Maritime Policy for the European Union,
Ships' monitoring and information systems.

Ryszard WAWRUCH[1]

CONCEPTION OF THE INTEGRATED EUROPEAN SHIPS' MONITORING AND INFORMATION SYSTEM

One of the main tasks of the integrated Maritime Policy for the European Union is enhanced interoperability and integration between different existing maritime surveillance and monitoring systems [4,5]. Paper presents information on existing vessel traffic monitoring and information systems that has recently been introduced and developed at European level, and aims to focus mainly on sharing aspects of data about ships and cargo carried onboard between ship, shipper, port, maritime administration of the EU coastal Member States, Island and Norway and Community institutions: European Commission, European Maritime Safety Agency (EMSA), Directorate General for Fisheries and Maritime Affairs on Fishing Vessels and European Agency for the Management of Operational Cooperation at the External Borders (Frontex).

KONCEPCJA EUROPEJSKIEGO ZINTEGROWANEGO SYSTEMU MONITOROWANIA RUCHU STATKÓW I PRZEKAZYWANIA INFORMACJI O STATKACH

Jednym z głównych zadań zintegrowanej polityki morskiej Unii Europejskiej jest zwiększenie współdziałania i integracji różnych istniejących morskich systemów nadzoru i monitorowania [4,5]. Referat prezentuje informację o istniejących systemach monitorowania ruchu morskiego i przekazywania informacji o statkach, które są od niedawna wprowadzane i rozwijane na poziomie europejskim i skupia się głównie na zagadnieniach transmisji i rozdziału danych o statkach i przewożonych nimi ładunkach między statkiem, załadowcą, portem, administracją morską nadbrzeżnych państw członkowskich Wspólnoty, Islandii i Norwegii oraz instytucjami UE: Komisją Europejską, Europejską Agencją Bezpieczeństwa Morskiego (EMSA), Generalnym Dyrektoriatem ds. Rybołówstwa i Spraw Morskich dotyczących Statków Rybackich i Europejską Agencją ds. Zarządzania i Współpracy Operacyjnej na Granicach Zewnętrznych (Frontex).

[1] Gdynia Maritime University, Faculty of Navigation, POLAND;
Gdynia 81-345, Jana Pawła II/3, Phone: + 48 58 690-11-12, 620-10-25, Fax: + 48 58 690-11-01
E-mail: wawruch@am.gdynia.pl

1. INTRODUCTION

There are different institutions and services inside EU collecting information about seagoing vessels and cargoes carried onboard:

1. European Maritime Safety Agency (EMSA) responsible for vessel traffic monitoring.
2. Directorate General for Fisheries and Maritime Affairs responsible for fisheries monitoring.
3. European Agency for the Management of Operational Cooperation at the External Borders (Frontex) responsible for UE border security.
4. Search and Rescue (SAR) services responsible for effective SAR operations.
5. National competent authorities responsible for ships' security.

Above mentioned authorities and services utilize different sources of information, different methods of data transmission and have different users. Today, the main task of the EU Member States and European Commission is integration of systems used by these authorities and services into common maritime surveillance and monitoring system for different users and with different levels of data availability.

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2. VESSEL TRAFFIC MONITORING SYSTEMS

2.1 Automatic Identification System (AIS)

According to the requirements of the Directive 2002/59/EC of the European Parliament and of the Council of 27 June 2002 establishing a Community vessel traffic monitoring and information system, the EU Member States had to complete national systems of the shore-based installations for implementing monitoring of the ships traffic using AIS by the end of 2007. The appropriate equipment for relaying the information to, and exchanging it between, the national systems of Member States had to be operational one year thereafter [3].

