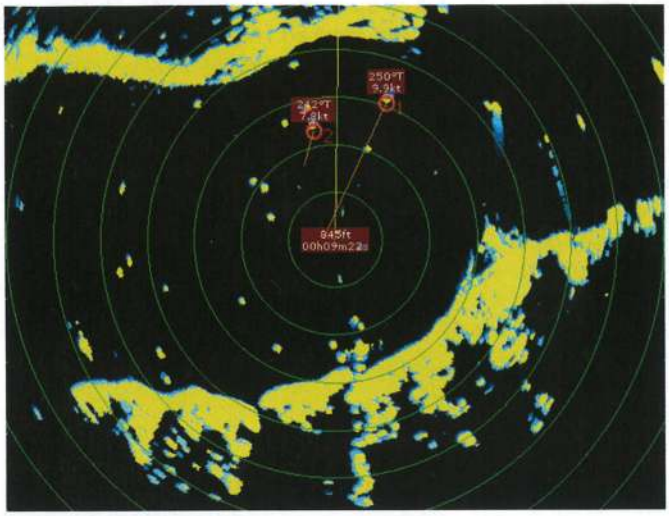
THE KNOWLEDGE

Jonty Pearce is a lifelong cruising yachtsman and retired GP. He keeps his Southerly 105 in Milford Haven



AIS vs radar

DO YOU REALLY NEED BOTH?

AIS and chartplotters have come a long way in the last decade, but are they enough to replace radar? Jonty Pearce examines the latest technology

All of us are keen to avoid collisions and to be aware of what other vessels might be in the vicinity. We all try to maintain a good watch, but looking out on a drizzly night can deter tired crew putting their 'heads above the parapet'. Then of course there is restricted visibility. Anyone who has sailed in fog, particularly in busy waters, will know how nerve-wracking it can be. We would all welcome any extra help in spotting other vessels and to make sure we are seen.

This is where electronic aids can be of use. AIS, radar target enhancers and radar each give an added layer of observation to the 'Mk1 eyeball'. While radar was once the only real option for blind navigation and collision avoidance, there is now a range of technology to help yachts wanting to see and be seen, but each of the options has its own strengths and limitations. With decisions to make for fitting out my own boat, *Aurial*, a Southerly 105 ketch, I set about exploring my navigation options.

RADAR

Radar (Radio Detection And Ranging), which really came of age in the Second World War, is perhaps the most established of the three. Put simply, it sends out a signal and listens for an echo in order to plot the range and bearing of anything solid, like land or other vessels. By tracking the changes of range and bearing relative to your vessel, and applying Rule 19 when navigating in fog, it is a hugely useful tool for collision avoidance, but historically it needed some skill to operate effectively. It also worked well as a means of blind pilotage, allowing a course to be steered relative to land otherwise unseen. While GPS chartplotters have largely replaced this function, data provided by radar is not subject to datum shifts and gives a highly accurate picture of where your vessel is in relation to land. It also has the benefit of revealing objects that are not charted or actively transmitting, including unmarked vessels, weather, and squalls.

More recently, radar technology has moved away from analogue magnetron systems to digital radar, which operates at a much lower power. Manufacturers are constantly working to make their radars have lower power consumption, better image resolution and greater range. The software that goes with them is also developing quickly, adding new functions and making it easier to interpret the key information from the radar display. Without getting mired in proprietary names, the following are some of the key innovations.

CHART OVERLAYS AND DUAL SCREEN RADAR

If your radar is connected to your NMEA network and chartplotter it will be able to overlay the radar picture onto the electronic chart, helping you decipher the picture, as well as your AIS screen, so you can match up radar targets with AIS contacts. The latest radars will also let you view your radar plot at two different scales simultaneously.

MARPA

MARPA (Mini Automatic Radar Plotting Aid) allows you to manually select radar targets which are then automatically tracked, giving you information such as closest point of approach (CPA) and time to CPA (TCPA).

