# WHITE PAPER: UNDERSTANDING SATELLITE AIS AND THE SDPOB ADVANTAGE

***Abstract:*** *Satellite Automatic Identification Systems (S-AIS) provide a means to track the location of vessels anywhere in the world, especially over open oceans and beyond the reach of terrestrial-based AIS systems. In this paper, we will examine the facts that are essential when deciding on which Satellite AIS system to use. This includes a closer look at whether Spectrum Decollision Processing (SDP) is effective on-board a satellite; the advantages of multiple satellites frequently passing over the same area to collect AIS data and the benefit of an extensive ground station infrastructure.*

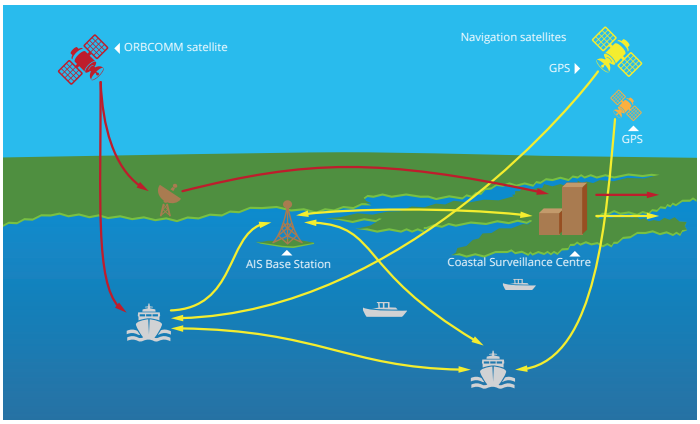
## Brief Overview of How AIS Works

Class-A AIS transponders are installed on most vessels over 300GT on international voyages while many smaller vessels are outfitted with the simpler and lower cost Class-B AIS transponders. In both cases, the transponders automatically broadcast information, such as the vessel's position, speed, and navigational status, at regular intervals via a VHF transmitter built into the transponder.

The signals are received by AIS transponders fitted on other ships; on land based systems, such as Vessel Traffic Services (VTS) systems; and on AIS satellites.

### AIS Terminology

- **Automatic Identification System (AIS)** is an automatic tracking system used for identifying and locating vessels by electronically exchanging data with other nearby ships, AIS base stations, and satellites.
- **Satellite AIS (S-AIS)** is the term used to describe when satellites are used to detect AIS signatures.
- **Spectrum Decollision Processing (SDP)** is the application of an algorithm where AIS radio signals are digitized and then filtered using software tools until the individual AIS signatures from the vessels can be detected.
- **Onboard Processing (OBP)** is the basic processing of AIS data onboard the satellites, instead of the ground equipment.
- **Spectrum Decollision Processing Onboard (SDPOB)** is the technology for processing AIS data onboard ORBCOMM satellites. It provides the ability to detect more AIS signatures in the most efficient and expedient method available.

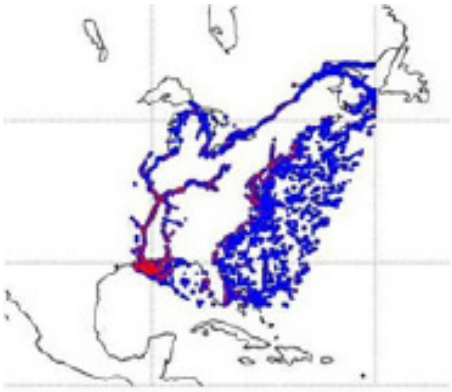



## Fact #1: Extracting AIS information using SDP can be done on board a satellite

In any given area, there may be many vessels that are transmitting their AIS information. To be able to decode the vessel's information from the VHF signals requires specialized equipment and methodologies.

Spectrum Decollision Processing (SDP) is the application of an algorithm where AIS messages are extracted from the noisy VHF environment. SDP is typically done on terrestrial-based AIS equipment but can occur on a satellite if there is sufficient power and processing capability.

