

GE Transportation Keeps Locomotive Development and Performance Rolling with Concurrent Real-Time Simulation

In the United States – and in countries around the world – railroads are important arteries for the economy.

At the heart of the industry is GE Transportation, a global technology leader and supplier providing freight and passenger locomotives, railway signaling and communications systems, and information technology solutions.



Key Benefits

- ◆ Mile-by-mile simulations rail conditions to develop optimal locomotive/train configuration
- ◆ Fault injection duplicating worst-case scenarios without endangering operators
- ◆ Shorter time to market and reduced developments
- ◆ National Institute of Standards (NIS) certification ensures the highest levels of quality and compliance
- ◆ Multi-generation capabilities cover changes to locomotives over the course of their lifecycle
- ◆ Fuel savings of up to 17% depending on type of service and rail topography
- ◆ Intuitive, easy-to-learn debugging and analysis

The Challenge:

Achieve New Levels of Performance Without Compromising Fuel Economy

Whether deploying freight or passenger trains, railroad companies must continually meet new levels of safety, performance and fuel economy without sacrificing power. These challenges are passed on to companies like GE Transportation who manufactures locomotives that are delivered globally.

The Solution:

GE Transportation's Simulation, Modeling and Integration Team (SimTeam) standardizes on Concurrent Real-Time Solutions

GE has responded with an investment in hardware-in-the-loop (HIL) simulation where many problems are solved and new efficiencies are developed – even before the metal meets the rail.

It Begins with Simulation and Fault Injection

Walk into GE Transportation's Pennsylvania SimLab and you'll see numerous complete closed-loop HIL locomotive systems and subsystem simulators supporting all locomotive product lines. All of these simulators leverage Concurrent Real-Time products.

GE Transportation's SimTeam has created an environment to help its transportation engineers develop solutions to address a broad range of customer needs and rail operating environments. A SimTeam engineer points out that diesel locomotives are comprised of a large number of electronic, electromechanical, mechanical, pneumatic and operator controllers.

The lab's simulation environments provide the necessary I/O, plant and behavior models along with scripted or user-induced fault injection to allow engineers to develop new control algorithms, customer-requested enhancements, new products and services.

The SimTeam originally developed the lab around Concurrent Power Hawk® systems with NightStar™ Tools. With the introduction of new Concurrent iHawk™ multiprocessors running the RedHawk™ Linux® real-time operating system, the SimTeam is increasing testing capacity and, more importantly, its overall test capability using more HIL, pseudo HIL and virtual platforms.

Taking Control, Reducing Risk

One of the key benefits of GE Transportation's integration SimLab is its ability to provide an environment in which locomotive and train control can be safely tested.

Many customer use-cases center around train safety operations.

To reproduce these scenarios on real locomotives can be a safety risk, therefore the simulation environment is the proper place for safety and failure mode testing. Controlled fault injection allows the SimTeam to duplicate the most hazardous and extreme operational scenarios without putting the operator/test engineer at risk.

As a SimTeam project manager touts, "That's the beauty of cutting-edge Concurrent HIL simulation."



Solution Chosen By GE Transportation Simulation LAB

- ◆ Concurrent RedHawk Linux
- ◆ Concurrent iHawk host system
- ◆ Concurrent NightHawk integrated debugging and analysis tool set

"These tools... are designed to work cross platform, they are intuitive and easy to use."

– GE Transportation SimTeam Member

IGE's Trip Optimizer™: "Cruise Control on Steroids"

Due to the typical 20-year lifespan of diesel locomotives, there needs to be a way to optimize performance in response to emerging regulations, new customer requirements for power and fuel economy and even changes in computer system platforms – without locomotive and system downtime. This leads us to a dramatic example of the power of HIL simulation – GE's Trip Optimizer energy management system. Trip Optimizer is a fuel efficiency software application that GE has built into its own diesel electric locomotives, and will be designing for other manufacturers.

Designed on simulators using Concurrent iHawk computers, Trip Optimizer is what the SimTeam calls "cruise control on steroids." The application helps heavy haul railroad companies to efficiently run a variety of trains on their rails. Trip Optimizer can virtually recreate a customer's rail route – mile by mile – accounting for a number of factors that affect operating efficiency.

Staying on Track: Standardizing on Concurrent Real-Time

GE Transportation began migrating its HIL simulation operations to Concurrent in 1995. Since then, GE has standardized on Concurrent products including NightStar tools for debugging, scheduling and developing model sets running in real-time.

According to a SimTeam engineer manager, "I have seen these tools evolve over 20 years. They have been especially helpful in optimizing performance, and they are intuitive and easy to use. In the hands of our senior engineers, there is a high degree of comfort in new application development and in the training of new engineers." Overall, standardization on Concurrent Real-Time products has provided consistency and multi-generation support that has easily accommodated technology insertion and new HIL features over time. This has saved time and money – with virtually no retooling.

Getting Ready for Next Generation Locomotive Design, Manufacture and Operation

GE Transportation is continually striving to anticipate and meet new customer requirements. One area of interest is the use of liquid natural gas fuel. Like in automotive hybrids, it is foreseen that the next generation of locomotives will be able to switch power sources from diesel to natural gas on the fly. Natural gas offers a significantly lower price point plus environmental benefits. Concurrent's iHawk real-time systems are designed to accommodate simulation for that evolution.

On the I/O side, GE is now using Concurrent's new CP-DA3218 32-channel, 18-bit analog output card in its complex simulation systems. With twice the number of channels as previous AO cards, the CP-DA3218 allows smaller subsystem HIL test stands to be used for stand-alone and HIL system integration. The new Concurrent card fully meets National Institute of Standards and Technology (NIST) requirements for quality and dependability.

The Results: New Economies, Better Performance, Increased Safety

Overall, GE Transportation has been able to reduce time-to-market while maintaining the highest manufacturing standards. The introduction of new, NIST-certified Concurrent technology offers GE customers assurance of optimal performance. And in response to ever-tightening EPA and global requirements, the simulation-designed Trip Optimizer application has helped GE customers realize fuel savings of up to 17% depending on type of service and rail topography. The effectiveness of GE Transportation's SimLab is a testimony to its approach to problem solving. In fact, at a time when many companies are mandated to do more with less, GE is increasing its investment in real-time simulation technology.

About Concurrent

Concurrent Real-Time is one of the industry's foremost providers of high-performance real-time Linux computer systems, solutions and software for commercial and government markets worldwide. Concurrent has deployed and supported thousands of multi-core solutions for the most demanding of mission-critical applications for over four decades. These applications include hardware-in-the-loop and man-in-the-loop simulation; data acquisition; and process control in the aerospace, defense, automotive, medical, energy, transportation and financial industries. The company's products include the RedHawk Linux real-time operating system with guaranteed response; NightStar tools for advanced Linux debugging and analysis; and application-specific tools for simulation and testing.

When you need guaranteed response time, you need Concurrent Real-Time for your mission-critical applications.
Schedule an online demo today.

Learn More

about Concurrent's award-winning Linux solutions:

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