The Limitations Associated with the Use of AIS in VTS Operations

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الخلاصة

أقرت المنظمة البحرية الدولية (IMO) تجهيز السفن بنظام التعريف الآلي(AIS), الذي يسمح للسفن بتبادل المعلومات بين السفن وبعضها وبين السفن ومحطات خدمات مرور السفن. سوف يساعد هذا النظام الحديث محطات خدمات مرور السفن في الحصول علي صورة حقيقة وشاملة ومتجددة آليا لحركة السفن بالإضافة إلي المساهمة في الارتقاء بدقة المعلومات المتوفرة لهذه المحطات.

وللمساهمة في الأستخدام الأمثل لهذا النظام فأن علي ضباط الملاحة ومشغلي محطات خدمات مرور السفن وكل من لهم علاقة بأدارة ومراقبة حركة مرور السفن الألمام التام بحدود تشغيل النظام وأوجه قصوره وذلك لتفادي وقوع الحوادث البحرية، كما أن توضيح هذه العيوب يساعد كل من المشرعيين ومصممين هذا النظام لتفاديها في المستقبل.

Abstract

IMO have adopted a new requirement for ships to carry AIS, which is capable of providing information - including the ship's identity, type, position, course, speed, navigational status and other safety and navigation related information - about the ship to other ships and to coastal authorities. AIS was introduced to improve the safety and efficiency of navigation and the protection of the environment.

AIS is a great tool for VTS operations in generating a comprehensive view of the traffic in the VTS area. It will help the VTS in compiling the traffic image of the VTS area. AIS will facilitate significantly the tracking of traffic as well as the communication process throughout the VTS area.

However, in order to utilize the AIS technology in the VTS operations, VTS operators, ship's officers as well as other parties' involved in monitoring, management and safety of maritime traffic must be aware of the system limitations and downsides. Defining such limitations will improve and facilitate the utilization of the system, for the benefit of the safety of navigation. Moreover, it will assist organizations involved in the design, as well as technical and legislative sides in overcoming such limitations in the future.

1. Introduction

Probably the most vital issue the VTS operators have to take into account is that not every vessel is required by the rules to carry AIS. Therefore the AIS will not be capable of providing the full picture of the maritime traffic in the VTS area unless it is integrated with other surveillance systems.

Moreover, the full comprehensive overview of the surrounding waterways and traffic, which AIS provide, may encourage a number of ship's officers to breach the Convention on the international regulations for preventing collisions at sea (COLREG). This could endanger the other vessels in the VTS area, especially the smaller non-AIS equipped vessels, which may not appear on radar display, adding to the workload of the VTS operators.

The AIS system was initially designed to serve collision avoidance, in addition to the VTS in the monitoring and management of traffic and maritime security matters. Hurriedly, VTS organizations, as well as other organizations involved, intended to use the system in many additional applications.

The questions raise themselves now:

- Is the system, with the present specifications is able to achieve its initial intended functions, as well as, other additional applications, safely and efficiently?
- What are the implications on the maritime security, with regard to the availability and accessibility of the AIS information?
- Are the personnel in charge of operating the system, onboard and ashore, trained and familiar with its capabilities and limitations?

2. Validity of Information

The validity of AIS information is one of the basic foundations of compiling comprehensive traffic images for the VTS, in order to ensure safety of navigation, management and monitoring of traffic; furthermore, it is the keystone in building a shipping information network.

Voyage related information is one type of information, which is manually entered by the ship's officers. Failure to correctly enter or update this information into the system will result in establishing unreliable traffic images and information network.

The Built-in Integrity Test (BIIT) checks only the integrity and functionality of AIS; therefore, the validity and accuracy of the navigation related information (dynamic information), which is generally derived from the ship's sensors, would mainly depend on the performance of the sensors of the transmitting ship. Various ships' sensors are fitted with individual integrity checks but not all of them; hence; the duty of checking the validity of the broadcasted information lies on the ship's officers, who are subject to human errors and fatigue.

