To reduce the risk of cost overruns and potential adjustments, early validation during the simulation process is a must. It is also important to have the right tool to perform this validation. With the increasing number of control units in train subsystems, Alstom Transport began looking for several tools able to validate the subsystem before its first integration in the train takes place. Alstom Transport selected ETAS LABCAR Hardware-in-the-Loop system to validate an auxiliary train subsystem, knowing ETAS is a global leader in providing tools and solutions for the development of embedded software in the automotive industry.

Train Subsystem Control Unit

The control unit is seen as a modular electronic control unit (ECU) able to control several different devices (such as genset, powertrain, and air conditioning). This means a dedicated HiL is mandatory for validating device behavior in advance and for checking communication networks – currently SAE J1939 as well as Common Industrial Protocol (CIP) and Multifunction Vehicle Bus (MVB).

Project challenges

Alstom is developing the application software for the TSSCU ECU. The first challenge was to create a tool for carrying out Model-in-the-Loop (MiL) tests. This was possible by integrating a model of the ECU software and a Dymola plant model using the experiment environment ETAS LABCAR-OPERATOR and the RTPC (Real-Time PC) real-time simulation target from ETAS. Alstom’s second challenge was then to perform Hardware-in-the-Loop (HiL) testing on the complete LABCAR bench with the real TSSCU hardware as a unit under test.

An extremely stable and reliable VME architecture with high-end I/O boards has been designed for this purpose. ETAS has developed a specific and flexible load box concept for the project, including a wiring harness. The final setup was performed together with the
Abs on the Rails

Knorr-Bremse relies on ETAS ASCET

High-speed trains are an essential part of efficient transport infrastructure in many modern industrialized countries. But the trains’ travel speeds – of up to 250 km/h and more – place enormous demands on brake system mechanical components and control electronics. For the last 15 years, ETAS tools have helped Knorr-Bremse AG to develop the software for managing and controlling these crucial safety-related systems.

For high-speed trains, the brake concept is a key element of the safety plan. It encompasses brake force management, comprising the optimum distribution of the brake force over the various brake systems throughout the entire train, specific actuation of the friction brakes, anti-skid/anti-slip protection, and rolling monitoring, as well as the recovery of electrical energy during braking.

The current generation of ICE trains has three complementary braking systems. Actuation of just the disk brakes suffices at lower speeds; at higher speeds the electrodynamic brakes also engage. These in turn are backed up by the eddy current brakes when traveling certain stretches. One thing is clear: no intelligent braking concept can be implemented without electronics.

Electronics instead of mechanical components

Rail vehicle brakes were constructed and actuated almost exclusively on a mechanical and pneumatic basis well into the 1970s. The impetus to introduce electronically controlled antilock braking systems (ABS) stemmed from the desire to reliably prevent annoying and dangerous vibrations or operational instability caused by braking-induced flat spots on the wheelsets.

ASCET software – safe, proven, and automatically generated

To develop open-loop and closed-loop algorithms requires reliable and professional tools. Engineers at Knorr-Bremse have relied on ASCET for model-based software development since 1999.

Previously, the engineers had to laboriously specify the system functions, which were then programmed in the computer language C by software developers. Back then, block diagrams of open-loop/closed-loop control systems were drafted on the computer with the help of MicroGrafX Designer, the first graphics program available for Windows PCs. When ASCET was introduced, its key advantage was how production-ready C code could be automatically generated from block diagrams.

Wheel-rail system: The brake system’s anti-skid/anti-slip protection prevents braking-induced flat spots.