Mx-Suite™ User Application

MiL/SiL Test Automation & Test Case Reuse

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Business Summary

Increasing cost pressure and compressed development timelines force automotive OEMs to utilize offshore suppliers and continue to push the limits of software development processes. In addition to these problems, OEMs are challenged to provide unambiguous and concise requirements specifications to their suppliers.   Miscommunicating or misinterpreting even a single requirement has disastrous consequences for a program.   The effects of rework can delay a vehicle program by months and create cost overruns.

Technical Summary

An automotive OEM adopted a model-based development process where simulation models are provided to suppliers as executable requirements specifications.   During regular vehicle program updates, the OEM added more features to an already extensive and complex body-control ECU. It took developers several weeks to perform a full test cycle. In the event that a software issue was found, the entire test cycle had to be repeated to insure that "fixes" did not break other features. In order to manage the complexity of the testing process and minimize the turnaround time for testing, the OEM began looking for a solution.

Solution – Mx-Suite™ offers reusable & reliable software testing using virtual ECUs

By using Mx-Suite™, the OEM was able to test the entire body-control module software overnight. In the morning, managers were provided with test result summaries, and detailed test failures were printed for so the designers could determine root-causes of problems. Fully automated, lights-out regression testing of the ECU software saved significant time; allowed new features to be completely tested; and accelerated release of design models to more than four weeks ahead of schedule. As an additional benefit, Mx-Suite™ test cases and results were provided to the supplier with the design models for a truly comprehensive executable specification.

Use Case

An OEM's body control power module is a feature-rich ECU that uses discrete electrical connections and communications over CAN and LIN buses to control power distribution and functionality of vehicle systems such as, lights, wipers/washer, theft alarm, door locks, remote start, ignition feed, etc. These features require complex and highly interdependent control software.

To learn more about the Power Module please refer to the SAE Technical Paper 2007-01-1742

The OEM generates an executable requirements specification of the Power Module requirements using simulation models and an automatic code generator. The suppliers receive the simulation models and prototype code. This model-based development process reduces implementation time, and allows the designer to test the requirements before releasing them to the suppliers. By themselves executable requirements specifications can either contain errors, or are subject to misinterpretation. With the test cases, the specifications are unambiguous and complete.

Issue Resolution - Manual Testing Was the Critical Path in the Schedule

Using manual testing methods, it took multiple people weeks to fully test the Power Module. Whenever a bug was discovered, the test cycle had to start over. Adding new features to the Power Module often caused old features to break and as a result, complete regression tests had to be run every time a change was made. Having an automated way to test the Power Module with a minimum amount of effort to write test cases was necessary to having an efficient model-based development process.

Customer Approach – MiL/SiL Testing

The OEM chose Danlaw's Mx-Suite™ as the tool to validate the Power Module model because of its ease in creating tests, its ability to measure code coverage during testing and its built-in support for requirements traceability. While other methods and tools were considered, they would have involved expensive electronic equipment, test setups and test engineers. With Mx-Suite™, the generated Power Module software code was imported to Mx-Suite's virtual microcontroller running on a PC, where it was thoroughly tested.
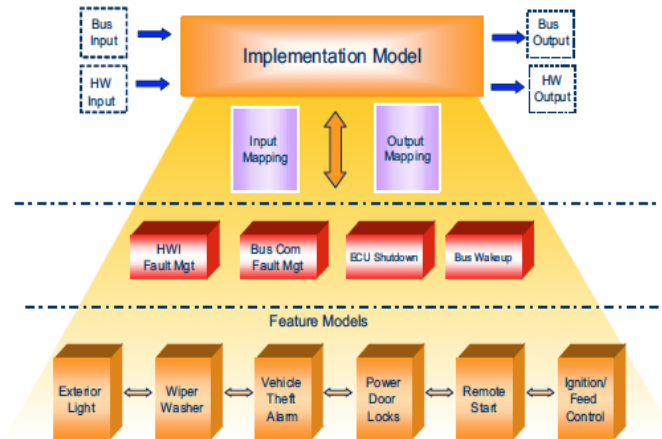
Setting up of the initial test cases consisted of importing field and bench data to Mx-Suite™. Model-based tests and results were imported into Mx-Suite™. Additional tests were quickly handcrafted using Mx-Suite's unified graphical interface to inject test signal/messages into ECU functions and verify its behavior. Software executable code coverage was employed with Mx-Suite™ to ensure that all functions were completely tested.

Initially, when it was thought that all the tests were completed, less than 70% of the code was actually tested. The OEM elected to use an offshore team to create additional tests to push the code coverage beyond 95%. The offshore team was able to quickly develop graphical test using universally understood engineering conventions of charts, graphs, and logs. After nightly tests, short meetings between the offshore testers and the local design team confirmed that the test cases documented the desired behaviors. With test cases and code audits, the code coverage was nearly 100%.

Benefits

With Mx-Suite™, the OEM was able to deliver comprehensive executable requirements specifications to their suppliers. This has the following benefits:

- Eliminates ambiguity and the possibility of misunderstanding the executable specification
- Significantly shorter development and test cycles
- More thorough testing
- Automatic requirements traceability
- Offshore production of test cases

The time and money needed to provide full coverage testing is considerably reduced with Mx-Suite™. Mx-Suite™ provides executive summaries, requirements-traceability, code-coverage and detailed test cases to prove that software is fully tested. Mx-Suite™ provides the test cases that are often missing with executable requirements specifications.

Company profile

Danlaw's 300+ engineering professionals have been providing automotive embedded electronics solutions to OEM's and their Tier-1 supply base for over three decades. Danlaw has facilities in the USA, India and China. Its specialty areas include embedded systems development and testing for Embedded Control Units (ECUs), vehicle network communications, infotainment, and telematics. Its customers include Automotive OEMs, automotive electronics suppliers, fleet and automotive insurance companies worldwide.