AIS: A tool for VTS

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Background

Automatic Identification System (AIS), as we know it today, is quite different from the original imaginations of a ‘transponder’ for ships. It was in the late 1980’s, early 1990’s that the concept of a transponder for ships began to surface, to aid in identification of vessels in Vessel Traffic Services (VTS). This idea was really brought to the forefront by the wide-spread acceptance of ‘positive control’ areas in air traffic control. In the 1960s the aviation world began successful testing of a system where aircraft in certain ‘positive control’ areas were required to carry a radar beacon, called a transponder, that identified the aircraft and helped to improve radar performance. Although there are many areas where parallels between VTS and air traffic control (ATC) cannot be identified, this appeared to be one area where VTS could learn from the lessons gained in ATC.

At the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) VTS Symposium in Rotterdam, 1996, many references were made to these ‘transponders’ for ships. The emphasis at this time was on the ship – shore benefits gained through positive identification of vessels and enhanced display. Indeed, in his 1994 report ‘Safer Ships, Cleaner Seas,’ Lord Donaldson urged the United Kingdom Government to “press for the introduction of a world-wide system of transponders”.

In the following years, at many international forums, the concept of ‘transponders’ for ships went through various evolutions until AIS, as we know it today, came into existence.

When we look back at how AIS evolved, it is easy to see how AIS and VTS fit together. The very concept of positive identification for ships was, initially, as a tool to aid VTS. The other benefits, and the system which is now known as AIS, have followed a natural evolution as the benefits of the system were more clearly identified.

Introduction

The International Maritime Organization (IMO) Assembly Resolution A.857(20), Guidelines for Vessel Traffic Services, established that the following tasks should be performed by a VTS:

“A VTS should at all times be capable of generating a comprehensive overview of the traffic in its service area combined with all traffic influencing factors. The VTS should be able to compile the traffic image, which is the basis for the VTS capability to respond to traffic situations developing in the VTS area. The traffic image allows the VTS operator to evaluate situations and make decisions accordingly. Data should be collected to compile the traffic image. This includes:

1. Data on the fairway situation, such as meteorological and hydrological conditions and the operational status of aids to navigation;
2. Data on the traffic situation, such as vessel positions, movements, identities and intentions with respect to manoeuvres, destination and routing;
3. Data of vessels in accordance with the requirements of ship reporting and, if necessary, any additional data required for the effective operations of VTS.”

What a VTS does is improve port efficiency and reduce the risk of marine accidents by providing timely, accurate, and relevant information to mariners and allied services.

According to SOLAS Chapter V, Regulation 19 – AIS shall:

- 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
- Receive automatically such information from similarly fitted ships
- Monitor and track ships
- Exchange data with shore-based facilities

According to the IALA Guidelines on AIS as a VTS Tool (published December 2001), AIS is an important supplement to existing communication systems and provides information to:

- Identify vessels
- Assist target tracking
- Simplify information exchange
- Provide additional information to assist collision avoidance

As we look at the implementation of AIS, we can see that it provides many benefits as a tool for VTS. In addition to the benefits envisioned in 2001, AIS provides valuable assistance in situational awareness and statistical analysis for overall traffic planning.

AIS: A tool for VTS

VTS performs three basic tasks relevant to the provision of its services – information (data) collection, evaluation and dissemination. Within the evaluation of the information, overall situation awareness is developed, and the various tools used by VTS assist in providing this picture of the waterway. In addition to these basic tasks, VTS can provide an ideal location for collection of statistical data that can be used in the overall provision of aids to navigation services.

While the ship-shore/shore-ship aspect of AIS is often overlooked, AIS can and does assist VTS. Indeed, as indicated in SOLAS Chapter V, to realise its full potential, AIS must be able to exchange data with shore-based facilities. Although the tool is very different from what was first imagined, AIS provides valuable information to VTS, including the originally envisioned positive identification of vessels.

In order to realise these benefits, however, the integration of the tool into the VTS centre is important. The effectiveness of the AIS can be significantly increased when it is integrated into other devices, such as electronic display of information, in the VTS centre.

The concept of the shore-based use of AIS is identified in the IALA Recommendation A-123, Provision of Shore Based AIS, and IALA Recommendation A-124, AIS Shore Station and Networking Aspects relating to the AIS Service. (IALA Recommendations are available for download from www.iala-asism.org – go to publications) Figure 4.1 in the recommendation identifies AIS as a tool for Shore Authorities (including VTS).
The key areas where AIS can act as a tool for VTS are information gathering, situational awareness, information dissemination and statistical analysis.

**Information gathering (vessel identification)**

AIS provides valuable information to both the mariner and the VTS centre through the automatic and immediate provision of vessel identity. When correlated with a radar track in a VTS centre, this is a very effective and reliable means of vessel identification.

