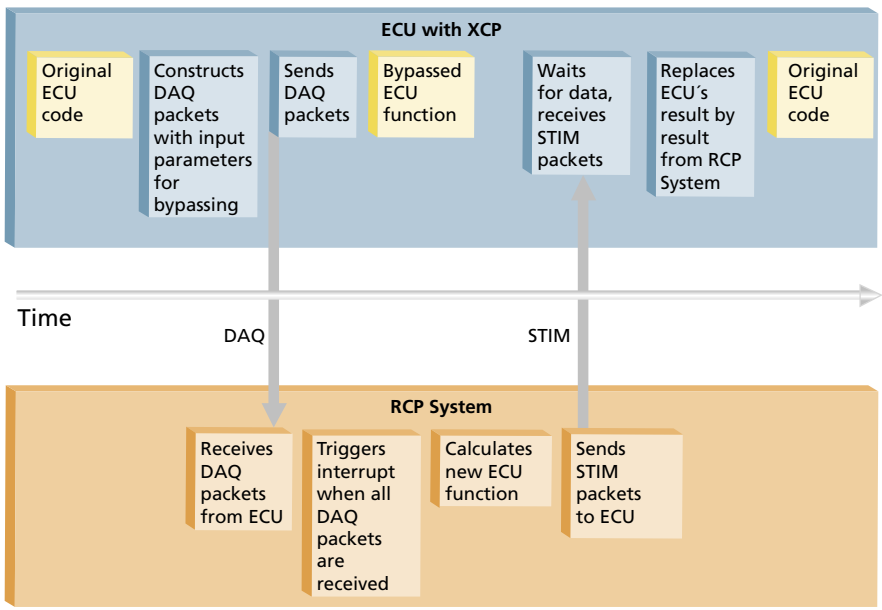
XCP on CAN and CalDesk at General Motors

- **Access to the ECU installed in the new six-speed transmission**
- **Measurement, calibration, and bypassing with the same tool**
- **XCP on CAN and CCP running parallel on the same CAN channel**

General Motors is employing XCP on CAN for software development and CalDesk, the universal measurement and calibration tool, to parameterize the electronic control unit (ECU) for advanced transmission projects. The dSPACE XCP Service provides dedicated features for bypassing functions in fast ECU rasters, and CalDesk gives the company an integrated environment for measurement, calibration, and bypass applications. Using CalDesk has numerous advantages compared to working with a combination of different tools: For example, measurements on ECUs and prototyping platforms can be run according to a common time base, with simultaneous parameter adjustments.

Accessing ECUs in the Transmission

ECUs in the transmission area are becoming more compact, and increasingly being installed in inaccessible places. This makes it all but impossible to connect additional interface hardware in or on the ECU for software development purposes as is the case with General Motors' new six-speed transmission, where the ECU is located inside the actual transmission. General Motors Advanced Transmission Group is using CCP for calibration and measurement, while bypass communication between the ECU and the prototyping hardware (MicroAutoBox in this case) is established via XCP on CAN. The dSPACE XCP on CAN Service runs in parallel to CCP on the same CAN channel, without the two affecting each other. The CCP implementation was already available in the development ECU software, and is being used for measurement and calibration tasks. The XCP on CAN Service and the necessary bypass hooks (service calls) were integrated into the ECU code. Unlike CCP, the dSPACE XCP Service provides special mechanisms for function bypassing, such as task-synchronous writing of variables, ensuring data consistency, and several error detection options for bypass communication. The dSPACE XCP Service is designed for a wide range of applications, from measurement and calibration to bypassing and right through to ECU flash programming.



▼ *Synchronous bypassing for time-critical parameters. The wait mechanism in dSPACE XCP on CAN allows synchronous data exchange between ECU and RCP system.*

CalDesk – Bringing Together ECU Calibration and Rapid Control Prototyping

Employing an integrated experiment environment featuring calibration and measurement access to both the ECU and the dSPACE prototyping hardware was a crucial requirement for GM in this project. CalDesk has been chosen for this.

CalDesk allows vehicle ECUs and their busses, and rapid control prototyping platforms, to be accessed simultaneously. It is capable of handling any number of devices in a single experiment. Thus, CalDesk

users have an integrated environment for performing function prototyping, calibration, measurement, data analysis and even ECU flash programming tasks in a single tool.

