Wabtec CORPORATION

DATA SHEET

PTC 2.0

The world's most advanced train control system

INCREASE SAFETY AND CAPACITY; REDUCE COSTS

One of the biggest challenges for railway operators is to increase capacity and reduce operating costs. Existing signaling infrastructure can't keep pace with today's rail demands for more efficient transport. Dedicated radio networks, track circuits, axel counters, transponders, signals, and cables all add cost, maintenance, and performance impacts.

PTC 2.0 combines virtual block signaling, communications, and precise positioning into a comprehensive train solution that is truly transformative for the rail industry, significantly reducing signaling infrastructure – and ultimately enhancing safety, increasing capacity, and saving railroads significant costs.

KEY DIFFERENTIATORS

Virtual Block Signaling
The integration of I-ETMS Protect with IVOC (Independent Validation Office Controller) enables the realization of virtual block capability, which is transformative for the rail industry in reducing or eliminating signaling infrastructure and enabling more traffic to move on existing track.

Communications
PTC 2.0 supports all IP-based telecom technologies, ensuring seamless integration with existing infrastructure and enabling flexible, future-proof communications.

Ultimate Safety Assurance
PTC 2.0 is a SIL 4 certifiable safety system, supporting the highest levels of safety and dependability.

KEY TECHNOLOGIES

OnBoard

Enhance the train and its crew with greater intelligence, safety, and visibility.

- **I-ETMS® Protect**: Interoperable Electronic Train Management System. Vital management and application of movement authorities and restrictions.
- **GoLINC™ Precision Navigation Module**: High precision locomotive location with centimeters of accuracy.
- **TrainLink™ EOT & HOT Devices**: Industry leading communication capabilities for robust train integrity monitoring.

Control Center

Optimize dispatch and transform the delivery of movement authorities and control of switches with virtual block signaling.

- **IVOC**: Independent Validation Office Controller. Safety critical delivery of movement authorities and restrictions. Centralized interlocking with remote control of power switches.
- **TMDS CAD**: Computer Aided Dispatch. Streamline dispatch execution and improve service delivery.
- **PTC Apps**: Back Office Server (BOS) and Mobile Device Manager (MDM) provide interface applications between Control Center and Onboard.

Wayside

Modernize wayside infrastructure by reducing equipment and associated maintenance.

- **Communications**: PTC 2.0 supports a wide range of communications technologies, including Cell, Radio, Wi-Fi, and Satellite, for powerful performance and cost effectiveness.
- **Object Controllers**: Simplified object controllers are used to control switches, electric locks, and derailers.
- **Wayside Detectors**: Integrates with wayside detector systems and Control Center to meet specific needs.
- **TMDS SSMC**: Smart Secure Mobile Client. Provides maintenance of way field crew users with real-time track line display and other features to increase safety and productivity.
- **Wireless Crossings**: Combines a wireless communication control system with powerful real time analytics and monitoring – for optimized crossing activations and insights.

BENEFITS & OUTCOMES

Cost

Minimal CapEx: Minimal equipment to be installed, minimal installation, minimal disruptions to operations.

Minimal OPEX: Minimal equipment drives minimal maintenance, minimal failures.

Safety

Prevents Collisions: Enforces safe train separation across the network.

Prevents Overspeeds: Enforces civil and temporary speeds.

Protect Track Workers: Enforces track permits, speed restrictions.

Flexibility

IP-based radio protocols ensure maximum flexibility.

Easy integration with other transport modes for intermodality.

Capacity

Increases capacity to move more goods and passengers by rail on existing infratructure.