AIS is a ship-borne transponder system designed for maritime safety and in particular collision avoidance. There are two classes of ship-borne equipment: class A designated for ships obliged to transmit AIS messages according to the requirements of the International Convention on Safety of Life at Sea (SOLAS) and class B for other vessels. The AIS transponder includes GPS receiver, VHF transmitter and three receivers and display unit. It transmits different messages in autonomous, dedicated and pooling modes using VHF frequencies. Messages contain ship's identification, position, speed, course and a number of detailed data about the ship and its cargo such as ship type, length, draft, cargo type, ports of providence and destination, etc. Ship's static data and identification are hardwired into the device. Dynamic data is taken automatically from the GPS receiver and gyrocompass but all other data has to be manually entered. The broadcast carries VHF range, which is basically line of sight, except under certain atmospheric conditions. In autonomous mode the transmission frequency depends on ship's speed and stability of movement. According to the SOLAS regulations V/19 the carriage of AIS class A is mandatory for all passenger vessels and cargo ships of 300 gross tonnage (GT) and up engaged on international voyages and of 500 GT and up on non international voyages. EU regulation requires AIS carriage by ship of 300 GT and up, except for warships, state-operated vessels in public service, fishing vessels, traditional ships and recreational craft shorter than 45 m and bunkers below 5000

tons. The range of coastal AIS receivers is typically 75 km, but can be considerable longer if the receiver is installed on an elevated position, and also during particular atmospheric conditions that are favourable to VHF propagation. AIS transmits messages on unrestricted, public available frequencies and everybody may buy AIS receiver and monitor ships' transmissions. Due to that, ship-borne AIS may be switched off where international agreements, rules or standards provide for the protection of navigational information and in exceptional circumstances where the AIS operation is considered by the master to compromise the safety or security of the ship.

AIS reception through low orbital satellite is possible and is seen as an attractive option. There are already some experimental systems in space. However, the so called SOTDMA system used by AIS for ensuring that vessels do not transmit at the same time only applies to ships within ground range of each other, not those seen from space at the same time. So it can be difficult to distinguish individual ships if more than one is transmitting at the same time. If this and other current technical problems with satellite AIS can be overcome, the availability of AIS data can be extended from only coastal seas to the entire globe [5].

2.2 Long Range Identification and Tracking (LRIT)

Long Range Identification and Tracking (LRIT) is a global maritime messaging system for security and SAR purposes. According to the SOLAS regulation V/19-1 it is mandatory for operating outside sea area A1 as defined for the purposes of the Global Maritime Distress and Safety System (GMDSS): all passenger ships, cargo ships of 300 GT and up and mobile offshore drilling units. The LRIT message includes the ship-borne equipment identity, location and date and time of the position. Ships' transmissions are coded and available for SAR services and SOLAS contracting states acting as a ship's flag state, coastal state and port state only. The coastal states have access to LRIT information of ships within1852 km off their shore. The main components of the LRIT system are: ship-borne transmitting equipment, satellite communication link, LRIT data centres, application service providers (ASP) and the International LRIT Data Exchange (IDE). The LRIT data centres communicate with each other and exchange information and data though the IDE. According to the Council resolution of 2 October 2007, Member States agreed on setting-up of a European Union Long Range Identification and Tracking Data Centre (EU LRIT DC), to be managed by the European Commission, in cooperation with Member States, through the European Maritime Safety Agency (EMSA) [2].

EU LRIT DC entered in production on 1 June 2009 after the approval by the International Maritime Organisation (IMO) and International Mobile Satellite Organisation (IMSO). At present there are 32 Member States, EFTA countries and Overseas Territories participating in the EU LRIT DC. This number may increase if other countries join in the future. The EU LRIT DC covers an estimated 20 to 25% of the world fleet subject to LRIT. In addition to tracking EU-flagged ships, the EU LRIT DC provides Member States, on request, with LRIT information of any third country vessel in the area of SAR operation coordinated by the Maritime Rescue Coordination Centre (MRCC) located in any EU Member State, Island and Norway or bound to, or sailing within, EU waters.

The two main distinctions between AIS and LRIT are first that AIS is coastal system while LRIT is global, and second AIS is broadcast whereas LRIT is only sent to specific recipients for confidential treatment. Furthermore AIS message contains much more

information and the possibility for receiving AIS data from satellites provides an attractive option that needs to be further explored also in the EU.

2.3 Port notifications and reporting of hazardous materials

Directive 2002/59/EC requires that the operator, agent or master of a ship bound for a port of a EU Member State (MS) shall notify to the destination port authorities 24 hours before arrival, or as early as possible if less than 24 hours before: ship identification, port of destination, estimated time of arrival at the port of destination or pilot station, as required by the competent authority, estimated time of departure from that port and total number of persons on board. If the port of call is not known or it is changed during the voyage, notification should be done as soon as this information is available. Additionally, ships coming from a port outside the Community and bound for a port of a Member State carrying dangerous or polluting goods, shall comply with the hazardous materials notification obligations [3].

