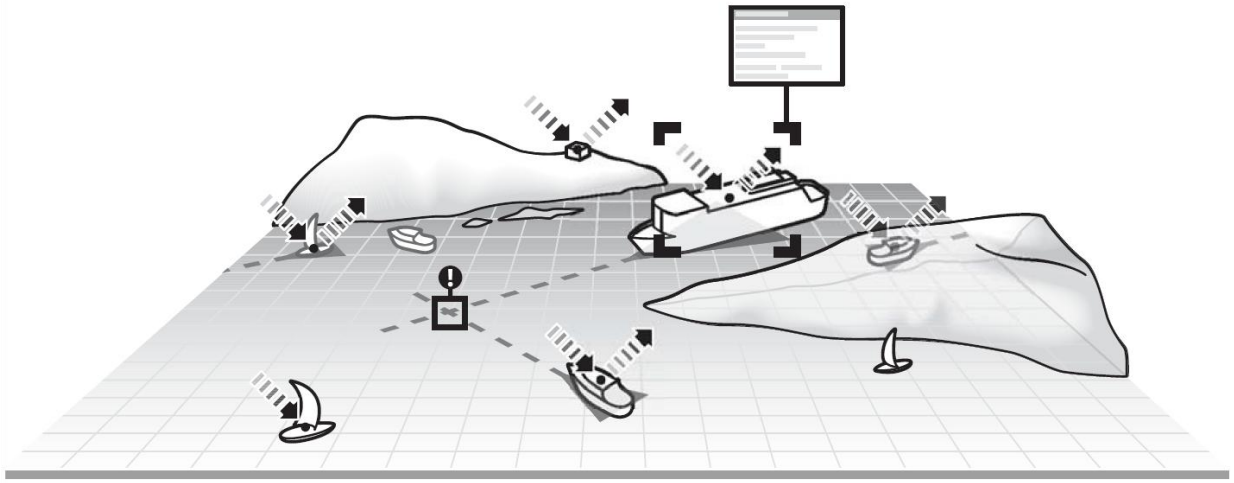
AIS Training

AIS Technology in Digital Yacht Products Explained

What is AIS?



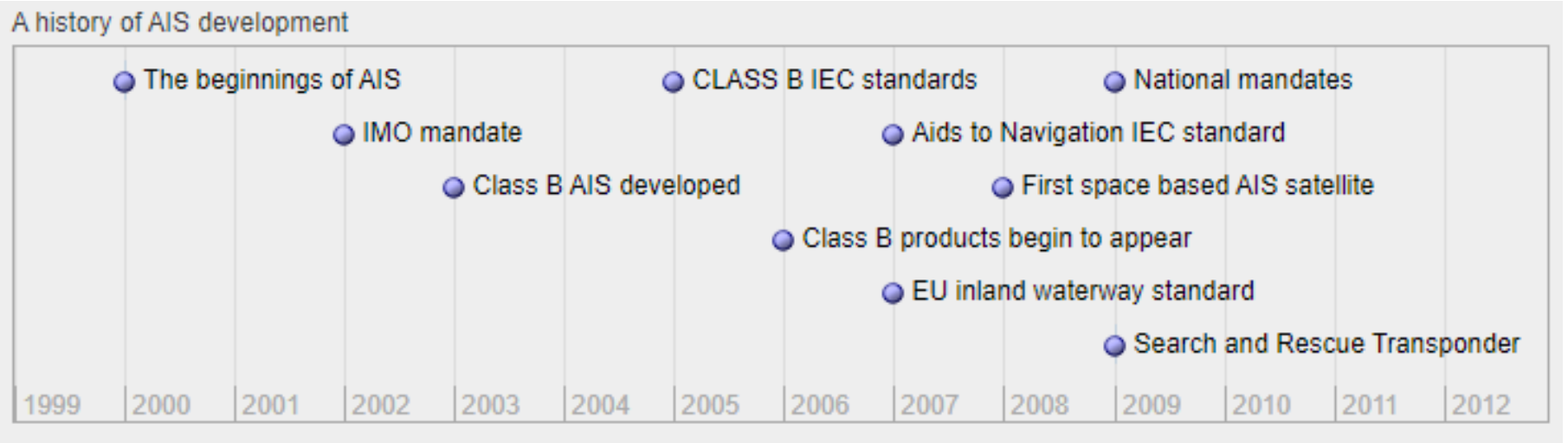
- **The Automatic Identification System (AIS)** is the biggest advance in marine navigation since RADAR
- AIS uses **GPS, VHF and Digital Signal Processing (DSP)** to communicate data between vessels
- Vessels can Transmit their position and Receive other vessel's positions (**Transponder**) or just Receive other vessel's positions (**Receiver**)
- An AIS transponder is **a mandatory fit on all vessels greater than 300 tonnes or carrying 12 or more passengers**

THE TECHNICAL STUFF

- AIS uses two VHF frequencies: 1. 161.975 MHz 2. 162.025 MHz
- AIS is subject to the same constraints as VHF radio i.e. line of sight range
- AIS data is transmitted in NMEA 0183 serial protocol but at a higher 38,400 baud rate
- There are two NMEA sentences reserved for AIS; 1. !AIVDM (other vessels) 2. !AIVDO (own vessel)
- AIS Data is also transmitted in NMEA2000 protocol and a total of 21 PGNs have been published for AIS
- A transponder must have a GPS position, whilst a receiver does not have to have one

History of AIS

- AIS was first conceived in the early 1990s, but the **first working systems called UAIS** at the time were not seen until **2000**
- When first released there were **no “Classes” of AIS**, just transponders **for SOLAS ships (later referred to as Class A)**
- The success of AIS has resulted in the different classes, types and uses of AIS that we now see