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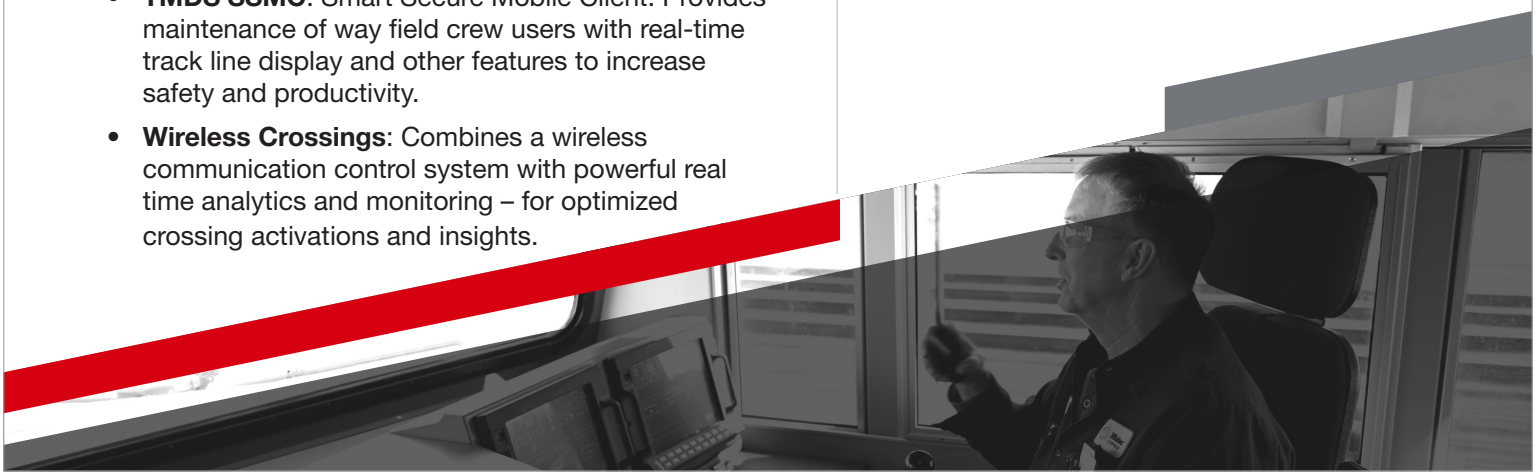
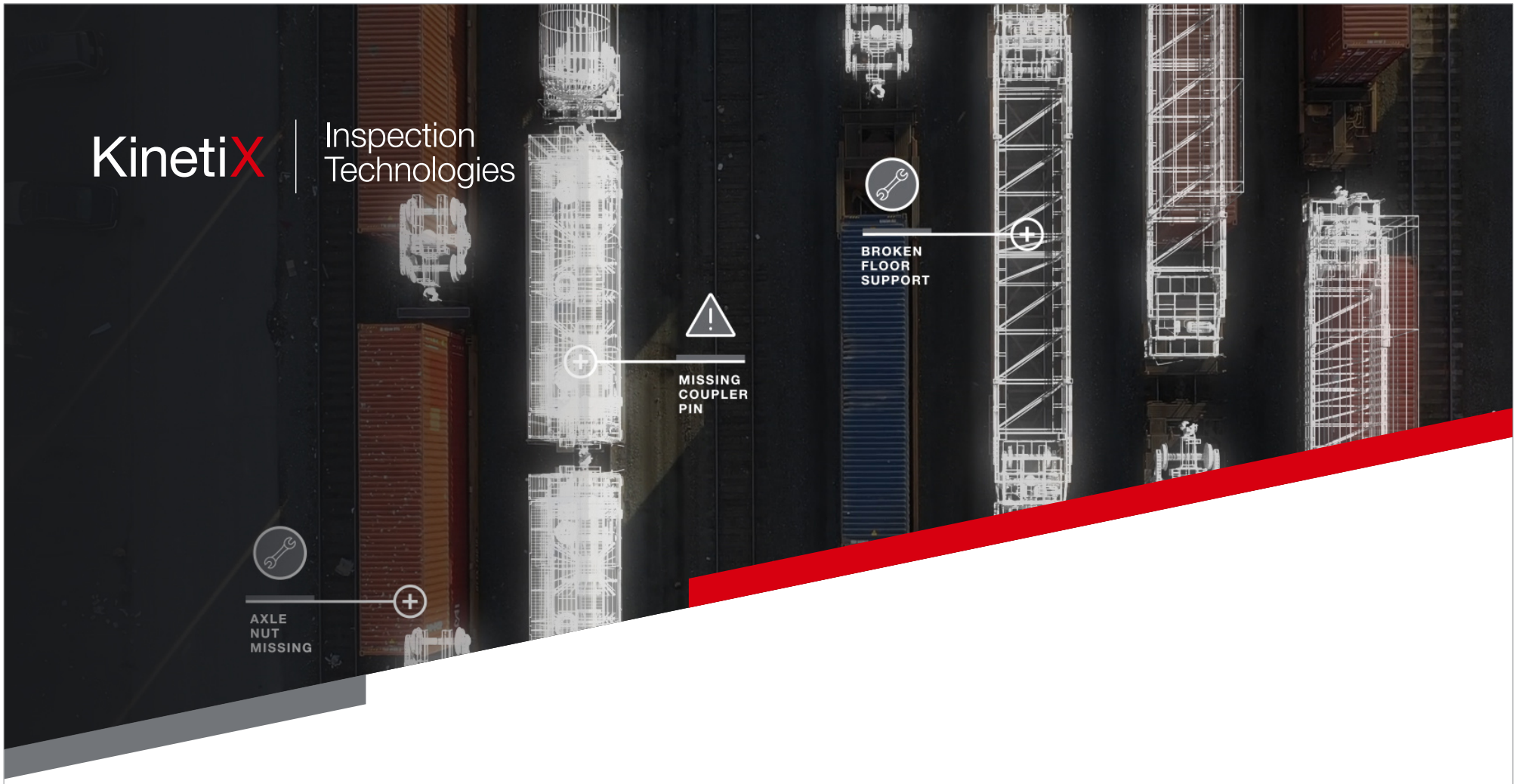




KINETIX INSPECTION TECHNOLOGIES

Keeping railway assets in motion

Wabtec CORPORATION

KinetiX | Inspection Technologies

How can you make your operation faster and more efficient while helping to ensure optimal performance and safety?

In today's challenging environment, many railroads struggle with asset condition, situational awareness, and a workforce in transition.

RAIL OPERATORS NEED THE ABILITY TO

Streamline inspections and operations:
Automate inspections. Improve accuracy.

