Appendix A
to Tender Specifications

SSN Ecosystem - Guiding principles for system architecture

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Executive summary

EMSA is seeking to further develop interoperable maritime information services based on the integration of capabilities provided by existing maritime applications.

This document outlines the EMSA strategy for the further integration and interoperability of the Agency applications related with vessel tracking, monitoring, situation awareness and pollution prevention/ response. The document describes a technical framework (a "system of systems") provisionally defined here-in as the "SSN Ecosystem". This ecosystem includes, in addition to the currently known as "SSN" (comprising the European index server and STIRES applications) and the IMDatE systems, the Earth Observation Data Centre (ex-CSNDC[1]) and LRIT CDC. The ecosystem is supported by a number of horizontal services these are also briefly outlined within the document.

The document is organised in three chapters:

A. Chapter 1 provides a broad outlook of the architectural aspects of the SSN ecosystem Following an explanation of the underlying assumptions and principles in section 1.2 are presented:
   i. The proposed composition of the Ecosystem (refer to 1.2.1), its core operational data sets (refer to 1.2.2) and its reference databases (refer to 1.3). Here are also presented the mechanisms these data sets could be exposed to external parties.
   ii. The essential services, at EMSA level for supporting the Ecosystem's proper functioning (refer to 1.4).
B. Chapter 2 provides an insight on the essential functionalities.
   i. Reference is made, in this respect, to the access control functionalities (those associated with the IdM (refer to 2.2.2) and those related to a still-to-be-developed common management console (refer 2.2.3).
   ii. Also included is an overview functionalities of each subsystem.

As presented in more details in the chapter 1 of the document, and the Figure 2 and Figure 6, the key elements of the proposed approach can be summarised as follows:

1. The data inception, processing, storage and service distribution capabilities of the SSN ecosystem systems shall be further integrated to allow a seamless provision of integrated services/data to users of the "SSN ecosystem". The integration mainly relates with the consolidation of the current IMDatE and current STIRES (SSN GI) systems functions into a single subsystem (identified in this document as "STAR").
2. The SSN European Index Server (EIS), the LRIT CDC and the Earth Observation DC (EODC)[2] shall be maintained as distinct subsystems within the SSN ecosystem, using a data driven approach. These components will be closely linked with the specific data they manage (voyage/ ship call information, LRIT information, Earth Observation data, etc.). Functionalities linked with each of the subsystems will not be replicated in other subsystems of the ecosystem but re-used taking into account interoperability principles.
3. Integration at horizontal level for the use of a single sign on mechanism and sharing reference data should be continued and completed.

[1] Details on the integration between CSN and IMDatE are not included in this document, since this is a subject to a separate ongoing analysis.

