

EMSA – European Maritime Safety Agency
Unit C.4 – Digitalisation and Application Development

Appendix C.1

EU LRIT Cooperative Data Centre Technical Overview

Date: 19/07/2016

Version: 1.0

1 Introduction

This document gives an overview of the EU LRIT Cooperative Data Centre. The EU LRIT Cooperative Data Centre (EU LRIT CDC) has been operational since June 2009 and EMSA hosts and operates the EU LRIT CDC since 5 November 2011.

2 EU LRIT CDC Overview

The Long-Range Identification and Tracking (LRIT) system is a global ship tracking service developed under the co-ordination of the International Maritime Organization (IMO) and available to IMO Contracting Governments.

The LRIT Data Centres (DCs) collect, store and provide LRIT information (ship position reports) to users worldwide through an Internet based network. The EU LRIT CDC is one of the many Data Centres (56) which are in the LRIT system.

The main function of the EU LRIT CDC is to provide positions of EU flagged ships worldwide and non-EU flagged ships passing or coming to Europe via the exchange of messages with other Data Centres.

There are currently 29 Contracting Governments and 7 Territories Participating in the Data Centre. Around 9000 ships are monitored/tracked by the EU LRIT CDC and around 3 million messages are processed per month with around 190,000 position reports per month being exchanged with other Data Centres. There are around 700 users of the EU LRIT Data Centre.

More details about LRIT system can be found in the document 1259-Rev-6.pdf

3 EU LRIT CDC Architecture

The high level architecture and context of the EU LRIT CDC is shown in Figure 1.