DOPPLER

Much like the changing noise of a siren as it passes by, Doppler processing quickly detects if a target is moving towards you or going away and can then mark the target accordingly to identify risk of collision. It doesn't give you numerical data though.

Radar isn't perfect, however. The picture depends on the set being tuned properly to be as sensitive as possible, while editing out

Radar is more expensive than AIS, but you may wish you'd taken the plunge when the vis closes in amid busy waters

wave clutter and rain. In doing so, it's possible to lose sight of vessels with small radar signatures, such as yachts made of fibreglass. The image also requires interpretation, and 'radar assisted collisions' have long been an issue.

TARGET ENHANCERS

Radar target enhancers are much more simple pieces of equipment. A powered antenna picks up when it is swept by the radar signal of another vessel, and sounds an audible alarm. At the same time, it amplifies the signal returned to the source vessel, making a larger, more visible target appear on its radar screen. The range at which you can pick up a signal depends on the height of the installation, but mounted on the mast, it can be more than 20 miles. It does not, however, tell you where the source of the radar signal came from, or how far away it is, so you are then on alert for traditional watch-keeping skills.

AIS

In contrast to both of these systems, the Automatic Identification System, or AIS, works by vessels actively broadcasting their GPS positions, as well as a huge range of information such as vessel name, course, speed, appearance, and details about their cargo and route, over VHF radio frequencies and appearing on receiving vessels' screens within range. As with VHF radio, this is line of sight, and so limited to 20 miles or so. This is a huge aid to collision avoidance, but also helps VTS services track and control shipping movements.

AIS SART beacons can pinpoint a man overboard to nearby vessels

The system was established internationally in the 1990s for commercial shipping (Class A), so it is still relatively new technology, but has been rapidly adopted by the yachting community. Sailors initially had access to receive-only sets but transmit and receive sets – transceivers – are becoming commonplace in the leisure market (Class B).

