7.6 Automatic Identification System (AIS)

Automatic Identification System (AIS) is a shipborne transponder system capable of broadcasting continuously, using the VHF marine band, information about the ship. Such information could include:

- ship identification data, i.e. ship name, call sign, length, breadth, draught etc.
- type of cargo carried and whether it was hazardous in nature
- course and manoeuvring data
- position to GPS accuracy limits.

Such broadcast information would be capable of reception by other AIS-equipped ships and by shore sites such as Vessel Traffic System (VTS) stations within broadcast range. Data received by a ship or shore station could be relayed to an ECS and AIS targets could be displayed, with GPS or DGPS accuracy, with a velocity vector indicating speed and heading. By 'clicking' on a target, other information such as ship identification data etc. could be displayed. A typical AIS scenario is illustrated in Figure 7.9.

An AIS transponder system requires a GPS or DGPS receiver, a VHF transmitter, two VHF TDMA receivers, a VHF DSC receiver and a standard marine electronic communications connection to the ship's display system. Position and timing information is derived from the GNSS (GPS) receiver. Information, such as ship's heading, course and speed over ground, is normally broadcast using AIS but other information such as destination, ETA etc. could also be promulgated if available.

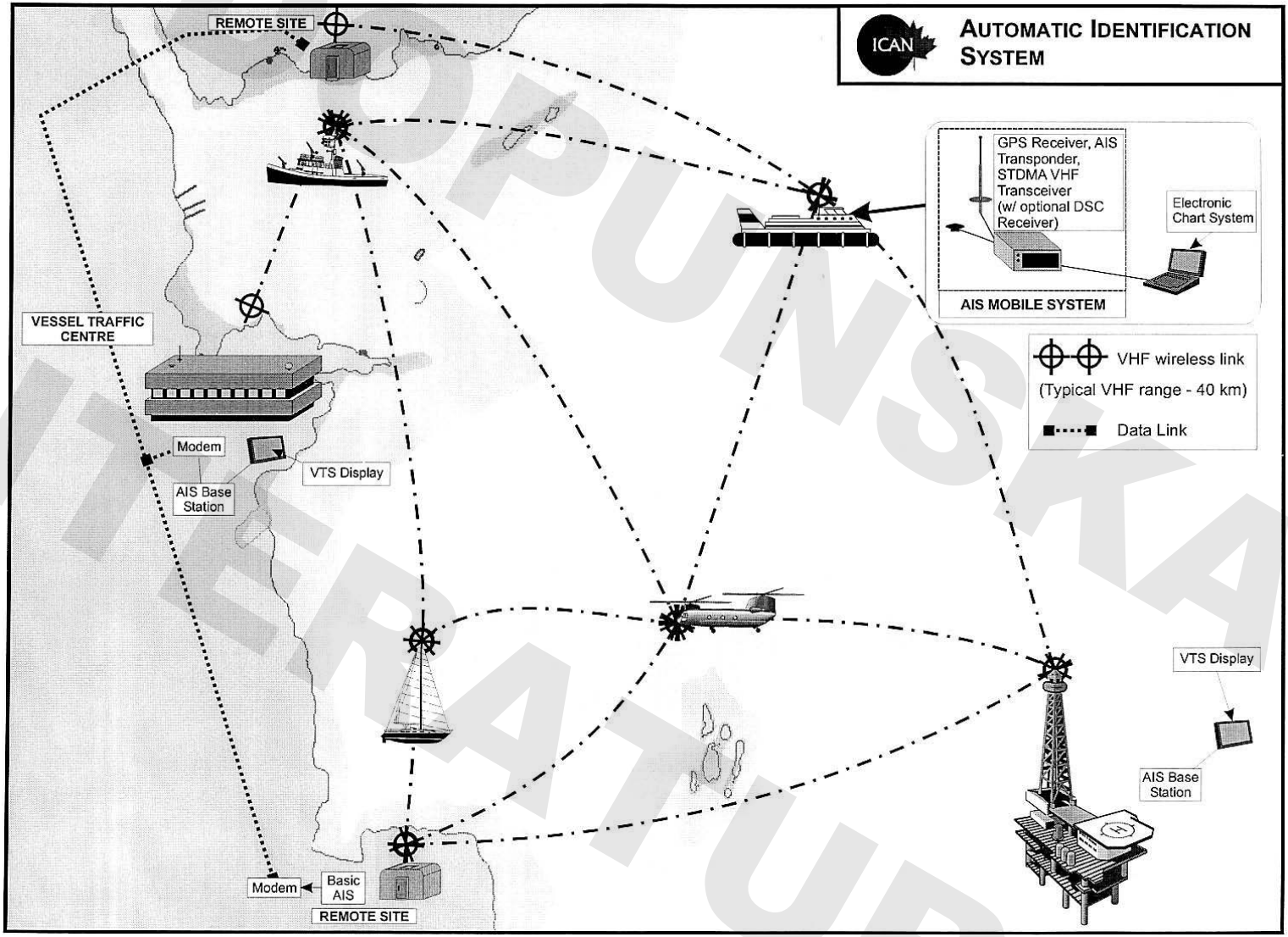

Figure 7.9 Automatic Identification System (AIS). (Reproduced courtesy of ICAN.)

The AIS transponder transmits using 9.6 kbyte GMSK (Gaussian minimum shift keying) FM modulation over 25 kHz or 12.5 kHz channels using HDLC packet protocols. The channel bandwidth of 25 kHz is for use on the high seas and the 12.5/25 kHz channel bandwidth used as defined by the appropriate authority in coastal waters. There are two radio channels available for transmission/reception that minimize RF interference, provide increased capacity and allow channels to be shifted without loss of communication from other ships. The ITU has allocated frequencies with AIS channel 1 using 161.975 MHz (ch87B) and AIS channel 2 using 161.025 MHz (ch88B).

Each transponder self-allocates time slots for its position reports and such reports occur at time intervals that correspond to the traffic situation. This method of communication is known as self-organizing time division multiple access (SOTDMA). The SOTDMA broadcast mode allows the system to be overloaded by up to 500% while still providing nearly 100% communication capacity for ships within 10 nautical miles of each other in ship-to-ship mode. If system overload tends to occur, then targets at the longer ranges will tend to drop out of the system leaving only closer range targets, which are the ones of greater interest to the navigator. There are 2250 time slots established every 60 s for each AIS channel; this gives a time slot duration of 26.67 ms and as each slot has 256 bits the data transmission rate is 9600 bit s^{-1}.

