



LOCKHEED MARTIN 
We never forget who we're working for®

Rail Systems
Improving Efficiency and Safety in the Rail Industry



System Integration and Solution Expertise

Lockheed Martin, a world leader in systems engineering, is helping to bring 21st century technology to the world of railroading. Lockheed Martin's Positive Train Control System utilizes commercial off the shelf technology with open architecture design to create a fully upgradeable product specifically tailored to fit the needs of each individual railroad. The Lockheed Martin solution increases train schedule reliability and track capacity, improves safety, and meets industry cost effectiveness objectives.

Lockheed Martin is currently working with Australian Rail Track Corporation on a full-scale communications based authority system and with Norfolk Southern on their Location Monitoring and Switch Awareness Program. Lockheed Martin is marketing the system on a world-wide basis — carefully tailoring the design to meet local operating rules and standards. Lockheed Martin provides rail project management and system engineering expertise in the United Kingdom, Australia and other countries.

The Lockheed Martin solution increases network capacity, reduces track infrastructure, improves safety and meets industry cost effectiveness objectives.

The Lockheed Martin design, development and test processes meet FRA and CENELEC rules for train control safety.

Cost Effectiveness, Safety Design and Innovative Technology

Lockheed Martin's PTC system is designed to perform in a stand-alone, vital, safety-critical manner. Not simply an overlay on existing signaling systems, which adds cost without providing sufficient operational benefits, the Lockheed Martin system is capable of performing the functions of today's CTC systems-at a much reduced cost.

The Lockheed Martin design, development and test processes meet FRA and CENELEC rules for train control safety. A quantitative risk assessment process greatly enhances the ability of new territories to deploy PTC in an expedient manner. Our systems and software engineering process is ranked in the top one percent for consistency and repeatability by the Carnegie Mellon University.

Lockheed Martin has designed the Location Determination System (LDS), which provides track position accuracy to within 3 meters. LDS uses a combination of GPS, inertial sensors, track database and application software to accurately determine precise train location and enable track discrimination — providing capacity increases while reducing track infrastructure.

Lockheed Martin Positive Train Control in Operation



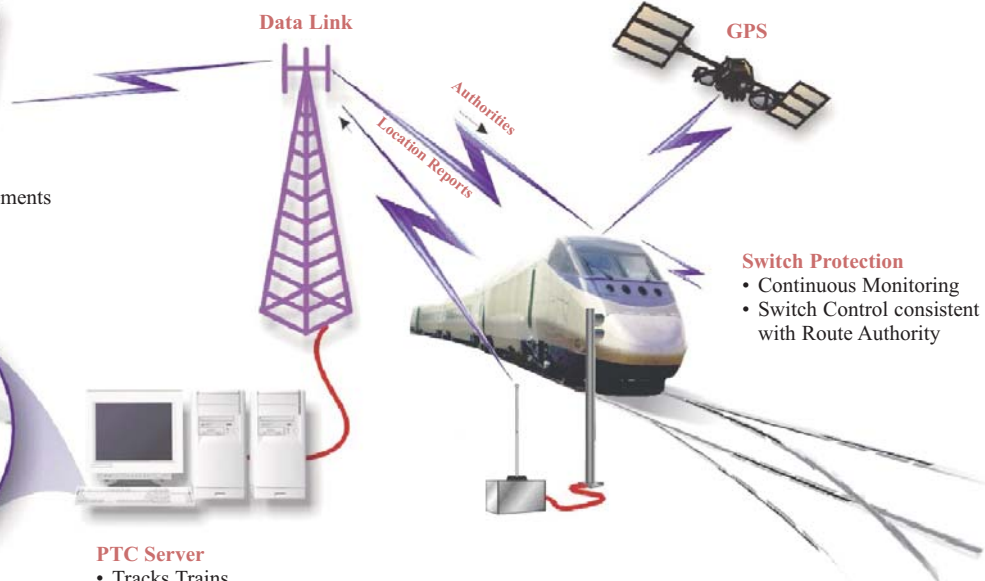
Roadway Worker Terminal

- Display Movement Authorities
- Accept Requests and Acknowledgements from Engineer-In-Charge