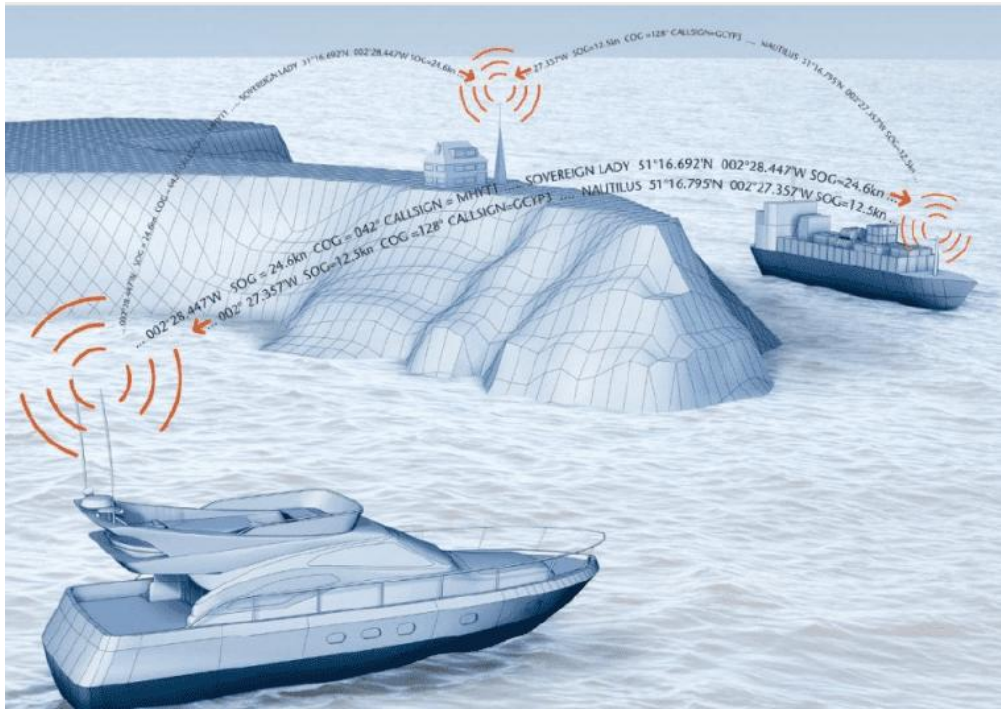


What AIS Does?

- There are **three classes of AIS:**
  - **Class A** – for mandated for vessels >300GRT, fishing vessels +15m, passenger & SOLAS ships.
  - **Class B** and **Class B+** – for smaller non-mandated vessels

- At regular intervals based on AIS class, navigational status and speed, a transponder will transmit the vessel's **"Dynamic Data":**
  - **GPS Position, SOG and COG**
  - **Heading and Rate of Turn**
  - **MMSI number**

- Every 6 minutes, a transponder will transmit the vessel's **"Static Data":**
  - **Vessel Name, Call Sign and MMSI**
  - **Dimensions and Vessel Type**
  - **Voyage Data (Destination/ETA)***
  - **Navigational Status***



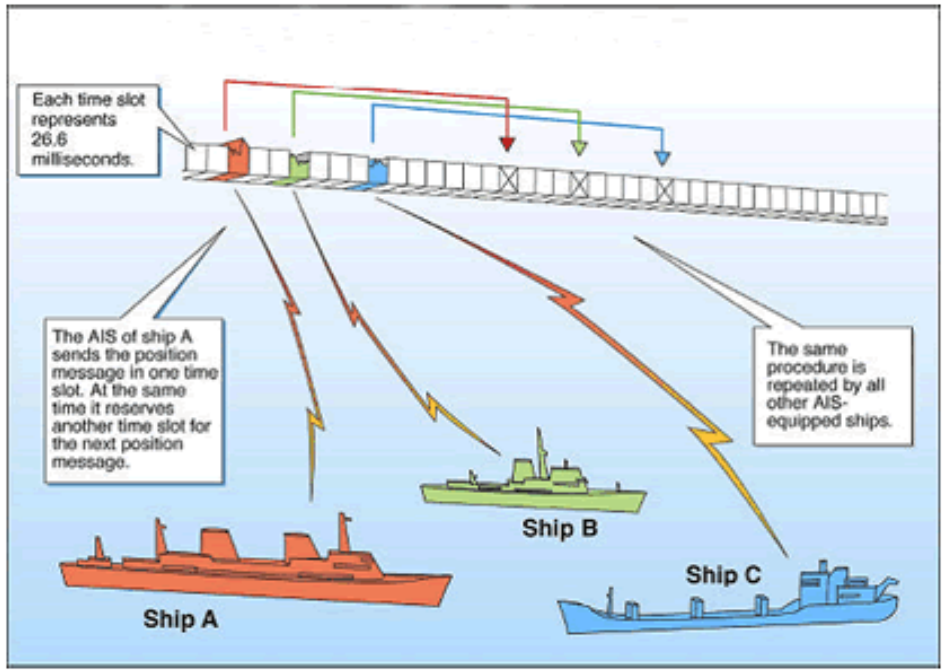
*** Note - Class A Transponders Only**

How it works

- AIS uses a technique called **TDMA*** that allows multiple transmitters to grab available time slots during which they can transmit their information

- There are **4500 time slots every minute** and if overloaded, Class A systems can share time slots and only vessels further away will be subject to drop-out

- **Class A systems use "Self Organised" SOTDMA** which gives them priority and effectively guarantees a time slot



- **Class B Systems use "Carrier Sense" CSTDMA** where they sense if a time slot is empty and quickly grab it, collisions can occur and Class B transmissions are not guaranteed

- **Class B+ Systems uses the same "Self Organised" SOTDMA** protocol that Class A Systems use, but transmits at a lower power and less often.

