

Trip Optimizer for Railroads

On-time arrival with the least fuel expenditure is a key priority for freight and passenger railroads worldwide. North American railroads consumed 4 billion gallons of fuel in 2008, 26% of operating costs.

Trip Optimizer is an easy-to-use control system that allows the crew or dispatcher to achieve on-time arrival with the least possible fuel use.

Optimal driving solutions are computed onboard and executed in a closed loop using GPS-based navigation. Train and track parameters are adapted online to reduce model errors. Fuel savings of 4%-17% are realized.

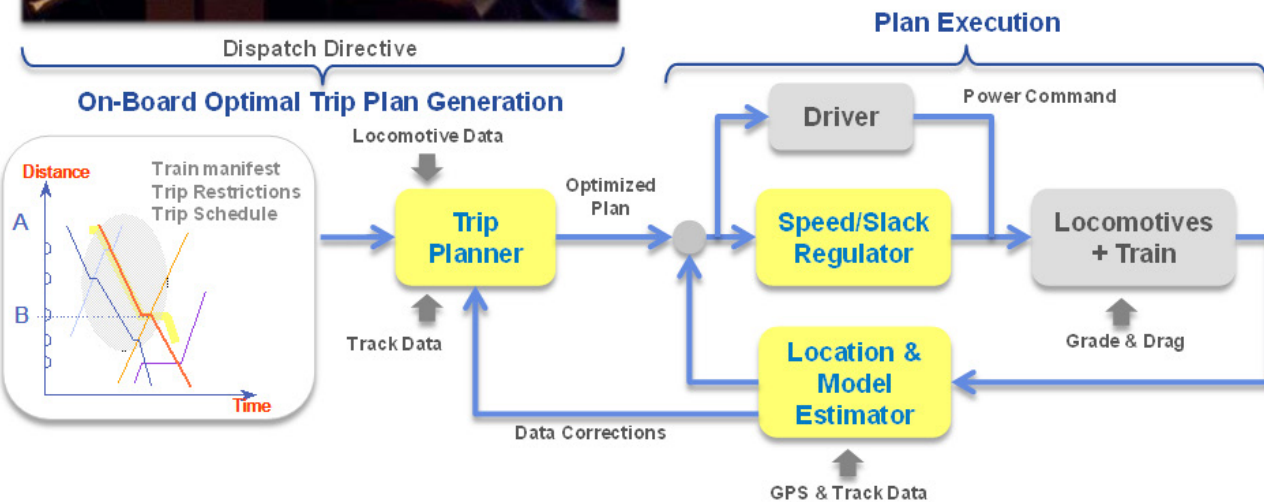


Trip Optimizer Modules

- *Trip Planner* finds the driving strategy (speed and throttle) that minimizes fuel consumption for the target arrival time and satisfies speed limit and other train and locomotive operating constraints.
- *Speed Regulator* closes the loop around the plan to correct for modeling errors and external disturbances and provides compensation for slack action in the distributed dynamics of typical mile-long, heavy trains; both hands-off closed-loop and driver-in-the-loop “coaching” solutions are available.
- *Location and Model Estimator* provides precise location of the train, compensation for GPS dropouts, and adaptively tracks train parameters such as weight, length, and drag.



Dispatch Directive



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Inventions and Innovations

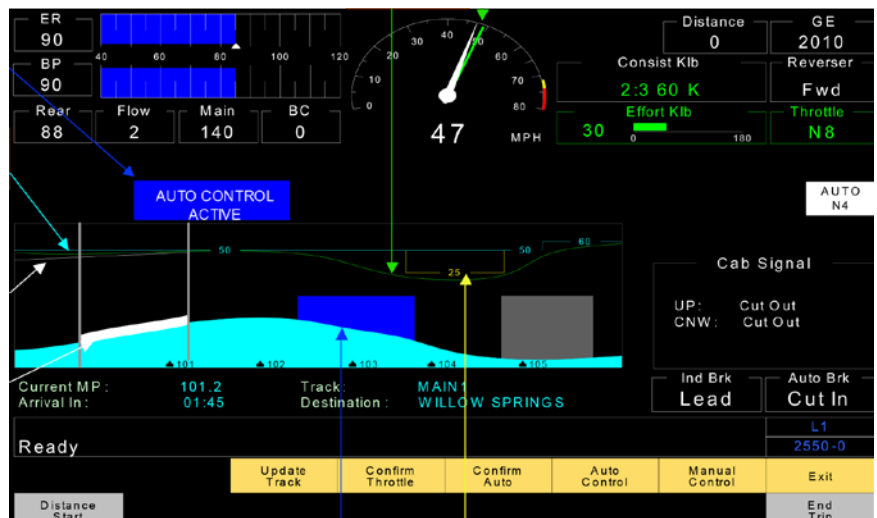
Trip Optimizer provides innovative solutions for optimization, estimation, control, and operator interface requirements to achieve fuel savings and emissions reductions for freight railroads.

- Computation of the driving plan requires solving a math program with thousands of constraints and decision variables in seconds, with time- and fuel-based objectives.
- A robust speed regulator design relies on a loop-shaping algorithm to maintain stable operation and to deal with variations in intercar separation and the resulting forces.
- A location estimator provides precise coordinate tracking via Kalman-filter-based compensation for GPS dropouts. Model-based methods adaptively track key train parameters using GPS and other locomotive data. Tools for extensive offline analysis were also developed to produce high-integrity database sources for use in control and estimation.
- Innovative displays bring intuitive mode awareness and ease of use to the underlying optimal control strategy. Experienced drivers can learn the system in minutes.
- Robust satellite communication from the locomotive provides rapid access to train data (and updates) directly from railroad mainframes with backup from a dedicated 24 x 7 GE facility.

For each Evolution locomotive on which it is used, Trip Optimizer can reduce fuel consumption by 32,000 gallons, cut CO₂ emissions by more than 365 tons, and cut NO_x emissions by 3.7 tons—per locomotive per year. If deployed on the ~10,000 similar locomotives in service in North America, this is equivalent to taking a million passenger cars off the road for a year.

Trip Optimizer is a product of GE Transportation, Erie, Pennsylvania, USA. It has recorded more than 150 million miles in successful revenue service worldwide.

- Adopted by railroads in North America, Australia, and Brazil.
- Total fuel savings to date of over 35 million gallons!



For more information: visit <http://www.getransportation.com/>.