Increase asset reliability and availability:
Preempt issues. Maximize workforce. Reduce cost.

Improve safety and compliance:
Mitigate incidents. Protect personnel.

Increase situational awareness:
Maintain visibility. Execute efficiently.

IMPROVE ASSET PERFORMANCE, REDUCE MAINTENANCE COSTS, AND MINIMIZE TRAIN DELAYS.

Railroads worldwide face a common challenge: how to maximize the operational availability and reliability of rail assets while minimizing costs. Within every trip, there are hundreds of variables that when not maintained properly, can reduce fuel efficiency, shorten maintenance intervals, degrade asset life, or even bring the mission to a complete halt, resulting in costly network delays and service interruptions.

KinetiX Inspection Technologies delivers the next generation of automated rolling stock and infrastructure monitoring, inspection, and maintenance optimization.

WAYSIDE

Automated inspection and condition assessment of assets — ranging from wheel surface condition to full train inspection — while operating at track speeds.

KEY TECHNOLOGIES

Advanced vision systems

Image processing

Acoustic sensors

Thermal sensors

Vibration sensors

Hot Bearing Detection

TRACK

Non-destructive internal flaw detection utilizing advanced ultrasonic technology and AI/ML-enhanced digital processing to monitor rail condition.

KEY TECHNOLOGIES

Multi-channel ultrasonic wheel probes

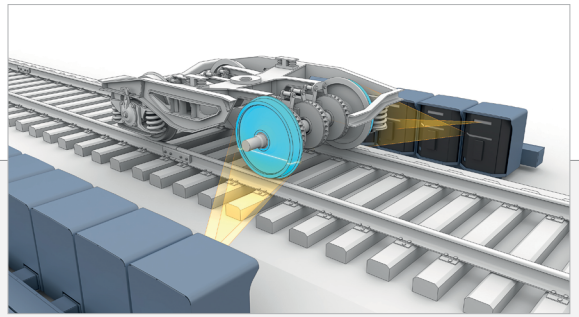
AI/ML digital data processing

Cloud data storage & reporting

Run-on-run condition monitoring

Solutions Showcase **Machine Vision**

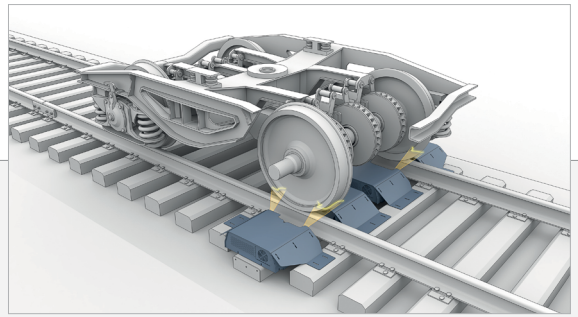
Wayside Inspection



WHEEL SURFACE INSPECTION

TreadView®

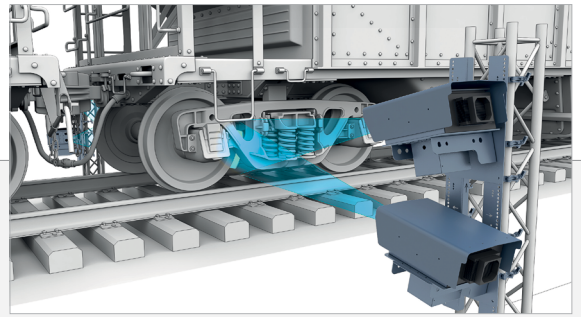
- Shelled and spalled tread
- Major scrapes, dents, and gouges
- Broken/missing wheel sections
- Shattered rim
- Broken /damaged flange
- Wheel flats and slid flats
- Wheel OOR (out-of-round)
- Built-up tread
- Tread groove



WHEEL PROFILE MEASUREMENT

WheelView®

- Full wheel profile
- Flange height
- Flange width (thickness)
- Flange slope
- Tread hollow
- Rim thickness
- Back-to-back (B2B)



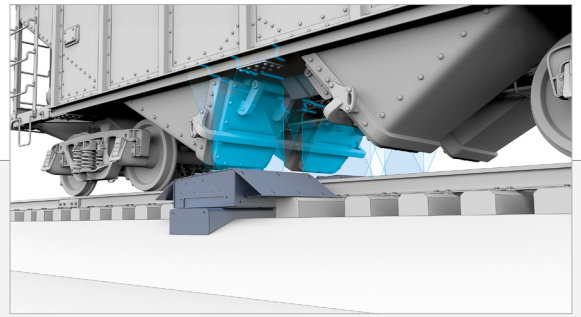
BRAKE INSPECTION AND MEASUREMENT

BrakeView®-Shoe

- Shoe thickness in top and bottom positions
- Shoe wear profile
- Shoe position with respect to the wheel surface
- Missing key detection
- Missing shoe detection
- Shoe securement key length

