# A National Monitoring System Supporting E-Navigation

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**Abstract**

This report introduces a National Vessel Monitoring System(NVMS) within the General Information Center On Maritime Safety and Security(GICOMS) project and a national legislation system for ship's safety management in Korea. We also represent future directions of NVMS in terms of E-Navigation(E-Nav), which is the new study item for COMSAR and NAV that has been adopted from the Maritime Safety Committee(MSC) 81st session. It concludes the future E-Nav system, when it is built, that all functions of NVMS should be used by NVMS controllers as well as mariners, and we should also consider the existing NVMS infrastructure including S/W and H/W.

**Keywords:** AIS, E-Navigation, GICOMS, VMS, Ship Safety, Fishing Boats.

## 1. Introduction

Post 9/11 security initiatives in maritime transport and shipping are largely focused against terrorist attacks. Most of these maritime security initiatives are being pursued under the International Maritime Organization(IMO) with its adopting international conventions. The IMO has mandated the carriage requirements for universal Automatic Identification System(AIS) and adopted ISPS code in SOLAS as special measures. Regarding with the national arrangement in an aspect of maritime security, Korea has launched the General Information Center On Maritime Safety and Security(GICOMS) project to control the marine crisis[1]-[4]. The GICOMS is a national system, that aims to prevent marine casualty, taking swift actions in any case of casualties, and minimize the damage through the Systematic Integration of vessels, people, traffic, security, port facilities, and cargos. This project is set for completion by 2008 at a cost of 17 million USD.

This report has two purposes. Firstly, it is to introduce a National Vessel Monitoring System(NVMS) within GICOMS project and a national legistration system for ship safety management[3][4]. Another purpose is to suggest future directions for NVMS implementation in terms of development of E-Navigation (E-Nav) strategy as a new study item of IMO. The concept of GICOMS and each unit system consisting of the GICOMS including its functions are described in section 2. In section 3, a national legislation system for maritime safety management is presented. In section 4, the future directions to implement the NVMS successfully are suggested in aspect of E-Nav[5]. This report is concluded in section 5.

## 2. A National Vessel Monitoring System(NVMS) in Korea

### 2.1 The Concept of GICOMS supporting NVMS

Recognizing the various maritime security concerns, Republic of Korea has set up GICOMS since 2001 in order to control the marine crisis. The project which build GICOMS over 2003-2007 will includes a comprehensive marine transportation safety management system covering Korea's ports and coastline areas; a tracking ship's location and management system for ships navigating the EEZ/near sea/open sea areas; an Internet based information provision system; and a marine safety/security management system. The GICOMS consists of three parts, Vessel Monitoring System(VMS), Integration of System, and Information Exchange. The VMS is for communication between ship and shore, for tracking vessels on a Electronic Navigation Chart(ENC) and for providing information service to ship. The integration of system is to collect safety data from various agencies and to construct central data base. The information exchange is for sharing a better information by using a network. The GICOMS monitors movements of Korea flagged vessels in the world and foreign flagged vessels in Korea waters. Through the GICOMS, all information regarding vessel, people, traffic, security, port facility, and cargo could be integrated in the Center. At MSC 81th session, IMO has mandated the carriage requirements of Long-Range Identification and Tracking of vessels(LRIT) by SOLAS Chapter 5. According to LRIT architecture, the GICOMS will perform a function as both a National LRIT Data Center and a Regional LRIT Data Center. The GICOMS plays an key role for maritime safety and security. It also ensures well-coordinated and solid management of maritime traffic at ports, coastal areas, the EEZ and distant waters.