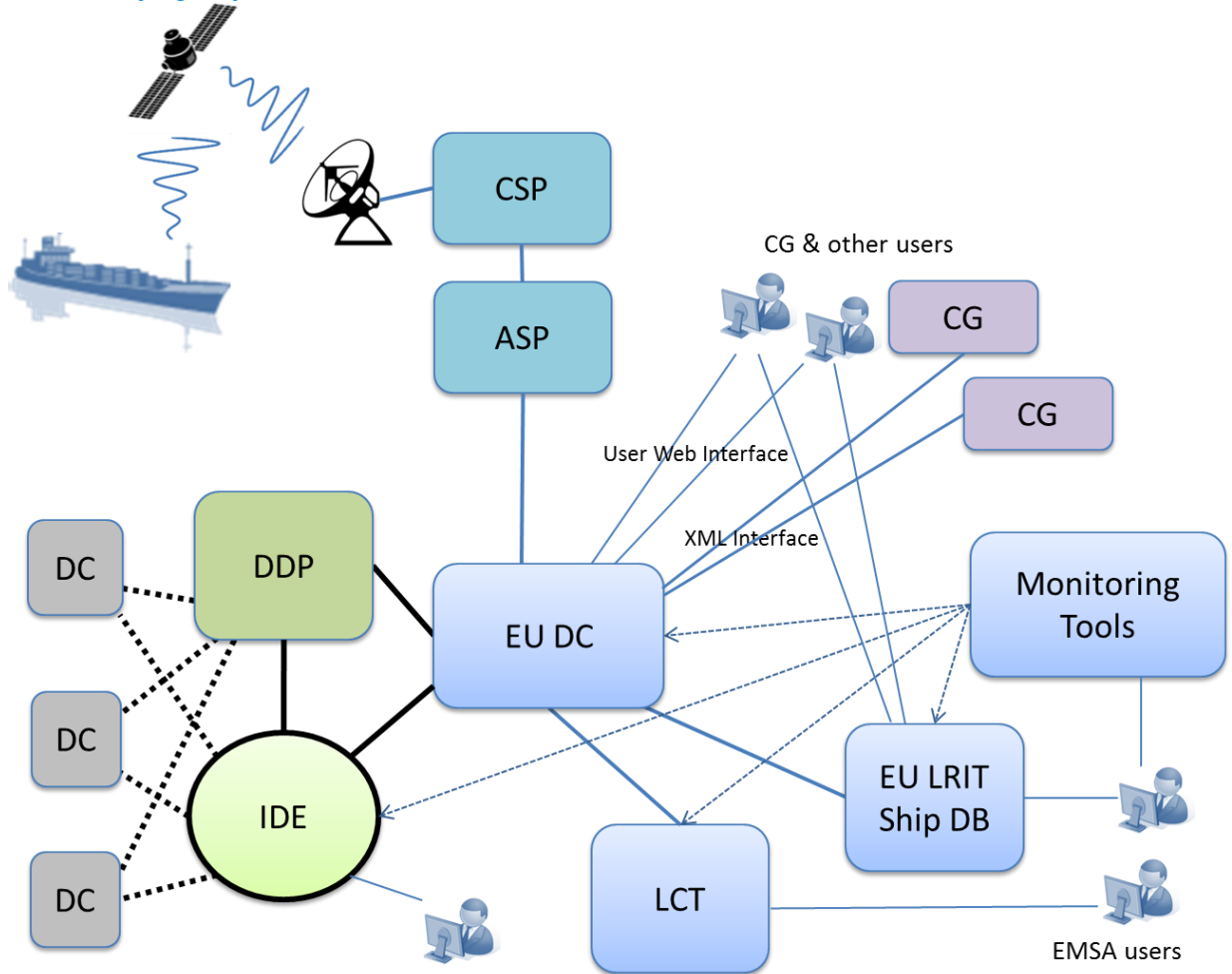


Figure 1 – The EU LRIT CDC within the LRIT System

On top left it shows the general flow of messages which are sent from the ship, via a satellite, through a communication service provider (CSP) (using various communication networks Inmarsat C, Inmarsat M2M, Iridium), an application service provider (ASP) and then to the EU LRIT Cooperative Data Centre (EU LRIT CDC).

The EU LRIT CDC has an interface with the EU LRIT Ship Database (Ship DB) which includes all the ship related information for each ship registered in the database for an EU flag. The EU LRIT CDC receives a copy of the Ship Database once a day. The EU LRIT CDC has a User Web Interface for users to be able to access the LRIT information and some participating countries of the EU LRIT CDC also use an XML interface or web service to receive streamed data.

The exchange of messages between DCs is done through the International Data Exchange (IDE) which can be seen as the communication hub of the LRIT network (Figure 1). The IDE routes the messages to the proper destination by using address information contained in the Data Distribution Plan (DDP), an XML document maintained by the Contracting Governments and made available by the DDP Server, hosted at IMO.

The EU LRIT CDC also has an interface with the LRIT Consumption Tool (LCT), which allows the EU LRIT CDC to bill users when they request LRIT information as well as

change the rate of reporting of a ship and allows invoicing of other Data Centres. A journal is transferred from the EU LRIT CDC to the LCT to allow these transactions to take place.

3.1 Software and technologies used

The LRIT CDC is basically a data driven system, which handles messages received from others systems (ASP, IDE, DDP server, etc.). The internal communication between the LRIT CDC sub-systems is also data driven.

The connection between the LRIT CDC and other components is established and made secure by means of a Private Key Infrastructure (1-way SSL for the UWI, 2-way SSL for system-to-system interfaces).

The LRIT CDC system architecture provides a high service availability system, which minimizes downtime and prevents message loss. The LRIT CDC has been designed to respond to demanding requirements in terms of latency and performance.

