



VITAL TRAIN POSITIONING

SIL-4 Ultra Wideband Localization

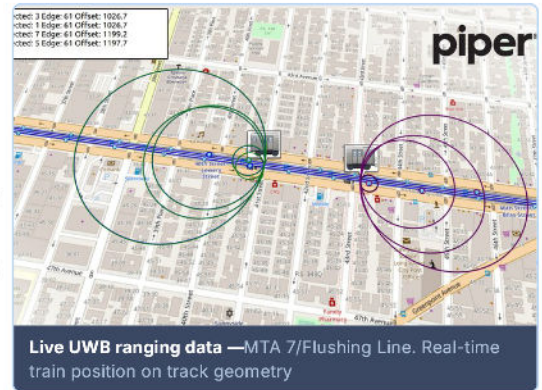
Enhanced Train Location System (ETLS) uses UWB technology to track trains with centimeter-level accuracy

THE POSITIONING CHALLENGE

Knowing the precise location of a train — which track it's on, how fast it's moving, and where it's heading — is the foundation of every safe and efficient rail operation. Yet for most transit agencies, achieving that certainty across an entire network remains one of the most technically demanding and operationally disruptive challenges they face.

Traditional positioning approaches each have real limitations. GPS provides useful coverage above ground but fails in tunnels and cannot reliably be used for track determination. Trackbed transponders require expensive, disruptive installation in the most hazardous parts of the railway environment. AI and camera-based systems cannot currently be certified to the safety integrity levels that vital train control applications demand.


Piper's approach is different. Rather than relying on any single technology Piper has developed a multi-sensor positioning platform — combining Ultra Wideband (UWB), solid-state LiDAR, and GPS-RTK — that delivers continuous, redundant, SIL-4 certified positioning across your entire network, regardless of environment. Underground or elevated, in tunnels or open track, in yards or on mainline — Piper knows where your trains are.



THREE TECHNOLOGIES. ONE PLATFORM. COMPLETE NETWORK COVERAGE.


Piper's three positioning technologies are each purpose-built for rail, independently proven in revenue service at major US operators, and designed to work together as a unified, redundant system. Each produces positioning data in a consistent format — feeding the same onboard control systems and CBTC interfaces without requiring changes from your existing suppliers.

ETLS™ — Ultra Wideband
SIL-4 Certified UWB Positioning




Pinpoints train location to within a few inches in real-time. Wayside anchors and onboard tags — no trackbed equipment required. World's first SIL-4 certified UWB system, assessed by TÜV SÜD

TrackSight™ — LiDAR
Train-Centric Solid-State LiDAR



Train-centric positioning with no wayside infrastructure. Fully deterministic — SIL4 certifiable. Works in total darkness using tunnel features, reflective markers, and track geometry as reference.

GPS-RTK
Centimeter-Level Above-Ground



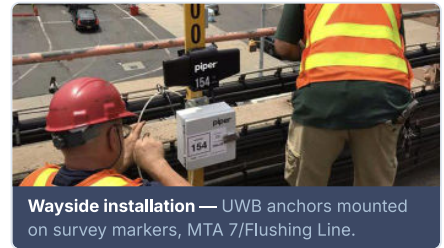
Sub-centimeter above-ground accuracy 35 base stations cover the entire Northeast Corridor. Automatically transitions to UWB or TrackSight™ when GPS is unavailable underground.

ETLS™ — ULTRA WIDEBAND TRAIN POSITIONING

World's First SIL-4 Certified UWB Train Positioning System



Piper's ETLS (Enhanced Transit Location System) uses Ultra Wideband (UWB) radio technology to pinpoint train location to within a few inches in real-time. UWB anchors are installed on tunnel walls and wayside poles, while compact UWB tags are fitted in the front and rear bonnets of each train. Onboard tag controllers capture ranging data and relay it to the Onboard Control Unit (OBCU), which continuously calculates precise train position and speed. Because all equipment is installed on the wayside and inside train cabinets — not on the trackbed or undercarriage — ETLS can be deployed faster, at significantly lower cost, and with fewer disruptions to revenue service. Cars can be retrofitted in hours and returned immediately to service. Wayside equipment can be installed under flagging, reducing the need for General Orders.