No dangerous or polluting goods may be offered for carriage or taken onboard any ship, irrespective of its size, in a port of a Member State unless a declaration containing following information about cargo has been delivered to the master or operator [3]:

- The correct technical names of the dangerous or polluting goods, the United Nations (UN) numbers where they exist, the IMO hazard classes in accordance with suitable IMO cargo codes, the quantities of such goods and, if they are being carried in cargo transport units other than tanks, the identification number thereof; and
- Address from which detailed information on the cargo may be obtained.

It shall be the duty of the shipper to deliver to the master or operator such declaration and to ensure that the shipment offered for carriage is indeed the one declared.

The operator, agent or master of a ship, irrespective of its size, carrying dangerous or polluting goods and leaving a port of a Member State shall, at the latest at the moment of departure, notify to the competent authority designated by that Member State the following information [3]:

1. Ship's identification, port of destination, total number of persons onboard and following general information:
   - For a ship leaving a port in a Member State: estimated time of departure from the port of departure or pilot station, as required by the competent authority, and estimated time of arrival at the port of destination;
   - For a ship coming from a port located outside the Community and bound for a port in a Member State: estimated time of arrival at the port of destination or pilot station, as required by the competent authority.
2. Cargo information listed above and confirmation that a list or manifest or appropriate loadings plan giving details of the dangerous or polluting goods carried and of their location on the ship is onboard.

Shipping companies may be exempt from this reporting if it concerns scheduled services, or they keep the relevant information on file, ready to be given immediately in electronic form to the authorities on request, or all Member State authorities of the port and coastal states involved in the voyage agree to such exemption [3].

Member States should put in place a procedure authorizing the operator, agent or master of a ship to notify the information listed above to the port authority of the port of departure or destination in the Community, as appropriate. The procedure put in place must ensure

that the competent authority has access to the mentioned data at all times should it be needed. The port authority concerned shall retain the information long enough for it to be usable in the event of an incident or accident at sea. The port authority shall take the necessary measures to provide this information electronically and without delay to the competent authority, 24 hours a day, 7 days a week, upon request. The electronic message exchange must use the syntax and procedures set out in Annex III to the Directive 2002/59/EC and described in 6.3 [3].

2.4 The West European Tanker Reporting System and other ship reporting systems

There are many ship reporting systems (SRS) introduced in different coastal areas according to the SOLAS regulation V/11 and adopted by IMO like SRS "Repline Hel" on the approaches to the Polish ports in the Gulf of Gdańsk adopted by IMO Resolution MSC.249(83) [7] and West European Tanker Reporting System "WETREP" adopted by IMO Resolution MSC.190(79) [8]. "Repline Hel" is mandatory ship reporting system for proceeding to and from the Polish ports in the Gulf of Gdańsk: all passenger ships, cargo ships of 150 gross tonnage and up and all vessels engaged in towing. "WETREP" is a mandatory ship reporting system for all oil tankers over 600 tonnes DWT carrying heavy types of oils and entering the Western European Particularly Sensitive Sea Area (PSSA). As adopted by IMO, they also fall under Article 5 of Directive 2002/59/EC and SafeSeaNet regulations described in 6.3. While WETREP is multinational, other reporting systems are single state or bilateral and sometimes cover international straits, e.g. CALDOVREP for the Dover Strait and GOFREP for the Gulf of Finland. Some of these are obligatory for particular classes of vessels but welcome joining by other vessels, e.g. the Italian ARES (Automated Search and Rescue System) or the US AMVER. The different reporting systems are not mutually exclusive: e.g., WETREP has a number of other mandatory reporting systems geographically within it [2].