The LRIT CDC is based on several software modules allowing an easy deployment and management of the LRIT CDC system. The following software technologies are used in the EU LRIT CDC system:

- **Operating system:** Red Hat Enterprise Linux 6.4
- **Database:** the LRIT CDC system is using Oracle 11g (v11.2.0.4) database – upgrading to Oracle 12c. All the sub-systems written in Java are using the Oracle JDBC drivers and the Hibernate persistence framework.
- **Web Application Server:** The LRIT CDC web application is running in the Tomcat 7 JSP and Servlet engine, using JDK 1.6.0_37.
- **SOAP web service and SOAP engine:** the web services of the LRIT CDC system are running in the Jetty engine, embedded in the Java application of the corresponding sub-system. The CXF services framework is used to implement the SOAP web service
- **Log4J:** is used by the LRIT CDC system to handle log files. It allows an easy configurable way to define the content of log files according to log levels and software components.
- **Web Ajax Framework:** the LRIT CDC web interface is built using the Ext JS cross-browser JavaScript framework for rich web apps.
- **Apache Commons:** several Apache commons libraries are used within the LRIT CDC (bean-utils, collections, dbcp, logging, pool, io)
- **Custom made:** several Custom made libraries are used by the LRIT CDC

There are 6 main categories of software components:

- Core Components
- User Web Interface

- XML interfaces (e.g. with ASP and contracting government systems)
- Database interfaces (e.g. with LRIT Consumption Tool)
- Monitoring Tools
- Infrastructure firmware (firewalls, switches, load balancing)

LRIT Consumption Tool is an independent module (inside the scope of this contract) and the EU LRIT CDC should interface with it, generating a journal to serve its invoicing and billing needs.

The size of the Java source code of the LRIT CDC software is:

- Lines of Code: ~ 157.806
- Number of Classes: ~ 2.242

The size of the Java source code of the EU LRIT Ship Database is:

- Lines of Code: ~ 40.635
- Number of Classes: ~ 367

3.2 Core components

The EU LRIT CDC is a stable system that has been running without any major issue for 7 years. All known bugs have been fixed.

A graphical representation of the LRIT CDC System Architecture is shown in Figure 2.

The central component MOM is a library providing a logical communication bus between the sub-components:

- ACQ: message reception
- POST: message dispatching
- WAS and WS: web user interface
- CORE: message processing
- DDP RULES CHECKER: data access rights entitlement based on the Data Distribution Plan (DDP)

