exactTrax™

Technology Whitepaper

exactTrax™ technology is embedded in the CMX7032 and CMX7042 Marine AIS Processor ICs from CML Microcircuits. The devices provided the highest level of performance and enable a low cost, fast route to delivering an exactTrax™ enabled AIS Class B transceiver.

For further details visit: http://www.cmlmicro.com/exactTrax

Executive Summary

Millions of small vessels traverse our oceans daily without the necessary equipment installed for proper identification and surveillance. Until now the complexity and cost of installing and operating long range identification systems on these vessels has been prohibitive.

exactEarth has created a brand new tracking solution utilizing exactTrax™ technology to overcome this problem. This small vessel tracking system incorporates exactTrax technology which, for the first time, enables low power AIS (Automatic Identification System) transponders that can easily be installed on small commercial and leisure vessels worldwide to be tracked from space.

This revolutionary technology results in a new global monitoring capability to track any vessel, regardless of size.

This whitepaper will explain the exactTrax technology in depth and the benefits it brings to the challenges associated with monitoring and tracking small vessels across the globe.

Background

With all the advances made in the monitoring of the world's shipping, there still remains a gap in the effective tracking of every boat on our busy waterways. A particular need has arisen around the thousands of small vessels currently traversing our oceans without the necessary equipment installed to allow for accurate monitoring and surveillance.

Security threats are heightened when these boats can essentially fly under the radar of the proper maritime authorities. Piracy incidents, smuggling, illegal fishing, pollution incidents as well as environmental zone encroachments continue to happen daily as the level of tracking and monitoring necessary to combat these issues has not been met.

AIS is a mandatory navigation safety communications system under the provisions of the Safety of Life at Sea (SOLAS) Conventions which requires ships of 300 gross tons and upwards engaged on international voyages, cargo ships of 500 gross tons and upwards not engaged on international voyages, and all passenger ships irrespective of size to be fitted with AIS.

The question remains though of how to effectively monitor the vessels that do not meet these size requirements as the security issues continue to pile up and boats continue to operate without the equipment necessary to facilitate global monitoring of all maritime activity.

exactTrax is a unique new technology which enables the transmissions from AIS Class B transponders to be reliably received by the exactEarth global satellite network.

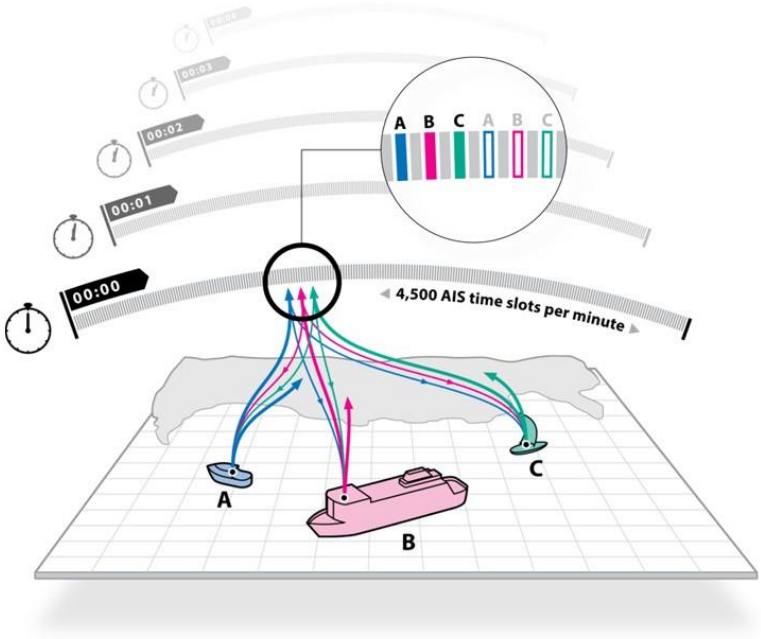
The reception of Class B units from space has been traditionally hindered because Class B transceivers transmit less frequently and with significantly lower power than Class A transceivers. As Class A populations increase within a satellite footprint, the Class B transmissions become indistinguishable from background radio noise. By utilizing patented exactEarth Satellite AIS techniques, exactTrax allows terrestrial and satellite tracking of these small vessels without requiring expensive equipment and per-bit message charges for the ship owner.

AIS overview

AIS transceivers use VHF radio technology to transmit vessel position and identification to other AIS equipped vessels and shore stations. All AIS transceivers conform to rigorous international standards to ensure interoperability wherever a vessel travels. Many vessels already carry AIS transceivers and shore based coastal monitoring infrastructure is deployed worldwide.

