



# ETLS™ by piper

## VITAL ULTRA WIDEBAND TRAIN POSITIONING

Piper’s ETLs (Enhanced Transit Location System) uses Ultra Wideband (UWB) Technology to track the location and movement of trains, vehicles, equipment, people and other objects in real-time for various location awareness needs.



Piper’s ETLs determines the location of trains throughout a system in real-time with unmatched positional certainty. The system is like a blanket of radio coverage over the subway lines - virtually surrounding the tracks with smart sensors that pinpoint train location down to a few inches.

Watch an explanation video on Piper’s recent Ultra Wideband train positioning deployment in New York City on the MTA’s Flushing 7 line.



## WORLD’S FIRST SIL-4 SAFETY CERTIFICATION FOR ULTRA WIDEBAND TRAIN CONTROL SYSTEM

Piper Networks has received a CENELEC Safety Integrity Level 4 (SIL-4) Certification for its Ultra Wideband (UWB) train control system from independent safety assessor, TÜV SÜD. The certification is a milestone achievement for Piper and the transportation industry as it becomes the first ever UWB-based position and speed technology to achieve vitality. The system is now ready for integration with signaling and train control programs being implemented by transportation agencies and their engineering contractors in the US and worldwide.



# Piper Ultra Wideband Technology Overview

Piper's UWB positioning technology is built specially for the transit industry. In New York City, the MTA can use Piper technology to accelerate the upgrading of train control signaling systems, enhance worker safety, and improve headways in order to move more riders each day.

## 02. Positioning

Piper onboard sensors communicate with track-side radios many times each second to determine accurate distances within a few inches.

## 03. Computing

Piper onboard computers use the positioning data to calculate the location of the train along the track and feed that information into the train control system.

## 01. Installation

Piper equipment is small and easy to install - helping put trains back into service faster with less downtime.

## 04. Smart Use of Data

Piper's UWB system can also be used for many operational functions including track worker safety, work train and equipment location, and fleet management.

## How it works

- **Piper UWB Tags** are available in various form factors, power and battery capacities based on size and environmental requirements. They are easily attached to any asset that must be tracked or monitored and can be customized to meet your needs. For rail, they are typically installed in front & rear bonnets.
- **Piper UWB Anchors** are installed wayside on tunnel walls or on survey markers of elevated tracks. These anchors detect the tags in the trains using UWB radio signals. Each anchor detects multiple tags simultaneously and uses a Time-of-Flight algorithm to calculate the changing distance between the anchor and the tags in real-time.
- **Piper Tag Controllers** in the bonnet of the train capture this location data and relay the information to the Onboard Control Unit (OBCU) which in turn sends the data to the cloud.
- **Piper Remote Monitoring Dashboard** is cloud-based and relies on a combination of network infrastructure for connectivity where trains can feed the dashboard through an LTE connection.

# BENEFITS OF PIPER ULTRA WIDEBAND SOLUTIONS

It's important to note that Piper is a systems integrator as well as a technology solutions provider and this has many benefits. Piper believes that the use of UWB in train control systems is an important evolutionary leap forward for signaling. Because UWB equipment is installed on the wayside and in the interior control cabinets on the train (as opposed to the track bed and the undercarriage of the rolling stock), the positioning systems required to manage train headways can be deployed faster, at lower cost, and with minimal disruption.

## • INCREASING SUBWAY THROUGHPUT

Ultra-precise positioning improves headways, allowing trains to run closer together and more frequently. The result is increased capacity that improves on-time performance and overall customer service.

## • REDUCING COST

Piper's positioning equipment significantly reduces the cost associated with the current generation of track bed units. Cars can be retrofitted in less than 2 hours and be ready for revenue service. As with most upgrades of trains or signaling, the majority of the cost is borne by the agency. Installing Piper equipment reduces the need for General Orders because the wayside equipment can be provisioned under flagging.

## • IMPROVING MAINTENANCE

Piper's UWB technology uses wayside instead of trackbed equipment, making it easier to install and safer to maintain. We are also able to adapt our equipment to existing infrastructure.

## • CAPTURING MORE VALUE FROM ASSETS

Once Piper equipment is installed, we can continue to collect data and introduce new technologies like our TrackSight™ without requiring a new build-out of infrastructure or requiring interface changes from the CBTC suppliers. Our equipment fits easily into train cabinets of legacy rolling stock and/or the Work Train fleet, which helps to reduce cabling required for positioning systems.

## • BUILDING INTEROPERABILITY

Interoperability with CBTC suppliers and UWB manufacturers will ensure that the technology will be compatible with future implementations. Piper is currently designing an interoperability specification that will help establish an industry standard for this technology.

## • INCREASING PERFORMANCE

UWB technology can help accelerate the installation times and performance of CBTC to be installed. Piper is focused on reducing the delays often associated with installing new equipment and improving reliability of revenue trains.



*Piper team members were present in NYC and near the trackside during the wayside installation to answer questions and resolve issues quickly. Anchors were installed wayside of elevated tracks by being attached to survey markers. Anchors were also attached to predetermined locations in tunnels by Piper's custom developed bracketry.*



*Piper did a live demonstration of its train positioning technology to members of the media and NYCT leadership. This screen shows the devices in the front and rear of the trains are continuously being detected by several anchors on the wayside simultaneously, allowing for direction and speed determination.*



## CASE STUDY: ULTRA WIDEBAND TRAIN POSITIONING METROPOLITAN TRANSPORTATION AUTHORITY, NYC SUBWAY SYSTEM

### Overview

Piper is currently engaged in an ongoing project to assist Metropolitan Transit Authority (MTA) and the New York City Subway System with collecting real-time subway train location data. Using customized Piper UWB Tags installed on trains in combination with Piper UWB sensors deployed in underground and elevated stations and tracks, Piper aggregates a stream of ultra-precise real-time positioning data. By integrating the data with MTA's systems, Piper helps track and locate trains, power countdown clocks with reliable arrival information for riders, and improve safety of track workers.

### Scope and Objective of the Pilot

Demonstrate the accuracy and reliability of a UWB-based Train Control System operating in Shadow Mode compared to a Revenue Service CBTC System. From the viewpoint of NYCT, the pilot project is related to the analysis of the Piper Networks UWB RPS system as a vital component of the CBTC system (providing train positioning required for CBTC operation). In this context, the UWB RPS provides the absolute reference locations on the guideway to the OBCU which uses the data to initialize localization of the train and re-localize, as needed.

### Results

Piper successfully demonstrated a system which utilized UWB and enabled the greater CBTC system to provide Automatic Train Protection (ATP) and Automatic Train Operation (ATO) functions as defined in the Technical Specification. The system demonstrated no interruptions to the certified interfaces with the ATS and SSI subsystem. While the technical specification called for a system which provided positional accuracy of 6-inches (15.24 cm) while stationary and 12-inches while in motion (30.48cm), Piper was able to far exceed this requirement by demonstrating a system which reliably and continuously provided a positional accuracy between 2 to 4-inches. Piper also substantially exceeded the requirement for 2,500 hours of data collection by collecting over 4,000 hours of data.



***“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