Understanding AIS

The technology, the limitations and how to overcome them with Lloyd’s List Intelligence
Background to AIS

The Automatic Identification System (AIS) was originally introduced in order to improve maritime safety by enabling a vessel navigator to view the identity, position and direction of other ships in their vicinity.

Since 2002 the International Maritime Organization (IMO) has required AIS transceiver to be fitted to vessels over 300 gross tonnage. Every few seconds AIS equipment automatically broadcasts data signals over VHF radio. This signal includes details of the vessel name, MMSI Number, time, latitude, longitude, speed, direction and course over ground of the vessel, amongst other information.

There are over 100,000 internationally registered ships in service today and their AIS data is picked up by land-based receivers and satellite receivers orbiting the earth.

The technical design and widespread adoption of AIS over the last decade has enabled the VHF signals broadcast to provide insight into a vessel’s commercial operations and to assist with maritime security.

Figure 1. Simple terrestrial and satellite AIS data routing map
What are the features and drawbacks of AIS technology?

The benefits of AIS in understanding maritime trade and operations are significant, but equally the technology has limitations, many of which are not openly discussed by other data providers.

1. AIS broadcasts over VHF radio waves.

The drawback: AIS is not the same as GPS (Global Positioning System). Whilst GPS is a satellite-based navigation system which works in any weather conditions and in any position in the world, AIS is broadcast on VHF radio waves. VHF radio waves travel in straight lines. This means that the transmission distance approximates to line of sight limits, roughly 20-30 miles from land receivers situated on high locations and is limited by the curvature of the earth. VHF radio waves are also affected by atmospheric conditions and landmass, resulting in variances in the range of signal and reach of land based receivers.

2. AIS is designed to operate in local areas with small numbers of vessels.

AIS uses time slices to ensure that each vessel gets a chance to broadcast its data on a radio frequency that isn’t being used at the same time by another vessel. As each AIS transmission fits into a designated time slot, this ensures information is not lost through broadcasts interfering with each other.

The drawback: In areas where many vessels congregate, for example large ports, vessel signals may be lost when they miss their time slot due to interference.

3. AIS signals are identified by MMSI number.

The drawback: Unlike an IMO number, MMSI numbers are not regulated and are not unique, meaning there can be duplication. Flag registries allocate MMSI numbers, and when a vessel changes flag, their MMSI number may be reallocated to another ship. In cases such as China, there are also reports of vessels selectively sharing MMSI number. This results in a vessel showing in two locations at the same time, known as “spoofing”.

Figure 2. AIS time slice representation

Each time slot represents 26.6 milliseconds.

The AIS of ship A sends the position message in one time slot. At the same time it reserves another time slot for the next position message.

The same procedure is repeated by all other AIS-equipped ships.

VHF radiowave time slots

AIS Receiver

Ship A

Ship B

Ship C

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VHF radiowave time slots

AIS Receiver

Ship A

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Ship C
4. Although never designed for the purpose, VHF signals can also be detected by satellites.

This enables AIS signals to be detected mid ocean hundreds of miles from any land based receiver.

**The drawback:** Due to the nature of satellite orbits and their trajectories, satellite AIS receivers cannot pick up AIS messages as frequently as terrestrial receivers which are in a fixed position. Also, VHF signals received by satellite do not use time slots, meaning that satellite detected AIS data provides valuable but less granular vessel position records than land based receivers.

5. As AIS data is self-reporting, transceivers, receivers and messages are open to manipulation through fraud.

This can happen for many reasons, including the following.

- AIS transceivers can be turned off manually by the deck officers, which is known as “going dark”.
- GPS manipulation and outage. Whilst AIS is not the same as GPS, AIS data can be validated against GPS data and an incorrect GPS position would still override AIS information.
- A vessel’s officers may choose not to enter their destination port into the AIS transceiver for transmission.