According to the IMO resolution A.851(20) "Guidelines and Criteria for Ship Reporting Systems, as amended" the objective of the SRS is to provide advance information to authorities responsible for traffic management, pollution prevention and search and rescue operations, in order that they can react quickly in case of an accident. The ship report must include: the ship's identification, date, time, position, course, speed, last and next port of call with ETA, type and quantity of dangerous cargo or other hazardous substances, number of persons onboard, and information on defects, damage, deficiencies etc. It must be sent to the nearest co-ordination centre of a responsible authority of the coastal state participating in the system, which can be a vessel traffic service (VTS), maritime rescue coordination centre (MRCC), or coast radio station. Reports may be sent by any modern communication form, including INMARSAT-C, fax and e-mail as appropriate. Usually they shall be done by voice communication using onboard VHF radiotelephone. Failure to submit a report results in information being passed to the flag state authorities for investigation and possible prosecution.

2.5 Vessel Traffic Services (VTS)

As described in SOLAS regulation V/12, vessel traffic services (VTS) contribute to safety of life at sea, safety and efficiency of navigation and protection of the marine environment, adjacent shore areas, work sites and offshore installations from possible adverse effects of maritime traffic. They are established in areas, like Dover Strait and Gulf

of Gdańsk, where, in the opinion of competent authority, the volume of traffic or the degree of risk justifies such services. The use of VTS may only be made mandatory in sea areas within the territorial seas of a coastal state. Flag state shall endeavour to secure the participation in, and compliance with, the provisions of vessel traffic services by ships entitled to fly their flag.

The VTS infrastructure typically consists of a station onshore where a picture of the local maritime traffic and hydro-meteorological conditions are displayed and registered. It uses primarily shore-based radars, hydro-meteorological sensors located in different positions in controlled area and communications links with the passing ships by VHF radio, fax or phone. In general also visual observations are made, sometimes aided by optical or infrared cameras. Auxiliary sensors may be available, such as radio direction finder (RDF) to locate the bearing of a radio transmission. Shore-based AIS stations begin to be an important source of data for VTS.

Article 8 of Directive 2002/59/EC states that EU Member States shall monitor and take all necessary and appropriate measures to ensure that [3]:

1. Ships entering the area of applicability of a VTS operated by one or more states, of which at least one is a EU Member State, within their territorial sea and based on the guidelines developed by the IMO, participate in, and comply with, the rules of that VTS.
2. Ships flying the flag of a Member State or ships bound for a port of a Member State and entering the area of applicability of such a VTS outside the territorial sea of a Member State and based on the guidelines developed by the IMO, comply with the rules of that VTS.
3. Ships flying the flag of a third state and not bound for a port in a Member State entering a VTS area outside the territorial sea of a Member State follow the rules of that VTS wherever possible. Member State should report to the flag state concerned any apparent serious breach of those rules in such a VTS area.

3. SYSTEM FOR FISHERIES MONITORING

EU legislation mandates the use of the vessel monitoring system (VMS) on fishing vessels longer than 15 m, for monitoring and control of their fishing operations. The fishing ship carries a transponder linked to a GPS receiver and operating in fully automatic manner in autonomous and pulling modes. According to legislation the transponder sends a short message containing vessel identification, time, geographic position, course and speed every hour. A VMS message may be sent on request too. The message is sent to the vessel's flag state authorities via satellite communication system INMARSAT-C, EUTELSAT or ARGOS. The flag state forwards the VMS message to the coastal state in which waters, usually exclusive economic zone (EEZ) that may extend out to 370.4 km, the ship is. The operational authority that handles the VMS is the Fisheries Management Centre (FMC) - one on each MS. In this way, the national FMC is continuously aware of all fishing vessels under its flag wherever they are on the globe, and of all VMS-carrying fishing vessels in the waters under its jurisdiction (i.e. in most cases in its own EEZ). The EU regulation requires that VMS data have to be stored for a period of 3 years [1].

4. FRONTEX SYSTEMS

Information collected by the European Agency for the Management of Operational Cooperation at the External Borders (Frontex) in the form of BORTEC reports is

confidential and not accessible. Now it concerns the maritime surveillance in the EU Member State that border the Mediterranean and the South Atlantic.