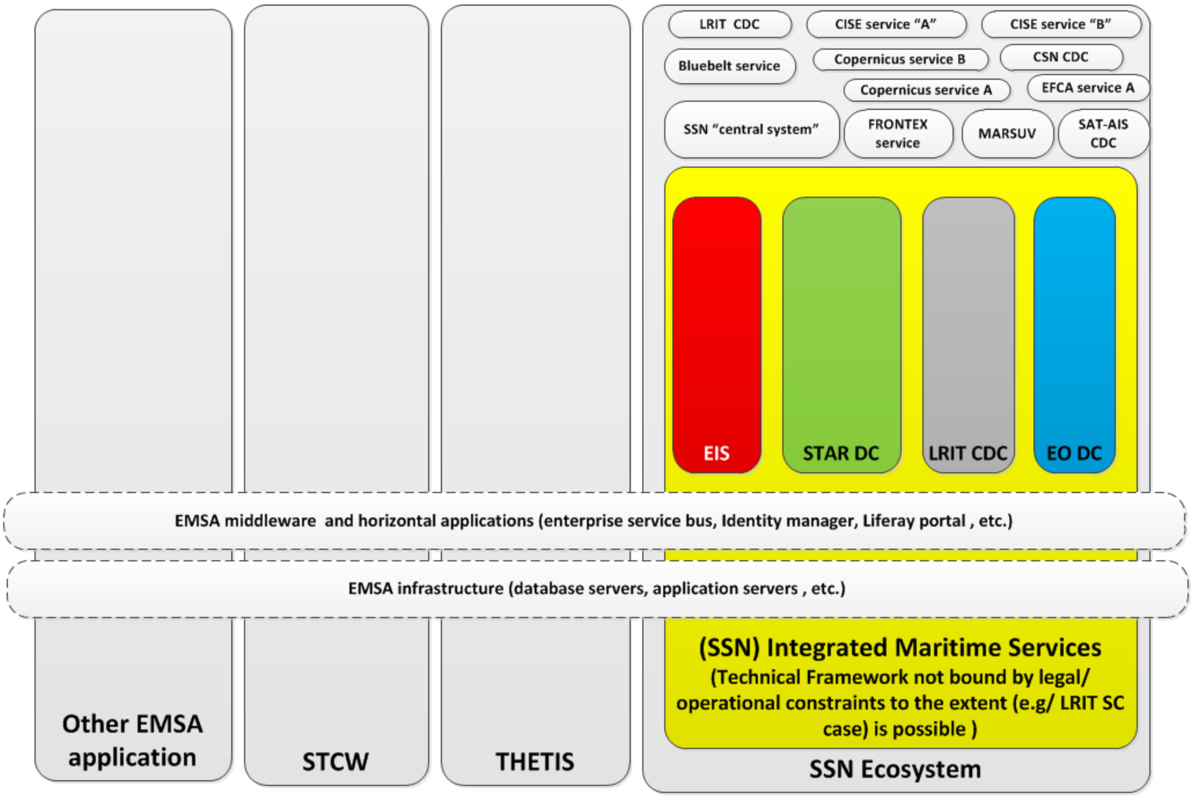
[2] The EODC is the evolution of the CSNDC where CSN is just one of the possible a services implemented on top the EODC)

1 System architecture outlook

1.1 Underlying assumptions and principles

In order to be able to address current and foreseeable user needs, EMSA aims to a more holistic design approach in terms of system architecture. This can be achieved if data processing, distribution and storage capabilities of the applications are integrated into the "ecosystem" and consolidated in a technically convenient manner. The architecture should enable EMSA to:

1. "Decouple" the technical implementation and system capabilities (the "enablers" of service delivery) from the legal and operational constraints that bind the service delivery to end-users.



EIS: European Index Server (
STAR DC: Ship Tracking Awareness & Reporting Data Centre,
LRIT CDC: LRIT Community Data Centre,
EO SC: Earth Observation Data Centre

Figure 1 Decoupling technical capabilities from legal/ operational constraints of services - The concept

As illustrated in the picture the systems included in the ecosystem shall offer all the technical capabilities to meet service requirements stemming from European Directives or existing SLA's, in a user driven manner. The technical decisions on system implementation (i.e. how a specific database is structured) shall be decoupled from the operational level. Obviously the primary aim remains that legal obligations and requirements shall be upheld and enforced by the technical solution selected for the service implementation.