Computer-Aided Dispatching

- Minimal Change to Operator Procedure



PTC Server

- Tracks Trains
- Monitors Field Conditions
 - Track Circuits
 - Switches
 - Defect Detectors
- Computes Authority Limits
- Transmits Movement Authority and Speed Restrictions to Trains

Onboard Equipment

- Displays Authorities and Speed Restrictions
- Warns Crew when Approaching Limits
- Warns of Roadway Workers Performing Authorized Work on Track
- Enforces Authorities and Restrictions
- Reports Location to Server

Switch Protection

- Continuous Monitoring
- Switch Control consistent with Route Authority

Building Block	Functions
Location Monitoring	<ul style="list-style-type: none"> • Train location determination • Route and track characteristics • Train logical initialization and termination • Negotiation of functionality levels between locomotive and territory • Display of train location to locomotive crews, office personnel, and at remote locations
Speed Management	<ul style="list-style-type: none"> • Civil and temporary speed restrictions • Lading and equipment-related speed restrictions • Display of speed limits to locomotive crews • Field entry of track condition speed restrictions
Authority Management	<ul style="list-style-type: none"> • Train authority issuance and release • Roadway worker authority issuance and release • Display of authorities to locomotive crews and roadway workers • Incremental authority issuance and release for “moving” block operations • Unequipped/non-communicating train tracking
Train Integrity Monitoring	<ul style="list-style-type: none"> • Train length monitoring • Train continuity monitoring • Wayside train detector monitoring
Route Integrity Monitoring	<ul style="list-style-type: none"> • Wayside and route device monitoring • Wayside route detector monitoring
Broadcast Warnings	<ul style="list-style-type: none"> • Detection of potential authority violations • Detection of trains stopped by emergency brake application
Emergency Response	<ul style="list-style-type: none"> • Emergency reduction of authorities • Detection of unauthorized movements
Power Switch Control	<ul style="list-style-type: none"> • Control of power switches
Warnings and Enforcement	<ul style="list-style-type: none"> • Locomotive crew warnings • Reactive and Predictive enforcement
Fuel Management	<ul style="list-style-type: none"> • Display of suggested train handling to locomotive crews

**Positive
Train Control
Functionality**

Customers can take control of their system and update technology using multiple suppliers to reduce acquisition and total ownership costs.



Location Control Unit (LCU)

- Locomotive position within 3 meters
- Train Control–Speed, Authority, Breaking



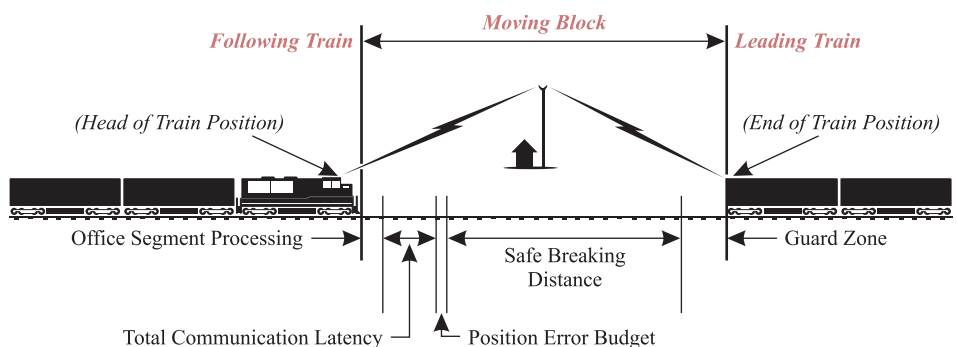
PTC Server

- Monitors all trains and track infrastructure
- Coordinates with Dispatch

Open System Architecture Approach

Lockheed Martin PTC is based on an open, non-proprietary system design that facilitates interoperability, compatibility and portability by using commercial off-the-shelf hardware and modular software components. Customers can take control of their system and update technology using multiple suppliers to reduce acquisition and total ownership costs.

Improving Safety and Increasing Capacity



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