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GLOBAL SHIPS MONITORING SYSTEM – BASIC REQUIREMENTS AND PRINCIPLE OF INTRODUCING

Summary. Paper presents legal and technical possibilities, architecture and principle of work of the Long-Range Identification and Tracking (LRIT) system prepared and established by the International Maritime Organisation (IMO) Intersessional Working Group on LRIT and described in resolutions: MSC.202(81), MSC.210(81) and MSC.211(81), adopted by Maritime Safety Committee of this Organisation.

ŚWIATOWY SYSTEM MONITOROWANIA STATKÓW – PODSTAWOWE WYMAGANIA I ZASADY WPROWADZENIA

Streszczenie. Referat przedstawia prawne i techniczne możliwości wprowadzenia oraz strukturę i zasadę pracy systemu identyfikacji i śledzenia dalekiego zasięgu (LRIT), opracowane przez Międzysesyjną Grupę Roboczą Międzynarodowej Organizacji Morskiej (IMO) ds. LRIT i opisane w przyjętych przez Komitetu Bezpieczeństwa na Morzu rezolucjach 202(81), 210(81) i 211(81).

1. INTRODUCTION

Ship borne Automatic Identification System (AIS) is an excellent tool for shore based ships monitoring systems providing in automatic manner and without time delay information about ships in area of coverage of the shore based VHF radio stations (in so called A1 sea area of the Global Maritime Distress and Safety System (GMDSS)) [1]. Additionally, there is a common growing demand from various maritime authorities and regional and national agencies for global ships monitoring system, so called Long-Range Identification and Tracking (LRIT) system to enable them to fulfil their individual tasks ranging from navigation safety and search and rescue (SAR) service to environmental protection and prevention of crime and security acts at sea and in ports [5].

Global ships monitoring system should primary enhance security of the coastal states and states of the ports of call by providing information about ships traffic in a timely manner to enable these states to take any appropriate action. Its introducing will also give following additional benefits [3]:
-   knowledge of the presence and movement of shipping could assist in responses to SAR incidents and medical evacuations at sea;
-   LRIT could provide a near real time database, which can be drawn upon to augment national ship reporting systems or provide early warning of the imminent entry of vessels into such systems;
-   LRIT information may be used to enforce compliance with national and international regulations and traffic routeing measures, assist with Exclusive Economical Zone (EEZ) management and monitor so called Particularly Sensitive Sea Areas (PSSA);

- LRIT information may serve as a deterrent for harm to the environment and assist in pollution investigations; and
- in many cases, LRIT may be the only one method for coastal states to monitor the transit of ships within their territorial waters or EEZ.

Created by the Maritime Safety Committee (MSC) and COMSAR Sub-Committee of the International Maritime Organisation (IMO) Intersessional Working Group on LRIT discussed all legal and technical aspects, architecture and principle of work of the LRIT system and prepared three resolutions adopted later by MSC [4]:

- MSC.202(81) "Adoption of the amendments to the International Convention for Safety of Life at Sea. 1974, as amended";
- MSC.210(81) "Performance standards and functional requirements for the Long-Range Identification and Tracking of ships"; and
- MSC.211(81) "Arrangements for the timely establishment of the Long-Range Identification and Tracking System".

2. BASIC REQUIREMENTS

LRIT system shall provide global identification and tracking of suitable equipped merchant ships sailing outside the areas of coverage of the shore based Automatic Identification System (AIS) stations working in the VHF band. According to the new SOLAS Regulation V/19-1 "Long-range identification and tracking of ships" following types of ships engaged on international voyages shall participate in the described system [4]:

- passenger ships, including high-speed passenger crafts and mobile offshore drilling units; and
- cargo ships, including high-speed crafts, of 300 gross tonnage and upwards.

The time schedule for LRIT introducing looks as follow [4]:

- establishing of the LRIT Data Distribution Plan – no later than 1 January 2008 and selecting and establishing of the LRIT Data Centres - no later than 1 July 2008;
- fitting of above mentioned ships with LRIT equipment:
  - ships built on or after 31 December 2008 – before entering into service;
  - ships constructed before 31 December 2008 and certified for operations in sea areas A1 and A2 or A1, A2 and A3 – no later than the first survey of the radio installation after 31 December 2008; and
  - ships built before 31 December 2008 and certified for operations in sea areas A1, A2, A3 and A4 – no later than the first survey of the radio installation after 1 July 2009.

LRIT system and equipment shall be capable of being switched off on board or be capable of ceasing the distribution of information:

- where international agreements, rules or standards provide for the protection of navigational information; and
- in exceptional circumstances and for the shortest duration possible where the operation is considered by the ship's master to comprise the safety or security of his ship [4].