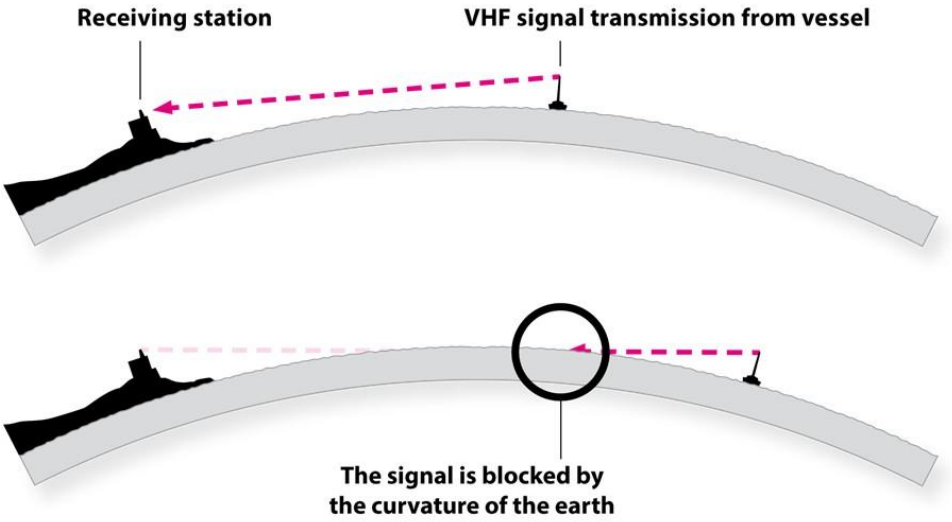
The ubiquity of AIS gives rise to many advantages when used as a vessel tracking technology; equipment and operating costs are low, existing infrastructure can be re-used and visibility of tracked vessels to other AIS equipped ships brings significant safety benefits.

AIS systems use a Time Division Multiple Access (TDMA) scheme to share the allocated radio channel between all users. The TDMA scheme defines 2250 time slots per minute on each of the two radio channels allocated to AIS (a total of 4500 slots per minute). At a basic level each AIS transceiver must determine which slot it will transmit in and ensure this slot is not allocated to another user.



Terrestrial AIS limitations

Traditional methods for tracking ships using AIS are fundamentally limited by the range of VHF radio transmissions. The range is essentially 'Line of Sight' between the transmitting vessel and a shore station and therefore limited by the curvature of the earth. VHF radio waves cannot bend around the curve of the Earth like some other radio waves. Both the transmitting antenna and the receiving antenna need to 'see' each other. The moment one or other dips below the horizon, communication is lost.



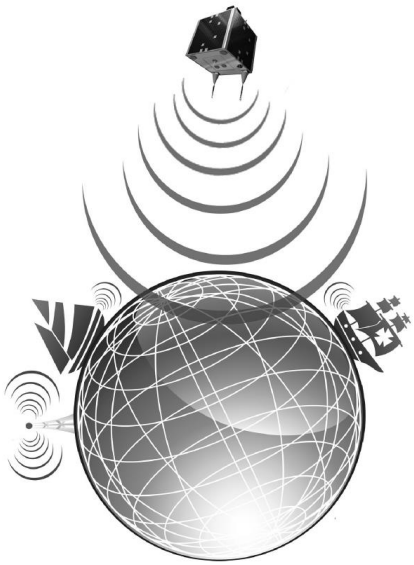
A VHF range of 20nm is typical for a vessel antenna mounted 10m above sea level and a coastal receiver antenna mounted 30m above sea level. Atmospheric conditions can give rise to much greater ranges; however, these conditions are temporary and variable.

A coastal AIS receiver network can provide reliable coverage up to around 20nm offshore and will guarantee reception of all regular vessel position reports within this range. Beyond 20nm an alternative approach is required and Satellite AIS has the potential to extend range globally.

Satellite AIS overview

Detection of AIS transmissions by satellite removes the 'Line of Sight' range restriction and enables global tracking of AIS equipped vessels. Transmissions from a vessels AIS antenna propagate largely horizontally, ultimately leaving the earth's atmosphere and entering the vacuum of space.

No longer are maritime authorities hindered by the horizon, as Satellite AIS (S-AIS) now detects vessels anywhere in the world, even in the most remote of regions. S-AIS greatly extends the range of traditional AIS as signals are sent and received from many kilometres above land and sea, so the barrier of the horizon does not limit these signals.