Solutions Showcase **Machine Vision**

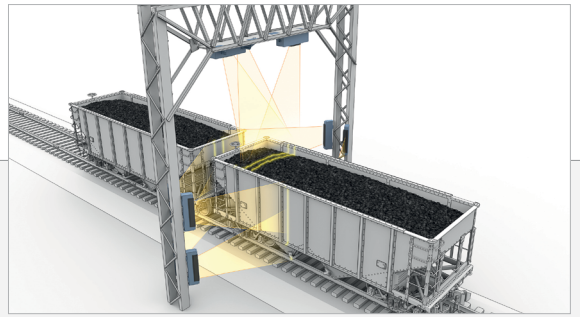
Wayside Inspection



RAILCAR STRUCTURAL
COMPONENTS + UNDERCARRIAGE

CSCView

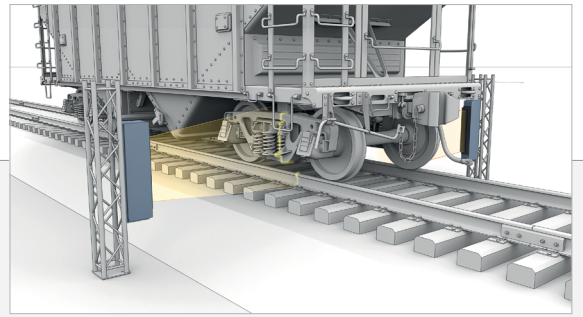
- Floor support inspection
- Center sill crack detection
- Brake beam inspection
- Missing bolt(s) detection: coupler and draft gear carrier plates
- Missing knuckle pin detection
- Missing uncoupling lever detection



FULL SCALE TRAIN IMAGING & INSPECTION

TrainView

- Wagon tag identification
- Missing/damaged reflective decals detection
- Missing label holder detection
- Missing brake wheel detection
- Missing/broken shedding shields detection
- Bent top chord detection



PANTOGRAPH INSPECTION

TruckView

- Wedge height
- Bolster height
- Spring nest height
- Spring inspection
- Missing bearing cap and cap bolts
- VTA valve inspection
- Missing R-clip and clevis pin detection

Solutions Showcase

Acoustic, Vibration, and Thermal Monitoring

Wayside Inspection

BEARING ACOUSTIC MONITOR

RailBAM

Axle bearing faults

Beam forming technology

Multiple bearing classes

Axle count

Aar rules compliant

Early and consistent fault detection

Fleet-wide data

Ib variant targets:

- Inboard axle journal
- Gearboxes
- Suspension/u-tube bearings
- Traction motors

WHEEL CONDITION MONITOR

WCM

Wheel impact detection

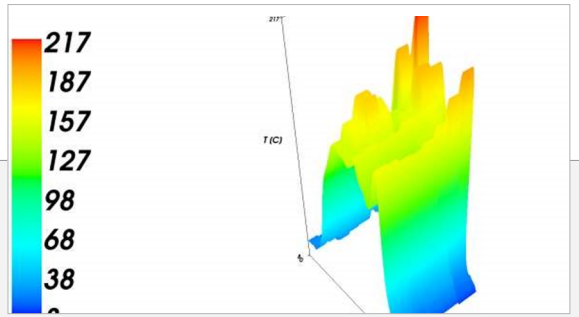
Weight measurements for wheel, axle and vehicle

Reporting overloading at different levels

Vehicle end-to-end (ETE) and side-to-side (STS) imbalance

Detection and reporting of poor wheel load distribution

Detail surface defect detection via imaging systems (optional)



ANALYTICS APPLIED TO THERMOGRAPHIC IMAGES

Hot Bearing Detection

Identifies and records temperatures of standard axel, wheel, and braking systems

Detects hot bearings, wheels and defective brakes with high reliability

Self calibration is accomplished after every train has passed, eliminating quarterly calibration efforts

The system is not subject to the failure modes of an externally calibrated relative temperature reading

Solutions Showcase

Ultrasonic Rail Flaw Detection

Track Inspection

ULTRASONIC

FLEX Ultrasonic Rail Flaw Detection System

Ease of maneuverability and compact size for tight clearances

Carriage can be mounted to multiple vehicle platforms (Nordco or customer provided)

Flex carriage can be raised in seconds

Multiple wheel probe configurations available to suit any application

Enhanded pattern recognition & defect classification software

GPS tagging of system movement and defect location, to the thousandth of a mile

ULTRASONIC

OnePass Portable Ultrasonic Rail Flaw Detection System

Portable, 12-channel, battery powered, digital ultrasonic flaw detector

RailTruck software with A-Scan, B-Scan, recognition engine & full audit capability

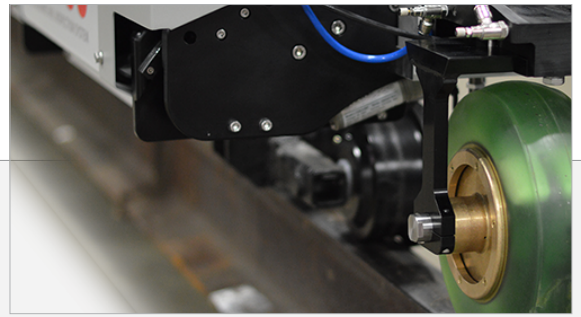
Lightweight, rugged tablet user-interface

