

The new control function has been completed in Simulink – the next step is to test it (more) easily and fast(er) in combination with the existing ECU software. dSPACE's tool chain for virtual bypassing offers a highly efficient solution.

The MATLAB®/Simulink®-based approach for developing control algorithms further is the prevailing method worldwide. Once the first control designs are done, their interaction with other software components or even complete electronic control unit (ECU) software has to be tested realistically. Until now, function developers had to wait for suitable prototypes of the production ECU to become available. But the required

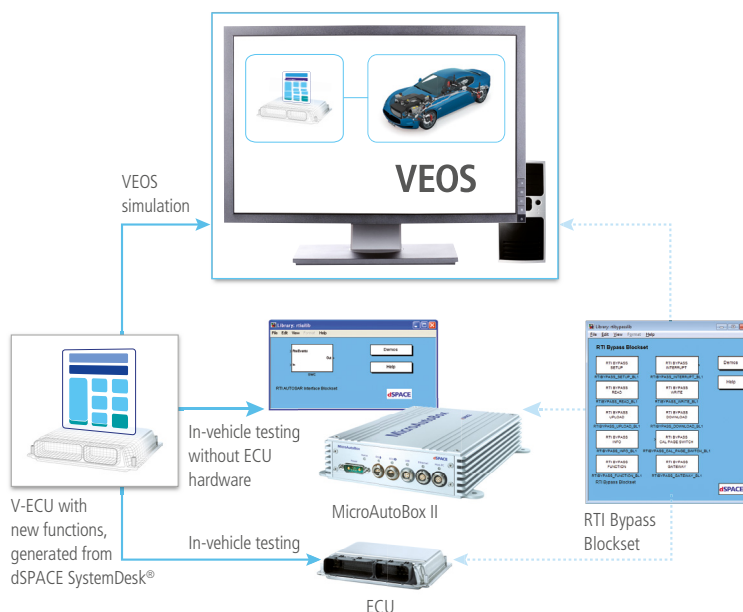
number of prototypes is not available until late in the development process.

However, the later testing begins, the less time developers have for integration, error search, corrections, and optimizations. This increases the time pressure, because the deadlines for new production ECUs are usually very tight and because corporate management and customers both have high expectations.

### Frontloading Tests with Virtual Bypassing

Here is the approach: When new functions are integrated into existing ECU software or a virtual ECU (V-ECU) via virtual bypassing and are simulated in this environment on the developer PC, function tests can be performed much earlier. This means that the developers can test much earlier whether their changes have the desired effect – without ECU hardware or access to the physical controlled system. Virtual bypassing makes integrating new functions into existing ECU software quick and easy, because the new function is used simply by selecting it; the ECU source code does not have to be modified. Therefore, ECU software does not have to be recompiled either, which saves developers long build times and allows for considerably more development iterations.

Figure 1: With the RTI Bypass Blockset, new ECU functions can be used on different platforms, such as VEOS, MicroAutoBox II, or the ECU prototype.



### Virtual Bypassing Tool Chain

Virtual bypassing is made possible by the dSPACE RTI Bypass Blockset, the same blockset used for external bypassing and on-target prototyping, and by VEOS®, dSPACE's PC-based simulation platform. With VEOS, developers can simulate entire virtual ECUs on the PC together with complex plant models such as the dSPACE Automotive Simulation Models (ASM).

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Earlier test results with  
virtual bypassing