### ORBCOMM'S SDPOB
ANALYZED AREA



| | PROCESSING METHOD | VESSELS DETECTED |
|---|---|---|
| ORBCOMM | SDPOB | Over 3,000 |
| Competitor | SDP | 1,969 |
| Competitor | OBP | 227 |

ORBCOMM's high performance AIS satellites and even more powerful next-generation OG2 AIS-enabled satellites meet these requirements and are able to perform **Spectrum Decollision Processing On-Board (SDPOB)** the satellites. This capability dramatically increases the ability to detect multiple AIS signals in and decreases the latency in AIS-data collection and reporting.

When comparing data collected and processed using the ORBCOMM SDPOB method with the SDP by other systems for data over the same area, ORBCOMM detected 57% more vessels.

For organizations that rely on AIS data, detecting more vessels means a more accurate view of who is present in an area and better vessel management.

**Summary:** ORBCOMM's SDPOB dramatically increases the ability to detect AIS signals and shortens the time of AIS-data collection and reporting.

### Satellite Passes per Day

Multiple satellite passes increase the detection and refresh detection rates. The number of passes depends on the location of the vessel.

Using the ORBCOMM network Brazil (at -5 Latitude) currently has 54 (2015) passes per day. Assuming satellites are in view of a vessel for 10 to 12 minutes per pass, vessels at -5 latitude are in satellite view for 9.1 hours. This will increase to 15 hours (91 passes) in mid-2015 with the launch of 11 of ORBCOMM`s next generation OG2 satellites.

Argentina/Australia (at -35 Latitude) currently has 70 passes per day (2015). This means that currently vessels at this latitude are in view of AIS satellite for 12 hours per day. This will increase to 21.7 hours (127 passes) per day with the launch of 11 more OG2 satellites.

## Fact #2: Multiple satellites passing over the same area increases AIS-signal detection

AIS messages are broadcast at different time intervals from every few seconds to every three minutes depending on message type, speed and status of the vessel.

The laws of probability come into play when looking at the likelihood of detecting and collecting an AIS message when you are in view of the vessel for minutes, as is the case for AIS-enabled Low-Earth Orbit (LEO) satellites. The probability of a LEO satellite detecting an AIS signal increases as you spend more time over the vessel or more satellites pass over a vessel.

ORBCOMM's planned constellation of nineteen (19) AIS-enabled satellites will be able to yield better and more AIS data than any other constellation.

**Summary:** More frequent satellite passes over a vessel increases the likelihood of AIS-signal detection. ORBCOMM's satellite constellation offers more opportunities for AIS data detection leading to better vessel management.

## Fact #3: Latency of AIS data delivery is important for maritime awareness

Latency of the AIS data delivery can be affected by two main factors: satellite constellation and ground station infrastructure. When the satellite receives an AIS message, it stores the message internally until the satellite becomes connected to a ground station. The satellite then downloads all the messages received since the last ground station connection.

Having a large network of ground stations strategically located to match the satellite constellation considerably reduces the latency of the delivery of data.

ORBCOMM's ground station infrastructure of 16 operational Gateway Earth Stations (GES) around the world and up to 19 AIS-enabled satellites offer a much reduced satellite-to-ground station delivery time, enabling latencies in the order of minutes (see side table).

**Summary:** ORBCOMM's geographically diverse ground station infrastructure and satellites offer a much reduced satellite-to-ground station delivery time, enabling latencies in the order of minutes. This provides the ability to have near real-time maritime domain awareness.

### Latency

Latency in reception of AIS data is partly determined by the location and number of ground stations. For the ORBCOMM network, the latencies are as follows:

Brazil (50% mean average):

- < 20 min – current (2015)
- < 3 min – with the launch of 11 more OG2 satellites

Argentina (50% mean average):

- < 20 min – current (2015)
- < 1 min – with the launch of 11 more OG2 satellites