Within the realm of information gathering, AIS provides information from a wider geographical coverage area using base or repeater stations. As AIS aims to achieve positional accuracy better than 10 metres when associated with Differential Global Navigation Satellite Systems (DGNSS) correction signals, the information provided to the VTS centre is highly accurate. The existing means of correlating AIS and radar targets allows for a hierarchy of position identification, using set parameters to ensure accuracy.

In addition, AIS on aids to navigation can provide real-time (or near real-time) data on meteorological, hydrological conditions and status of the aid to navigation (monitoring). The ability to use AIS as a ‘pseudo’ aid to navigation can provide timely responses to changes in the waterway situation (for example, emergency marking on a wreck or hazard to navigation). As experience is gained, we will continue to identify further benefits to the use of AIS, and its integration into VTS.

**Situational awareness (target tracking, traffic planning, additional information for collision avoidance)**

For many VTS operators, the traffic image is the key to their job. Developing a picture, and then projecting that picture into the future to anticipate developments in the traffic image, is a skill that is taught and developed. The overall concept is situational awareness – the degree of accuracy by which one’s perception of his/her current environment mirrors reality. To develop an accurate perception, the information received must also be accurate. AIS can greatly aid in the quality of the information used to develop this ‘traffic picture’.

Some of the benefits gained with AIS for VTS situational awareness are:

- Elimination of Target Swap - AIS information is not prone to the target ‘swapping’ that is often seen with radar-tracked objects
- Real-time information on manoeuvring - radar data provides, by its very nature, historical data regarding manoeuvring. AIS has the ability to provide elements of real-time manoeuvring data with ships heading and rate of turn information
- Limiting weather effects on tracking performance - heavy rain or snow affects radar images. While VHF radio transmissions can be affected by atmospheric ducting, (often extending range), rain and snow are not likely to affect the traffic image presented
Information dissemination (information exchange)
When AIS is integrated into a VTS system, there is a possibility to use the AIS for information dissemination. This means that data can be both received, and disseminated, by AIS. In addition, AIS information can easily be integrated into other formats for dissemination. Thus, information exchange can be ship-shore/shore-ship as well as from shore station-shore station (i.e. VTS centre to VTS centre).

With increasing emphasis being placed on networking VTS centres on a regional, national or even international basis, the increased potential for information exchange using AIS is being realised.

The Helsinki Commission (HELCOM-Baltic Marine Environment Protection Commission) AIS information exchange is one example of information exchange between shore stations. In 2001 at a ministerial meeting of the commission, a decision was made to enhance the use of AIS by:
- Establishing a national AIS based monitoring system before 1 July 2005
- Establishing a common Baltic Sea monitoring system, based on and with access to all national AIS systems
- Preparing reliable statistics on ship traffic in the Baltic Sea (based on AIS)

As AIS information can be transmitted by a variety of media, including the internet, it is seen as an effective tool for AIS networks. The information exchange can include search and rescue centres, pollution response centres, customs agencies and other allied services.

As developments lead to the use of AIS on aids to navigation (AtoN) (i.e. buoys), information exchange will also include data on the waterway itself, AtoN status, meteorological and hydrological data.

Statistical data (planning, waterway use)
AIS can assist with many aspects of statistics for vessels and waterway use. The digital data stream of AIS facilitates the rapid and comprehensive recording, replay and archiving of data. This data can be used for many different purposes, including accident investigation, analysis of waterway use and analysis of effectiveness of the placement of visual aids to navigation.

AIS has already proven useful in assessing actual waterway use – providing historical data on vessel tracks to better assess the placement of vessel traffic separation schemes, buoy placements, etc. This information assists not only the VTS centre, but the overall provision of all aspects of AtoN.

Challenges
As with any new technology, there are challenges facing the full integration of AIS with VTS. Among these are the display and correlation aspects of AIS on existing VTS displays, integration of AIS into the operational aspects of a VTS centre and the integrity of the AIS information received.

These issues relate not only to the integration of AIS into a VTS environment, but to the overall implementation of AIS. As experience is gained in the use of AIS, issues such as incorrect data entry, equipment installation and the overall means of displaying AIS information will be resolved.

Conclusion
AIS is a very powerful tool, and has the potential to improve safety and efficiency in VTS. The degree to which this potential may be realised will depend on the local operational circumstances, the AIS shore coverage and the integration of AIS into individual, and regional VTS centres. The use of AIS as a tool for VTS will require careful consideration, but is necessary to realise the benefits of AIS as indicated in SOLAS.

As a tool for VTS, AIS can assist in many key areas – information gathering, situational awareness, information dissemination and statistical analysis. The IALA Recommendations A-123 and A-124 provide the basis for developing shore infrastructure for AIS, and the IEC testing standard for non-ship based AIS will provide a means of ensuring compatible systems.