Taking Function

Development  
to the Next Level

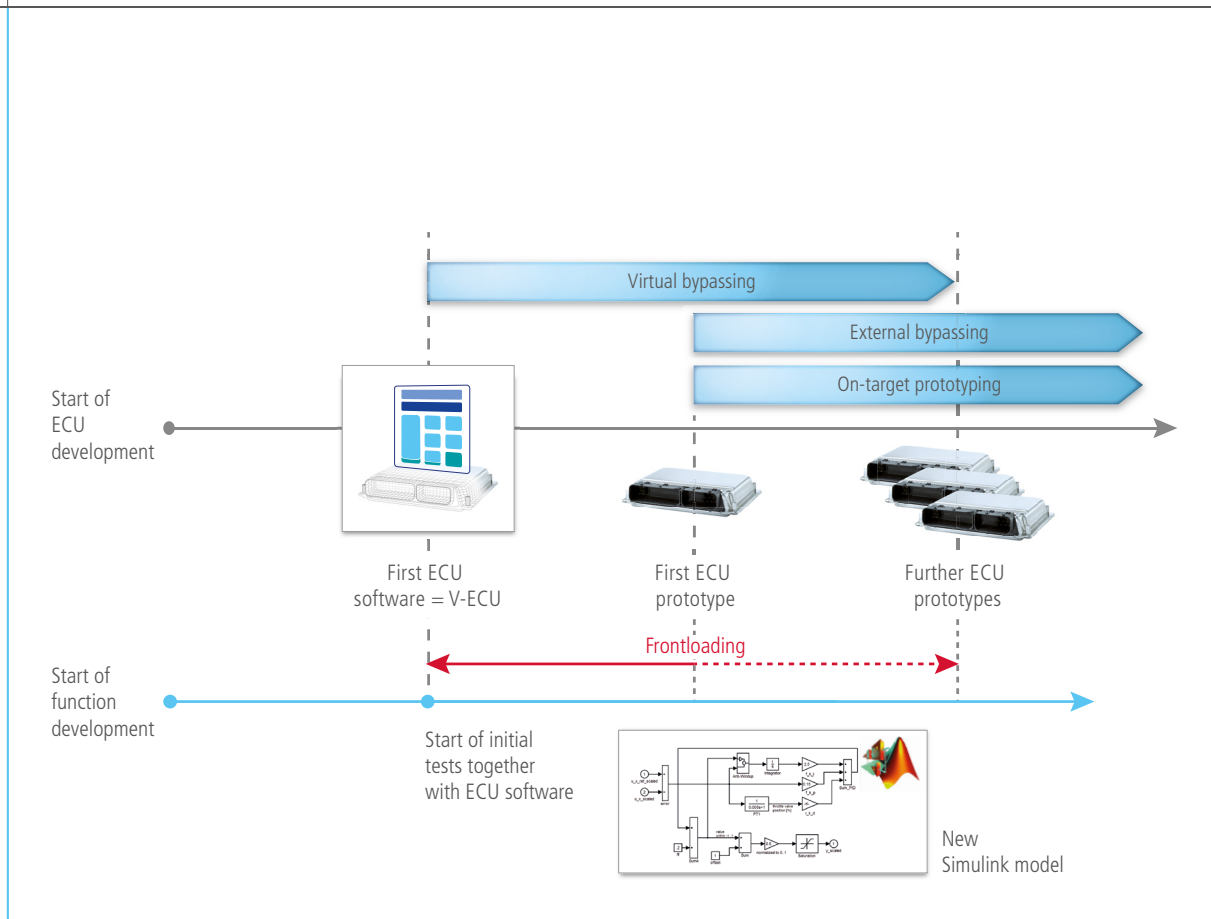


Figure 2: Using virtual ECUs makes it possible to start function tests earlier and achieves a better software quality faster.

The V-ECU can be provided by a software integration expert. The function developers just have to use the RTI Bypass Blockset to connect their Simulink functions with the functions of the ECU software – without any special software skills or integration know-how. This lets them focus completely on implementing and optimizing their functions and testing them in combination with other software components. It is also possible for several developers to use the same V-ECU for very different controller components, without having to generate it again (figure 2). Virtual bypassing therefore eliminates redundant work.

#### Validating More Iterations Faster

The RTI Bypass Blockset not only allows for integrating new functions into the V-ECU without a new software build. It also lets

developers replace controller models during a running simulation. Different variants of a controller can therefore be tested and compared without a simulation restart, i.e., without causing a delay. This approach is even more efficient because VEOS can simulate faster than in real time. Another benefit of virtual bypassing is the possibility to run tests before a hardware prototype is available. Tests can therefore be performed earlier. This frontloading means that developers have more time for developing and testing. It also mitigates project risks.

#### Offline and Online

As soon as the real ECU becomes available, developers can perform real-time tests on it together with the physical controlled system, in the lab or in the vehicle. The users switch from virtual bypassing to either external or internal bypass-

ing. To do this, the new control function is integrated into the final ECU software on the real ECU. The transition is seamless, and is also performed using the dSPACE RTI Bypass Blockset so that users do not have to become familiar with new software. In the blockset itself, users simply select a different execution platform, such as an ECU instead of the V-ECU (figure 1). With ControlDesk® Next Generation, developers can then use measurement and calibration data and experiment layouts for all platforms.

#### Real-Time Testing Without the ECU

If real-time testing is required when the ECU prototype is not available yet, dSPACE's MicroAutoBox II prototyping system replaces the ECU. With the RTI AUTOSAR Blockset, the V-ECU is transferred to the MicroAutoBox and used in



the vehicle. Virtual bypassing can also be used here to extend the functionality of the V-ECU. The Simulink model of a new function, including the bypass blocks, can remain completely unchanged, which allows for a seamless transition from VEOS. ■

## Conclusion

Virtual bypassing makes it possible to frontload function tests to the PC-based simulation with dSPACE VEOS and start them earlier. This approach enables more and faster development iterations, without a real ECU or physi-

cal controlled systems. The RTI Bypass Blockset allows for a seamless transition between the different dSPACE development platforms, providing a continuous, highly efficient development process with a very short training period.

Figure 3: The dSPACE RTI Bypass Blockset allows for a seamless transition from virtual bypassing with VEOS to external bypassing with MicroAutoBox II and the production ECU.

