# DIGITAL YACHT

SAIL BOAT   SPORT FISHING   MOTOR BOAT

White Paper on New AIS Class B Standard

1. Background

AIS (Automatic Identification System) is now one of the most widely used and significant navigation safety technologies since the introduction of radar. The system was originally developed as a collision avoidance tool to enable commercial vessels to 'see' each other more clearly in all conditions and improve the helmsman's information about his surrounding environment.
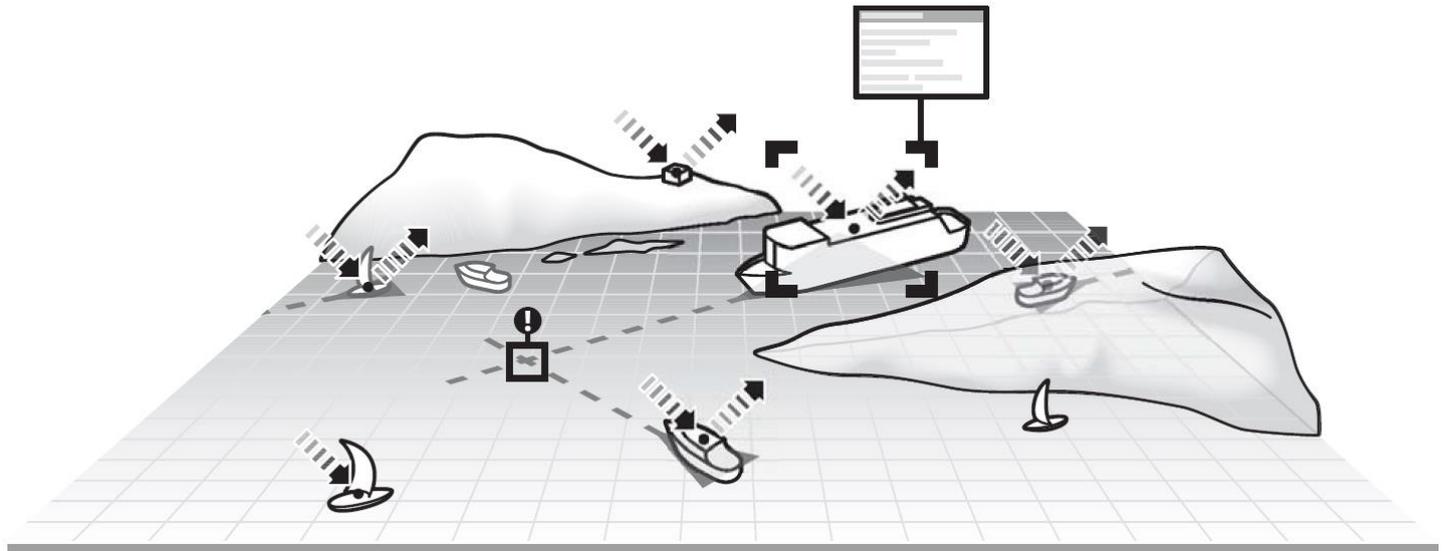
AIS does this by continuously transmitting a vessels identity, position, speed and course along with other relevant information to all other AIS equipped vessels within range. Combined with a shore station, this system also offers port authorities and maritime safety bodies the ability to manage maritime traffic and reduce the hazards of marine navigation.

Due to the great safety benefits offered by AIS, the fitting of a Class A transponder was made compulsory throughout the world in 2002 for all vessels over 300 gross tonnes or that carried more than 12 passengers. For smaller vessels that fell outside of the mandate, a Class B transponder was defined which allowed fishing and leisure vessels to fit a lower power/cost transponder that worked on the same AIS network and could receive and transmit signals to the Class A transponders fitted to commercial vessels.

AIS transponders are now commonly seen on many leisure vessels and with the approval of personal AIS SARTs for use as Man Overboard systems, in conjunction with Search and Rescue vessels/helicopters now fitting SAR transponders, AIS is becoming an important part of the Global Maritime Distress and Safety System (GMDSS).