Smart Tracking of GPS locations

SmartFlow couplant delivery

On-board hand test kit with wireless flaw detector software

Rugged transport case



ULTRASONIC

Rail-Bound Ultrasonic Rail Flaw Detection System

Continuous, non-stop testing at speeds up to 45 mph (60 km/h) under optimal rail conditions

Integration with other track inspection systems to provide maximim defect detection and management

Patented enhanced pattern recognition and defect classification

GPS tagging of car movement and defect location, to the thousandth of a mile

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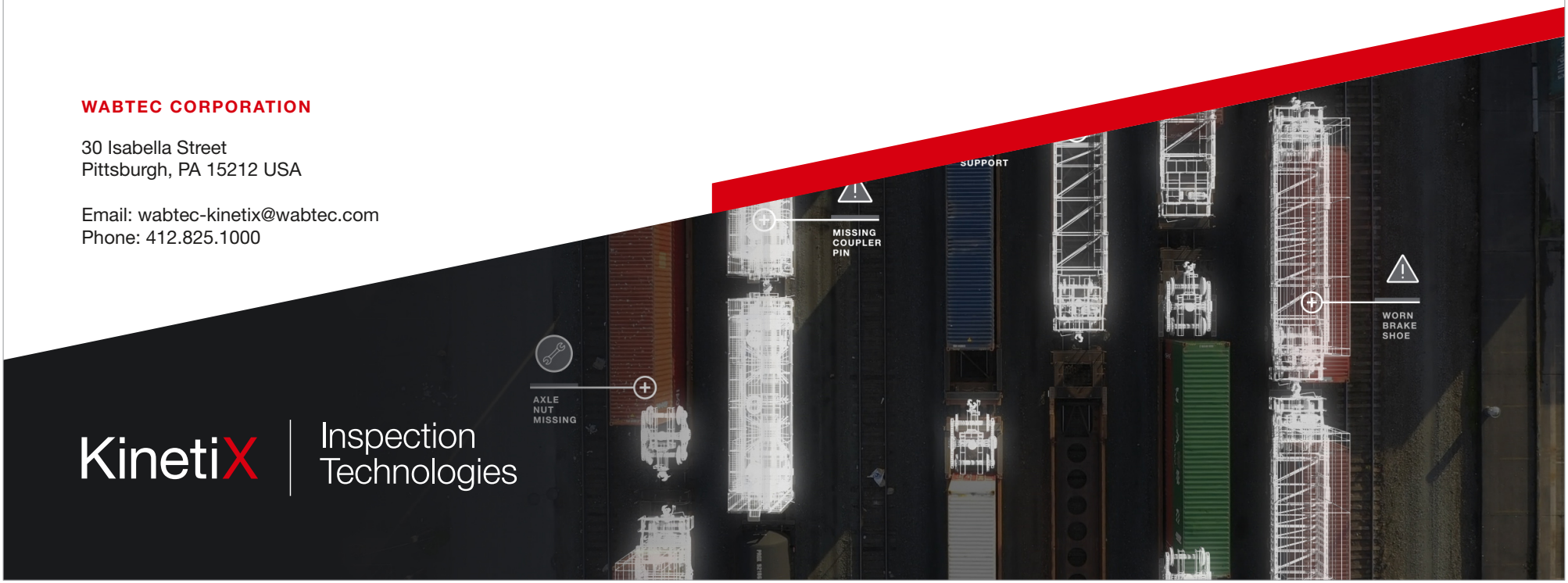


KinetiX | Inspection Technologies

Wabtec CORPORATION

OVERVIEW DATA SHEET

RAILCAR TELEMATICS

Enabling smart connected assets.

TRANSFORMING RAILCAR ASSETS

Today, there is no real-time visibility into the status and health of over 90% of the estimated 5.2 million railcars worldwide. Equipping these freight cars with telematics, GPS, and sensor technologies enables customers to capture the hidden information and turn it into actionable data that is transformative to the customer experience and supply chain efficiency.

Railcar Telematics builds on Wabtec's rich history serving the freight car markets with next generation solutions. The solution enables customers to capture the hidden information inside a railcar and drive outcomes that matter. With Wabtec's new solution, rail shippers and operators can turn cargo into smart connected assets that communicate their location, health, and status. The result: freight visibility, increased safety of rail assets, and new levels of operational efficiency.

BENEFITS

Asset Visibility:
Track and trace your freight and rail assets. Gain access to first and last mile data.

Increase Safety:
Use health data to improve railcar maintenance and ensure reliability and safety.

Customer Satisfaction:
Enhance customer communications through informative insights and status notifications.

Productivity & Operational Efficiency:
Learn how railcar and tank container assets are being utilized to drive operational improvements.

