheral high-speed I/O (PHS) bus, in the long term?*

I am sure of it. This will be driven mainly by customer requests, but it will not happen overnight. PHS-based systems have been around for over 25 years. They have set the standard for modular real-time systems. We will therefore continue to offer them in the medium term and service them

for a longer period of time. However, in the future the growing and changing demands can be optimally met only by using SCALEXIO with its performance power, flexibility, and openness. One day, we will eventually ship the last PHS-based system. Then, we will have fully entered the SCALEXIO era.

*Thank you for talking to us.*

*As Lead Product Manager Rapid Prototyping Systems, Frank Mertens is responsible for the entire RCP tool chain at dSPACE GmbH, Paderborn, Germany.*



**FUTURE  
START**

## The SCALEXIO Product Line – Now also for Rapid Control Prototyping

The SCALEXIO product line is based on a state-of-the-art, innovative technology that was specially developed for modular real-time systems. It is highly scalable and can be flexibly configured. SCALEXIO-based systems provide high computing power and a fast, broadband I/O connection. This makes them ideal for a wide range of applications. The bottom illustration shows some of the SCALEXIO components that are particularly suited for RCP in the lab (function design, execution, and validation), and complement the portfolio by adding new options to the HIL use cases. The system is based on a compact chassis, the SCALEXIO LabBox, which has a slot

for a processor board as well as slots for I/O boards, and can be used in a 19" rack or on a desk. Other benefits of the SCALEXIO LabBox are low noise emissions and an easy board replacement. The real-time processor is either provided by an external SCALEXIO Processing Unit or the new DS6001 Processor Board, which can be integrated in the LabBox. With its four processor cores and a computing power of 2.8 GHz, the DS6001 is ideal for the most complex model calculations. If even this computing power is not sufficient, multiple processor boards or Processing Units can be coupled. The system has a high number of powerful, partly FPGA-based, I/O boards

for connecting sensors, actuators, buses, and networks. The boards are connected to the real-time processor with the IOCNET data network developed by dSPACE, which has a high bandwidth but very low latency and jitter. For faster cycle times and large-scale data preprocessing, dSPACE offers the freely programmable SCALEXIO DS2655 FPGA Base Board, which can be extended with additional I/O modules. It is also possible to include dSPACE-qualified PCIe cards of third-party suppliers in the system. Other components, such as a chassis for in-vehicle use (SCALEXIO AutoBox) and more I/O boards are currently being developed and will be available soon.