According to IMO resolution A.917 (22) "If the master believes that the continual operation of AIS might compromise the safety or security of his/her ship, the AIS may be switched off." Switching off the AIS will affect the reliability of the AIS as one of the VTS sensors and source of information. Moreover, it will fade the validity of the information provided by the VTS to other concerned parties.

For instance, if the system is used by the VTS to provide information to other VTS allied services and clients e.g. agents, rescue coordination centers (RCC) and pilot stations, switching off the system will stop the flow of information leaving the VTS with non-valid information, although it is necessary for safety and security considerations.

In addition to the above limitations, certain significant information is not included in AIS information packages, which is important to the VTS operations in managing and monitoring of the traffic such as, ship's nationality (Flag), ship's gross tonnage, air draught, ship's agent, sailing condition (transiting ship or port calling), AIS dynamic information must be provided with data age, particularly the information that is used in tracking the traffic. (Harre, 2002)

3. Security and Confidentiality of Information

Information Service and navigational assistance are the most vital services provided by VTS. They assist Masters on taking the right navigational decisions. Both types of services and others are provided through the exchange of information between the ship and

VTS. Additionally, the VTS is required to share and communicate information with many other organizations, in order to facilitate maritime traffic, shipping and port management.

Breaching of information has become easy, as a result of the vast improvement in communication technology; consequently, AIS broadcast information may contribute negatively to the ship security as well as commercial confidentiality.

Piracy, terrorism and other organized crimes against ships are planned depending mainly on pre-collected information about the ship. The accessibility of AIS broadcast information may assist in the collection of information by illegal organizations, which could be used to attack or threaten ships.

In the AIS environment, everybody can see everybody, in other words, critical and comprehensive data of the ship are exposed to the public. For instance, type of cargo, crew nationality, route plan and destination, so such information could be valuable for evil intent organizations. Additionally, false information could be transmitted using the AIS, to misguide the authorities and other ships, in order to attack or carry out other illegal acts against ships or States, so VTS systems may require to establish secured and accurate database to authenticate vessels using the AIS.

Furthermore, the implementation of the long-range identification and tracking of ships is a necessity, in order to effectively utilize the AIS technology in the national maritime security. The 30 to 40 NM coverage range of VHF may be enough for an evil intent ship to attack or breach the security of a State.

4. Overloading the System

The vast increase in the installation of AIS onboard ships and VTS stations, as a response to local or international regulations, as well as using it in other applications, including the intent to create shipping information networks using the AIS information technology as a

communication link, will contribute to the overloading and congestion the AIS network, providing that all these functions are done using the two AIS assigned VHF channels.

The dispersal of information on the AIS screen, particularly in busy water, may overload the work on both the VTS operator and ship's officers, increasing the possibility of making mistakes. Bearing in mind, that the AIS base station (VTS) is in charge of allocating the time slots for the repetition and transmission of message from and to the AIS mobile station (Ships), it is essential that the AIS base station ensure that the transmitted messages do not reduce the available time slots for the vessel to vessel collision avoidance function.

Consequently, AIS station may not be sufficient to handle the huge amount of information been broadcast and may reduce the radio cell extremely by dropping out transmissions, which may reduce the coverage and functionality of the system. However, the position report has the priority in broadcasting, leaving limited bandwidth available for other information, particularly for shore to ship information.

"H.Ericsson, the sales manager of SAAB Celsius transponder technology, emphasizes that AIS should not be regarded as just a convenient way of pushing data around. The AIS link is not intended to carry bulk data, because shipping should always have first claim on any available time slots" (Safety at Sea International, 2004, 38, 424).

5. Displaying and presentation of information

An organizational structure of shore originated information messages including, specification, update rate, presentation, alarms, indications and symbols have to be established. The standardization of shore-originated information will provide a common operating environment, which will ensure the safety of navigation.