### 2.2 The NVMS within GICOMS

As mentioned in section 1.1, the VMS is the key component to achieve the goals of GICOMS. Recently, some leading ports of the world have widened the monitoring range of VTS to secure maritime safety in the vicinity of their coastal zone. On the other hand, it is reported that in Korea, 85% of marine casualty has occurred outside the harbour limit[7]. Due to increase of high speed vessels and VLCC, the probability of marine casulty tends to get higher than the last several years. A huge disaster at sea may occur at any time, irrespective of wherever vessels navigate. While the existing VTS is dependent on RADAR, the recent traffic situations in port makes it difficult to control vessels by

using only RADAR. The NVMS within GICOMS project supports not only VTS operations, but also enhances VTS facilities. Korea had established a nationwide AIS network from 2001 to 2004 which consists of 22 AIS shore stations. The 11 AIS operation systems in major VTS center are shown in Fig.2. The AIS informations that are collected by nationwide AIS is displayed on VMS console. As a result, the AIS was a main contributor in widening the monitoring range of VTS. The VMS is also a monitoring system to display the symbol and track of ship on ENC. All information for the ship are gathered from AIS, mobile phone and satellite on board. The NVMS aims the following :

① to identify and track all Korean flagged vessels in the world.
② to support prompt search and rescue(SAR) operations.
③ to improve the safety of shipping lanes and port areas.
④ to protect marine environment from pollution.
⑤ to monitor illegal fishing and reserve fishery resources.

Korea is hoping to exchange AIS information with neighboring countries in near future. This is for international cooperation on safety and security at sea.

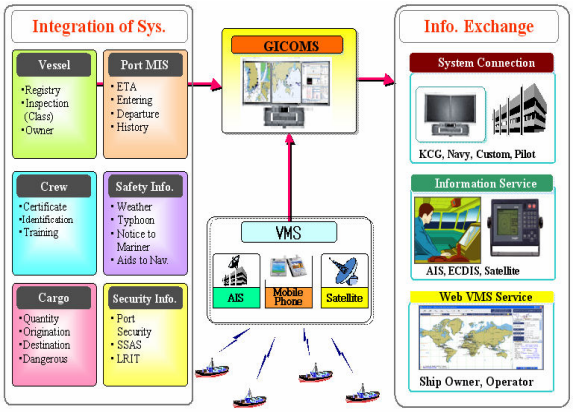


Fig. 1 General Configuration of GICOMS

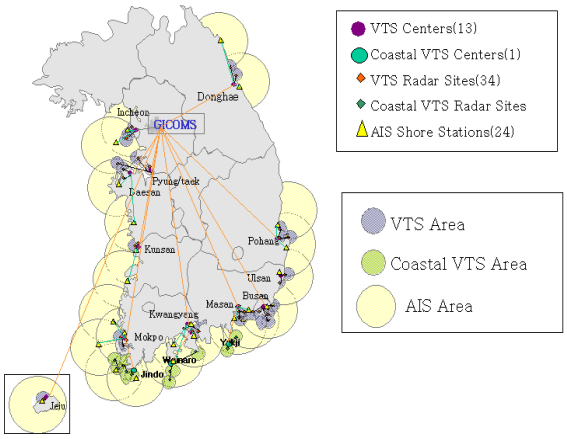


Fig. 2 VTS and AIS Area for NVMS in Korea

The NVMS is basically operated in A1, A2, and A3 area to provide the coverage of wide areas, finally to monitor all Korean flagged vessels irrespective of where they are located. Table 1 represents the construction of NVMS in Korea.

The key elements of NVMS consist of a nationwide AIS, a shore monitoring system, S/W with ECDIS, wireless network infrastructure between ship and shore, VMS equipments on board, wired and wireless network among regional VTSs and GICOMS center. Among of VMS equipments, the AIS operating at A1 area provides various real time informations regarding the vessels which navigate at A1 area, such as ship's position, time at the position, speed, cargos, ETA, destination etc. In fact, AIS is one of core components supporting VMS.