Wayside installation — UWB anchors mounted on survey markers, MTA 7/Flushing Line.

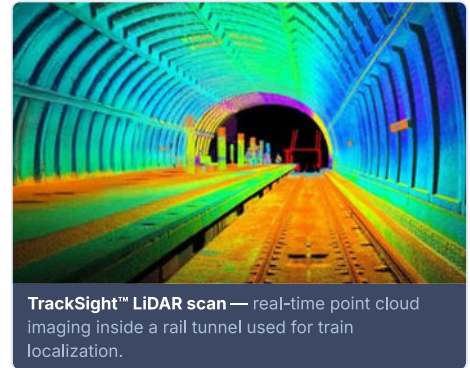
WORLD'S FIRST SIL-4 CERTIFIED UWB SYSTEM

Piper holds the world's first CENELEC SIL-4 certification for a UWB-based train control system, independently assessed by TÜV SÜD — ready for integration with CBTC and ATP programs in the US and worldwide.

TRACKSIGHT™ — TRAIN-CENTRIC LIDAR POSITIONING

Patent-pending solid-state LiDAR · no trackbed equipment · no wayside infrastructure required

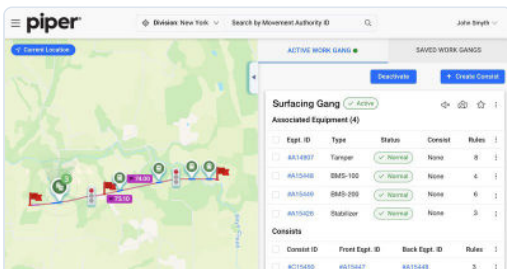
TrackSight™ is Piper's patent-pending solid-state LiDAR positioning system and the next evolutionary step in train positioning technology. Unlike every other positioning approach, TrackSight™ requires no trackbed equipment and no wayside infrastructure. A compact solid-state LiDAR sensor mounted on the train continuously scans the environment ahead and compares real-time imaging against an onboard database to determine precise position, speed, and track identity — even in total darkness, using tunnel features, reflective markers, and track geometry as reference points. TrackSight™ is fully deterministic — it does not rely on AI or machine learning, making it safety-certifiable to SIL-4. It is compatible with Piper's UWB and GPS-RTK systems, producing positioning data in the same format and enabling seamless sensor fusion and redundancy with no software changes required from CBTC suppliers. In addition to positioning, TrackSight™ provides obstacle and worker detection — continuously monitoring the track ahead for hazards and alerting operators with sufficient stopping distance.



TrackSight™ LiDAR scan — real-time point cloud imaging inside a rail tunnel used for train localization.

GPS-RTK — CENTIMETER-LEVEL ABOVE-GROUND POSITIONING

Sub-centimeter accuracy · 35 base stations cover the entire Northeast Corridor



Fleet Manager App — real-time vehicle positions, movement authorities, and track points of interest on network map.

For above-ground operations, Piper's GPS Real Time Kinematic (RTK) technology delivers centimeter-level positioning accuracy — far exceeding standard GPS, which provides only meter-level accuracy and cannot reliably be used for track determination. Piper deploys a network of redundant, rack-mounted RTK base stations roughly every 50 miles along the right of way, continuously transmitting correction data to onboard receivers. The result is sub-centimeter positioning certainty that definitively determines which track a vehicle occupies and calculates precise distances to work zone limits, signals, grade crossings, and other points of interest. When GPS signal is lost in tunnels or urban canyons, the system automatically transitions to UWB or TrackSight™, maintaining continuous positioning without interruption.

HOW THEY WORK TOGETHER

MULTI-SENSOR POSITIONING — ENVIRONMENT COVERAGE

UNDERGROUND / TUNNEL

- UWB — primary
- TrackSight™ — primary
- GPS-RTK — unavailable

ABOVE GROUND / MAINLINE

- GPS-RTK — primary
- UWB — redundant
- TrackSight™ — obstacle det.

YARDS / COMPLEX JUNCTIONS

- UWB — primary
- TrackSight™ — primary
- GPS-RTK — degraded

A single onboard computer fuses all sensor inputs and delivers one continuous, validated position and speed output to the train control system — regardless of which sensor or combination is active. No single point of failure can compromise positioning.