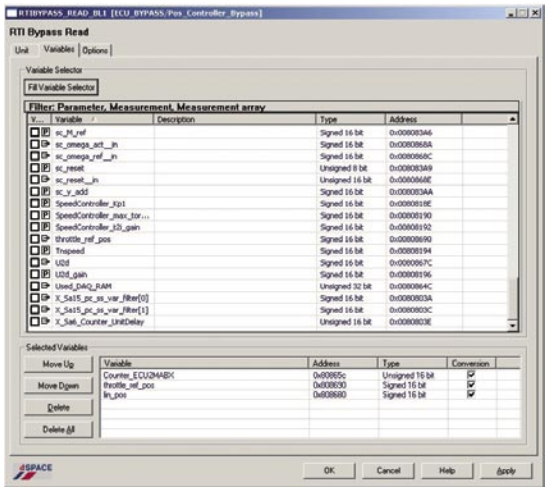
The Advantages of CalDesk

Using CalDesk has a lot of advantages:

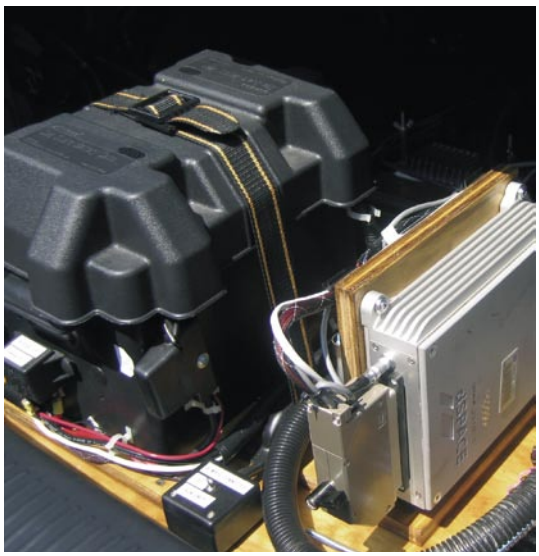
- A single tool for various use cases
- Common time base for variable measurement on ECUs and dSPACE prototyping systems
- Simultaneous parameter adjustment on ECUs and dSPACE prototyping systems in the same step (proposed calibration)
- The same automation interface used for access to ECUs and dSPACE prototyping systems

Bypass Implementation on the Transmission Control Module

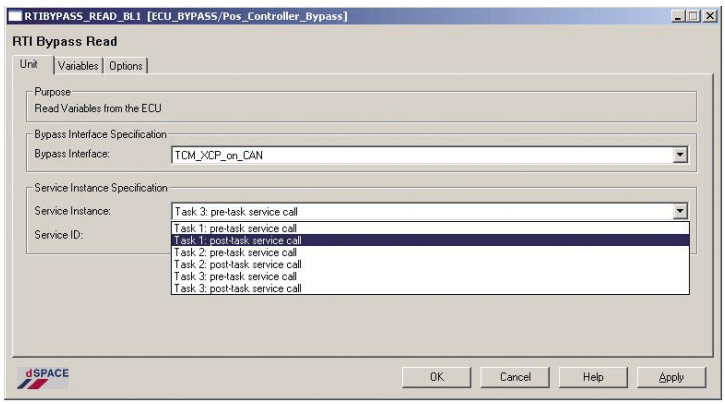
Many new algorithms for the transmission control module are being developed by means of the external bypass approach in connection with dSPACE prototyping systems. Depending on the type of data to be exchanged via XCP on CAN, different implementation methods are used. Where input and output data do not require consistency in terms of the associated ECU task cycle, the respective model inputs are received via CAN on the RCP system, and the bypass model is calculated in a timer task. Typically, the RCP system responds in the same ECU task cycle; however, this behavior is not guaranteed. Time-critical data is handled differently: An interrupt is triggered on the prototyping system when the respective model inputs are received. A dedicated mechanism of the dSPACE XCP Service is used to ensure data consistency. This mechanism allows a time interval to be defined for the ECU to wait for new data sent by the RCP system. Thus, model outputs are always guaranteed to be available without ECU task cycle delay. In addition, provisions are in place to ensure that the ECU does not overrun and that all data is retrieved. The transmission control module provides multiple tasks with different priorities and activation rates. Two bypass hooks have been implemented in each of the first three ECU tasks, of which the fastest ECU task features an activation rate of less than 7 ms. The first bypass hook, called "pre-task", serves for capturing bypass model inputs using the XCP DAQ mechanism at the beginning of the ECU task. The second service call, "post-task", allows bypass model outputs to be written to the ECU synchronously by means of the XCP data stimulation method. All bypass hooks are described in the associated ASAP2 file, so that the user does not have to worry about implementation details. Using the RTI Bypass Blockset in the modeling environment, he or she can simply select the name of the service call from a list and associate it with the variables to be read from or written to the ECU.



▲ *The ECU variables can be selected via the variable browser of the RTI Bypass Blockset.*



▲ *Prototyping hardware: MicroAutoBox installed in the trunk.*



▲ *Service calls selected via the RTI Bypass Blockset, in this case the "post-task" service call for writing bypass model outputs to the ECU.*

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