* Time Division Multiple Access – same technique as used In GSM mobile phone networks

Benefits of AIS:

1. **Collision Avoidance:**
   - Receive clear and regular position reports of all AIS equipped vessels in your area
   - Set CPA and TCPA alarms
   - AIS can ‘see round corners’ and beyond the RADAR line of sight.

2. **Identification:**
   - Identify and make a DSC radio call to a dangerous vessel using their MMSI number.
   - Friends and family can use online AIS services to track your trip from home.

3. **Security:**
   - Emergency services can use AIS to co-ordinate search and rescue operations
   - Shore stations can receive vessel details automatically

AIS Range

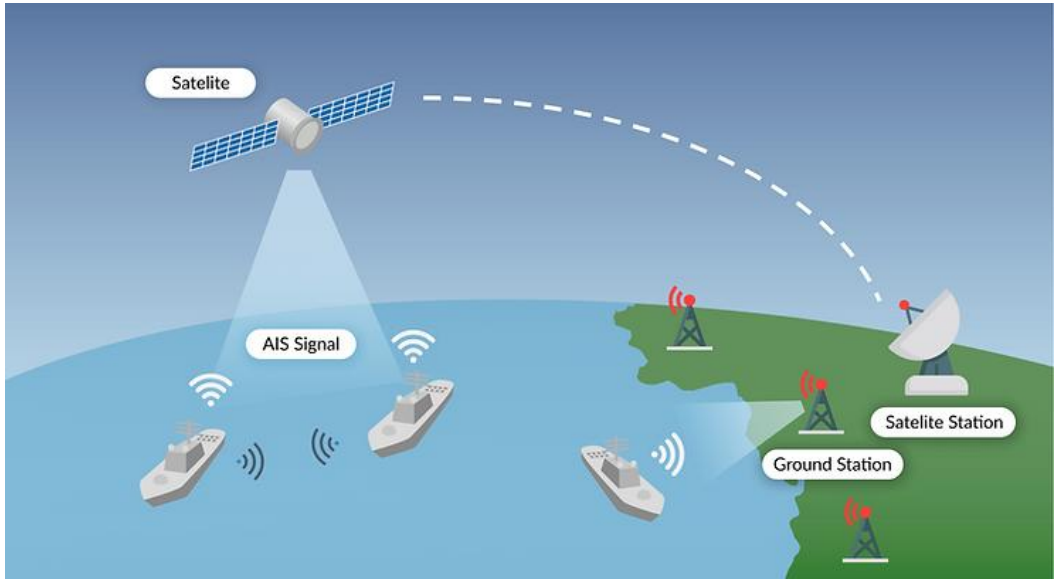
- **AIS uses VHF radio frequencies** and is subject to the same range issues
- Higher the antenna and higher the transmit power, the longer the range:
  - **Class A** Transponders transmit at 12.5W expect **20-25 Nm**
  - **Class B+** Transponders transmit at 5W expect **10-12 Nm**
  - **Class B** Transponders transmit at 2W expect **7-8 Nm**
  - **AIS MOB/SARTs** transmit at 1W expect **3-4 Nm**

	Class A	Class B+	Class B
Power	12,5 W	5W	2W
Transmit Rate	Up to every 2-3 secs	Up to every 5 secs	Every 30 secs
Technology	SOTDMA	SOTDMA	CSTDMA
Guaranteed Time Slot Allocation	YES	YES	NO
Satellite Tracking	YES	YES	NO

SPAIS™ Satellite Tracking

In addition to the latest Class B+ SOTDMA technology, Digital Yacht AIS transponders also incorporates **our latest SPAIS™ (space AIS) connectivity** with additional transmissions for **reception by AIS satellites** for true ocean tracking capability.

- Additional safety and security with global satellite AIS tracking capability
- Turns the AIS into a **global tracking solution**
- Transmissions can be optionally enabled
- Enhanced services for the future with “over the horizon” and long-range AIS



Frequency of AIS transmissions

- The table below shows the **frequency of transmission for different classes of AIS**
- The **Speed Over Ground (SOG) from the transponders GPS decides the update rate** and on a Class A transponder, the Rate of Turn from the Gyro/Compass decides if it is changing course

Ship's Dynamic Conditions	Class A	Class B+	Class B
Ship at Anchor or Moored	3 mins	3 mins	3 mins
SOG 0-2 knots	10 secs	3 mins	3 mins
SOG 2-14 knots	10 secs	30 secs	30 secs
SOG 2-14 knots and changing course	3.3 secs	30 secs	30 secs
SOG 14-23 knots	6 secs	15 secs	30 secs
SOG 14-23 knots and changing course	2 secs	15 secs	30 secs
SOG > 23 knots	2 secs	5 secs	30 secs
Ship Static Information	6 mins	6 mins	6 mins

Data transmitted

- The table shows what **information is communicated by different classes of AIS**
- In terms of data transmitted **Class B and Class B+ are the same**

Data Transmitted	Class A	Class B and B+
MMSI + Vessel Name + Call Sign	YES	YES
Position + COG + SOG	YES	YES
True Heading	YES	YES
Rate Of Turn	YES	NO
Nav Status	YES	NO
IMO Number	YES	NO
Type of Vessel	YES	YES
Vessel Dimensions	YES	YES
ETA + Destination + Draught	YES	NO

AIS message types

- Inside the Binary Encapsulation will be one of the 26 AIS Message types
- Some of the messages are specific to a Class A or Class B transponder
- Other messages are specific to particular types of AIS targets;
  - Aids to Navigation (AtoN)
  - AIS SART
  - Search and Rescue
- Not all AIS units or Chart Plotters can read all message types
- This can lead to some products not displaying all AIS targets