2. Allow human users to access the whole set of services made available to them via a unique system interface;

3. Facilitate the re-use of existing interfaces for the purposes of new or modified service schemes (leveraging the potential of existing interfaces in the delivery future services.
4. Consider, when designing new system interfaces, the potential use in the context of several delivery schemes (e.g. a general purpose web map/feature services (WMS/WFS) for delivery of position data that could be re-used for different user communities e.g. to FRONTEX, EUNAFOR, Copernicus, CISE user groups, etc.)
5. Provide a configurable graphical interface. In this interface shall be made available all the information the users need to build up a tailor made situational picture (that meets their operational requirements). In this sense, the integration of features in the graphical interface should follow a user oriented approach ("SSN central system" services, FRONTEX service, EFCA, etc.) enabling the users to visualize in the graphical interface, considering their data access rights, the information that addresses their specific operational requirements.
6. Establish a more coordinated approach to dissemination/delivery of data via system-to-system interfaces and avoid implementing a new interface when an existing one can serve the requirements of a service with minimum modifications. In the medium term this should lead to the implementation of a Service Catalogue that describes the data sets and interfaces available for delivery of data.
7. Re-use the functionalities of existing EMSA systems to the extent that:
   - There is no duplication (or only limited if it is absolutely imposed by legal constraints) with similar functions in other critical maritime applications in the ecosystem. Examples of functions that should be maintained are:
     - LRIT DC data centre with respect to the interface to IDE and ASPs,;
     - European Index Server (EIS) for the exchange of information between Member States national systems and with Thetis;
     - EODC functions for EO image reception and processing. .
   - For optimisation of storage resources and infrastructure usage, the duplication of exactly the same information in the operational databases of the ecosystem should be avoided, except if it is imposed by operational and/ or legal constraints (i.e. the case of LRIT DC position database)
8. All the applications in the ecosystem shall share a common management console utilised for:
   - Managing access rights
   - Managing reference data
9. Access control in the various applications shall be harmonised and centralized to allow the provision of integrated data and services to the users in a seamless manner.
10. Ensure that users can access the system via internet or the S-Testa network.
11. Enable the traceability and accountability of information, by allowing the verification of the history, location or application of the information received from the MS by means of a documented recorded identification.
12. Ensure non-repudiation and traceability of actions performed by users accessing the ecosystem.
13. Certify that the information is authentic and complete. The information transmitted via the ecosystem shall only be modified by the data provider itself or by the SSN ecosystem in accordance with the rules/procedures agreed with the data providers.
14. From a "project management perspective" there should be a clearer emphasis on documenting appropriately the system, modules, and components.

In order to clearly distinguish the technical capabilities of the "SSN ecosystem" from those of the underlying EMSA infrastructure and middleware, the suggested approach requires a distinction of:

1. System Integration activities at SSN ecosystem level
   a. Operational data processing & exchange (see Figure 3);
   b. Reference data, data processing & exchange (see Figure 5);
   c. Common management console (refer to 2.2.3).

2. System Integration activities at horizontal services level
    a. Human users Identity management (refer to2.2.2);
    b. Semantics-based Interoperability[3] (Enterprise service bus);
    c. Maritime Application Portal.

1.2 SSN Ecosystem

1.2.1 SSN ecosystem – composition

The technical framework of the SSN ecosystem (identified in figure 1 as IMS – Integrated maritime services framework) shall be composed of four "component" sub-systems: Three already existing and evolving - SSN European Index server, LRIT CDC, EODC and a new one, the "SSN Integrated Ship Tracking, Awareness and Reporting Services" subsystem (identified in the drawing below as STAR). The STAR will merge the functions and capabilities of the systems nowadays understood as STIRES and IMDatE. The component sub-systems will be responsible for delivering the following capabilities:

1. The SSN European Index Server (EIS) is the component system interacting with the MS for the exchange of information with MS through a message based mechanism or web-browser based mechanism .The EIS will also be the provider of reference data for ship particulars (Central vessel database), location information (LOCODE registry) and Organisations (Authorities, External providers) to all sub-systems of the ecosystem as well as to external organizations. Lastly, it will be the subsystem where the reference operational database for **voyage information** (Dangerous cargos, waste security data, exemptions) shall be maintained and updated.
2. The LRIT CDC shall continue acting as the interface with IDE and ASPs and hold the central operational (that can be audited) database of LRIT positions. The LRIT CDC will be also the subsystem where the central database for countries (Countries registry – initiated in 2013) is implemented.
3. The Earth Observation Data Centre (ex-CSNDC) shall be further evolved as described in this FWC.
4. The current STIRES capabilities shall be merged with those of the IMDatE within STAR subsystem. STIRES, in this sense, shall be "phased-out" with the understanding that most of the functionalities supported today in STIRES (e.g. those related to the streaming interface, processing / enrichment of incoming position data, etc.) shall be maintained and re-used in STAR. Furthermore, the present SSN GI business logic shall be considered as a guideline for future developments of STAR graphical user interfaces.
5. The central database for T-AIS, SAT-AIS, VMS, VDS, radar positions, etc. shall be established in STAR as well as the central database for geographical objects. Furthermore STAR shall be in control of the graphical web front-end for all types of users accessing STAR resources.
6. A centralized access policy enforcement solution should be implemented, removing hard coded access control from the individual applications, improving consistency and auditability.