The AIS target symbols, as specified in IMO SN/Circ.217, the interim guidelines for the presentation and display of AIS target information, as well as, the proposed draft performance standards for the presentation of AIS navigation-related information may not

be suitable for VTS. The VTS centers require a wider range of information than it is necessary on board ships; however, when it is required to transmit the position of a vessel from the VTS center using the AIS, it will be necessary to be transmitted in terms, which will be recognized by the vessel (IALA, 2002).

Although the IMO is in a process of developing new measures for adopting mandatory performance standards for the onboard AIS, the new proposed standards leaves the question of minimum display requirements unspecified, leaving the minimum keyboard and display (MKD), as the minimum required displaying equipment.

MKD may considered to be useless, if both the VTS operator and the ship's officer fail to identify which target on the radar display relate to which information report on MKD. The situation may become more complicated for the targets out of the radar range. Moreover, the effort to identify such relationship by the operators may decrease their surveillance abilities, endangering the safety of navigation.

The track fusion function serves to avoid the presentation of two target symbols for the same physical target, which may overload the radar screen and cause confusion for both VTS operator as well as ship's officer. According to IMO NAV 50/4 "… as a default condition, the activated AIS target symbol and the alphanumeric AIS target data should be automatically selected and displayed."

Taking into consideration the different operational principles of both the radar and AIS, particularly the different update rates used by both systems in collecting ship's data and monitoring ship's maneuver, there are so far no defined standards or specifications regarding setting track fusion criteria in VTS stations. Such criteria include:

- The weight of data obtained from each system,
- The principles used in integrating data obtained from the radar and AIS,
- Presetting the filter characteristics,

- Priority of presentation requirements over the individual performance standards of each system.

Currently, various VTS manufacturers set different criteria; hence this will reduce the reliability of the shore-originated information and may create confusion or misjudgment, particularly for the pseudo targets, which are retransmitted to the traffic by the VTS.
Perhaps, certain requirements should have been settled and regulated before setting the mandatory regulations to carry AIS onboard ships and recommending it as VTS tool. Already all SOLAS ships and a considerable number of non-SOLAS ships are equipped with AIS, yet the IMO is still in the process of developing standards for presentations and displaying of AIS broadcast information.

Nevertheless, the IMO working group involved in the presentation of AIS navigational information recommends that the performance standards of electronic chart display and information system ECDIS need to be reviewed to introduce new requirements in order to serve as AIS navigational information display.

6. Coverage and Accuracy

Presently the only reliable global navigation satellite system (GNSS) is the global positioning system GPS, which is one of the AIS station components, which provide time for the timing of slot synchronization as well as position redundancy; therefore, the AIS operation is mainly dependent on the accuracy and functionality of GPS.

Being dependent on only one positioning system is a disadvantage to AIS accuracy as well as reliability, keeping in mind that GPS in a national military system, particularly if the ministry of defense in the US decided to re-apply the selective availability in the context of the heightened security measures, which was implemented following the attacks on USA in September 2001.

Major GPS breakdown on one satellite occurred on January 1, 2004 in Jobourg VTS in France. The surveillance team, who logged all vessel VHF reports during this breakdown,

observed the following: some GPS receivers were not able to provide a position for approximately one hour; some receivers transmitted position reports with very large errors of about 1 nm (Marechal, 2004). Perhaps in the near future when the Galileo satellite system is operational and reliable, this will provide redundancy to the GNSS and eliminate such weakness.

In the principle of operation of AIS, the organizing time division multiple access (SOTDMA) is organizing the time slots for all AIS stations within VHF range. However, assuming that two ships approaching the VTS area at the same range but from opposite directions, both the ships may use the same time slot, as they are out of range from each other. Consequently, this may create confusion and will demolish the accuracy and reliability of data.

AIS is the perfect solution to many of the VTS problems. Assuming that mobile AIS stations in the VTS area broadcasting correct data, keeping in mind that AIS is a "co-operative tracking" system, and the accuracy of AIS information, particularly the navigational related information, are depending entirely on the accuracy of the data fed by the sensors of transmitting station, such mutual dependency may create threats to the safety of navigation.