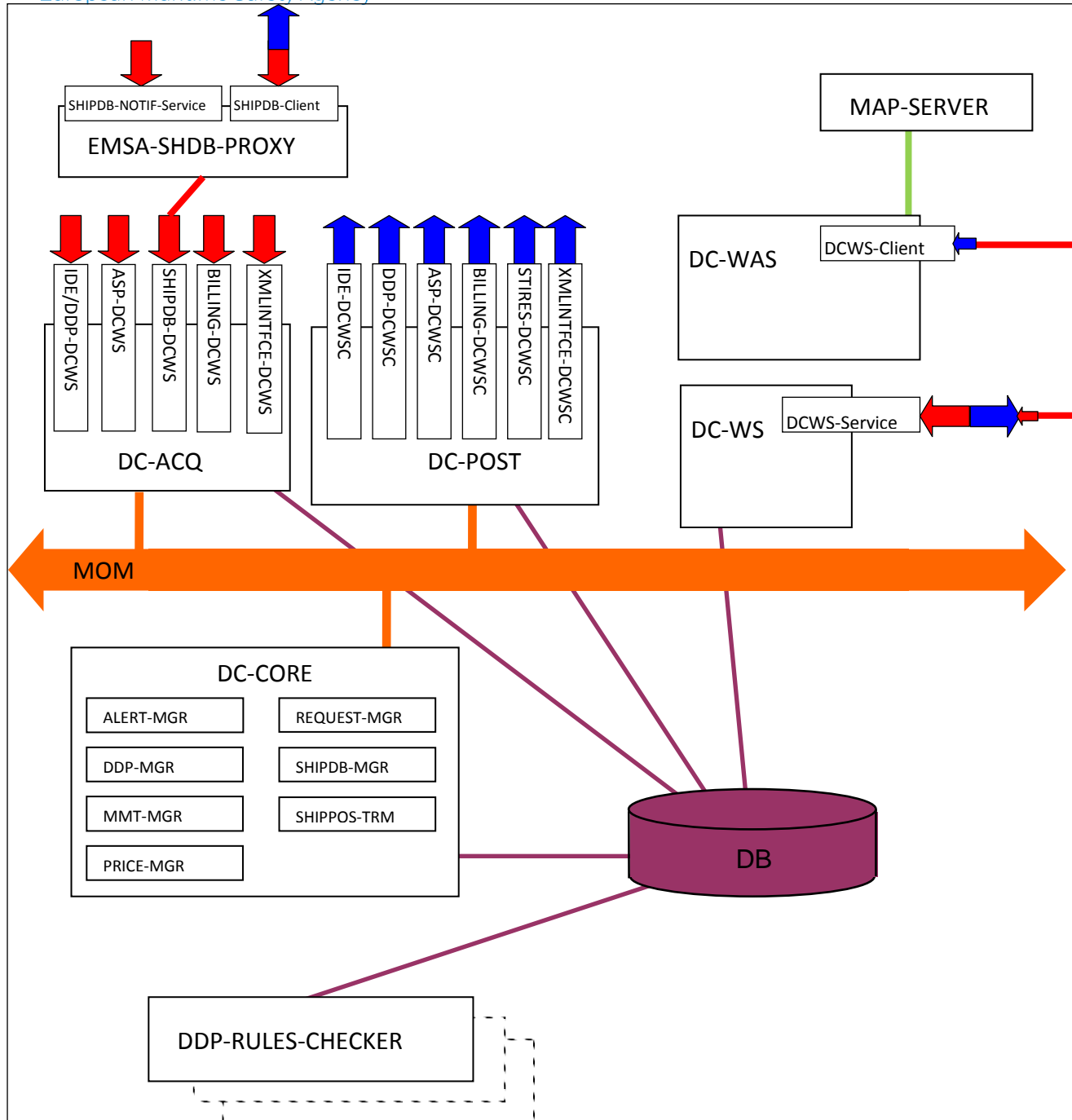


Figure 2 – Software Architecture diagram

The EU LRIT CDC components are responsible for the following tasks (see sample Use Case diagram in Figure 3):

- message reception from external systems, e.g. the ASP
- message processing
- message storage
- message delivery to external systems, e.g. the IDE