Another new AIS application is vessel tracking, with websites like Marine Traffic and AISLive that collect and display thousands of AIS targets from their shore based AIS reception networks, and global satellite reception via companies such as Orbcomm, exactEarth and Spacequest.

Many national marine authorities are installing special Aids to Navigation (AtoN) transponders that can replace traditional Buoys and Beacons and transmit local weather/tidal information to passing vessels, while some large and busy harbours or shipping areas use AIS as part of their Vessel Traffic Services (VTS) to manage and control shipping movements.

It is this continuous expansion of the global AIS network, that has led to the approval of a new Class B technology that sits half way between the original Class B technology and the Class A technology found on commercial shipping. This new technology does not supersede or replace the original Class B transponders, but it does offer significant improvements for some types of vessels and applications. For the purposes of this White Paper, we will refer to this new technology as Class B+.

2. How AIS Works

To fully appreciate the benefits of this new Class B+ technology, it is necessary to understand how AIS works.

An AIS transponder consists of a GPS receiver and a VHF "Data" Radio. The transponder takes its GPS position and transmits this in Digital Form on two VHF channels dedicated to AIS (161.975MHz and 162.025MHz).

In order that multiple AIS transponders can "play nicely together" and avoid all of the devices transmitting at the same time, causing interference and loss of data, AIS transponders use a system called Time Division Multiple Access (TDMA). This is a similar system to that used in mobile phones, where each AIS transponder claims a very short 26.6 millisecond "time slot" where it transmits its information. The claiming of Class A time slots uses "Self Organised" TDMA where multiple transponders know how to claim and reserve time slots and what to do if there is a dispute with another transponder trying to claim the same time slot.

The system works well and allows up to 4500 ships to work within close proximity of one another, automatically giving priority based on distance apart, i.e. as the number of vessels increases, the ones furthest away do not get a time slot.
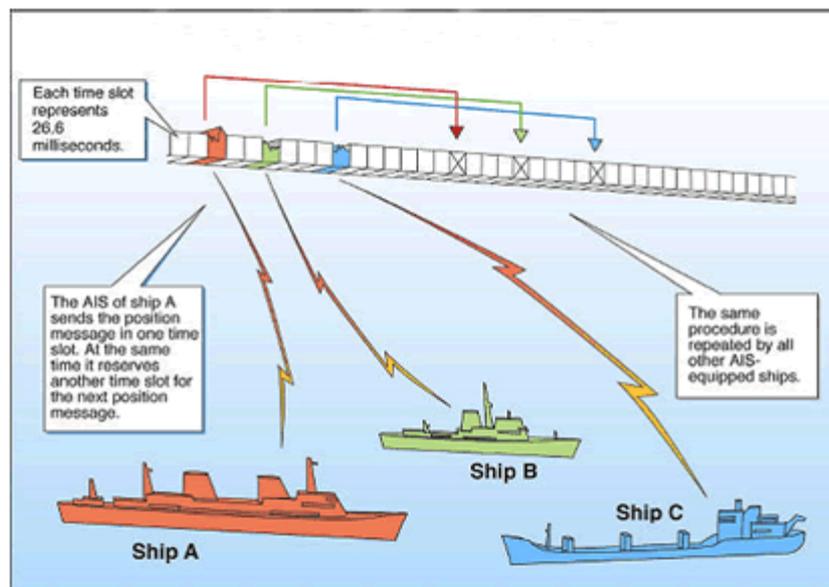
When Class B transponders were introduced, they used a slightly different technology called "Carrier Sense" TDMA where the Class B transponder listens to the Class A transponders and as soon as it detects an empty time slot, grabs it and makes its transmission. Occasionally a Class A transponder will "steal" a time slot from a Class B transponder and the system is designed that Class A transponders always take priority over Class B, so the Class B transponder will have to delay its transmission and start listening again for another empty slot.

The number of transmissions that a transponder makes and the type of data it sends varies, based on its Class (A or B), its speed, whether it is manoeuvring and its navigation status. The Class A transponder of a fast-moving ferry may output its position every couple of seconds while a Class B equipped pleasure vessel will only transmit every 30 seconds, whilst underway.