Message ID	Name	Description
1	Position report	Scheduled position report; (Class A shipborne mobile equipment)
2	Position report	Assigned scheduled position report; (Class A shipborne mobile equipment)
3	Position report	Special position report, response to interrogation; (Class A shipborne mobile equipment)
4	Base station report	Position, UTC, date and current slot number of base station
5	Static and voyage related data	Scheduled static and voyage related vessel data report; (Class A shipborne mobile equipment)
6	Binary addressed message	Binary data for addressed communication
7	Binary acknowledgement	Acknowledgement of received addressed binary data
8	Binary broadcast message	Binary data for broadcast communication
9	Standard SAR aircraft position report	Position report for airborne stations involved in SAR operations, only
10	UTC/date inquiry	Request UTC and date
11	UTC/date response	Current UTC and date if available
12	Addressed safety related message	Safety related data for addressed communication
13	Safety related acknowledgement	Acknowledgement of received addressed safety related message
14	Safety related broadcast message	Safety related data for broadcast communication
15	Interrogation	Request for a specific message type (can result in multiple responses from one or several stations)(4)
16	Assignment mode command	Assignment of a specific report behaviour by competent authority using a Base station
17	DGNSS broadcast binary message	DGNSS corrections provided by a base station
18	Standard Class B equipment position report	Standard position report for Class B shipborne mobile equipment to be used instead of Messages 1, 2, 3(8)
19	Extended Class B equipment position report	Extended position report for class B shipborne mobile equipment; contains additional static information(8)
20	Data link management message	Reserve slots for Base station(s)
21	Aids-tonavigation report	Position and status report for aids-to-navigation
22	Channel manage-ment(6)	Management of channels and transceiver modes by a Base station
23	Group assignment command	Assignment of a specific report behaviour by competent authority using a Base station to a specific group of mobiles
24	Static data report	Additional data assigned to an MMSI Part A: Name Part B: Static Data
25	Single slot binary message	Short unscheduled binary data transmission (Broadcast or addressed)
26	Multiple slot binary message with	Scheduled binary data transmission (Broadcast or addressed)

AIS NMEA 0183 data

There are **two NMEA0183 sentences** reserved for AIS:

- !AIVDM (other vessels)
- !AIVDO (own vessel)

The VDO message was intended to provide own ship data to a listening ECS or ECDIS but in reality very few systems read and use this message

The VDM sentence is transmitted each time an AIS message is received:

- !AIVDM,1,1,,A,177l?m9000`:Pk`<i`kh0lSd00R;,0*30
- !AIVDO,1,1,,,B>eq`d@3wk?8mP=18D3Q3wv5sP06,0*6C

Unlike normal NMEA 0183 sentences that use human readable ASCII characters, the two AIS sentences use 6 bit binary encoding for the bulk of the sentence to reduce the amount of data

AIS NMEA 2000 data

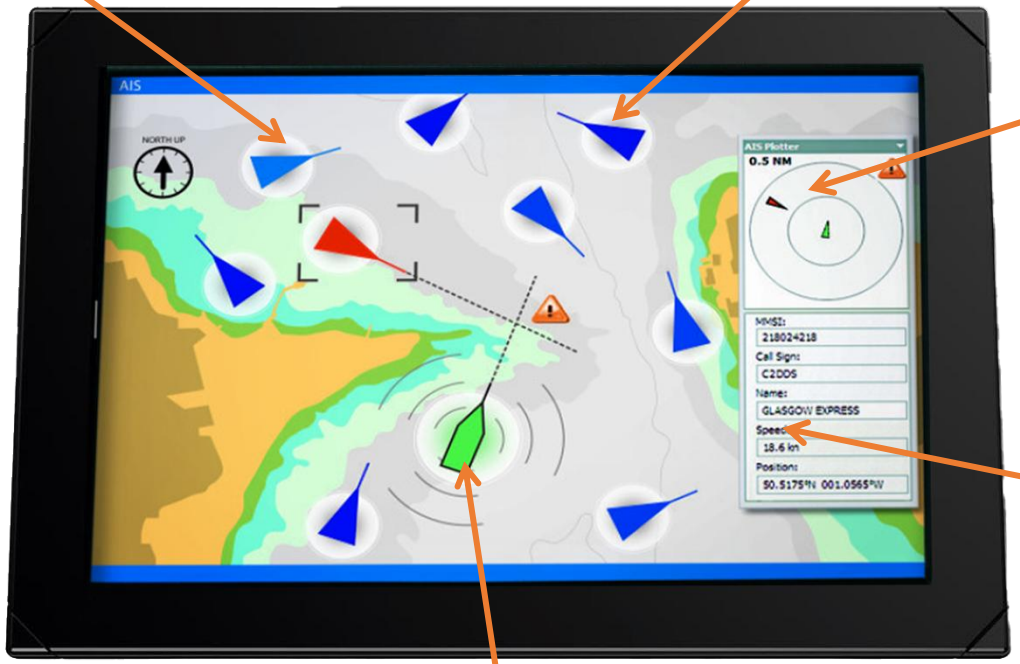
- When designing the **NMEA 2000 PGNs** for AIS, the NMEA created a PGN for each AIS message
- Some **PGNs** cover more than one AIS message type
- Not all NMEA2000 Chart Plotters accept all of the AIS PGNs
- There is no **VDO type PGN**, but applicable PGNs have a field that indicates “Own Data”