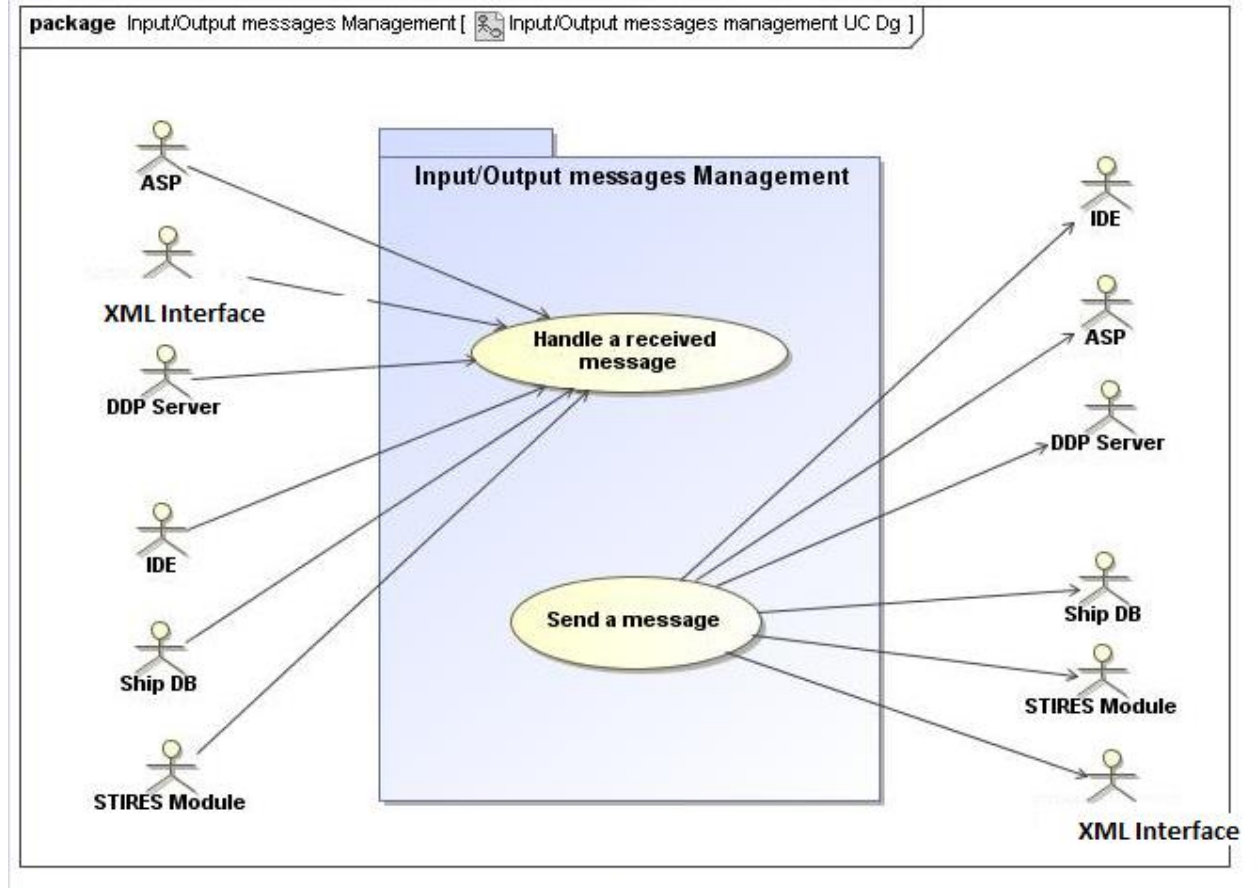


Figure 3 - Message Management (Use Case diagram)

The LRIT CDC Core is composed of 15 sub-systems. The business model comprises more than 70 classes.

3.3 User Web Interface

(see Appendix User manual)

The EU LRIT CDC has a User Web Interface (UWI) built using the Ext JS cross-browser JavaScript framework for rich web apps and is running in the Tomcat JSP and Servlet engine.

The interface has a menu with around 29 menu items and has features such as: user management, worldwide map view, detailed filtering, customizable web interface, manual LRIT requests menu, ship integration, reporting and monitoring menu, administration menu, etc.

The following figure shows the worldwide map view of the EU LRIT CDC UWI:

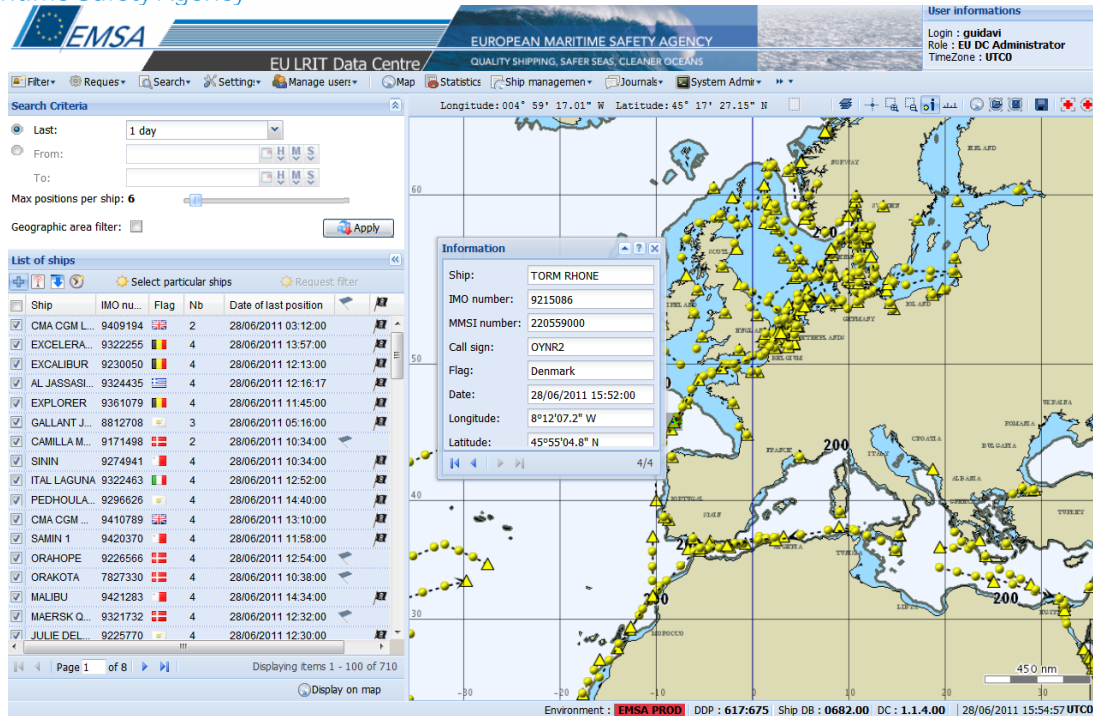


Figure 4 – EU LRIT CDC Map View

More details about the User Web interface can be found in the document LRIT_TN User Manual V3 _ 20110222.

3.4 XML Interfaces

The external interfaces between the DC system and other systems consist of web services. For all of these web services, the same principle is adopted: it consists in the exchange of a message which content is defined under the form of an XML schema.

There are around 14 active external interfaces with around 10 WSDLs, 22 message schemas and operations, and 20 messages types.

Internally, there are around 70 internal interfaces with around 3 WSDLs, 9 message schemas and 4 messages types.

3.5 Monitoring tools

The EU LRIT CDC is continuously monitored through a custom made monitoring tool specifically tailored to the architecture and requirements of the system. The DC is monitored 24/7 by EMSA operators (Maritime Support Services). It is very important that this tool remains available for the operators.

It is composed of:

- **Supervisors:** these are *bash* and Perl scripts which look into the application, identify alerts and warn the DC operators through the web interface.

- **Reports:** which include system incident and performance information; these are in HTML format
- **Web Interface:** a dashboard that is the user interface for the DC operators
- **Wiki:** which contains all operational procedures for the DC operators

3.6 Environments

The EU LRIT CDC system consists of several application servers and a database stored on an Oracle Exadata system.

The application servers provide the processing power and do not store any data; aside from some configuration files, all data is stored in the database.

There are 4 separate environments for the EU LRIT CDC:

- Pre-Production (DEVTEST): Connected to DEVTEST IDE and DDP through the internet, Ship DB Test Environment and ASP simulator.
- Production (PROD): Connected to PROD IDE, DDP, ASP, Ship DB and end users.
- Test: Connected only to simulators.
- Training: Connected to simulators with UWI access for end users.

4 Performance and Availability

- The EU LRIT CDC should process any regular position report in the system from the time it transmitted by the ship within 15 minutes.
- The EU LRIT CDC should process and handle any request sent by an LRIT Data User within 30 minutes of the time the LRIT Data User requested the information.
- The EU LRIT CDC should operate 24/7 with an availability of:
 - 99 % over any 1 month;
 - 95 % over any 24 hour period.
- The EU LRIT CDC should have:
 - seamless switch-over to local redundant servers;
 - seamless switch-over to remote disaster recovery site server

4.1 Message Size

The average size of an LRIT position report or a request message is of some kilobytes. The size of a full DDP message is approximately 3 MB.