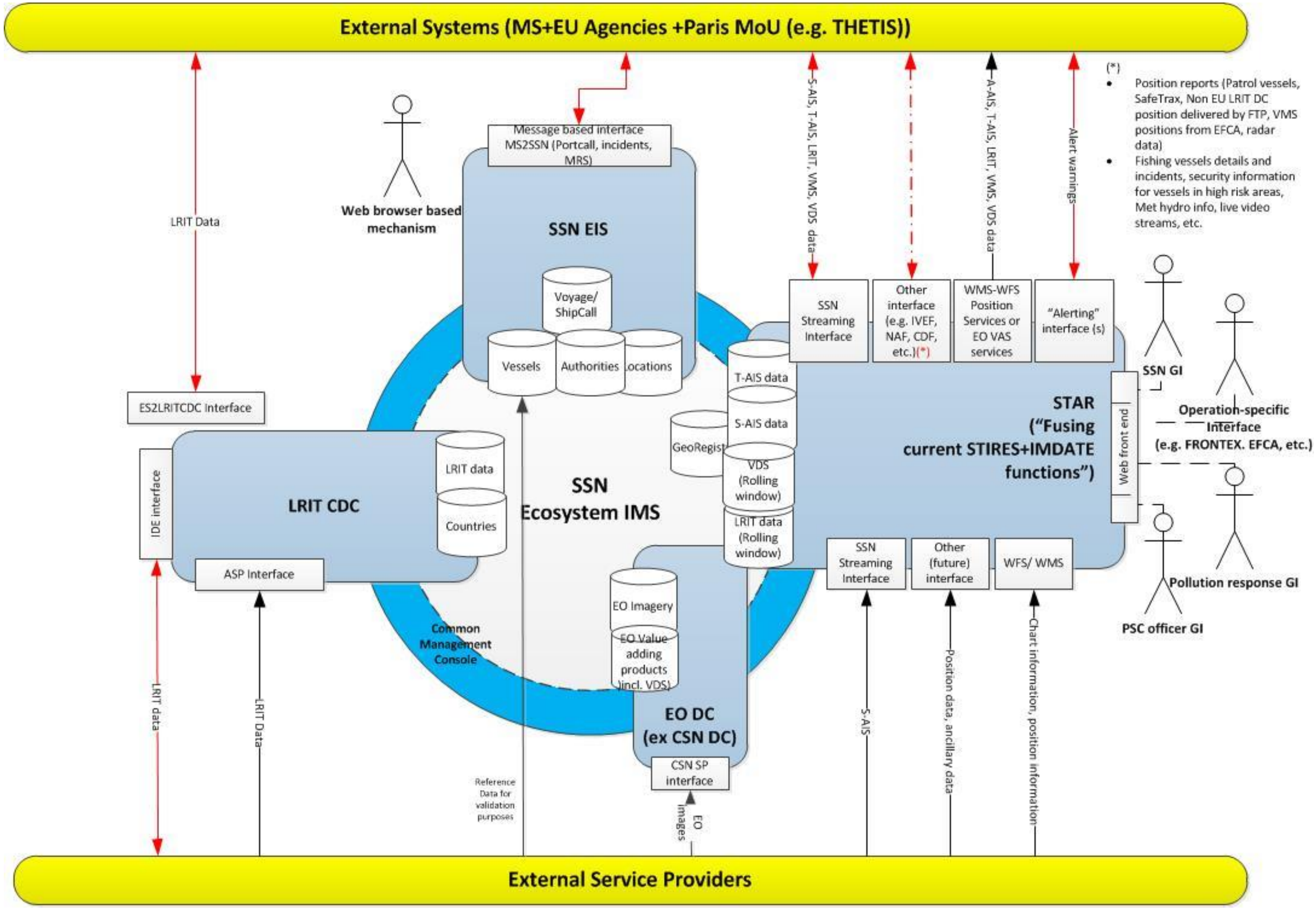


Figure 2 SSN Ecosystem – technical architecture – 2015 and beyond

1.2.2 SSN ecosystem – Operational data sets

Towards fully comprehending the reasons for maintaining for maintaining four distinct subsystems it is useful to provide an insight on the nature of the operational data[4] that the different SSN ecosystem subsystems should store, process and exchange.