Ship's master shall inform his flag state administration about switching the LRIT equipment off without undue delay. Additionally he shall make an entry into the ship logbook setting out the reason for the decision and indicating the period during which the equipment was switched off. It means that the ship's master has the same right to switch LRIT equipment off as for ship borne AIS.

Government – IMO member state participating in the system have the right to receive LRIT information about ships [4]:

- entitled to fly its flag irrespective of where such ships are;
- which have indicated their intention to enter a port, or a place under the jurisdiction of that government, irrespective of where such ships may be located provided they are not within the inner waters of another government; and

-   entitled to fly the flag of other government, not intending to enter a port, or a place under the jurisdiction of that coastal state, navigating within a distance not exceeding 1000 nautical miles of its coast provided such ships are not within the inner waters of another government.

Above-mentioned government is not entitled to receive such information about a ship within the territorial sea of the state whose flag the ship is entitled to fly. Additionally in order to meet security standards each government has at any time the right to order the ships entitled to fly its flag to prohibit the distribution of LRIT information to any coastal state. This decision shall be reported without delay to IMO. Governments receiving LRIT data shall bear all costs associated with any LRIT information they have requested and received. Particularly any charges in relation to the transmission or receiving of the LRIT information shall not be imposed on ships [2,4].

In order to identify ships which may be called to provide assistance in relation to the search and rescue of person in distress at sea, search and rescue (SAR) services are entitled to receive free of any charges LRIT information actually transmitted by all ships located inside the geographic area specified by these services. Specified area may be even outside the search and rescue region associated with the SAR service requesting the information.

LRIT system should [2]:
-   protect the privacy and security of data reported by ships during its transmission from the ship to the system, within the system, during transfer from the system to authorised recipients and when handling by these recipients;
-   be financially self-supporting;
-   allow authorised administrations:
    -   to receive LRIT data in an assured way to meet the needs of homeland security;
    -   to collect and distribute data in a secure and private environment;
    -   to remotely instruct ships' LRIT equipment to send more frequent reports under certain circumstances;
    -   to control the operation of the system in a cost effective and efficient manner; and
-   allow ship owners and managers:
    -   to choose from a number of recognised LRIT service providers;
    -   to provide in automatic manner only the internationally mandated minimum number of reports;
    -   to use any suitable recognised communication system for reporting; and
    -   to use their existing ships communications equipment to meet the LRIT requirements without additional equipment cost.

Analysed system shall transmit, distribute and receive in fully automatic manner information described in Table 1.

Tab. 1

Information distributed by LRIT system [3,4]

Data transmitted by ship equipment	Ship's equipment identifier
	Ship's GNSS position based on WGS84 datum and Universal Co-ordinated Time (UTC) and date associated with this position
Data added by so called Application Service Provider (ASP) and LRIT Data Centre	The IMO ship identification number and Maritime Mobile Service Identity (MMSI) for the ship
	The data and UTC the ship report is received by the ASP
	The data and UTC the ship report is transmitted by the ASP to the selected LRIT Data Centre
	LRIT Data Centre identifier
	The data and UTC the report is received by the Data Centre
	The data and UTC the ship report is transmitted by the LRIT Data Centre to LRIT Data User

The quality of LRIT service accounted as relation of the number of delivered LRIT ships reports meeting latency requirements to the total number of requested LRIT reports and expressed in percentages should be 95% of the time over any 24-hours period; and 99% of the time over any 1 month [4].

3.   SYSTEM ARCHITECTURE

General requirements

System might have centralized, distributed or mixed structure. Due to the political reasons International Maritime Organization (IMO) Working Group on Long Range Identification and Tracking (LRIT) decided to suggest establishment of the LRIT system with mixed architecture comprising all types of possible LRIT Data Centres: International, Regional, Co-operative and National. IMO Maritime Safety Committee (MSC) approved this suggestion. Proposed system consists of [3]:

- ship borne LRIT information transmitting equipment;
- Application System Provider(s) – ASP;
- Communication Service Provider(s) – CSP;
- National, Regional, Co-operative and International Data Centre(s) including related Ship Monitoring System(s) – SMS(s) and Vessel Traffic Service(s) – VTS(s);
- International Data Exchange System – IDES working according to the approved Data Distribution Plan - DDP; and
- LRIT Co-ordinator monitoring international part of the LRIT system and acting on behalf of all governments participating in the system.