Message	Name	Description	PGN
1	Position report	Scheduled position report; (Class A shipborne mobile equipment)	129038
2	Position report	Assigned scheduled position report; (Class A shipborne mobile equipment)	129038
3	Position report	Special position report, response to interrogation; (Class A shipborne mobile equipment)	129038
4	Base station report	Position, UTC, date and current slot number of base station	129793
5	Static and voyage related data	Scheduled static and voyage related vessel data report; (Class A shipborne mobile equipment)	129794
6	Binary addressed Message	Binary data for addressed communication	129795
7	Binary acknowledgement	Acknowledgement of received addressed binary data	129796
8	Binary broadcast message	Binary data for broadcast communication	129797
9	Standard SAR aircraft position report	Position report for airborne stations involved in SAR operations only	129798
10	UTC/date inquiry	Request UTC and date	129800
11	UTC/date response	Current UTC and date if available	129793
12	Addressed safety related message	Safety related data for addressed communication	129801
13	Safety related acknowledgement	Acknowledgement of received addressed safety related message	129796
14	Safety related broadcast message	Safety related data for broadcast communication	129802
15	Interrogation	Request for a specific message type (can result in multiple responses from one or several stations)	129803
16	Assignment mode command	Assignment of a specific report behaviour by competent authority using a Base station	129804
17	DGNSS broadcast binary message	DGNSS corrections provided by a base station	129792
18	Standard Class B equipment position report	Standard position report for Class B shipborne mobile equipment to be used instead of Messages 1, 2, 3	129039
19	Extended Class B equipment position report	Extended position report for class B shipborne mobile equipment; contains additional static information	129040
20	Data link management message	Reserve slots for Base station(s)	129805
21	Aids-tonavigation report	Position and status report for aids-to-navigation	129041
22	Channel management	Management of channels and transceiver modes by a Base station	N/A
23	Group assignment command	Assignment of a specific report behaviour by competent authority using a Base station to a specific group of mobiles	N/A
24	Static data report	Additional data assigned to an MMSI Part A; Name Part B; Static Data	129809 + 129810
25	Single slot binary message	Short unscheduled binary data transmission (Broadcast or addressed)	N/A
26	Multiple slot binary message	Scheduled binary data transmission (Broadcast or addressed)	N/A

What AIS looks like

Each vessel is displayed in its position on the chart

Targets constantly moving to reflect real time position and direction



Warning of collision or 'close' proximity automatically provided

By selecting any vessel displayed on the screen all static and dynamic data is displayed

Your own position is displayed on the chart

Displaying AIS

Although AIS data is always the same, it can be displayed in a variety of ways:

- **Chartplotter, Radio & MFD** via NMEA
- **Smartphone & Tablet** via Wi-Fi
- **PC & MAC** via USB

Splitter vs Dedicated VHF Antenna

Pros
- Single Antenna Solution
- Top of mast for Maximum Range
- Easy Installation – no cables to run
- No loss of performance

Cons
- 4x the Cost of a Dedicated Antenna
- Misses Targets while VHF transmits

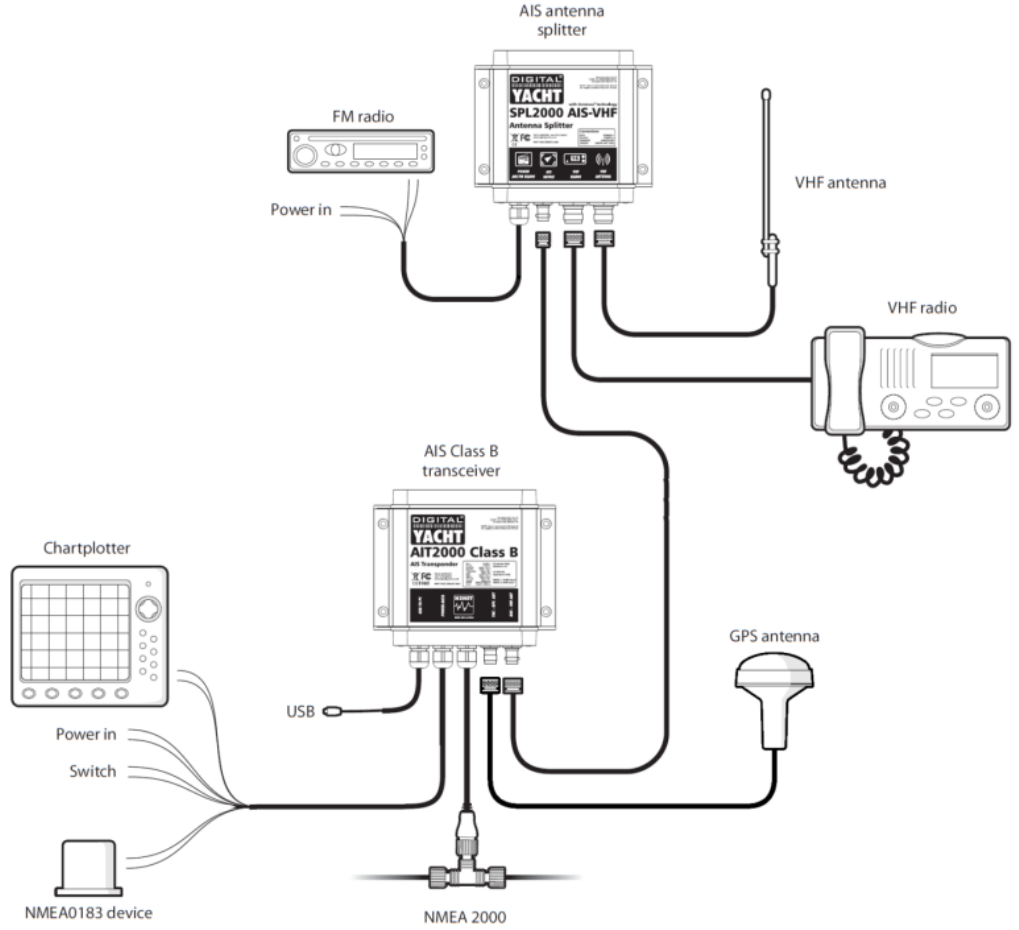
VS

Pros
- Low Cost
- Backup Emergency Antenna for VHF
- Not affected by VHF voice activity

Cons
- Less Range at deck level (10-15NM)
- Installation can be time consuming/costly
- “Not Another Antenna !”

