Transmission Dynamics

Trains with Brains®: Real-Time Intelligence for Safer, Smarter Rail Operations

The rail industry faces increasing pressure with passenger and freight demand rising, tighter timetables and reduced possession opportunities.

Much of today's network relies on life-extended assets working alongside modern builds, resulting in highly variable performance across routes and fleets. At the same time, climate variability is amplifying seasonal stresses: heat, icing, wind and vegetation drive seasonal fault patterns that periodic inspections often miss.

Traditional inspection regimes are no longer enough. Static or interval-based inspections are labour and cost-intensive and often miss emerging faults that only occur under dynamic interactions. Many failures give little or no warning until they have escalated into service-disrupting incidents. Workforce constraints and safety reinforce the need to only do the work that matters, exactly where it matters, with less time on track.

What is needed now is a shift in approach: away from periodic checks and delayed reporting, towards continuous, in-service monitoring that delivers real-time visibility of the whole system. Railways need real-time fault detection that is precise, fast and actionable — ensuring interventions are made exactly where and when they are required.

Trains with Brains®

Transmission Dynamics is trusted by global rail operators seeking turnkey solutions to these challenges. Our expanding Trains with Brains® portfolio is the industry's answer — client-driven, proven approaches to real-time monitoring and predictive maintenance. By equipping routinely operating passenger and freight fleets with advanced, train-borne sensors and edge-processed AI analytics, we transform them into intelligent, continuous, mobile inspection platforms.

With Trains with Brains®, every passenger or freight journey doubles as an inspection run. Our edge processing based systems detect and report faults within minutes, enabling targeted maintenance at precise GPS locations, and reducing unnecessary manual inspections. AI insights feed directly into operational control systems, helping teams avoid escalation of identified faults, adjust schedules or reroute services to maintain reliability.

The result is a fundamental shift from reactive, calendar-based maintenance to predictive, data-driven decision-making. For operators, this means fewer unplanned disruptions, safer working practices, reduced time on track, and significant savings across asset life cycles.

OLE Reliability: Continuous Monitoring at Scale

Overhead line equipment (OLE) is central to reliability on electrified routes, yet traditional approaches rely on periodic inspections or dedicated measurement runs. PANDAS-V® changes this by inspecting the pantograph-OLE interface continuously during normal service and covering hundreds of kilometres each day without taking capacity out of the timetable. A roof-mounted camera system is synchronised with a pantograph-mounted wireless accelerometer, capturing

PANDAS-V camera & wireless accelerometer

and reporting impacts at precise locations. AI analytics recognise and contextualise events such as carbon-strip chip initiation and progression, repetitive impact locations, arcing, pantograph height and wire stagger deviations, dropper-related anomalies and foliage proximity. Detection events are reported quickly, typically within minutes, so resources are directed exactly where they are needed, and repairs are targeted and fast.

Track Integrity: Detecting Issues before They Escalate

Points, crossings and rail joints are among the highest-stress elements of the railway network. Failures here can have immediate and serious consequences.

RailBug, a compact wireless sensor, automatically detects joint integrity issues in fishplates and clamps. It attaches magnetically in minutes and requires no bolt instrumentation or preload interference. Activated dynamically by passing trains, it captures inertial signatures that reveal loosening or structural changes over time.

Combined with PANDAS-X, our high-definition, video-based track diagnostics that provide continuous track imaging to detect alignment changes, defects and debris, operators gain early warning and precise fault location. This allows targeted interventions, improves safety and keeps networks running reliably despite the tough operating conditions.

RailBug

Rolling Stock and Freight: Fleet-Wide Intelligence

Condition monitoring cannot stop at infrastructure – rolling stock and freight are equally critical to performance and safety.

Our AI-powered solutions, including SmartBug®, Smart Oil Plug®, and the HIVE Cargo Gateway, continuously collect data on vibration, temperature and other performance indicators while vehicles are in service. AI analytics detect early warning signs from wheel and track interface issues such as wheel flats, rolling contact fatigue and polygonisation, to component health including bearing degradation, gearbox wear and out-of-balance conditions.

By analysing this data across entire fleets, operators can quickly identify outlier vehicles and recurring problems, reducing risk of escalating failures. Predictive maintenance strategies become achievable: parts are replaced when required, not simply on schedule. This extends component life, minimises depot downtime, improves fleet availability and lowers lifecycle costs.

A Complete, AI-Driven Monitoring Portfolio

From overhead lines to track, rolling stock and freight, Transmission Dynamics delivers a full suite of monitoring solutions that embed intelligence directly into the railway system. With Trains with Brains®, every journey becomes a source of actionable insights. The impact is tangible: fewer service disruptions, improved safety for the workforce, more efficient use of maintenance resources and networks that remain resilient under increasing demand.