Table 1 Construction of NVMS in Korea

| Area | VMS EQUIPMENT | Coverage |
|---|---|---|
| Near Coastal (A1 Area) | AIS+RADAR CDMA, TRS, Satellite Phone, VHF DSC | Within 50 miles |
| Coastal (A2 Area) | SSB, Satellite | 50~150 miles |
| Ocean (A3 Area) | Satellite (Inmarsat, Orbcomm, Argos) | Over 150 miles |

## 2.3 Example of Operations

Fig. 3 shows the AIS information for M/V KOBE that is displayed on VMS console. M/V KOBE is approaching the port of Busan.

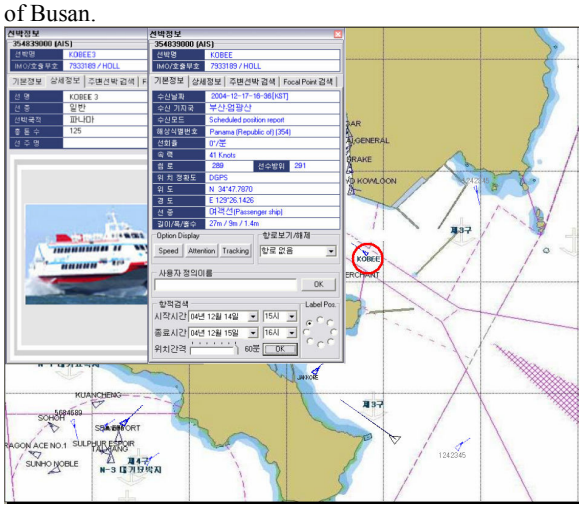

Fig. 3 AIS information displayed at the NVMS console.

The NVMS can grasp not only the information of ship movements, but also the specified information regarding crews, registration, ship's particulars etc, as shown in Fig. 4. By using the informations gathered from vessels, we may take swift actions in the case of casualties and minimize the damage. If the vessel navigating in the designated lane lost its route, then the alert message will be displayed. In Fig. 5, it shows the alert message of 'Out of Route' of M/V Baekryeong by VMS.

In Korea, the NVMS provides the ship's security information, irrespective of where Korean flagged vessels are located. The NVMS also provides weather information to recommend the optimized route in aspect of operation cost and marine safety. In case of marine accident, the NVMS can replay the recorded vessel track. The history of vessel track may be effectively utilized to conduct scientific investigation of maritime accidents by Korea Maritime Safety Tribunal(KMST).

Fig. 4 Display of vessel information by VMS

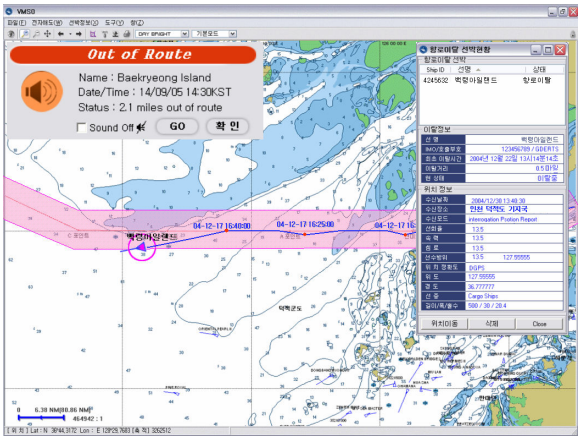


Fig. 5 Alert message of 'Out of Route'

## 3. A National Legistration System for Ship Safety Management

According to Korea Ship Safety Act, all ships of 300G/T and upwards engaged on international voyage and cargo ships of 500G/T and upwards engaged on domestic voyage, passenger ships irrespective of size, tugboats and tankers engaged on domestic voyage and fishing vessels of 45m in length and upwards shall be fitted with an AIS, as follows:

Table 2 Time Schedule for AIS Carriage

| Ships to be applied | | Date to be installed |
|---|---|---|
| For International Voyage | Passenger Ships, Tanker above 300G/T | July 1, 2002 |
| | Cargo Ships above 50,000G/T | July 1, 2004 |
| | Cargo Ships above 300G/T | Dec. 31, 2004 |
| For Domestic Voyage | Passenger Ships | Dec. 31, 2005 |
| | Tug Boats above 50G/T and Tankers<br>- Over 3,000G/T<br>- 500G/T~3,000G/T<br>- 150G/T~500G/T | Dec. 31, 2004<br>July 1, 2006<br>July 1, 2007 |
| | Others | July 1, 2008 |
| Fishing Boats | Ships above 45m in length | July 1, 2008 |

Korea Ship Safety Act strengthens AIS carriage requirement, comparing with SOLAS.