How splitter works

- Single Antenna is shared by the AIS and VHF
- **Two super fast, intelligent switches inside** the splitter sense when AIS or VHF is transmitting
- A typical Class B AIS transmission **only lasts 26mS**
- **VHF gets priority** and whilst transmitting no AIS reception is possible
- When neither system is transmitting both systems are connected to the aerial
- Splitter **protects the VHF or AIS from receiving the full transmit power** from the other device



Other AIS types: MOB & SART

- An AIS MOB/SART is basically a **low power Class A transmitter** (1W):
  - AIS MOB is A personal emergency beacon worn by an individual crew member.
  - AIS SART is a vessel or liferaft-level emergency beacon.

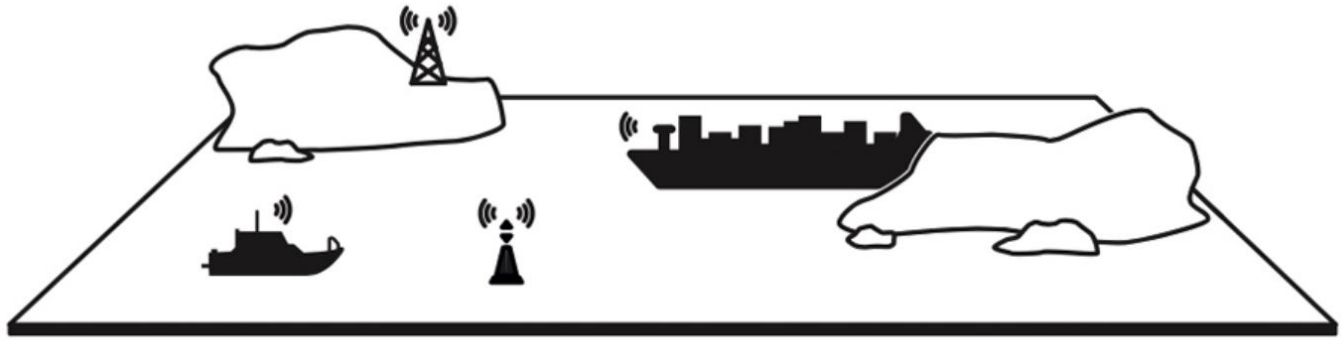
- **Once activated, an AIS MOB/SART should start transmitting its position** within 1min and continue transmitting every minute until the battery is dead

- They also **output a Safety Related Message (SRM) every four minutes**

- When held 1m above sea level the AIS SART should be received by all AIS units **within 5NM radius**