The initial idea for AIS was to prevent collisions between ships. Using AIS technology, vessels within close proximity of each other send signals to form a communication cell, and each ship has its own time slot to prevent messages from getting mixed up, or colliding.

A satellite can detect many of these communication cells at the same time as it captures thousands of individual ships' signals all at once. While capturing ship signals is important, it is equally important and necessary to disseminate and process those signals into actionable data.

Utilizing spectrum decollision processing (SDP) allows for the satellite to listen and capture all AIS signals from across the AIS radio frequency spectrum. It then transmits all this information to the ground to allow for signal processing and decolliding using special algorithms. SDP works very well for areas with heavy maritime traffic and it is important for detecting enough messages to allow for S-AIS to work efficiently.

The deployment of a highly effective Satellite AIS constellation capable of excellent first pass

detection faces many challenges due to the fact that AIS was primarily intended for local sea-level transmission and reception. The saturation of the satellite receiver due to the high amount of AIS message broadcasts, particularly in highly dense shipping areas such as the Mediterranean and Baltic Seas, and the Straits of Malacca can create a significant technical barrier to developing an accurate picture for maritime domain awareness using satellite AIS only.

The completeness of the maritime traffic domain for any given Area of Interest (AOI) can be defined as the ability to detect ships and the latency for any given ship position report. Latency is defined as the time interval between the reception of the ship's position report on the satellite to delivery of that report to the end user. Latency is impacted not only by the mechanics of satellite constellation (i.e. the time it takes for the satellite to find and downlink data to an Earth Station), but also by the ability to detect as many ships as possible within a single pass over the AOI. If multiple satellite passes are required to detect all ships, the true latency is significantly higher than any S-AIS service with a high first pass detection rate as it will take a substantial longer period of time to obtain a complete picture of the AOI. Additionally, ships are moving targets therefore each satellite may have only a single opportunity to detect the ship before it travels out of the AOI.

Satellite AIS limitations for small vessel tracking

Tracking small vessels using satellite AIS brings a number of technical challenges. Installation of high powered Class A AIS transceivers is prohibitively expensive for this vessel category and requires a permanent power supply that is not typically available on small vessels. Class B or AIS 'Identifier' products are ideally suited to small vessels; however, they transmit at a lower power and less frequently than Class A equipment.

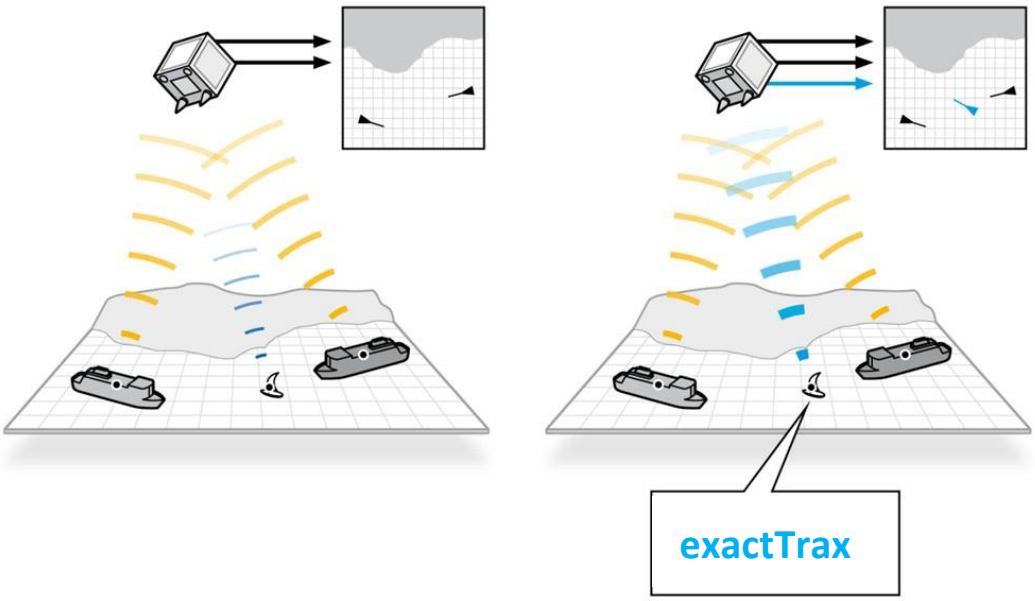
Detection of low power Class B transmissions using Satellite AIS is traditionally problematic, particularly in areas with high vessel density where there is significant AIS traffic. Whilst the low power transmissions from Class B AIS can be received by satellite in quiet areas, in existing satellite AIS systems they are masked by higher power Class A transmissions in busy areas.