International Data Centre will be established by MSC working on behalf of all governments willing to participate in this centre. Particular governments may establish National, Co-operative or Regional LRIT Data Centres co-operating with the international centre. Governments establishing non-international LRIT Data Centres should report updated relevant details about these centres to IMO. Non-international LRIT Data Centres may serve as a National, Regional or Co-operative Vessel Monitoring System (VMS) or Vessel Traffic Service (VTS), e.g. as VMS required by 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 and repealing Council Directive 93/75/EEC. LRIT Data Centres serving as VMS or VTS may require transmission from ships additional information not required by LRIT system and at different intervals. They may also perform other functions.

Ships, other than those, which are required to transmit LRIT data to a National, Regional or Co-operative Data Centre, should transmit required data to the International LRIT Data Centre. An International LRIT Data Centre may, upon request, collect additional information from ships entitled to fly the flag of some states on the basis of specific agreements signed by IMO with the governments of these states [3,4]. Each government shall decide to which LRIT Data Centre ships entitled to fly its flag are required to transmit LRIT data and provide to the selected Data Centre complete identification data for each one of these ships (name of ship, Call Sign, IMO ship identification number and Maritime Mobile Service Identity - MMSI).

Ship borne equipment

Ship borne LRIT equipment should be capable to automatic transmit LRIT data mentioned in Table 1 to the selected LRIT Data Centre at 6-hour intervals, using selected by the ship owner or flag state authority satellite or terrestrial CSP (working in high frequency band) providing coverage in all areas where the ship operates, and to be configured remotely to transmit data at variable intervals ranging from 15 minutes to 6 hours and following receipt of polling commands.

Application and communication service providers

Application Service Providers (ASPs) provide services to the selected LRIT Data Centres and should [3,4]:
-   be recognized by IMO (ASPs providing services to an International Data Centre) and contracting governments (ASPs providing services to other types of the LRIT Data Centres), adequately;
-   provide a communication protocol interface between Communication Service Providers (CSPs) and Data Centres to enable remote integration of ship equipment into selected LRIT Data Centre and automatic management, configuration, modification, suspension and recovery of LRIT data transmissions;
-   add the data identified in Table 1 to each transmission of the LRIT information;
-   provide an integrated transaction management system for the monitoring of LRIT data through-put and routine; and
-   ensure that LRIT data is collected, stored and routed in a reliable and secured manner.

Communication Service Providers (CSPs) connect all parts of the LRIT system including end data receivers (system users) using communications links and protocols in order to ensure the end-to-end reliable, timely and secure transfer of LRIT data. Communication between ships and Data Centres may be secured by different Satellite and Terrestrial CSPs recognized by IMO. Some of them were described in [2]. Particular LRIT Data Centres will be connected together and with data end receivers (competent governmental authorities and search and rescue centres) using landline links, mainly Internet. To provide communication security should be used methods such as authorization of data providers and receivers and authentication, confidentiality and integrity of exchanged data. The competent ship flag state authority should select CSP and Data Centre. LRIT information should be available to the end receiver within 15 minutes of the time it is transmitted by the ship. On-demand LRIT data reports should be provided to the LRIT user requesting this data within 30 minutes of the time the user requested the data.

LRIT data centre

LRIT Data Centre shall [2,3,4]:
-   keep updated list of ships instructed by their owners or flag state administrations to transmit LRIT data to this centre and collect LRIT data transmitted by them;
-   add the data identified in Table 1 to each transmission of the LRIT information;
-   distribute data received from particular ships to the end receivers entitled to receive it;
-   execute requests received from LRIT data users for pulling of LRIT data or for change in interval of sending this data by a ship or a group of ships;
-   participate in ship's data exchange between particular Data Centres through the International LRIT Data Exchange;
-   obtain data about ships sailing in coastal waters of the state or to the port situated in the state registered in given Data Centre from other Data Centres collecting information transmitted by ships through the International LRIT Data Exchange;
-   make available, on request of authorized receivers, ship's data collected by another centre;
-   archive LRIT data from ships for at least one year and make it available on request:
    -   within 30 minutes for data archived within the last 4 days;
    -   within 1 hour for data archived between 4 and 30 days previously; and
    -   within 5 days of receiving request for data archived more than 30 days previously;
-   destruct archived information after one year time of its storage;
-   back-up at regular appropriate intervals stored data using recognized hardware and software and available it in the event of damage of the main LRIT Data Centre; and
-   maintain record of ships transmitting data to the centre; and co-operate with the LRIT Co-ordinator.

International LRIT data exchange

An International LRIT Data Exchange is a message handling service and shall be established by the IMO member states under co-ordination of the Maritime Safety Committee (MSC) of this organization. It should be connected to all LRIT Data Centres and route LRIT data between particular Data Centres using a standard agreed protocols, secure access and routing table to establish the correct route. Additionally it should [3,4]:
- use a store and foreword-buffer to ensure LRIT data is received;
- automatically maintain journal containing headers of all routed messages;
- archive journal for at least one year for invoicing and audit purposes; and
- not store or archive LRIT data.