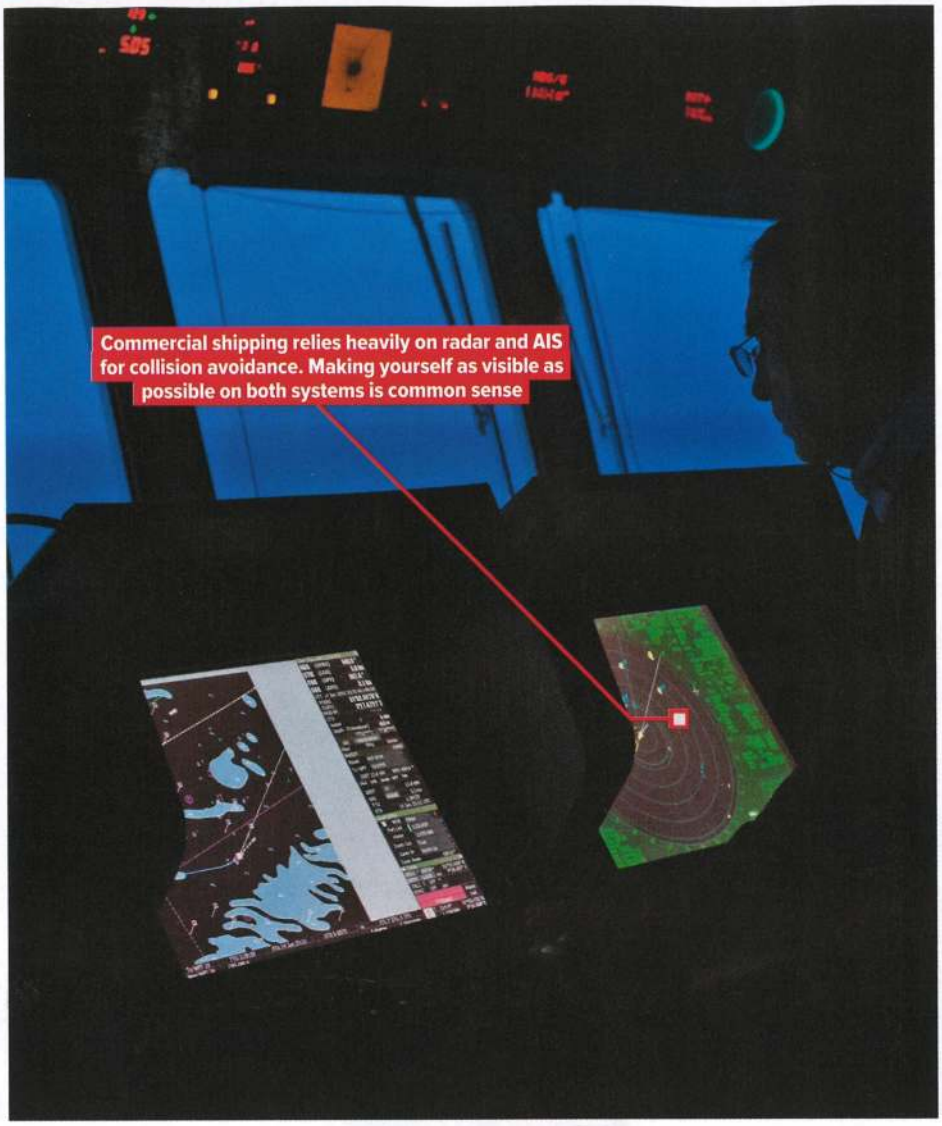
SOTDMA AND AIS SART

New AIS technology is about improving the way in which your data is transmitted, and the latest development for the leisure market is Self-Organised Time Division Multiple Access (SOTDMA). Rather than waiting for a free moment to jump in and transmit your data, SOTDMA allows your AIS unit to pre-book a slot in which to can transmit, so you don't get crowded out. For vessels that are moving quickly, rapid transmissions are key to maintaining an accurate picture of traffic.

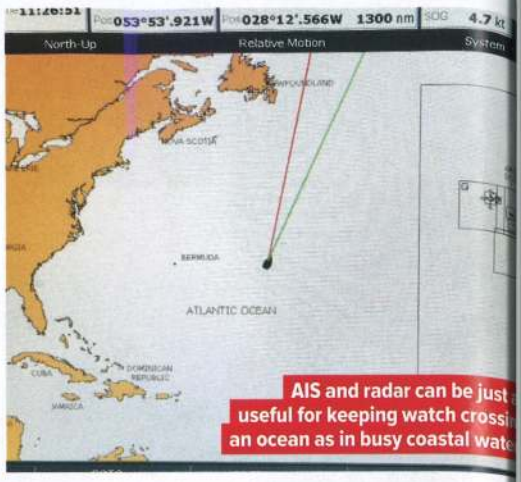
An additional benefit of AIS was the arrival of AIS SART (search and rescue transponder) beacons, which indicate the position of a man overboard to AIS-equipped vessels in range.

The limitations of AIS, as I discovered on my own boat, is that I remained invisible on other vessels' AIS screens, as did any other vessels not transmitting on AIS. Transmitting your own AIS position can warn receiving vessels of your existence and give them the option to avoid you, as well as facilitating them calling you using DSC radio.

This is all well and good for picking up commercial vessels that must carry AIS by law, but many smaller boats are either not equipped or prefer not to transmit their position. The system is also reliant on the other vessels' transmitted data being correct and up to date. Nor can AIS show you the outline of land or navigation marks and is incapable of warning you of nearby squalls.



Commercial shipping relies heavily on radar and AIS for collision avoidance. Making yourself as visible as possible on both systems is common sense



AIS and radar can be just useful for keeping watch crossi an ocean as in busy coastal wate

Many cruising yachts carry radar sets that are now ageing, and may speak a completely different language to modern instruments' code of NMEA 0182 or NMEA 2000. If you want to upgrade even a single part of your electronics, therefore, you risk making your radar set obsolete. Faced with the choice, and the cost, do you do away with radar, keep your old one and add AIS, or update the lot?

