# APPLICATION AND DEVELOPMENT PLAN OF AIS IN KOREA

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*Abstract.* The AIS system has been established and operated for maritime safety and security, and protection of marine environment in Korea after the Performance Standard of AIS was adopted by IMO in 1998. 37 AIS shore-based systems have been established to monitor ships within 100 nm from all coasts of South Korea in real time, and the AIS information from the 37 AIS shore-based systems is integrated into the National AIS (NAIS) system.

NAIS information has been used by the maritime related organizations to monitor vessels for safe navigation, maritime security and environment concerns. In addition, the Information Service has been operated via AIS network, which provides safety related information, maritime accident information, weather information, news, etc.

AIS will be used for not only situation awareness and monitoring vessels but also analysis of maritime traffic risk and support of decision making with archived AIS data and maritime traffic status. Moreover, the Global integration with not only neighbor country's system but IALA-Net, MSSIS, MEH and other international maritime systems will be implemented.

## 1. INTRODUCTION

The AIS (Automatic Identification System), the navigational equipment which has been in use after the introduction of the Radar system at seas, serves to improve the navigation environment in an epoch-making manner. In the past, numerous equipments and systems were introduced for vessels to detect the operational status of nearby vessels and the AIS system has allowed the mutual exchange of digital information among the vessels in real time, thus heralding the beginning of actual-information based navigation.

This document explains the history and status of AIS implementation in Korea and also details how the AIS is utilized by government and civilian organizations. Therefore, its usage on land, i.e. in the ship-to-shore field, rather than at seas is extensively dealt with.

## 2. CONSTRUCTION OF NATIONAL AIS

### (1) Status of NAIS Implementation

In accordance with the adoption of the Performance Standards and functional requirements of the AIS in the year of 1998 and the amendments of the SOLAS convention in the year of 2002 by the International Maritime Organization, ships and coastal nations have begun to employ the AIS as major equipment for safe navigation and ship control.

In Korea, with the launch of the feasibility study and execution design for the construction of the AIS base station in the year of 2001, it has taken 7 years and 6 billion Korean Won to build 12 operation centers (VTS center) and 37 base stations in the coastal areas all over Korea.

Dual processing facilities have been introduced in the major base stations which take care of harbors and these dual processing facilities are run non-stop, thus enhancing the system availability and effectiveness.

Also, the entire coast in Korea has been divided into 3 major bodies of water, namely, the East Sea, the West Sea and the South Sea and the AIS information is synchronized through the real-time networks. The AIS information from all base stations is consolidated at the GICOMS (General Information Center on Maritime Safety and Security) and is operated as NAIS (National AIS)., thus exercising consolidated control of the AIS information over a wide area.

The characteristic feature of the base stations in Korea is that the high altitudes of mountainous terrain above sea level where the base stations are located (maximum of 1100 meters) permit the real-time monitoring of the entire water body within 100 nautical miles off the coastline and by constructing base stations on nearby islands, the coverage of the sea by AIS base stations is maximized.

It is utilized for the purpose of safety, security, environmental protection etc. in the maritime field.

## (2) Carriage Requirements in Korea

Domestic law (Korea Ships Safety Act) has been amended to include the installation of the AIS in accordance with the SOLAS convention and the AIS installation requirement has been further enforced on coastal ships to install the AIS on board. As can be seen in the table, it has been made mandatory even for small-size ships which require safety management such as tug boats, fishing boats measuring more than 45 meters and passenger ships to install AIS terminal to maximize the effects of the AIS implementation throughout the coastline all over Korea. The number of Korean flagged vessels on which the AIS is installed amounts to 2,472 as of 2008.

The Korean government is reviewing the mandatory implementation of the equipments transmitting ships position including Shipborne AIS terminals on leisure boats, small-sized fishing boats etc.

## 3. APPLICATIONS OF AIS

### (1) Information Sharing

Basically, the NAIS information is accessible by about 10 government institutions such as harbor and coastal VTS center, Korea Coast Guard, Korea Navy, The National Emergency Management Agency, CIQ etc. which are networked together; they utilize the real-time AIS traffic image for the purpose of navigation safety and maritime security management.

- *VTS Integration Monitoring*

The scheme of integrating the AIS information into the VTS has been implemented right from the beginning of the AIS construction; AIS target and radar target are integrated and the entire system is being operated. This has resulted in the expansion of the VTS function to include monitoring reaching up to the coastal and farther regions from its initial monitoring of only the port areas.

Not only the AIS base stations but AIS base station for each harbor area are collectively monitored by the VTS center and for the sake of control of passenger ships and small-sized dangerous cargo over a wide range of areas, AIS information is utilized by integrating sea areas of the East Sea, West Sea and the South Sea regions. Also, VTS not only provides the ship monitoring service but also text-based safety information service by making use of the AIS networks.