As previously mentioned, the AIS data is transmitted over two channels of the VHF frequency range and a Class A transponder transmits at 12.5 Watts while an original Class B transponder only transmits at 2 Watts which - to put this in to perspective - is a third of the power of a hand-held VHF that transmits at 6 Watts.

This 2 Watt transmit power restricts Class B transmissions to an absolute maximum range of about 8-10 Nautical Miles and also means that traditional Class B transmissions are often not received by the AIS Satellites that provide global vessel tracking.

3. The New Class B+ Technology

The new Class B+, often referred to as "Class B SOTDMA" or "Class B 5W", has been defined to bridge the gap between Class A and Class B transponders, offering some clear advantages for some types of vessels and applications.

Class B+ uses the same SOTDMA technology as Class A and therefore has the same priority when it comes to reserving a time slot, guaranteeing that it will always be able to transmit, even in busy AIS congested waters. For fast moving vessels this is important as a missed transmission can result in a vessel moving a long distance before it next manages to send a transmission.

Another feature that the new Class B+ technology it has taken from Class A, is the increased and automatic changing of transmission rates depending upon speed. Unlike Class A, the update rate is unaffected by whether the vessel is manoeuvring, but as the vessels speed increases, the number of transmissions increases so that other vessels get a clearer and more up to date view of where the boat is.

For slow moving vessels the increased update rates of Class B+ are not so important, but a fast power boat travelling at say 23 knots, will move 360 metres in 30 seconds, which is the update rate of a normal Class B transponder. On a Class B+ vessel travelling at 23 knots or more, the update rate is 5 seconds, so (using the above example) only 60 metres would be moved between updates.

Finally, Class B+ transponders have a higher power transmission 5 Watts instead of 2 Watts and this not only increases the range over which the vessel's transmission will be received, assuming good antenna height and performance, but it also significantly improves the AIS Satellite reception, enabling global tracking.

4. Comparison of AIS Classes

The following tables have been created to provide a "side by side" comparison of the three different classes of AIS.

Class A, B and B+ Functionality

Function	Class A	Class B+	Class B
Transmit Power	12.5W	5W	2W
Transmit Rate	Up to every 2-3 secs	Up to every 5 secs	Every 30 secs
Minimum Keyboard + Display (MKD)	YES	NO	NO
Technology	SOTDMA	SOTDMA	CSTDMA
Guaranteed Time Slot Allocation	YES	YES	NO
Voyage Data	YES	NO	NO
External GPS Connection	YES	NO	NO
Price (approx)	£2000	£650	£500

As can be seen from the table above, in normal operation a Class A transponder transmits at a much higher power than a Class B. In "real-life" terms a well installed Class B transponder should be able to transmit up to 7-8NMs whilst a Class A transponder maybe seen as far as 20-25NMs away. With its 5W output, a Class B+ will be better than a Class B (2W), but not x2.5 better, typically 10-12NM should be seen.

As illustrated in the following table, Class B and B+ transmit the same data, a sub-set of the data transmitted by a Class A transponder.

Class A, B and B+ Transmitted Data

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	NO	NO

Finally, the table below shows the different data transmit rates of the three systems. As can be seen, Class A transponders have several different transmit rates, based on speed, manoeuvring and Nav Status, whereas the Class B+ transmission rate is purely based on speed.

Comparing Class B+ to the original Class B, it can be seen that the simple two update rate (underway or stationary) of the original Class B has been expanded and increased in Class B+. For any boat that regularly travels at over 15 knots and particularly for boats capable of travelling at over 23 knots, the increased transmission rates offered by Class B+ are an important benefit.

Class A, B and B+ Transmit Rates

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

5. Useful Links

If this White Paper has encouraged you to learn more about AIS or even purchase an AIS system for your boat, then the links below should be of interest…

- Digital Yacht's Website where you can find the latest information on our AIS products.
- Digital Yacht's Blog for all of the latest news and articles on AIS
- All About AIS website for more information on AIS systems
- Wikipedia article on AIS
- IMO website that details the global carriage requirements of AIS
- US Coast Guards website on AIS
- Maritime Traffic website leading online AIS website