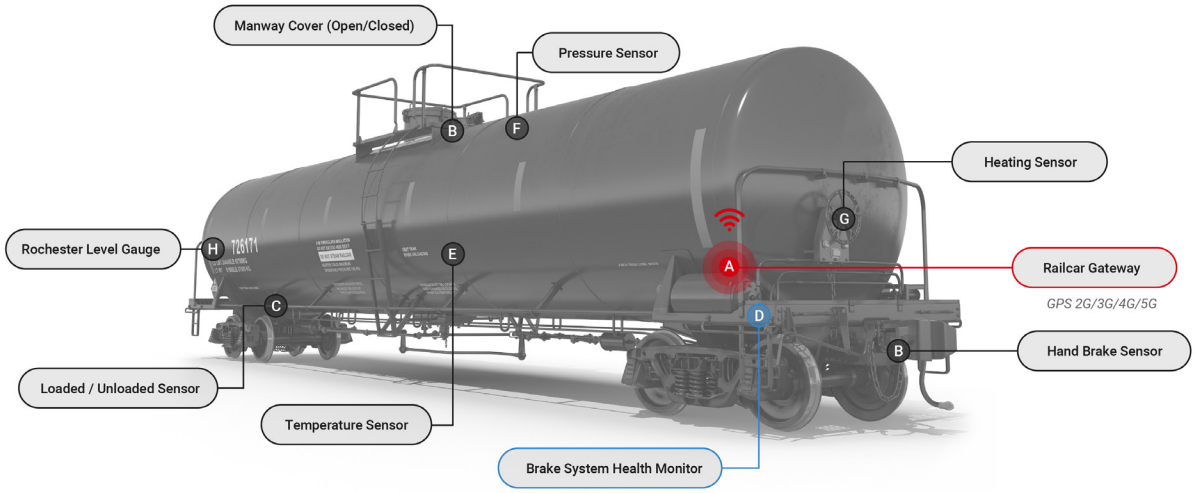
Preserve Product Quality:
Monitor the required temperature and pressure levels of tank containers to ensure that cargo reaches its destination in optimal condition.

SENSOR EXAMPLES

SENSORS & VALUE DELIVERED

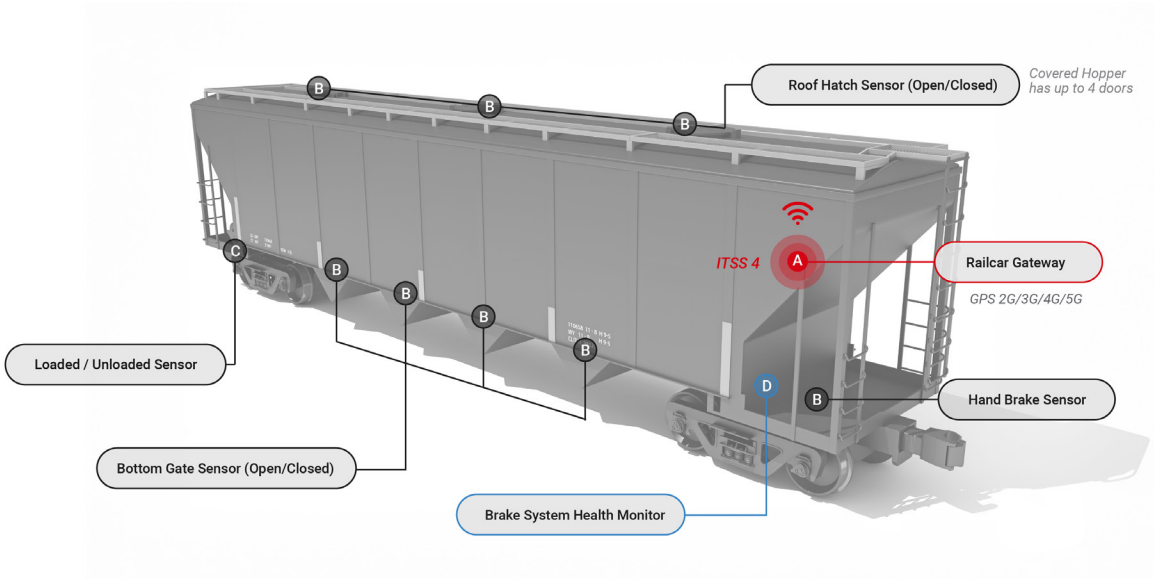
Name	Description	Value Delivered			
		Visibility	Safety	Equipment Utilization	Service Excellence
Communication & Location Terminal	Location status, communication of sensor data, and data transfer	●	●	●	●
Bridge	Location status, communication of sensor data, and data transfer	●	●	●	●
Open/Close Sensor	Determines if hatch, manlid, or valve is open or closed		●		●
Handbrake Sensor	Status of the handbrake		●	●	
Door Sensor	Measures if a railcar door is open or closed		●		
Brake Sensor	Status of the brake-rod		●		
Brake System Health Monitor	Operational condition and status of the brake system		●	●	
Load/Unload Sensor	Load status of the railcar			●	
Pressure Sensor	Pressure inside the tank		●		●
Temperature Sensor	Temperature of the tank contents		●		●
Heating Sensor	Temperature of an external heat source to warm the cargo				●
Heating & Cooling Terminal	Provides control of heating and cooling systems for the cargo				●