- *Korea Coast Guard (including SAR Aircraft AIS)*

The Korea Coast Guard, consisting of 4 offices and 14 stations all over Korea, is updated with the integrated AIS information in real time and such information is utilized for maintaining maritime security and Search and Rescue operations. Especially, the AIS is installed in the SAR (Search and Rescue) aircraft of the maritime police and the Marine Rescue Coordination Center, maritime police vessels and SAR aircrafts carry out SAR operations three-dimensionally.

*- The Navy and Intelligence agency*

South Korea is, at present, technically at war with North Korea and it is not an exaggeration to say that the maritime security activities on the Korean waters are more intensive than anywhere in the world. All navy ships are equipped with the AIS terminal to monitor the seas, various military institutions are currently carrying out operations by actively utilizing the NAIS information, the AIS information is also made use of in the counter-terror operations and risk management areas as well.

### (2) Passenger ship Monitoring

AIS is installed on about 200 ships such as international and national coastal passenger ships, which operate with Korea as the home port and it is possible to monitor most of these vessels within 100 nautical mile radius in real time.

The detailed way points of the fixed navigation routes and safe navigation ranges for all passenger ships are constructed as a database and so, should a passenger ship deviate from its navigation route for no particular reason, route deviation warning sets off and the situation is immediately reported to the operation man-in-charge, the concerned shipowner and relevant organizations. Similarly, should the speed of a vessel on its normal navigation route decrease below 5 knots, an alarm sets off, which will bring to the attention of all those concerned about the dangerous situation the vessel finds itself in.

In the case of those passenger ships operating over long ranges, they are out of the VHF range and therefore, operational information is exchanged through AIS text-based broadcast.

### (3) Tanker Exclusive Zone Monitoring

The Maritime Traffic Safety Act dictates that the operation of tankers be prohibited within about 15 nautical mile radius off mainland coast to minimize the damage in case of an oil spill.

Tankers carrying liquid oil cargo of more than 1500 tons must not navigate in the tanker exclusive zone unless it experiences danger to its safety owing to deterioration of weather conditions etc. or in case of emergencies. Once a tanker finishes loading the liquid oil cargo and departs a port, the cargo information of the captioned vessel is entered into the Port-MIS(Port Management Information System) and the data are transferred to the integrated database of GICOMS; linked with the information on the real-time location of the tankers from the AIS, it monitors whether or not tankers intrude into the tanker exclusive zone.

If a tanker carrying a liquid oil cargo enters a tanker exclusive zone, the monitoring system displays the alarm and the detailed information of intrusion to the operator and the details are immediately relayed to the shipowner, the captioned vessel, Korea Coast Guard, and other related organizations to guide the vessel move away from the tanker exclusive zone.

### (4) Dumping Area Monitoring

As a matter of principle, Korea prohibits the dumping of waste matter into the sea, however, in accordance with the London Convention and Maritime Environment Maintenance Act, for the purpose of reducing the amount of waste to be processed on land and protecting the coastal areas, some of the wastes, which do not pose harmful effects to the marine environment and which are easily biodegradable can be dumped at sea, more than 100 nautical miles off the coastline.

Once a waste cargo disembarks with the permission to dump waste at a designated location, the "Dumping Area Monitoring" monitors the operational status, the designated location and the status of dumping. Especially, at the waste dumping valve, the motion sensors and AIS terminals are connected, which makes it possible to monitor the opening and closing of the valve from land; if the waste dumping valve is open at a location other than the designated location, system alarm sets off, which immediately notifies the person-in-charge of the dumping status. This information is made available to the shipowner, the vessel etc.

This system allows us to manage the amount of waste dumped at sea and, it will be possible to understand and evaluate the extent of pollution and the changes in the marine environment by limiting and managing the maximum amount of the waste dumped for each designated water body.

## (5) Dredging Ship Monitoring

The "Aggregate Extraction Act" dictates that extraction work of permissible amount in designated areas be carried out if marine aggregates are to be extracted.

The aggregate extraction ship monitoring system monitors the entire process right from the disembarkation of the vessel to its extraction work status in the designated area by making use of the AIS location information. The extraction work is always carried out when the vessel is in a state of rest and therefore, if the vessel is stopped at a location other than a location in the designated water body, the monitoring system concludes that the extraction work is being carried out in an unauthorized location; an alarm is set off and information regarding the unauthorized work is provided to the administrator. The relevant information is relayed to the shipowner, the vessel and concerned organizations, which enable immediate counter measures to be taken.