I recently sailed across the Atlantic on a friend's Beneteau 475 that had three alternative systems side by side: radar, AIS and, as a backup, an active radar target enhancer. This proved an interesting test bed and made a good comparison to my own boat, *Aurial*, which is equipped with an AIS receiver only, to see precisely how much benefit radar adds.

What is clear is that a combination of AIS and radar gives you the best tools possible in every possible situation.

There are many who would argue that radar is still more useful for collision avoidance than AIS, and it certainly has a greater range of functions. The final decision will depend primarily on your budget, but as with all things safety related, one close call in fog is often enough to persuade people to take the plunge for both AIS and radar.

POWER CONSUMPTION
RAYMARINE: AN EXAMPLE

A typical small older unit such as the Raymarine RD218 2KW consumed 2.3A (28W) on transmit and 0.75A (9W) on standby. The larger digital RD418 4KW used 3.3A (40W) on transmit, and 1.6A (20W) in standby. The RD418HD increased that to 5A (60W) and 2A (25W) respectively.

This ever-hungrier trend was reversed by the new broadband Quantum CHIRP to the much more reasonable 1.4A (17W) and 0.58A (7W). Looking at matching 8-9in MFDs to display the radar image, the early C80 consumed 0.83A (10W). The C90 Widescreen used 2.6A (32W); the e95 1.3A (16W); the eS97 1.6A (20W), while the latest Axiom 9 has it sussed at 0.75A (8.95W).

The point of all these figures is to show that even a conservative, small older radar and MFD might drain more than 7.5A from your battery bank (a huge 180Ah over 24hrs), while the latest combinations of radar and MFD might draw a mere 2.15A on transmit (51.6Ah over 24 hours).

RANGE

On the west-to-east Atlantic crossing from Antigua to the Azores we had the benefit of a Raymarine RD418 combined with an E120 MFD. While scanning we could see targets well over the horizon at up to 24 miles and were able to track them accurately at a distance of 12 miles; we could also set guard zones to alert us to other vessels' positions.

The radar was handy for spotting and tracking squalls; several times we used it to take avoiding action for blobs of nasty weather shown on the screen. Our AIS should have been a boon, but a faulty aerial limited its range from what should have been 20 miles to less than two, but my AIS aboard *Aurial* allows me to identify and track craft well over the horizon when at sea as well as being useful to spot tanker and tug activity in the confines of Milford Haven.

We were also equipped with an Echomax Active-X radar target enhancer. We found our unit had a range of at least 25 miles as it regularly picked up radar sweeps from large ships beyond our own radar range. The option of activating AIS or radar tracking could then be reserved for occasions where more detail was warranted. Mounting it lower down would, however, have given a more useful warning range when we would then be more able to assess the risk.

POWER

Few small cruising yachts enjoy the reserves of battery power required to support a continuously transmitting radar. Our radar and MFD drew over 5.8A on transmit – 160Ah in 24 hours was just not practical given our battery bank and power generation capacity. If you are going to use radar as a lookout, you need to be confident that its power draw, combined with the other instruments you are running, can be supported by your battery capacity, and that you have sufficient power generation available to recharge the batteries.

By comparison, AIS units sip power far more gently, though this will also depend on the interface with which you use them. Frugal sailors could install a Radar Target Enhancer. Their tiny current draw means that they can be left on day and night, though they are less useful for collision avoidance.

Radar and AIS: entry-level options

Raymarine AXIOM 9in
Power: 8.95W

£1,149.95

Garmin GPSMAP 7408 8in
Power: 22W

£1,679.99

B&G Vulcan 9in
Power: 12W

£1,169.99

Furuno GP-1971F 9in
Power: 12W

£1,199.95*

Raymarine Quantum Q24C 18in
Output power: 20W
Range: 24 miles
Transmit: 17W
Standby: 7W
Weight: 5.6kg
£1,845

Garmin GMR Fantom 18in
Output power: 40W
Range: 48 miles
Transmit: 48W
Standby: n/a
Weight: 7.7kg

£2,179.99

B&G Broadband 3G radar
Output power: 165mW
Range: 24 miles
Transmit: 18W
Standby: 2W
Weight: 7.4kg

£1,729.99

Furuno DRS4D-NXT 24in solid-state doppler
Output power: 25W
Range: 36
Transmit: 30W
Standby: n/a
Weight: 7.3kg
£2,199.95*

AIS options

The choice of AIS receivers and transceivers (also called transponders) is vast, but the main choice is whether you go for a black-box system, an integrated AIS and VHF radio, or a stand-alone system.