EXAMPLES
TANK CAR



Sensor Types

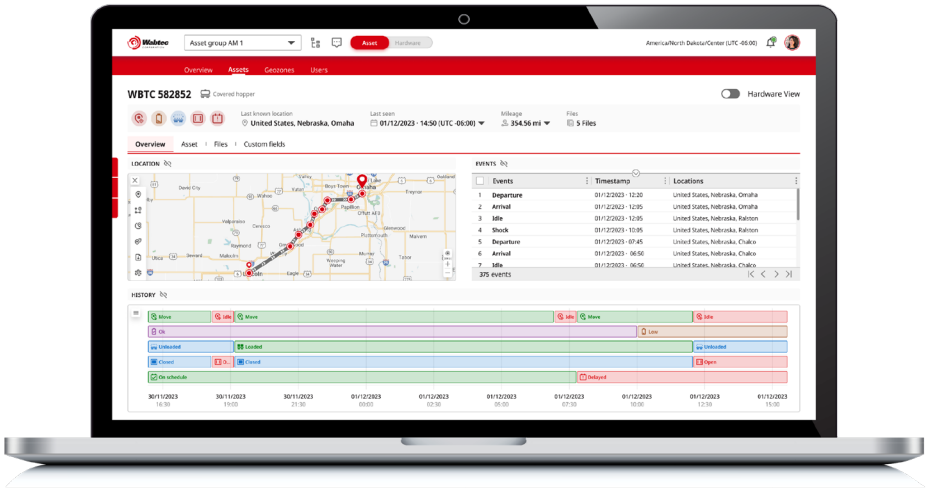
COVERED HOPPER



Sensor Types

WEB PLATFORM

Powerful digital tool for cargo and fleet management.



PLATFORM FEATURES

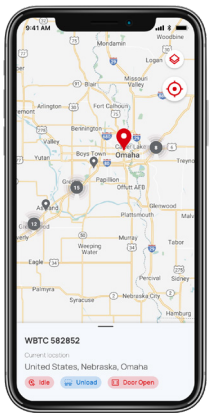
- **Cargo Monitoring Asset View**: Actively monitor freight in transit; view historical data.
- **Powerful Table Options**: for easy data selection, analysis and management.
- **Analytics Dashboard**: a customizable overview of assets and their status.
- **Asset Group Navigator**: Easily structure your assets/fleets; create & control business groups, assets, geozones & products.
- **Access Control**: provide the right stakeholders access to the right data.
- **Business Attributes**: add your own fields to asset groups, assets, geozones or products.
- **Business Status**: apply your own set of rules to trigger business decisions.
- **Integration with 3rd Party TMS**: Use telematics data to compare to plan.

PLATFORM FEATURES (CONT'D)

- **Event Notifications**: Can be shown on the platform, sent to e-mail addresses, and sent to phones via a text message.
- **Upload Files**: Technical documents, maintenance reports, and custom documents are directly available when you're handling assets.

MOBILE FLEETS APPLICATION

Provides a lightweight alternative to the Web Platform for mobile devices; supports IOS/Android.



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Wabtec CORPORATION

DATA SHEET

MOVEMENT PLANNER PACING

TRANSFORM INEFFICIENCY INTO FUEL SAVINGS

When trains sit in sidings, there is a two-fold impact on efficiency: First, wasted fuel spent getting to the destination quicky, only to have to sit and wait in a siding. And second, the impact on the crew, having to spend more time in the CAB, waiting for another train to pass.

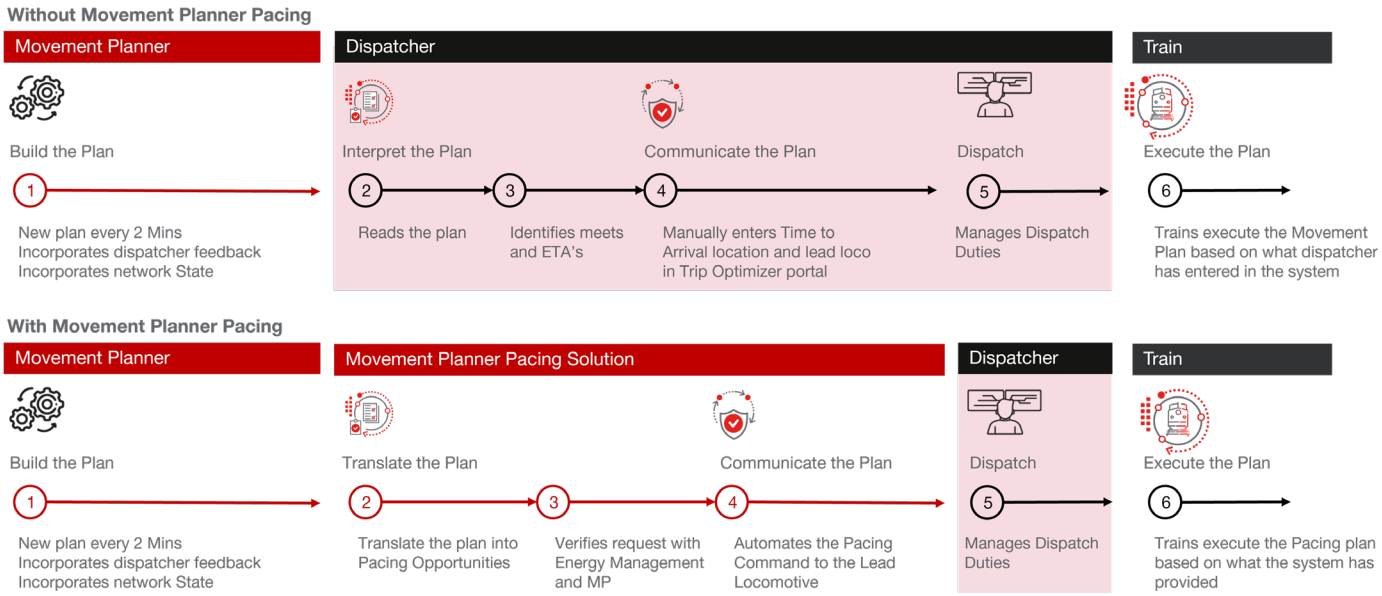
Movement Planner Pacing shifts the delay from sidings to line-of-road, minimizing idle time, saving incremental fuel, and having no impact on network velocity.

