Central data management
for efficiently moving to
series production

Agile
Model-Based
Development

Agile development and test methods make it possible to arrive at deployable software more quickly and to improve it continuously. Transparency and consistency when exchanging data between development teams in different locations is as important as the automation of repetitive processes. Central data management as well as a concerted tool chain prove to be decisively beneficial in this process.

Automotive software development is subject to a continuous process of increasing efficiency and professionalization. More and more development teams jointly work on the ECU software from different locations. Specialized tools and procedures have been established for the different process phases. The shorter cycles for developing and testing functional components as well as their ever more frequent integration into an overall model allow for an agile process when validating and testing modifications. Software versions are thus available faster and continuously.

Central Data Management in the Development Process

During distributed software development, it is essential for architects, function and software developers, testers, and integrators to work with the same data base. This increases the demand for a central system that keeps data and files consistent and traceable for the different roles, tasks, and tools used. The data management software SYNECT, functioning as the data backbone during the model-based software development with MATLAB®/Simulink®, and the production code generator dSPACE TargetLink enable all parties, from software developers to project leaders, to get an overview of all the development artifacts and stages. The complete integration of the data backbone into the tool chain makes it possible to continuously use the established tools of the individual development phases and perfectly cross-connect them, for example, tools for requirements management or testing. This results in the following benefits:

- Full traceability from requirements to models, interfaces, parameters, and tests as well as automated effects analyses by linking data.

Transparency and efficient change management based on integrated user rights management and version management.
- A high degree of automation because tools are efficiently connected.
- Efficient multi-user support for all Simulink/TargetLink users because they can work with a uniform, consistent database

The following sections describe the benefits of a tool chain with Target-Link, BTC EmbeddedPlatform, and SYNECT for validating the models for the various development phases.

Consistent Data Management to Ensure Efficiency

The central, cross-phase data management of models, interfaces, parameter specifications, tests, and test results as well as their link to the requirements in SYNECT ensures the efficient support of all parties involved in the development project. Architects use SYNECT to centrally determine the interfaces and parameters to be used by developers for individual components of the overall model. SYNECT offers automated processes for frame model generation and model updates to easily transfer the required data and interface specifications to the TargetLink model and the TargetLink Data Dictionary. This also allows for the simple and easy transfer of subsequent changes to the component models. Therefore, all developers can work with consistent data.

The tests that the component developers or test teams developed to validate the models are managed centrally by SYNECT. The option to directly connect requirements, models, tests, and test results allows for querying the development status of the software and its quality at any time. Moreover, the requirements coverage can be analyzed and tracked. Additionally, components can be integrated into the overall model fully auto-

Powerful Tool Chain

- dSPACE TargetLink for generating ECU production code of the highest quality

- BTC EmbeddedPlatform for building a highly integrated test environment

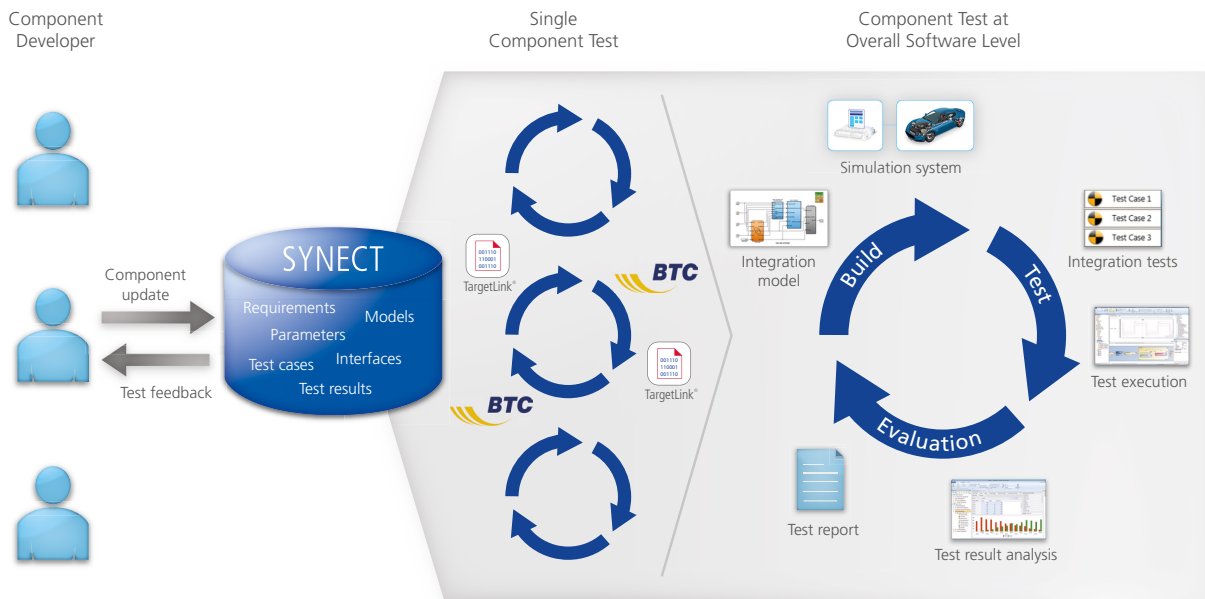- dSPACE SYNECT as the central data management tool for teams working from different locations