BLACK BOX AIS UNITS

Digital Yacht AIT2500 Class B+ transponder (with SOTDMA technology) **£690**

Ocean Signal ATB1 Class B+ transceiver (with SOTDMA technology) **£754.80**

Garmin AIS800 Class B transceiver (integral splitter) **£889.99**

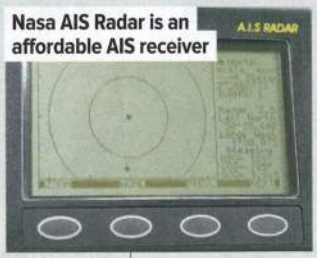
McMurdo M10 AIS Class B transponder (integral splitter) **£588.69**

Raymarine AIS700 Class B AIS transceiver (integral splitter) **£995**

Navico NAIS-500 Class B transponder with GPS (excluding splitter) **£790**

NASA AIS Engine 3 (for PC viewing) **£139.64**

Icom ICM506 VHF + Transceiver



Nasa AIS Radar is an affordable AIS receiver

VHF RADIOS WITH AIS

Icom IC-M605EURO VHF/GPS/AIS with separate transponder **£1,559.99**

Icom IC-M506EURO VHF/GPS/AIS receiver **£499.98**

Standard Horizon GX6000E VHF/GPS/AIS receiver **£539.95**

Standard Horizon Matrix GX2200 VHF/GPS/AIS receiver **£382.95**

B&G V60 VHF/GPS/AIS receiver **£550**

Garmin 210i VHF/AIS receiver **£629.99**

Raymarine Ray73 VHF/AIS receiver **£725**

STAND ALONE AIS

Nasa AIS Radar stand-alone AIS receiver **£269**

Vesper WatchMate 850 Class B Standalone AIS transponder **£839.99**

Icom MA-500TR AIS transponder **£719.99**

ACTIVE RADAR REFLECTORS

Echomax are the only real source of Active Radar Target Enhancers. The Active-X unit is for detection by coastal craft with smaller radar units, or for offshore and ocean passaging the Active-XS-Dual Band unit is more appropriate.

Echomax Active-X Radar Target Enhancer **£483.33**

Echomax Active-XS Dual Band Radar Target Enhancer **£749.99**

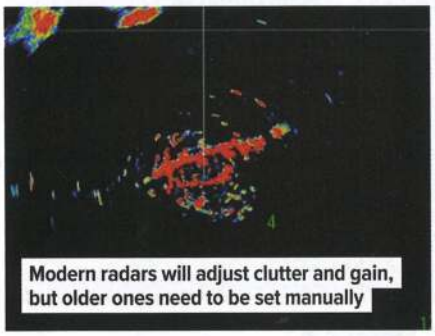
The range of a target enhancer is controlled by the height at which it's mounted

Radar & AIS user tips

Tim Davies, customer support manager at Navico, shares his top tips on getting the most from your radar and AIS

1 GET SET UP CORRECTLY

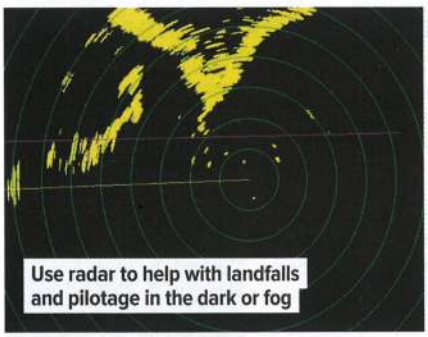
Check your radar installation is properly aligned. In open water, steer your boat towards a target that is obvious visually and on radar, at a distance of about 2 miles. The target should appear dead on your radar heading line. If it doesn't you'll need to correct the alignment.