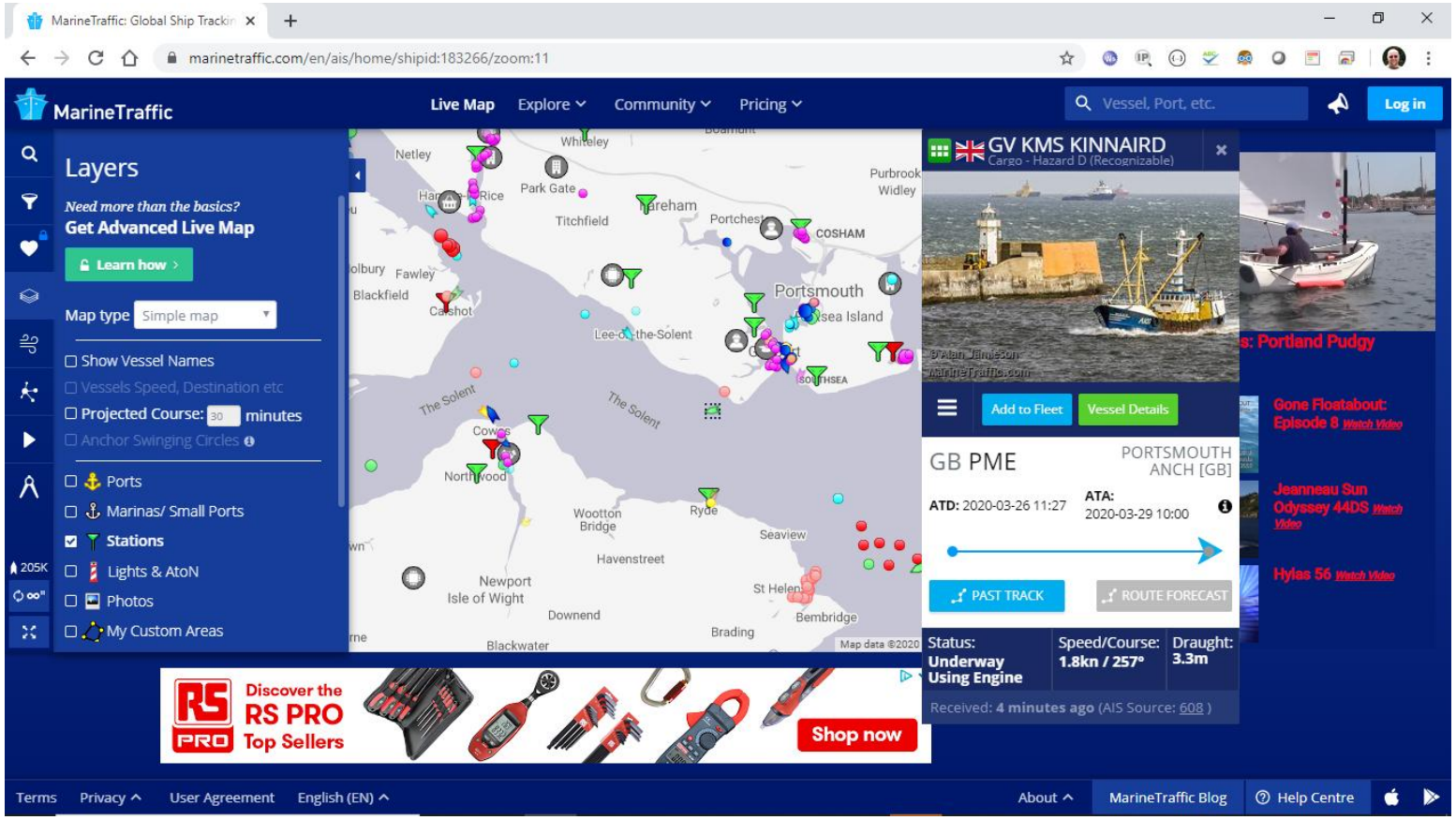
Other AIS types: AtoN

- **AtoN** stands for **Aid to Navigation.** It fits to **marine structures, hazards, buoys** or can be configured to represent a virtual (up to 5 points) or synthetic point
- AtoN **Class 1 device** (transmit only) or a **Class 3 device** (transmit and receive).
- Class 3 devices can **internally allocate slots for transmission** allowing them to be placed anywhere
- Class 3 devices **support chaining and remote (VDL)** configuration and monitoring
- **Custom data transmission to base stations** such as electrical status, local tide, current, salinity etc. measurements



AIS on the internet

- Websites like Marine Traffic are a great source of AIS information and maintain ship databases with photos, but beware holes in coverage and stations that are poor or off.



Our range of AIS

The most complete range of AIS transponders

Entry Range AIS Transponder

iAISTX/iAISTX Plus

Class B+ AIS transponder with WiFi interface

- AIS transponder for tablet navigation.
- Basic solution for AIS reception on board.
- Internal WiFi antenna and up to 20 m range.
- External GPS antenna and 10 m cable.
- Integrated web interface for easy configuration.

- **iAISTX Plus:** WiFi and NMEA 2000 interface for MFDs.

Class B+ AIS Transponder

AIT2500

SOTDMA Class B AIS transponder with NMEA

- Compact AIS transponder with multiple interfaces for all types of **boats with chartplotter.**
- NMEA 0183 input and outputs.
- NMEA 2000 interface
- USB interface for PCs and configuration.
- Supplied with external GPS antenna (10m cable).

Portable AIS Transponder

NOMAD 2

Portable Class B+ AIS transponder with WiFi

- Perfect AIS solution for charter, skippers, tenders, AIS functionality on small boats and as a backup system.
- Supplied with a combined GPS-VHF antenna.
- Power supply via cigarette lighter plug or 12/24V
- Built-in WiFi interface.
- Simple configuration via the web interface.

Self-contained & Waterproof AIS Transponder

AIB1000

Vessel tracking Class B AIS transponder

- Ideal for small vessel tracking and monitoring.
- 5 day continuous use from its internal battery or connect directly to power source (e.g. battery or solar installation) for a permanent installation.
- Takes only 5 hours to completely recharge.
- Integrated antenna and rugged IPX8 design ensures reliable performance.).

Class A AIS Transponders

CLA2000

Globally approved IMO Class A AIS transponder.

- For ships over 300 tonnes, fishing vessels >15 m, passenger ships and for the SOLAS Convention.
- 5″ colour display (MKD) with user interface.
- Multiple sensor and NMEA 0183 interfaces.
- NMEA 2000, USB and WiFi.
- Configurable alarms (AIS SART MOB, CPA, TCPA).

The ultimate AIS Transponder

AIT6000

SOTDMA Class B AIS transponder with WiFi and splitter

- NMEA 0183, NMEA 2000, USB, and WiFi interfaces.
- Built-in VHF splitter.
- Configuration via web interface.

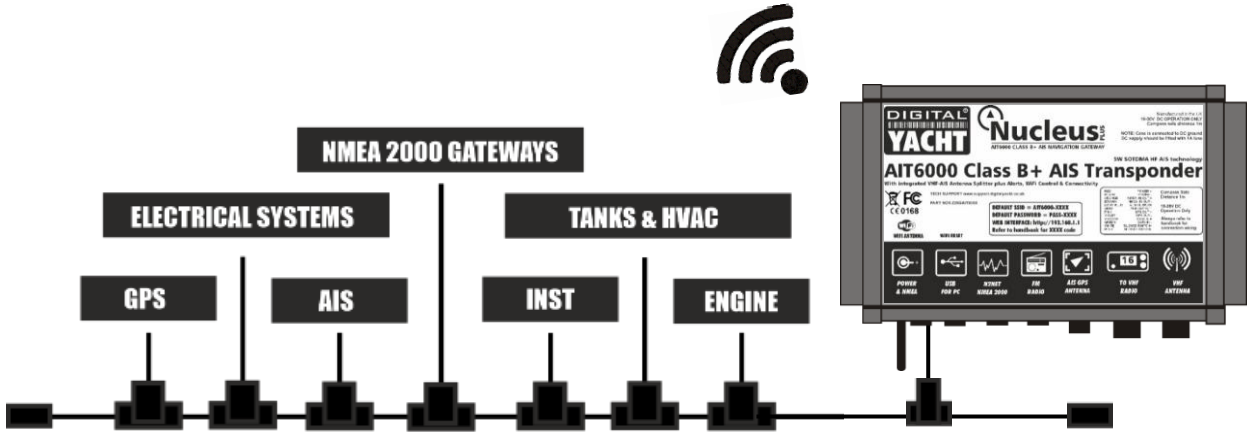
NEW FEATURES :