AIS stations continuously synchronize with other stations to obviate any slot transmission overlap. Slot selection by an AIS station is randomized within a defined interval and triggered with a random timeout of between 0 and 8 frames. When a station changes its slot assignment the new location and associated timeout is pre-announced, thus allowing new stations to be received.

Although the AIS concept has been around for many years and trials have taken place at many geographical locations, there is still much work to be done to produce an internationally-agreed standard. Some of the detail of what has been achieved to date is listed below.

IMO Resolution MSC.74(69). Annex 3, Recommendation on Performance Standards for a Universal Shipborne Automatic Identification System (AIS)

The 43rd session of the IMO Navigation Subcommittee, which met in July 1997, completed a draft performance standard on shipborne automatic identification systems (transponders). This performance standard describes the operational requirements for the device but does not define the telecommunications protocol the device must use. The 69th session of the IMO Maritime Safety Committee formally adopted the standard without change in May 1998.

A report from the Subcommittee on Safety of Navigation on its 45th session included the following items.

1 All ships of 300 gross tonnage and upwards (engaged on international voyages), cargo ships of 500 gross tonnage and upwards (not engaged on international voyages), and passenger ships, irrespective of size, shall be fitted with AIS, as follows:
   - 1.1 ships constructed on or after 1 July 2002;
   - 1.2 ships engaged on international voyages constructed before 1 July 2002;
   - 1.2.1 in the case of passenger ships irrespective of size and tankers of all sizes, not later than 1 July 2003;
   - 1.2.2 in the case of ships, other than passenger ships and tankers, of 50000 gross tonnage and upwards, not later than 1 July 2004;
   - 1.2.3 in the case of ships, other than passenger ships and tankers, of 10000 gross tonnage and upwards but less than 50000 gross tonnage, not later than 1 July 2005;
   - 1.2.4 in the case of ships, other than passenger ships and tankers, of 3000 gross tonnage and upwards but less than 10000 gross tonnage, not later than 1 July 2006;

1.2.5 in the case of ships, other than passenger ships and tankers, of 300 gross tonnage and upwards but less than 3000 gross tonnage, not later than 1 July 2007; and

1.3 ships not engaged on international voyages constructed before 1 July 2002, not later than 1 July 2008.