5. EMERGENCY REPORTING SYSTEMS

5.1 GMDSS and COSPAS-SARSAT

Global Maritime Distress and Safety System (GMDSS) is a system intended to enable communications to/from ships in relation to emergencies. Using ship-mounted equipment and protocols, ships can alert authorities on shore as well as other ships in the vicinity in case of an emergency. Ships can also receive such alert messages, plus SAR information and navigational and weather warning messages. These broadcasts are collectively called maritime safety information (MSI) broadcasts. The onboard GMDSS equipment depends on the areas where vessels navigate, so called A1, A2, A3 and A4 areas. The global full implementation of GMDSS services became effective on 1 February 1999.

The COSPAS-SARSAT is an international satellite system intended to react to distress calls from land, sea and air. COSPAS is operated by Russia, and SARSAT is operated by Canada, France and the USA, but they work as one system. The system has four parts: emergency radio beacons, which call for help; satellites as communication link, ground stations, which receive the message; and control centres, which sound the alarm. The beacon transmits on 406 MHz message which can include identification of the beacon and its country of registration. There are different kinds of radio beacons for land, sea and air. At sea, COSPAS-SARSAT is a part of GMDSS and vessel should have the Emergency Position Indicating Radio Beacon (EPIRB). The polar orbiting satellites are able to receive the signals from the beacons and relay them to ground stations. It may take some hours before a satellite passes over a beacon after it has been activated. If a ground station is in sight, a message received by a satellite is down linked immediately; otherwise it is stored and down linked later. The ground stations, in turn, process the signals to determine where the beacon is located within a radius of 2 km. The ground stations then relay this information to search and rescue authorities (services).

5.2 Ship Security Alert Systems (SSAS)

SOLAS regulation XI-2/6 requires ships engaged on international voyages and mobile offshore drilling units to be equipped with a ship security alert system (SSAS). When activated, the SSAS shall initiate and transmit a security alert to a competent authority designated by the flag state administration and typically to the ship owner or company, identifying the ship, its location and indicating that the security of the ship is under threat. The system does not raise any alarm onboard the ship. This IMO regulation was transposed in EU law by Regulation (EC) No 725/200411, restricting the above implementation to international shipping and domestic Class A passenger ships with a due date of July 2005, and a decision to extend to other domestic ship categories by July 2007 [8]. The procedures for the security alert are agreed with the ship's administration as part of the ship security plan. It is not intended that the ship security alert procedures should be to an internationally agreed standard or conform to any particular format for all ships. Suggested implementations include the use of dedicated GMDSS messages, or voice calls using previously agreed code words. Commercial providers offer solutions employing e.g. INMARSAT-C or Iridium.

6. EXCHANGE OF DATA AND INTEGRATION OF SYSTEMS

6.1 Vessel monitoring system (VMS)

The transmissions about a fishing vessel that is in the waters of another country are sent to that coastal state Fisheries Management Centre (FMC) via X.25 link, currently migrating to https, and are routine and automatic. VMS data are also forwarded to Regional Fisheries Management Organisations (RFMOs) by flag states whose vessels are active in the waters controlled by the RFMO. This typically happens at longer intervals, e.g. 6-hourly. According to regulation European Commission has access to VMS data on specific request, and received data are to be treated as confidential. In practice, VMS data are jealously guarded and generally not exchanged with other national authorities – customs, police and navigation – as a matter of routine. However there do not appear to be any insurmountable barriers to their using for the execution of ships' responsibilities in specific cases [5].

6.2 EU AIS networks

In several regions, neighbouring countries are collaborating to maintain a regional AIS network, in which the AIS data are in real time combined. This is the case for the Baltic Sea where the regional network is managed by the Helsinki Commission (HELCOM) according to the requirements of the Declaration on the Safety of Navigation and Emergency Capacity in the Baltic Sea Area (HELCOM Copenhagen Declaration) adopted on 10 September 2001 and for the North Sea where the network is managed by the North Sea Safety at Sea Working Group. On the EU level AIS data is accessible via SafeSeaNet (SSN). Additionally, there are a number of military initiatives for AIS networks, mostly in the state of being built up NATO operates Maritime Safety and Security Information System (MSSIS).

6.3 EU vessel traffic monitoring and information system

Directive 2002/59/EC on a Community vessel traffic monitoring and information system calls Member States for cooperation to ensure the interconnection and interoperability of the national systems used to manage the information required by the directive. Communication systems shall display the following features [3]:

- Data exchange must be electronic and enable messages of dangerous and polluting goods carried on ships to be received and processed;
- The system must allow information to be transmitted 24 hours a day, 7 days a week; and
- Each Member State must be able, upon request, to send information on the ship and the dangerous or polluting goods onboard without delay to the competent authority of another Member State.