However, if the data being transmitted by mobile AIS stations in the VTS area is in conflict with the data obtained from the radar, such conflict may confuse the VTS operator as well as ship's officer transiting the VTS area. Furthermore, while AIS tracking overcomes most of the radar track shortcomings such as masking and target swap, according to IALA VTS manual (2002, p.51), "…buildings and bridges can cause difficulties for AIS transponders in heavily built-up areas. This is a consequence of inhibiting either the reception of the differential GNSS signal by the AIS transponder, or the transmission of the subsequent AIS message."

7. Additional AIS Applications in the VTS area

Although the carriage requirement for AIS has been introduced following a relatively small number of small-scale trials, many maritime authorities are encouraged to proceed in applying this technology in additional fundamental maritime applications, before it is properly tested or approved feasible for such operations including:

- **Remote pilotage**: It is doubtful that remote pilotage can replace the physical presence of pilot onboard the ship in many situations. The physical presence of the pilot on the bridge is very important for many reasons, such as his local knowledge and experience of the area including the meteorological and hydrographical conditions, physical observance of the ship's maneuver, the overstress on the bridge team, as well as the ability to communicate with tugs and mooring gangs.

  AIS is a piece of equipment liable to failures and breakdowns like any other equipment. However, the consequences of an AIS breakdown situation while a ship is being remotely piloted in a critical or narrow waterway may differ, if the pilot is present on board physically.

- **Aids to Navigation:** the pseudo buoy and other floating navigational aids will encourage the ship's officers to rely totally on the AIS and ignore lookout of the bridge windows. Albeit visual sighting is an important method in observing and assessing navigational aids, as well as, the motion of other ships and other surrounding features.

  Perhaps before employing the AIS in such application, the AIS device has to be tested for the exposure as well as the extreme motion, which buoys and other aids to navigations are usually exposed to.

On the other hand, focusing only on the bridge electronic screens by the ship's officers may endanger the safety of navigation in the VTS area in certain situations, such as equipment failure and extreme metrological conditions.

8. Training and familiarization

Definitely, among the fundamentals of ensuring the safety of navigation in VTS areas are the familiarization with the existing systems and the level of knowledge, competence and skills of VTS operator as well as ship's officers, particularly in dealing with traffic situations. Competencies, such as the ability of using the available navigational tools and VTS sensors efficiently and understand their potentials and limitations are essential.

Yet, there are no training standards on the AIS operation either for ship's officer or VTS operator, despite the fact that the system is already operational and mandatory. Although the Sub-Committee on standards of training and watchkeeping (STW) on its 37th session held on May 2006 had validated a model course on training of AIS operations, yet IMO have not consider setting mandatory rules for the training of the use of AIS equally to ARPA and radar in the STCW Code. Similarly IALA has to begin amending its present VTS training model courses to include the training in the use of AIS for VTS Operators.

Such technical publications contain definitive information available to the maritime education and training (MET) institutions, administrations and other training providers. However the training and model courses can be readdressed and amended once the experience of using the AIS technology is gained.

At the present time some work is in progress by some concerned parties. Positively it may end up with the implementation of training standards for AIS. For instance the fifth VTS training workshop was held in February 2003 in Rotterdam with the objective to identify the impact of AIS on VTS operators, including possible training requirements, among other objectives.

Furthermore, the STW sessions 34, 35 and 36 discussed the submitted documents by the UK and International Federation of Shipmasters' Associations (IFSMA), regarding the training requirements for the use of AIS onboard ships.

9. Conclusions

AIS will assist VTS in achieving its objectives, in managing and monitoring the maritime traffic safely and efficiently and protecting the environment, as well as serve as a great tool in economical and security related operations. Moreover, it will assist many VTS allied services in performing their operations.

A number of AIS limitations, when associated in VTS operations have to be settled, the intention of introducing AIS technology in many other fundamental maritime applications, such as remote pilotage, SAR operations and shipping management, with the existing limited broadcasting capacity, will overload the system and reduce its validity, reliability and credibility. Perhaps AIS required more research and development as well as trial periods before it was set mandatory to be carried onboard ships.

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