SCENARIO

Train Dwelling in a Siding

- An energy management system (EMS) equipped train is traveling at the EMS recommended speed to its next planned stop.
- The EMS is not aware the train, based on Movement Planner, is planned to meet a high priority train and dwell in a siding before it reaches the planned stop.
- The train speeds to the meet location and idles for an extended length of time in the siding, burning excess fuel.
- What if you could proactively identify these meet events, communicate them to the EMS system and slow the train on the line of road, resulting in fuel savings without impacting network velocity? Movement Planner Pacing makes this possible.

HOW PACING WORKS



BENEFITS

Saves Fuel
2-4% fuel savings per dispatch region.*

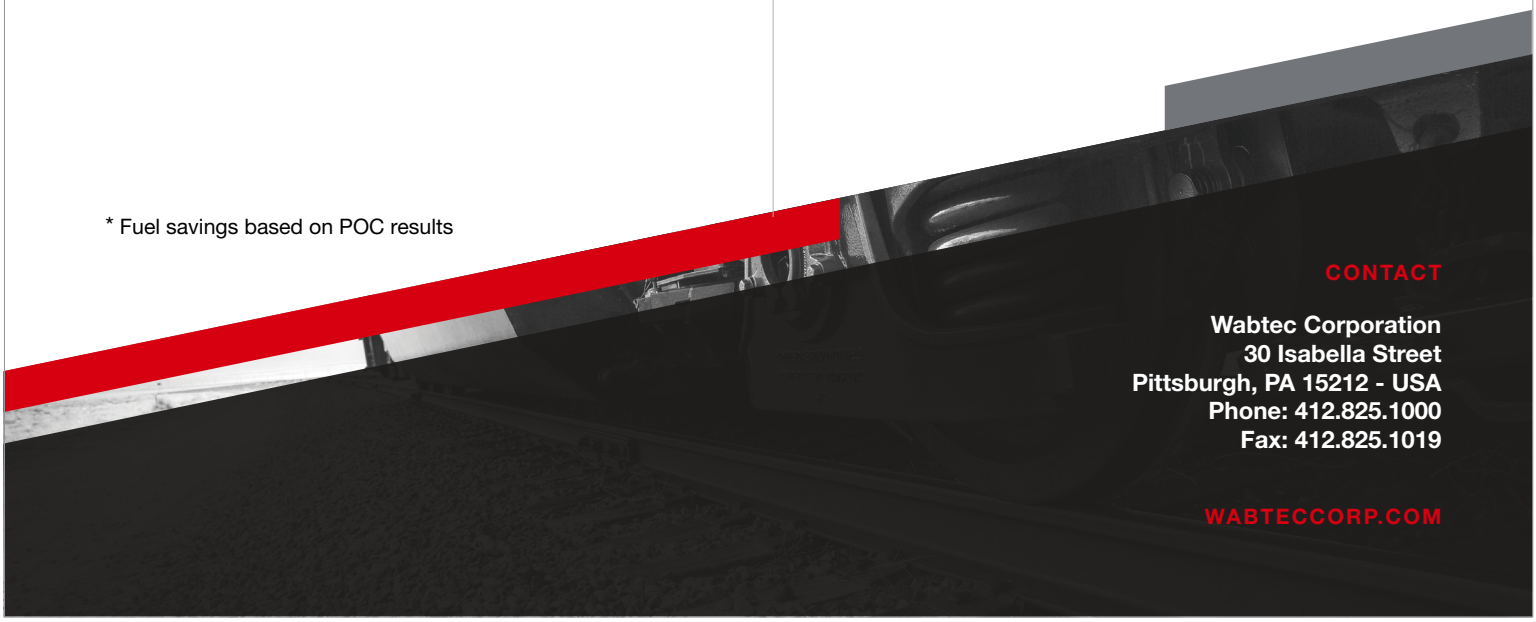
Minimizes Idle Time
Less time spent in sidings.

Zero Impact to Network Velocity
Maintain service levels while gaining fuel efficiency.

FOUNDATION OF NETWORK FLUIDITY

Pacing is the foundation of network fluidity. Its functionality will continue to evolve – from looking at meets today to looking at overall network demand and network availability in the future to ultimately achieve network fluidity.

* Fuel savings based on POC results



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