Modern radars will adjust clutter and gain, but older ones need to be set manually

2 RADAR TUNING

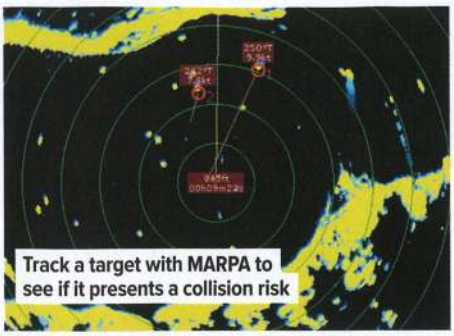
If you have an old radar set, turn your radar on and let it run for a few minutes, then adjust for gain by turning up till you get some clutter, then backing off just enough to clear it. You can also select presets for being in harbour or offshore, which may help.



Use radar to help with landfalls and pilotage in the dark or fog

3 RADAR PILOTAGE

Have a go at blind pilotage by radar, which is potentially more accurate than the GPS position on your chartplotter. Plan your route into harbour on your GPS and then your radar will be able to display a bearing to your next waypoint, as well as clearly displaying nearby land and anything else that's out there.



Track a target with MARPA to see if it presents a collision risk

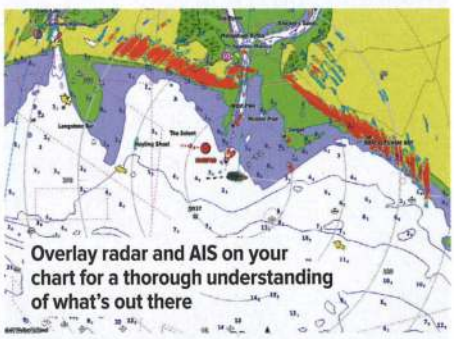
4 MARPA TARGETS

Look in your manual to find out how to acquire a MARPA target, then select a target that could pose a collision risk. Within two or three sweeps, you'll see a square around the target and useful data including its speed, course and closest point of approach. Most systems let you track up to 10 targets.

Adjust the range circle and bearing line to track targets

5 RANGE AND BEARING

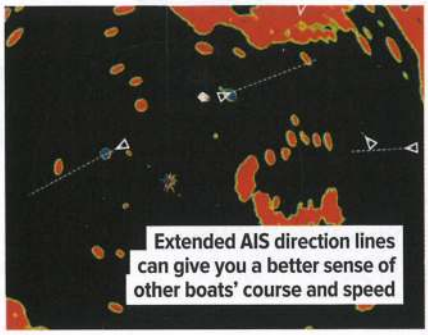
If you don't have MARPA, use the electronic bearling line (EBL) and variable range marker (VRM) to mark the location of the target relative to you. If the target slides down the line towards you, there's a risk of collision. If you change course you'll need to reset it..



Overlay radar and AIS on your chart for a thorough understanding of what's out there

6 CHARTPLOTTER OVERLAYS

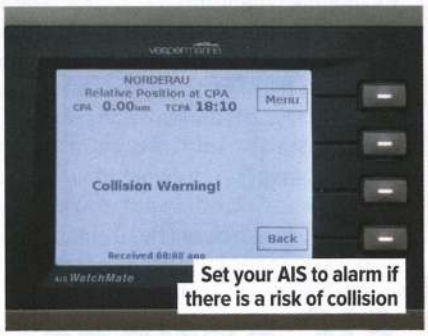
Overlaying the radar image on your electronic chart makes it simple to identify what you're looking at on radar. If it corresponds with a charted image, you know what it is. If it doesn't, the chances are it's another vessel. Having AIS on the same screen should tie in with at least some of these so you can identify the vessels.