LRIT data distribution plan

The LRIT Data Distribution Plan shall be established and maintained by IMO and should contain [3,4]:
- a list of governments participating in the system and search and rescue services entitled to receive LRIT data, and their points of contact;
- the boundaries of areas within which particular governments are entitled to receive LRIT data about ships in the area and within which these governments have requested LRIT data;
- a list of all introduced National, Co-operational and Regional LRIT Data Centres and information about governments serving by them;
- a list of ports and port facilities around the world and their geographical positions; and
- information supplied by IMO in relation to the non-provision of the LRIT data to particular governments.

LRIT co-ordinator

It should be appointed by MSC in order to:
- assist in the establishment of the International LRIT Data Centre by participating in the development of technical specification and preparation for MSC recommendations concerning operational, technical and financial aspects of this establishment;
- supervise the proper work of the international part of the LRIT system;
- perform administration functions like investigation of disputes and operational, technical and invoicing difficulties connected with operation of the international part of LRIT system, mainly International Data Centre and Application and Communication Service Providers;
- audit the performance of all LRIT Data Centres annually; and
- participate in testing for the integration of new Data Centres into LRIT system and new or modified procedures and arrangements for communication between particular LRIT Data Centres.

Actually International Mobile Satellite Organization (IMSO) is designated as the LRIT Co-ordinator.

4. CONCLUSIONS

Worldwide sea traffic is increasing and security, safety and environmental risks are increasing too. These are the reasons of introducing the analysed system. Establishment of the LRIT system shall increase level of ships, coastal states and port states security and improve environmental protection, safety of navigation and efficiency of the search and rescue operations at high seas. It will increase the range of reporting requirements already imposed on ships engaged on international voyages by regulations either international (conventional) or regional and national introduced in a variety of places. But

ships will send LRIT reports automatically and this function will not increase workload of the ships personnel. IMSO should prepare under the IMO MSC supervision procedures for LRIT service, data collecting and distribution and approval and supervision of the service providers (data centres and application and communication providers). International service providers should work on the basis of contracts (Public Service Agreements) signed between each one of them and IMSO or IMO [2,3]. It is possible that particular flag states will reserve the right to approve service providers acceptable for their vessels.

It shall be stressed that LRIT system as described in this paper is technically attainable already. Technologies are available to provide cost effective solution. Additionally according to the information presented by IMSO there is now about 45 000 ships which should participate in the LRIT system. If all of them will send daily four reports for 20 cents, the total global cost will be around 13140000 USD per year. That is the reason that IMO and IMSO do not suspect any problems with finding the service providers. There are a number of parties with a legitimate interest in receiving LRIT data from ships [2,3,4]:
-   search and rescue, immigration, customs, quarantine and navigational services,
-   security, environmental protection and Port State Control agencies,
-   port authorities and ships' agents,
-   commercial, bodies (ships owners, cargo forwarders, charterers, etc); and
-   fisheries management authorities.

Many different commercial and government owned and operated systems have been developed and introduced to cater for these interest. They vary in the type of technology used and costs of reporting a ship's position and related information [2]. All existing conventional vessels engaged on voyages outside A1 sea areas are fitted and will be fitted with the terminals of the global satellite radio communication system Inmarsat-C for reception of Maritime Safety Information (MSI) and to meet other requirements of the Global Maritime Distress and Safety System (GMDSS). Those terminals can be used to transmit reports required by LRIT service without extra cost to the ship. Other ships may have to be fitted with additional equipment, but will be able to choose from a range of Communication System Providers. Additionally some conventional vessels are already fitted with special equipment for ships reporting purposes introduced as a tool for so called fleet management required by the Company Quality Management System. Many fishing vessels including Polish have already satellite transponders to enable their monitoring when at sea by competent authorities [2,3]. Since 1st December 2004 the mandatory ship reporting system in the Great Barrier Reef and Torres Strait Vessel Traffic Service (REEFVTS) has been upgraded by introducing obligatory so called Pre-Entry Report and 15 minutes position updates transmitted via Inmarsat. It means REEFVTS creates already first in the world obligatory LRIT system for conventional vessels [2].

At present there are unsolved questions of the financial aspects of introducing and maintaining of the analysed system. It is difficult to estimate total system cost at so early stage, but according to the calculation presented by experts from IMSO the cost for each report in the LRIT service will be on the level of about 20-25 cents US and system set-up cost will be between half and one million dollars US [2,3]. It is suggested that the primary source of funds should be governments receiving information from system database. They should pay for data they received, on a "per report" basis or a standard price, accounted probably on annual basis.

Literature

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