2 The Administration may exempt ships from the application of the requirements of this paragraph when such ships will be taken permanently out of service within two years after the implementation date specified in paragraph 1.

3 AIS shall:

3.1 provide automatically to appropriately equipped shore stations, other ships and aircraft information, including the ship's identity, type, position, course, speed, navigational status and other safety-related information;

3.2 receive automatically such information from similarly fitted ships;

3.3 monitor and track ships; and

3.4 exchange data with shore-based facilities, the requirements of this paragraph shall not be applied to cases where international agreements, rules or standards provide for the protection of navigational information. AIS shall be operated taking into account the guidelines adopted by the Organization.

ITU-R Recommendation M.1371, Technical Characteristics for a Universal Shipborne Automatic Identification System Using Time Division Multiple Access in the Maritime Mobile Band

The International Telecommunications Union Sector for Radiocommunication (ITU-R) met in March 1998 to define the technology and telecommunications protocol for this device. The draft recommendation completed by Working Party 8B was approved by Study Group 8, which met in July 1998. The recommendation was formally adopted in November 1998 and the publication is now available for a fee (see website www.itu.org). The International Association of Lighthouse Authorities (IALA) has been the main organization co-ordinating the development of the Universal AIS Transponder and a revision of this standard is being prepared by IALA for submission to the ITU-R Working Party 8B in October 2000. If adopted it will become ITU-R Recommendation M.1371–1.

IEC Standard 61993–2 on AIS

In July 1998, the International Electrotechnical Commission TC80/WG8-U.AIS started work on the performance, technical, operational and testing standard for the Universal AIS Transponder. The working group is expected to meet regularly and complete its work during the year 2000 with an expected publication date for the standard of December 2001. This standard will supersede IEC Standard 61993–1 on digital selective calling AIS transponders. This new standard will define testing and interfacing requirements for AIS systems. Commercially-produced systems should meet all the three standards described above.

ICAN have developed an AIS module which is an add-on to their 'Aldebaran' Electronic Charting System. The module has been developed for use with Saab TransponderTechs AIS hardware for which ICAN is the exclusive Canadian agent. The AIS module enables ICAN's ECS to display broadcast AIS information on screen in InfoPanels and as overlays. A typical screen display with this feature is shown in Figure 7.10.