As it is illustrated in the Figure 3, the data exchanged and subsequently stored, processed or “relayed[5]” by the ecosystem’s components are falling into four major categories:

1. Ship voyage/ passage/ Ship call related information (pre-arrival notifications, arrival / departure notifications, Security, Waste and Hazmat notifications , and potentially in the future cargo notifications,);
2. Ship position information originated from various sensors (terrestrial/ satellite AIS, LRIT, VMS, etc.);
3. Events/ reports (incidents, accidents) related to safety of navigation, safety of people, marine environment;
4. Earth observation data (geo-referenced images and value adding products derived from earth observation data).

These data are collected from data providers or are disseminated to users with a variety of formats. Due to their “operational” definition, the data sets can contain more than one of the data categories mentioned above. For instance:

1. A maritime reporting system report (MRS) report received currently by SSN contains ship voyage and passage information but also ship position information.
2. An EO data set delivered to EMSA by a CSN service provider contains, apart from the oil spill image, vessel detection data that is position information extracted from EO images.
3. An incident report received from a MS would contain, apart from the incident details, also ship position information
4. A BlueBelt report that has to be delivered to Customs would contain, apart from ship call information (e.g. last ten port calls of the ship), the image of the ship track during her voyage which is derived from position data as well as “detected” ship entry information.

Towards ensuring high performance and flexibility in the service delivery the following aspects need to be considered:

a. The design of the ecosystem applications should allow the “as fast as possible” and “reliably as possible” processing of incoming data. This imposes a clear distinction of processes and business logic concerning the four categories of data mentioned above.
b. The design of databases and data exchange mechanisms should facilitate the “merging” of information stored in the various data sets “on the fly”, with as less as possible overhead.
c. The design of the ecosystem data exchange mechanisms and business logic should facilitate the adaptation of the available interfaces to the requirements of the services requested and the nature of data flows (“non real-time” or “real-time”, “event triggered” or “continuous” inflow and/ or outflows). This requires a segregation of functions and capabilities embedded in data exchange interfaces and subsystems.

[4] “Operational” data are those that are dynamically changing over time.

[5] Reference is made to data actually stored at MS level and “indexed” in the database for easy retrieval

In this respect, it is anticipated the implementation of “four” categories/ families of message exchange mechanisms.

- A mechanism focused in exchange of voyage related data.
  - A good starting point in this respect is the work associated with PortPlus/ Ship-Call request response of SSN. This work should be completed with the establishment of a “voyage notification” mechanism enabling the “push” of voyage information to service subscribers on the basis of a set of criteria. The mechanism should cover the evolving needs of MS related to the reporting formalities but also BlueBelt future requirements.
- A mechanism focused in the exchange of incident reports.
  - The work associated with Incident_Detail messages in SSN is very relevant, in this respect. Future work should build further on what is currently available.
- A mechanism focused in the exchange of ship position reports.
  - In this respect the work associated with the SSN Streaming interface, the EMSA canonical data format (CDF) and the FRONTEX WFS is very relevant. The mechanism should continue evolving taking into consideration the international standards in the domain (e.g. IVEF).
- A mechanism focused in the exchange of EO data and value adding products.
  - In this respect the work related to the EODC WFS / WMS is very relevant.
- A mechanism to provide the information as sent by the data provider to ensure the segregation between the enhanced functionalities (e.g. correlation, fusion etc.) and the raw data included in the original messages received from data providers.
- The design of all the subsystems should envisage the utilisation of an “enterprise service bus”. This is particularly important for delivering services to user Communities using external systems with pre-defined interfaces other than those provided by EMSA systems. In such cases and on the assumption that there is at minimum an agreement at “semantics” level, the ESB could be utilised for transforming the data into the format that the external system can accept.