Operation of such a system aims to notify the ship operators of the monitoring system in use and to prevent the ship operators from committing illegal offenses and guide them in the right direction, rather than monitor the illegal offenses or enforce restraints.

## (6) DGPS Correction Data Service

In Korea, DGPS Corrected Signal Service is provided throughout the sea of the entire peninsula through the 17 DGPS Correction reference stations. The errors in the GPS information received at the reference stations are corrected and the corrected signal is relayed in real time to the ships in the RTCM SC-104 format by making use of the medium electric waves.

However, on small-sized ships with the exclusion of large-sized ships, expensive beacon receivers are not installed and so as to maximize the effects of the DGPS service, small-sized ships avail themselves of the AIS-based DGPS corrected signal service.

In the AIS technical standards, it is stipulated that the AIS message 17 be utilized as the DGNSS corrected signal message and if the AIS message 17 is broadcast from the shore-based AIS transponder (or transmitter-receiver), the shipborne Class A terminal, after taking into account the received correction information, transmits corrected information of the ship's location of within 10 m accuracy.

At present, the AIS-based DGPS corrected signal service is mainly provided for major ports and departure & entry navigation routes; even though differences might arise depending on the shipborne AIS the location is corrected in such a way that the accuracy error is less than 10 m. The service usage results of last month show that for certain sea area in Korea, when the AIS DGPS corrected information service is not utilized, the percentage of ships transmitting accurate DGNSS locations was at 13 % (equipped with beacon receiver) while the AIS DGPS corrected information service is in use, it has been shown that the accuracy of 86 % of the ships changed to DGNSS.

From the viewpoint of ship control by VTS, the importance of the AIS-based location information is gaining ground and the accuracy of the AIS-based location information is uniformly implemented in many ships, which has made more accurate ship control possible.

## (7) AIS AtoN (including Virtual AtoN)

To realize the remote control of the Aids to Navigation and information service, IALA makes use of the AIS to recommend that the AIS AtoN is to be managed and serviced at the same level as the AIS.

In accordance with the above, in Korea, AIS AtoN is installed onto the existing Aids to Navigation, which has enabled us to provide accurate information on the Aids to Navigation; from the viewpoint of AtoN facility management, it has become possible to monitor and remotely control the status of the Aids to Navigation in real time by making use of the AIS communication channel, which in fact has maximized the effectiveness of the AtoN service management.

Also, if the Aids to Navigation are temporarily damaged, lost, or if it is deemed difficult to install the Aids to Navigation due to current or water depth or if it is difficult to install them in waters of less frequent navigation by committing a large amount of budget, or if there occurs a capsize of a vessel or a high-alert area due to military training, navigation information becomes much useful through the virtual AIS.

Virtual AIS broadcast through a AIS base station is currently under way and it serves as emergent Aids to Navigation without committing a budget for separate facilities.

## (8) Navigational Information Service

Also, the AIS, being a VHF-based two-way data communication networks serves as the network of information exchange between ships and land facilities. Maritime Safety Information Service such as the safety information, accident information, weather information, news etc. on the GICOMS is provided through the AIS network.

## 4. FUTURE PLAN FOR AIS

The effectiveness of the AIS at seas in the areas of safety, security and environmental protection has been proven worldwide and measures will be taken to expand the usage of the AIS. At present, mid-sized and large vessels are equipped with AIS terminals, however, to ensure the safety of all ships, safety and security measures must be expanded to install simple terminals even on small-sized vessels such as fishing boats, leisure boats etc.

The basic maritime functions of the AIS such as the situational awareness, monitoring etc. are expanded to analyze maritime traffic risk and based on the analyzed AIS data, decision-making support system in line with the maritime traffic situation is constructed; by executing the VTM based on these systems will serve as a major factor in realizing e-Navigation.

What is more, to achieve control over wide area (global), beyond domestic ports and coasts, Far East Maritime Safety Network will be constructed through sharing of AIS information among Korea, China and Japan in real time and plans are currently under way to connect international networks such as the IALA-Net, MSSIS, MEH etc.

## References

[1] International Telecommunication Union, ITU-R M. 1371-3 Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile band, 2007.

[2] International Maritime Organization, SOLAS Convention Chapter V. Safety of navigation, 2002.

[3] International Association of Marine Aids to Navigation and Lighthouse Authorities, IALA Recommendation A-124 On Automatic Identification System (AIS) Shore Station and Networking Aspect relating to the AIS Service, 2005.

[4] Ministry of Land, Transport and Maritime Affairs, Project Report of NAIS Construction, 2003 – 2008.

[5] Ministry of Land, Transport and Maritime Affairs, Standard of Ship's Equipments, 2004.