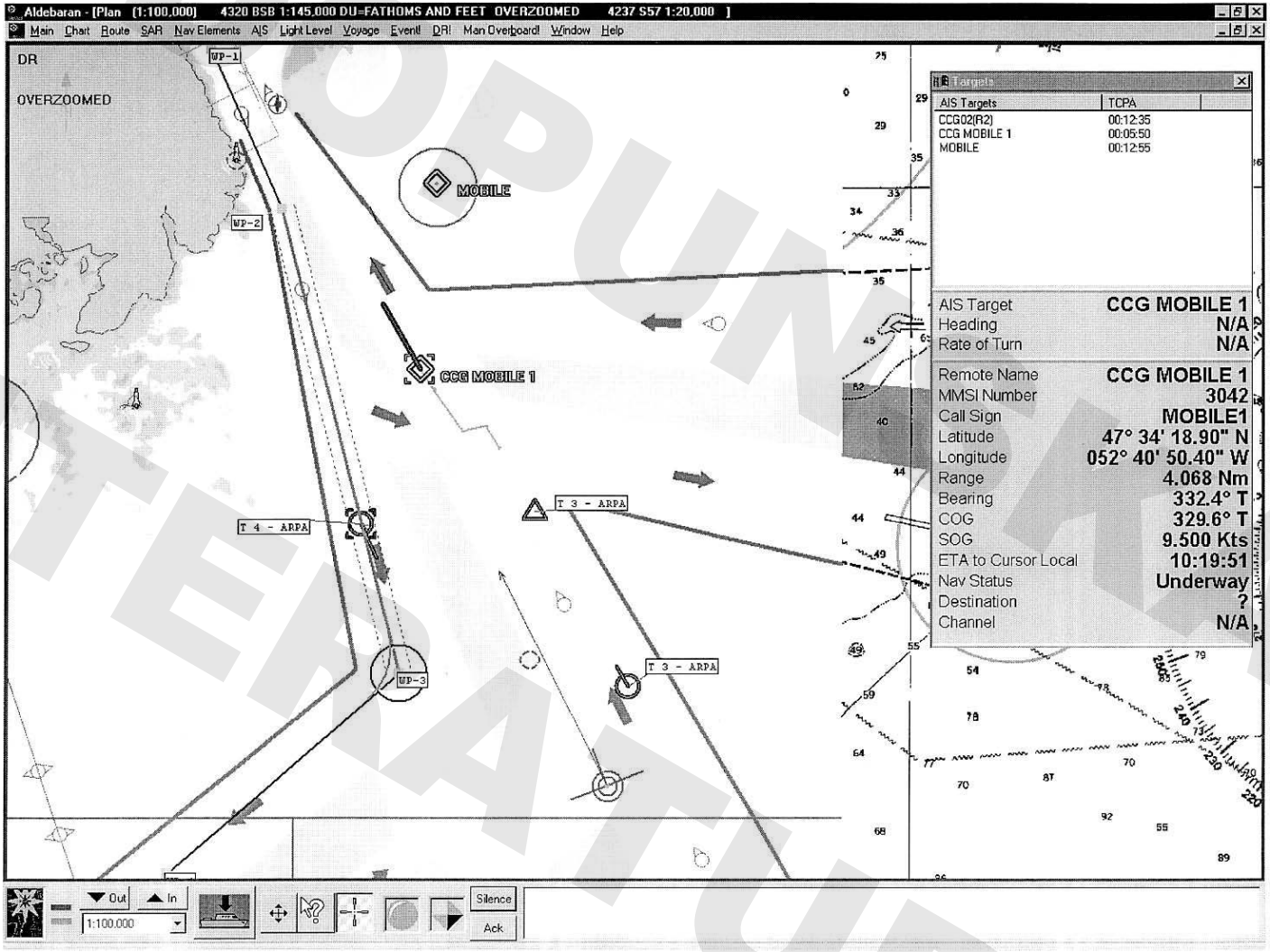

Figure 7.10 Display showing AIS target information. (Reproduced courtesy of ICAN.)

Features of the ICAN AIS module are as follows.

1 AIS Target Monitoring
- Unlimited on-screen AIS targets.
- AIS Tracking InfoBox sorted based on TCPA and RCPA.
- Targets can be individually centred on screen.
- Single target activation.
- Messages can be addressed or sent via broadcast as binary or ASCII data on specific channels.
- Automatic (scheduled) and manual data transmissions.
- Binary transmissions include: man overboard, ARPA, markers and points of interest (SAR, waypoints, routes and zones).
- Displayed AIS transponder channels.
- On screen CPA display.
- Alarms and indications based on configurable CPA properties.

2 Long Range AIS Monitoring
- Microsoft's MAPI (Mail Application Programming Interface) based mail set-up.
- Office and remote monitoring through Inmarsat terminal or service provider.
- Filtered sender information.
- Multiple e-mail address transmissions (single Inmarsat message).
- Configurable gateway formats.

3 AIS Module Configuration
- Remote target properties (shape, labels).
- Name, call sign, ship type, MMSI, IMO no., draught, trip, destination and ETA to destination.
- Own ship transponder transmission information (Nav sensor, antenna location, UTC date time and channel designation).
- Distinguishable transponder characteristics (R2 vs R3 labelling).
- ECS back-up positioning device (transponder GPS).
- Transponder GNSS status.
- Closest point of approach (time and range based).
- Channel polygons.

4 Data logging and Distribution
- Unfiltered logging of serial inputs, including AIS transponder information.
- File-based distribution of logged data.
- TCP/IP distribution of serial inputs.
- Playback of recorded data.

5 ICAN ECS Environment
- Seamless display of charts of S-57, NTX, BSB and MRE formats (other formats in development include ARCS and CM-93).
- Point-of-interest feature allows constant update of range/bearing to any point, marker or waypoint (station keeping).
- Ability to add other software modules including high resolution radar overlay, useful for coastline mapping (scanner up to 120 rpm, 8-bit radar image, raw radar data recording capable).

Information on this AIS module and other useful products offered by ICAN are available on their website www.ican.nf.net.