Extended AIS direction lines can give you a better sense of other boats' course and speed

7 AIS DIRECTION LINES

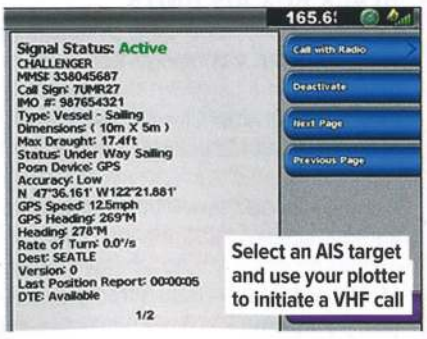
You can change your AIS setting to extend the direction line that shows which way each target is travelling. It'll be much more obvious whether vessels are coming towards you and how fast, but be careful not to clutter up your screen too much.



Set your AIS to alarm if there is a risk of collision

8 AIS ALARMS

If a vessel is going to come near you on its closest point of approach (CPA), you want to know about it. You can set an alarm that alerts you in advance of any vessel within a certain range. You can do the same for other parameters, such as time to closest point of approach (TCPA).



Select an AIS target and use your plotter to initiate a VHF call

9 AIS DIRECT CALLING

If your AIS is networked to your DSC VHF radio, you can find and call friends easily. Go to the vessel list view on your AIS and then sort alphabetically to find them. It will show you where they are, and you can also initiate a direct DSC call with them, all from the AIS screen – great if you're cruising in company.

AIS apps – the pros and cons

Duncan Kent explains how to choose an AIS app you can rely on at sea

There are many marine navigation apps available for both Android and Apple tablets and phones that offer a wide range of navigational features, but too often AIS isn't one of them. The budget apps will often just give you a low-resolution chart, whereas the more expensive ones will provide (or work with) decent, zoomable, hi-res charts from an approved source.

Most tablets have a GPS function, allowing the app to plot your current position and direction of travel and speed over the ground (SOG). You need to be aware that not all 'location' services found on tablets and smartphones actually incorporate a GPS receiver. Many of them get the position from triangulation on phone masts. If your tablet doesn't have an integral GPS receiver then you can often overcome this by using a Bluetooth GPS such as the Bad Elf or the Dual XGPS150A.

One thing all tablets lack is a communication port and yet being able to import your own boat's instrument data into the app can make them considerably more detailed, accurate and useful. For your tablet or phone to pick up this data, it needs to be broadcast initially over a Wi-Fi-enabled, multiplexer/router, of which there are quite a few (Digital Yacht's WLN10 or Comar's I300W, for instance). These devices are wired to the NMEA-0183/2000 outputs from your instruments, the data from which they will then stream out over Wi-Fi (802.11). Even better, Quark Electronics produces a combined GPS/AIS black box receiver (QK-A026) that has a built-in NMEA-0183/2000 multiplexer and Wi-Fi bridge – all for under £100. One slight irritation when using any of these devices, however, is that they utilise a TCP/IP Wi-Fi connection, so you lose access to the internet once you've selected the router.

AIS APPS

Confusion often arises when discussing AIS apps, usually due to the difference between an online AIS repeater service – Vessel Finder, Boat Finder, or Marine Traffic for example – and navigation apps that are capable of importing real-time AIS data from your vessel's own AIS receiver.

Online versions are usually land-based and collect AIS data from various VHF masts around the coastline using the same method as a normal ship's receiver. Users of Marine Traffic's mAIS app, however, can even use a smartphone or tablet to 'self-report' their position and status by programming a GPS-enabled mobile device to automatically report its position, vessel details and status directly to the MT network via SMS.

Either way, this information is then fed into a database and retransmitted to users via the Internet. While this can sometimes be useful when you're simply interested to see where a vessel currently is, it isn't a collision-avoidance device and should never be relied upon as such. During extensive trials of these apps it has been found that a vessel's AIS signals can either sporadically disappear from the display when refreshed or appear in a different position to where they actually are (as confirmed by a pukka marine AIS receiver). This can be due to a variety of reasons, none of which are possible for the tablet user to overcome or correct.

So if you are going to be using your device for real-world collision avoidance you'll need to pick an app that can connect to your AIS receiver