exactTrax provides a solution to this problem through innovative AIS transceiver and satellite detection technology.

exactTrax™ Advantage

exactTrax technology overcomes the challenges involved in detecting low power Class B AIS transmissions by satellite. The combination of advanced & patented signal processing techniques and unique AIS transponder technology enable reliable detection of low power AIS transmissions from Class B or 'Identifier' tracking devices.

exactTrax is fully compatible with existing AIS infrastructure and enables vessels to be tracked by both coastal receiver networks and by satellite. Fusion of the data from these sources enables a seamless tracking solution with the benefits of detailed tracking close to shore and regular, reliable reporting beyond the horizon.

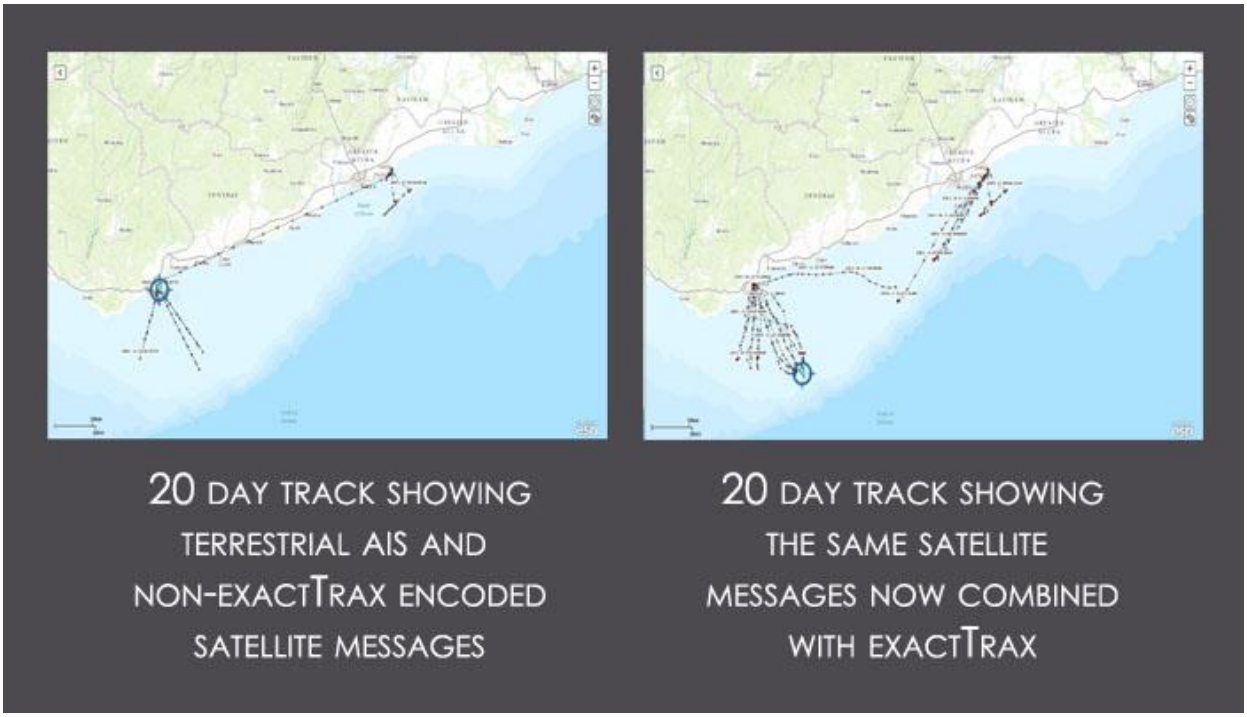


exactTrax technology is available for activation in all AIS transponders and an enabled AIS transponder can provide:

- Regular AIS position reporting (typically every 5 minutes for an 'Identifier') when in range of coastal AIS receivers.
- Reliable and regular position reports beyond the horizon.
- Flexible vessel track history reporting contained within every satellite position report provides even more information about the vessel behaviour in-between each satellite capture.

Summary

exactTrax technology represents a solution to the growing problem of being able to track the millions of small boats on our oceans that was not previously possible. Enabled AIS transponders are not only easily deployed but are the only truly cost-effective solution available for the efficient monitoring of small vessels.



exactEarth Ltd (www.exactearth.com) is a private data services company delivering near-real time (NRT), global location-based maritime vessel tracking information and solutions for government authorities and a wide range of commercial organizations, through its exactAIS® tracking service.