In fact, the number of fishing boats among total registered vessels amounts to 90,735, which occupies 92.7% of the total registered vessels. Among of them, fishing boats under 10G/T amounts to 86,263. According to the reference[7], marine accidents that are directly related to small fishing boats are around 70% of the total marine accidents. To reduce marine accidents by small fishing boats and monitor them efficiently in aspect of safety and security at sea, The government of Korea has adopted the legislation for compulsory carriage of vessel positioning systems on non-SOLAS ships including fishing vessels, such as class-B AIS[8], mobile phone, and VHF DSC.

According to Korean Ship Safety Act, all Korean ships above 2 G/T should install the transmitters on board for vessel tracking and identification. The works to make the subordinate regulation of Korean Ship Safety Act is in process by Korea government. The subordinate regulation will deal with the details regarding a kind of transmitters on board and the date to be installed. A kind of the transmitter on board depends on the operating areas of vessels. Thereby, small fishing boats may be monitored by NVMS. As a result, Korean government is going to mandate ship's position report for small fishing boats above 2G/T, irrespective of where the vessels are located.

## 4. Future Directions of NVMS

It is expected that the NVMS within GICOMS contribute on implementation for clean and safe environments at sea. The diverse functions of NVMS are for vessel's traffic controlling, provision of weather information, ship security alert, Web VMS service, vessel monitoring and so on. Regardless of many advantages of GICOMS and financial supports, however, the NVMS might not bring a satisfactory results in its operation, if it only monitors and manages vessels, and then it does not give an useful information to the vessels in real time. Therefore, the diverse informations obtainable from NVMS should be provided for mariners in terms of E-Nav. If the NVMS information is displayed on shipborne VMS equipment whenever a mariner needs, it is expected that the safety of navigation would be gradually enhanced. For example, let us consider a vessel which is going to enter into a port. The master or the navigators of the vessel would like to know traffic conditions of the port entrance. In this case, the shipborne equipment displaying VMS information is helpful for safety of navigation by mariners. The common objectives of E-Nav is to deliver 'safety, secure and efficient shipping on clean oceans'. Consequently, E-Nav. should be utilized for maritime domain awareness(MDA). The VMS plays a key role to implement the MDA successfully. The MDA may be done by seamless information exchange between ship to ship as well as ship to shore. IMO now has an opportunity to develop and map out a clear strategic vision integrating and utilizing all navigational technological tools, at the same time to deliver substantial operating efficiencies with resulting commercial benefits. It should be noted that a successful E-Nav strategy may be achieved only by an harmonized integration with

the existing safety and security systems. In such a point of view, all functions of VMS including human resources and the gathered information should be used by VMS controllers as well as users, such as mariners and pilots.

## 5. Conclusions

In Korea, the NVMS within GICOMS project was briefly introduced. Especially, the concept, functions, and examples of VMS operation were described in details. The national legislation system for safety management was also introduced. To reduce marine accidents in small fishing boats and to monitor them efficently in aspect of safety and security at sea. Korean VMS monitors non-SOLAS vessels including small fishing boats. Finally, the future directions for a successful NVMS implementation were suggested in aspect of E-Nav. It concludes that all functions of VMS should be used by VMS controllers and users, such as mariners and pilots. For this, we must consider the existing VMS infrastructures including S/W and H/W.

In the future, when the E-Nav system was established, it is emphasized that E-Nav should be implemented with seamless information exchange between ship to ship as well as ship to shore.

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