All three systems produce positioning data in a consistent, compatible format. From the perspective of your CBTC or ATP system, it receives one reliable positioning input — regardless of which sensor or combination of sensors is providing it. This multi-sensor redundancy is not just a technical advantage — it is a safety and resilience argument. No single environment can defeat the system.

SIL-4 Certified

Piper's UWB positioning system has achieved CENELEC SIL-4 certification — the highest safety integrity level in the industry — independently assessed by TÜV SÜD. TrackSight™ is designed and certifiable to the same standard. This certification is the prerequisite for integration with CBTC and ATP train control systems.

Compatible with your existing systems

Consistent positioning data format across all three technologies means no software changes required from CBTC suppliers. Piper's platform integrates with existing signaling infrastructure and evolves alongside your train control modernization program. Piper is also developing an interoperability specification to establish an industry standard for UWB-based positioning.

BENEFITS OF PIPER VITAL TRAIN POSITIONING

Complete network coverage

UWB for tunnels, GPS-RTK for above-ground precision, TrackSight™ for infrastructure-free deployments — every environment, without gaps.

Faster, less disruptive deployment

No trackbed equipment means fewer General Orders and less disruption to revenue service. Vehicles retrofitted in hours and returned to service immediately.

SIL-4 certified — ready for vital applications

World's first SIL-4 certified UWB train positioning system. The prerequisite for CBTC and ATP integration — already achieved.

Reduced infrastructure cost

Wayside UWB and train-centric LiDAR dramatically reduce trackbed hardware — lowering both capital and long-term maintenance costs.

Interoperable and future-proof

No software changes required from CBTC suppliers. Compatible with existing signaling infrastructure and legacy rolling stock.

One platform, one integrator

Piper is both the technology developer and systems integrator. One partner designs, installs, commissions, and supports the full positioning platform.



UWB Anchor — installed on wayside infrastructure like girders, or on tunnel walls using Piper's custom-developed bracketry.



Carborne installation — UWB tag and GPS antenna are easily mounted on the roof of the vehicles. No undercarriage work required.



Technology provider and systems integrator — Piper is an experienced partner with major transit projects.

DEPLOYMENTS

MTA New York City

UWB Train Positioning & PIDS

ETLS deployed on the 7/Flushing Line and Canarsie Line in partnership with Thales. Demonstrated 2–4 inch positioning accuracy — exceeding the 6-inch specification. Over 4,000 hours of data collected. PIDS powering nearly 2,000 signs across 269 stations.

UWB PIDS

Amtrak

Northeast Corridor

Full multi-sensor positioning platform deployed across one of the busiest rail corridors in the United States. 35 GPS-RTK base stations covering the entire NEC. UWB positioning in all tunnel segments.

UWB TrackSight™ GPS-RTK



460 installations — Piper and Amtrak teams celebrate milestone deployment of SecureTrack LCCAS across the Northeast Corridor.

CASE STUDY: MTA NEW YORK CITY



Piper partnered with Thales on a pilot program for an Ultra Wideband Based Train Control System on the MTA's 7 (Flushing) Line — subsequently extended to the Canarsie Line. Operating in shadow mode alongside the revenue CBTC system, Piper's ETLS demonstrated positioning accuracy of 2 to 4 inches, far exceeding the technical specification requirement of 6 inches stationary and 12 inches in motion.

Over 4,000 hours of positioning data were collected — substantially exceeding the 2,500-hour requirement — with no interruptions to certified interfaces with the ATS and SSI subsystems.

- 2–4 inch positioning accuracy — exceeded 6-inch specification
- 4,000+ hours of data — exceeded 2,500-hour requirement
- No interruptions to ATS and SSI certified interfaces
- Extended from Flushing 7 Line to Canarsie Line

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Ultra Wideband wireless technology brings the promise of fewer and shorter delays, and faster and cheaper installation of modern CBTC signaling, by eliminating much of the equipment traditionally fitted under trains and on tracks. This is a game-changer for our customers.



Pete Tomlin

Former MTA Signaling Chief

2–4"

Positioning accuracy achieved

4,000+

Hours of data collected