**The drawback:** Receivers and transceivers are technical pieces of equipment that make up a network. By their very nature they are subject to technical failure and manipulation. No maritime data provider can offer a completely “always on” AIS network. For those tracking vessels for regulatory or defence purposes this technical vulnerability can leave them with no visibility on vessel movements, other than human intelligence records of port callings and departures.

6. AIS receiver technology can be susceptible to technical malfunctions like any computer system.

**The drawback:** An AIS receiver relies on a constant supply of power and internet connection in order to send a consistent stream of AIS transmissions to a centralised server. Much like any computer technology it can be subject to technical malfunctions. These are especially pertinent in the more remote parts of the world, where internet connections are poor and power outages are more common. The AIS antenna can also be affected by adverse weather conditions such as lightning strikes. This means an AIS receiver can go offline and subsequently vessels’ AIS transmissions can be missed.
How do you overcome the drawbacks of relying on AIS technology alone?

Lloyd’s List Intelligence have developed solutions to the drawbacks inherent with AIS:

1. **A dedicated team of Expert analysts who check and clean AIS data.**

AIS data cannot be taken at face value. It requires expert analysis to identify the inconsistencies and errors. The Lloyd’s List Intelligence data fusion centre combines land based AIS signals, satellite AIS signals and information from our network of agents on the ground, to ensure our AIS data is comprehensive and vessel position discrepancies, such as “spoofing” or duplicate IMO numbers are identified, investigated and verified, before entering our database. This allows us to present the most comprehensive and accurate commercial picture of vessel deployment on the market. We also allow customers to query our data, directly with analysts.

Lloyd’s List Intelligence have also implemented processes that allow us to identify receivers that are not performing due to technical failure or disruption. We actively investigate these instances and resolve outages as soon as possible in order to provide the most consistent service possible to our customers.

2. **An on the ground human intelligence network to verify port callings and departures.**

Even if vessels switch off their AIS, or there are technical issues that prevent messages being received, we still track and report on vessel port callings and departures. We hold an exclusive relationship with the Lloyd’s Agents Network. Over 400 of the world’s ports are not currently covered by AIS and those wishing to monitor these ports must rely on port agent records. This is particularly important in sanctioned regions and ports where vessels make deliberate attempts to avoid detection.

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**Figure 4.** The Lloyd’s List Intelligence Satellite AIS, Terrestrial AIS and Human Intelligence routing map
3. Providing context and clarity on the last known vessel position.

As previously discussed in this paper, AIS transceivers can be shut off or broken, meaning a vessel may be many miles from the location shown on Lloyd’s List Intelligence. We know that our users need to have clarity on the last known position time to provide the context of how likely the vessel is to be found at the location shown. Therefore, unlike other maritime data providers, the Lloyd’s List Intelligence online service provides the last known position for all vessels in the fleet.

4. Access to several data sources to give an accurate picture of a vessel’s next destination.

Vessels advise port agents on their next destination when leaving a port. As they are reporting to a person, the location given is often more accurate than the one keyed into the AIS system. Often the AIS destinations provided by the crew can be miss-typed or obscured to mask the true destination. To address this issue, Lloyd’s List Intelligence also collects information from ports about the vessels they expect to be arriving at their location to provide you with as much information and accuracy as possible.

In conclusion

AIS is an incredibly useful source of vessel movement intelligence, that has revolutionized the vessel tracking industry despite evolving almost by accident. However, those that use AIS data for business, compliance and logistical intelligence need to understand the limitations and drawbacks of this technology. Relying on AIS alone risks inaccurate information and confusion due to technical limitations, ease of manipulation or insufficient human intelligence and verification.

It is vital that AIS is analysed in conjunction with other information sources, especially on the ground human intelligence, such as port agents. Without this, insurers, financial institutions and others relying on this data to make commercial and security decisions will not have an accurate picture of vessel movements on the water.

Contact us

If you would like to find out more about AIS technology, or ask our specialists any questions, please email info@lloydslistintelligence.com, we would be delighted to discuss further with you.

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