Figure 1: Continuous, automated testing of components – individually and at the overall software level.

matically because interface conformity and quality are constantly ensured. This way, SYNECT supports the developer teams in continuously delivering deployable software versions.

Integration and Test: Automated and Reproducible
To ensure the required quality of a component model while working with ever shorter development cycles, developers must not only develop, perform, and save the unit tests themselves. They also have to test and evaluate the components in the context of the overall software. SYNECT perfectly supports the developers in these tasks by seamlessly integrating commonly used test tools, such as BTC EmbeddedPlatform (figure 1). This way, developers can use the tools to define the unit tests on the basis of the require-

ments assigned to the model as well as additional analyses, such as code coverage and back-to-back tests. The increasing number of tests that are required with every new model version can then be performed fully automatically, for example, before the release of a new component. SYNECT offers the possibility to integrate every development version automatically, which allows for continuous testing at the overall software level (figure 1). Central data management with SYNECT makes it possible to directly use existing tests that were developed for validation on the HIL simulator, for example. Even without a real-time simulator, the component developers can carry out a PC-based offline simulation with dSPACE VEOS to identify how the components influence each other. This brings the

various phases of software development much closer together, which means that they can be run through in shorter iterations for nearly every software change. Developers also receive direct feedback about the functions they developed from test results and reports. This gives them the opportunity to react quickly and flexibly to input received from the continuous development of the software and creates an agile and highly automated development process that includes reproducible tests.
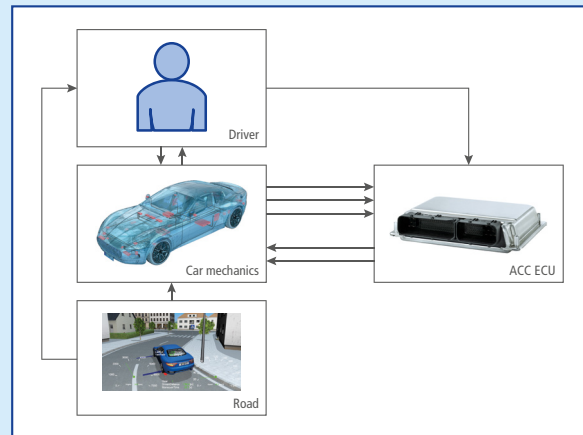
Implementing Continuous Delivery Scenarios
The fully automated integration offers added value to the component developers and at the same time simplifies the tasks of all persons involved in the ECU development. For example, SYNECT can trigger the

Continuous Development – Transparent, Automated, and Efficient Thanks to the dSPACE Tool Chain

Graphically Editing Models

In the upcoming Version 2.4 (dSPACE Release 2017-B), SYNECT introduces the option to graphically edit the connections of models. The different models, such as individual software components, virtual ECUs and environment models that were created by teams working from different locations, can thus be merged to an overall system model. From this model, a simulation system can be generated for the offline simulation with dSPACE VEOS. Future plans are to also enable creating real-time applications in the same manner. SYNECT supports various model formats, such as MATLAB/Simulink, TargetLink, Functional Mock-up Units (FMUs), and V-ECUs. For connecting the models, both the signal-based communication and the communication via automotive bus systems is taken into consideration. In addition, SYNECT offers the added value that tests can be directly planned and performed automatically for the created simulation systems.

software build process regularly and at defined times, such as every night, for the last approved component of the continuous delivery. Afterwards, the generated virtual ECU (V-ECU) can be validated in an offline simulation using all available tests. As a result, the virtually validated software and the test results can be continuously provided for tests on the HIL simulator or in the vehicle.

Summary
TargetLink, the production code generator; BTC EmbeddedPlatform for building highly integrated test environments; and SYNECT, the data management software, form a tool chain that provides component developers with a high-performance environment for agile software development and continuous delivery strategies. As an integral part of the tool chain, SYNECT makes it possible to fully automate repetitive tasks and put the agile development approach into practice. Central data management throughout the complete model-based development process allows for a tight-knit network of all tools, users, and development artifacts. ∎