Transmission Dynamics is redefining the future of global rail by providing the intelligence needed to operate safely, efficiently and with confidence.

www.transmissiondynamics.com

Transmission Dynamics®

Trains with Brains®

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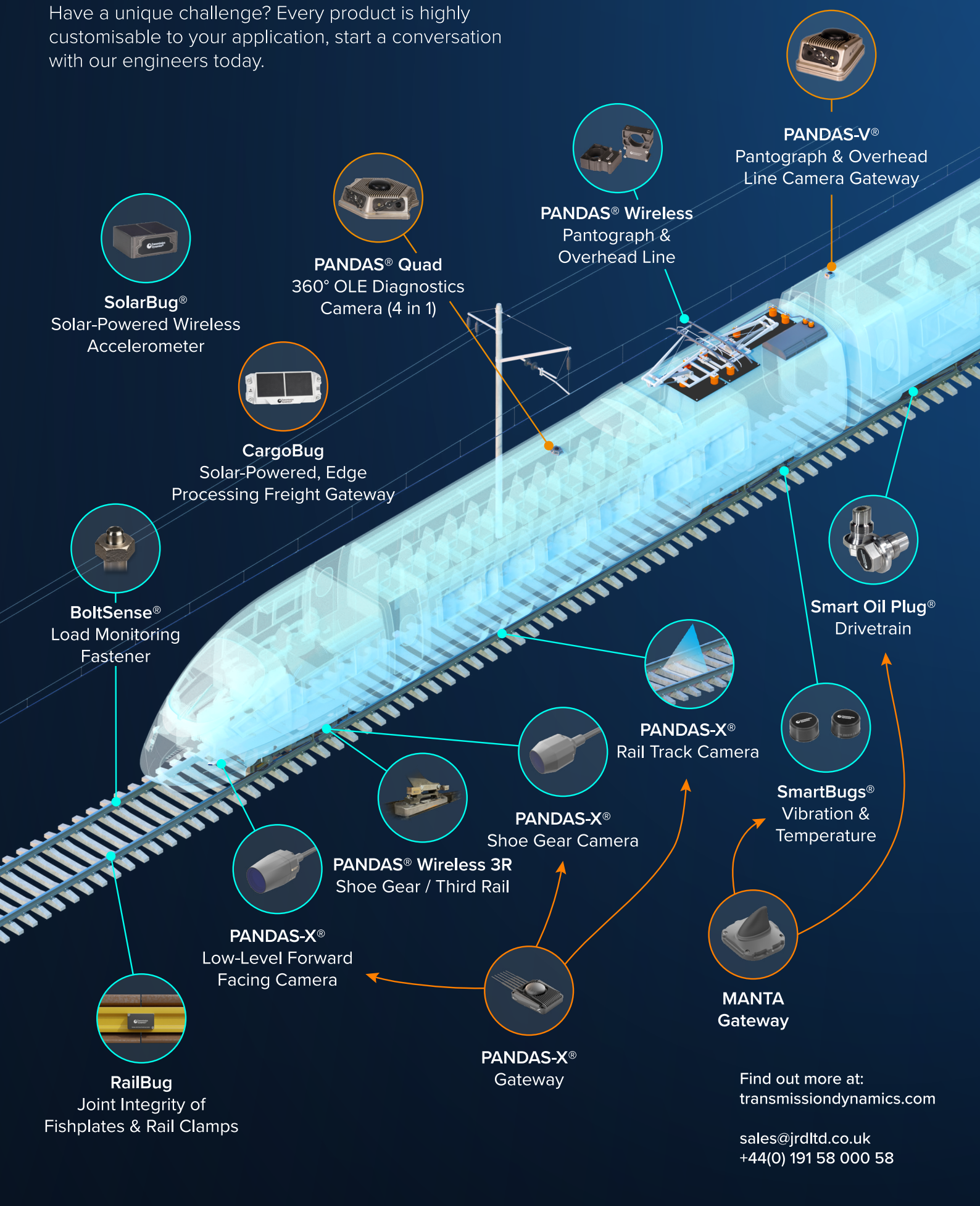
The complete, AI-driven monitoring portfolio redefining the future of rail networks globally

Have a unique challenge? Every product is highly customisable to your application, start a conversation with our engineers today.



PANDAS-V®
Pantograph & Overhead Line Camera Gateway

PANDAS® Wireless
Pantograph & Overhead Line

PANDAS® Quad
360° OLE Diagnostics Camera (4 in 1)

SolarBug®
Solar-Powered Wireless Accelerometer

CargoBug
Solar-Powered, Edge Processing Freight Gateway

BoltSense®
Load Monitoring Fastener

Smart Oil Plug®
Drivetrain

PANDAS-X®
Rail Track Camera

SmartBugs®
Vibration & Temperature

PANDAS-X®
Shoe Gear Camera

PANDAS® Wireless 3R
Shoe Gear / Third Rail

PANDAS-X®
Low-Level Forward Facing Camera

MANTA
Gateway

PANDAS-X®
Gateway

RailBug
Joint Integrity of Fishplates & Rail Clamps

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