In order to achieve above mentioned goals [3]:

1. Member States shall develop and maintain the necessary infrastructure to enable transmission, reception and conversion of data between systems using XML or EDIFACT syntax, based on Internet or X.400 communication facilities.
2. The Commission shall develop and maintain, in consultation with the Member States, an interface control document (ICD), which describes the system facilities in terms of the message scenario, the message functions and the relation between the messages. The message timing and performance shall be detailed, as well as data interchange protocols and parameters. The ICD shall further specify the data content of the required message functions and describe those messages.

3. Described procedures and infrastructure should incorporate, whenever practicable, reporting and information exchange obligations resulting from other Directives, such as Directive 2000/59/EC of the European Parliament and of the Council of 27 November 2000 on port reception facilities for ship-generated waste and cargo residues.

On this legal basis, EMSA is developing functionality for the communication system with the following elements:

- SafeSeaNet (SSN);
- Short Range Identification and Tracking (SRIT); and
- Shore-based Traffic Monitoring and Information Database (STMID).

SSN is a system to exchange information between EU Member State, Island and Norway maritime authorities to help prevent pollution and accidents at sea. It handles messages with information on ships (static data) and on ship traffic (dynamic data). All data are stored in Member States databases, with index information stored in the European Index Server (EIS). The EIS is hosted on a platform of the Commission's Informatics Directorate in Luxemburg. Any data request from a Member State is directed to the EIS, who forwards the request based on the index to the Member State where the data is actually stored. There the data is retrieved and sent back, via the EIS, to the requestor. Access to the EIS is only from one national system in each Member State. Individual users in the Member State have to go via that "national competent authority - NCA". Any user has to be registered before he can get access. The SSN ship data base contains: ships' identification, port notifications, dangerous and polluting goods notifications, AIS reports, ship reports received in ship reporting systems and warning messages concerning ships posing an extra risk. Under discussion is inclusion of security alerts and waste notifications. The information is exchanged either by web interface (manual) or by XML (automatic) [5].

SRIT stands for short range identification and tracking and is a system to collect AIS data at a central EU level in real time from regional AIS hubs. It shall create an EU AIS-based real time traffic image with an update rate of 6 minutes integrated into SSN.

STMID is an initiative to collect at central level descriptive information on the shore-based vessel monitoring and reporting infrastructure from the Member State. EMSA is compiling this information from two surveys carried out in 2004 and 2006 and from other documents such as obtained from Helsinki Commission (HELCOM) on shore AIS infrastructure in the Baltic States. The information comprises AIS stations, servers and centres; boundaries of territorial waters, exclusive economic zones (EEZ) and search and rescue regions (SRR), ports, VTS locations, and SSN-related contact points. Data can be visualised on maps in a geographic information system (GIS) environment. The processing of the STMID information supplied by the MS is still ongoing [5].

6.4 LRIT

The Council Resolution 13736/07 foresees that, subject to the completion of necessary technical work, the EU LRIT DC should make use of the existing SafeSeaNet system communication platform in order to facilitate the sharing of LRIT information between Member States. Moreover, it encourages the integration of AIS reports into the data managed by the EU LRIT DC in order to enable savings of costs and avoid unnecessary fitting of equipment onboard ships sailing in maritime areas within the coverage of AIS monitoring stations [2].

7. CONCLUSIONS

The general desirability for further integration of maritime monitoring and surveillance systems was signalled in the 2006 Green Paper for a new Maritime Policy of the European Union. The European Commission follows this up by expressing its intent to take steps towards a more interoperable surveillance system to bring together existing monitoring, tracking and information systems used for maritime safety and security, protection of the marine environment, fisheries control, control of external borders and other law enforcement activities. Such integration of the existing or future maritime monitoring, surveillance and information systems is considered as an essential tool towards the improvement of services provided by authorities at sea in all the aforesaid areas and may be done in the scope of so called e-navigation.

8. REFERENCES

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