- **SPAIS™ technology:** optimized AIS tracking via satellite.
- **Built-in NMEA 2000 multiplexer:** sends NMEA 2000 navigation data via WiFi.
- New interface with **built-in CPA/TCPA, MOB, anchor alarms.**
- **Alarms on NMEA 2000 bus** and **external buzzer.**

AIS Transponders – AIT6000

WiFi & NMEA 2000 Gateway

- Password protected Wi-Fi interface for tablet nav
- Allows the AIT6000 to always act as an independent navigation hub using a tablet or iPad
- AIT6000 sends AIS and GPS data from the transponder to navigation apps & software but also **boat instrument data from the NMEA 2000 network** – such as depth, heading, speed and wind information (PGNs available online)
- Multiple devices can connect using TCP/IP or UDP
- Data filtering through wireless interface



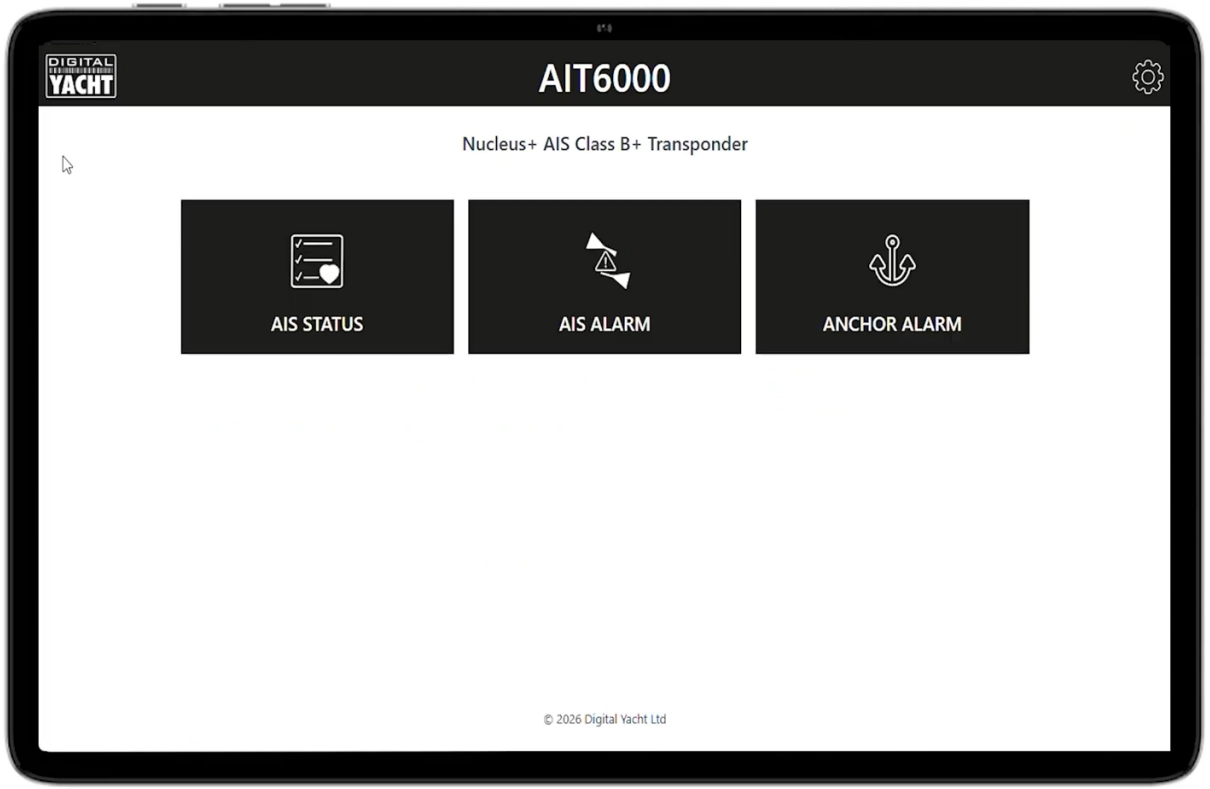
AIS Transponders – AIT6000

User interface

Built-in alarms

AIT6000 has a unique, optimised interface with **integrated AIS and navigation alarms.**

- **CPA/TCPA alarms:** Calculates the risk of collision based on AIS data.
- **AIS SART and MOB alerts.**
- **Configurable anchor alarm.**
- **NMEA 2000 alert generation:** Transmits alarms and AIS error on the N2K network. Also compatible with external buzzer and NavAlarm.



What AIS to choose?

Features	iAISTX & iAISTX Plus	AIT2500	AIT6000	NOMAD 2	AIB1000	CLA2000
Type of AIS & Transmit Power	5W Class B+	5W Class B+	5W Class B+	5W Class B+	2W Class B	12.5W Class A
Transmit Rate	Up to every 5 secs	Up to every 5 secs	Up to every 5 secs	Up to every 5 secs	Every 30secs	Up to every 2secs
Power Supply	12/24V	12/24V	12/24V	Cigarette Lighter Plug	Internal Battery or 12/24V	12/24V
External or Built-in GPS	External GPS	External GPS	External GPS	External GPS	Built-in GPS	External GPS
Built-in VHF Splitter	No	No	Yes	No	No	No
NMEA 2000	Yes for Plus Version	Yes	Yes	No	No	Yes
NMEA 0183	No	Yes	Yes	No	No	Yes
Wi-Fi	Yes	No	Yes	Yes	No	Yes