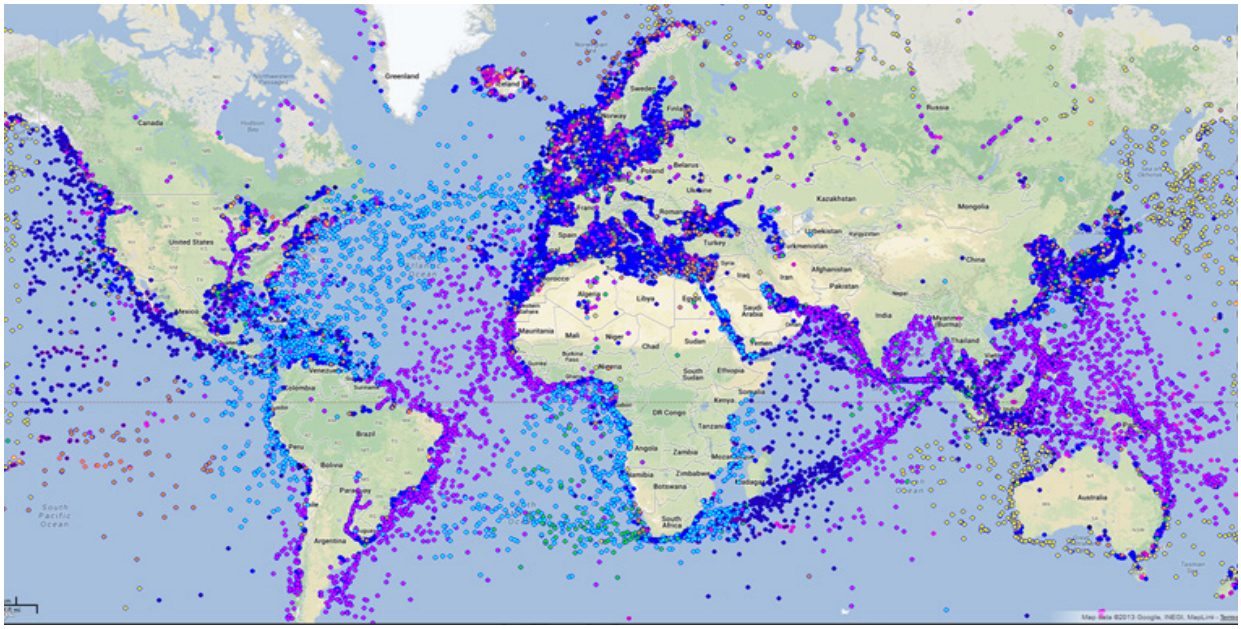
These near real-time latencies ensure that organizations get the most accurate view of which vessels are in a specific area.

## ORBCOMM's Experience in AIS

The ability to collect AIS data from space is very complex and involves numerous factors that are dynamic by nature. ORBCOMM has studied space-based signal detection in the VHF range for nearly 20 years and has excelled on AIS data collection since 2001. The company has collected and analyzed billions of AIS messages and developed the technology for the U.S. Coast Guard and other maritime agencies.

This experience has led to ORBCOMM's SDPOB approach for accurately detecting and collecting AIS data. ORBCOMM's constellation of 19 satellites and 16 ground earth stations will provide the best-in-class satellite AIS system.

For more information on the ORBCOMM Satellite AIS system, please contact us at 1-703-433-6525 or satelliteais@orbcomm.com.




Global AIS data collected by ORBCOMM's satellite constellation

## About ORBCOMM Inc.

ORBCOMM is a global provider of Machine-to-Machine (M2M) solutions. Its customers include Caterpillar Inc., Doosan Infracore America, Hitachi Construction Machinery, Hyundai Heavy Industries, I.D. Systems, Inc., Komatsu Ltd., Cartrack (Pty.) Ltd., and Volvo Construction Equipment, among other industry leaders. By means of a global network of low-earth orbit (LEO) satellites and accompanying ground infrastructure as well as our Tier One cellular partners, ORBCOMM's low-cost and reliable two-way data communication services track, monitor and control mobile and fixed assets in our core markets: commercial transportation; heavy equipment; industrial fixed assets; marine; and homeland security.

ORBCOMM is an innovator and leading provider of tracking, monitoring and control services for the transportation market. Under its ReeferTrak®, GenTrakTM, GlobalTrak®, and CargoWatch® brands, the company provides customers with the ability to proactively monitor, manage and remotely control their cold chain and dry transport assets. Additionally, ORBCOMM provides Automatic Identification System (AIS) data services for vessel tracking and to improve maritime safety to government and commercial customers worldwide. ORBCOMM is headquartered in Rochelle Park, New Jersey and has its Innovation & Network Control Center in Sterling, Virginia.

For more information, visit www.orbcomm.com.