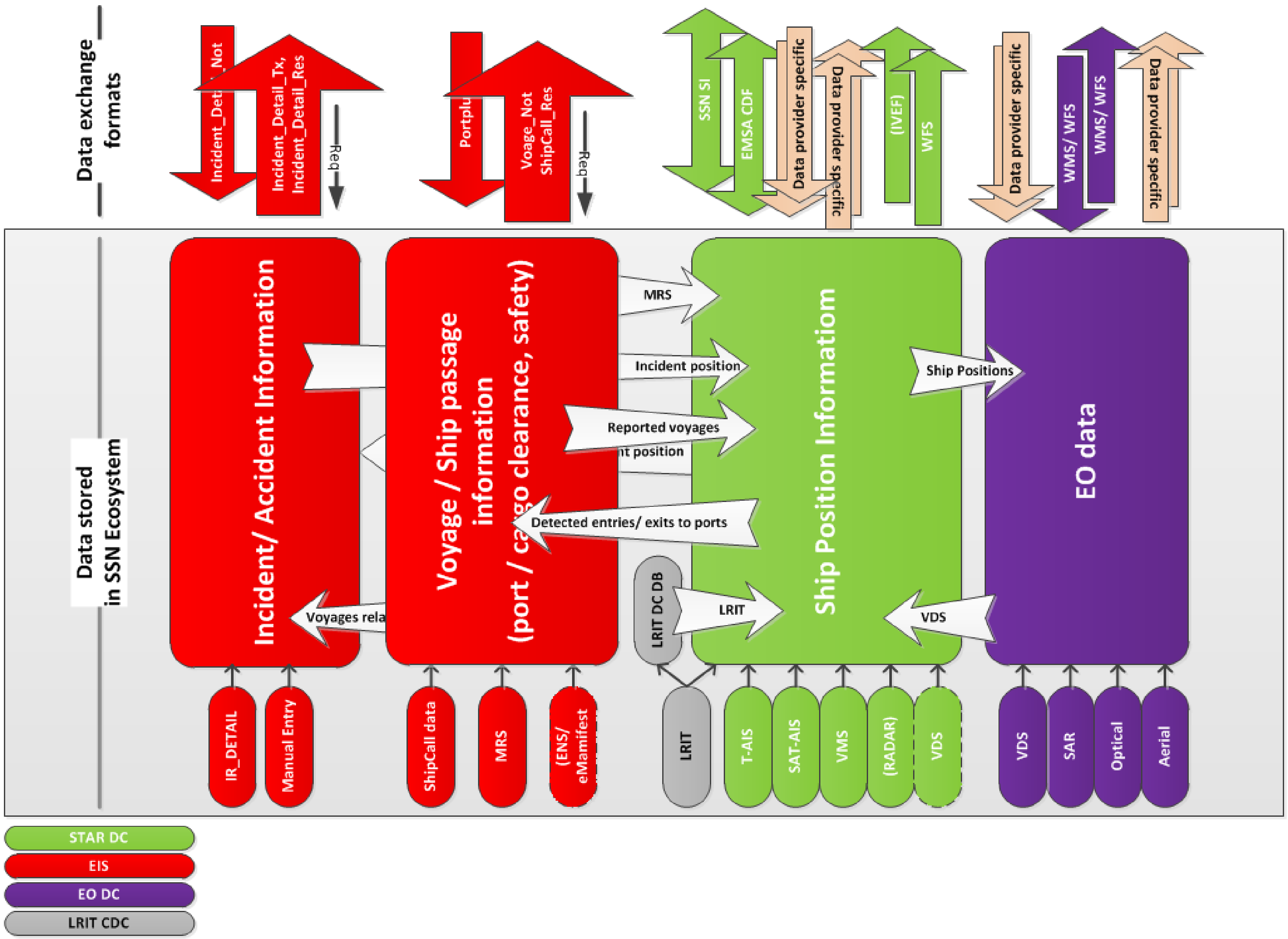


Figure 3 SSN Ecosystem - Data stored/ processed and their exchange mechanisms

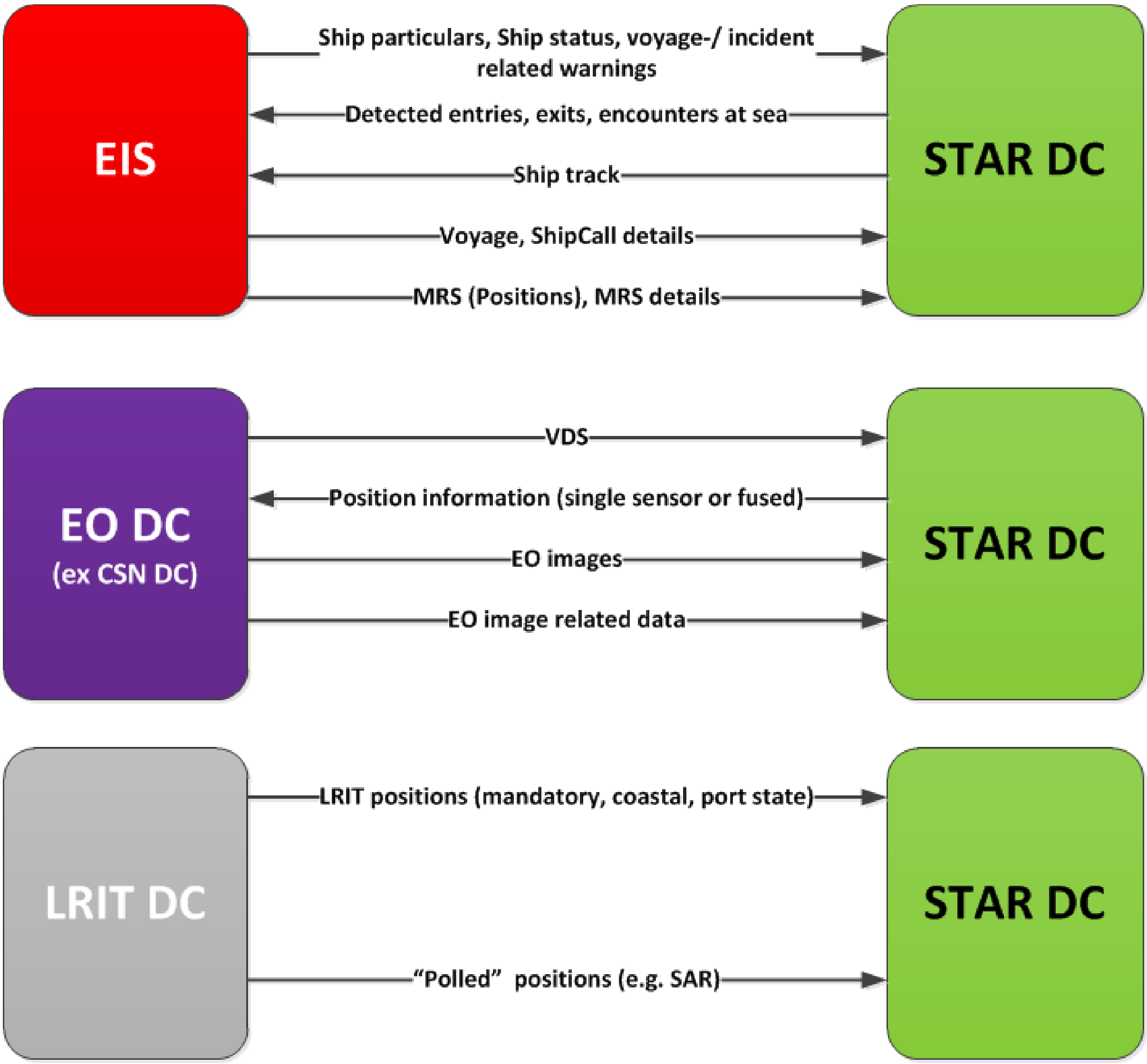


Figure 4 Interfaces among Ecosystem applications

1.3 Reference databases

1.3.1 Overview

The figure below presents the databases of the SSN ecosystem that hold the reference datasets.

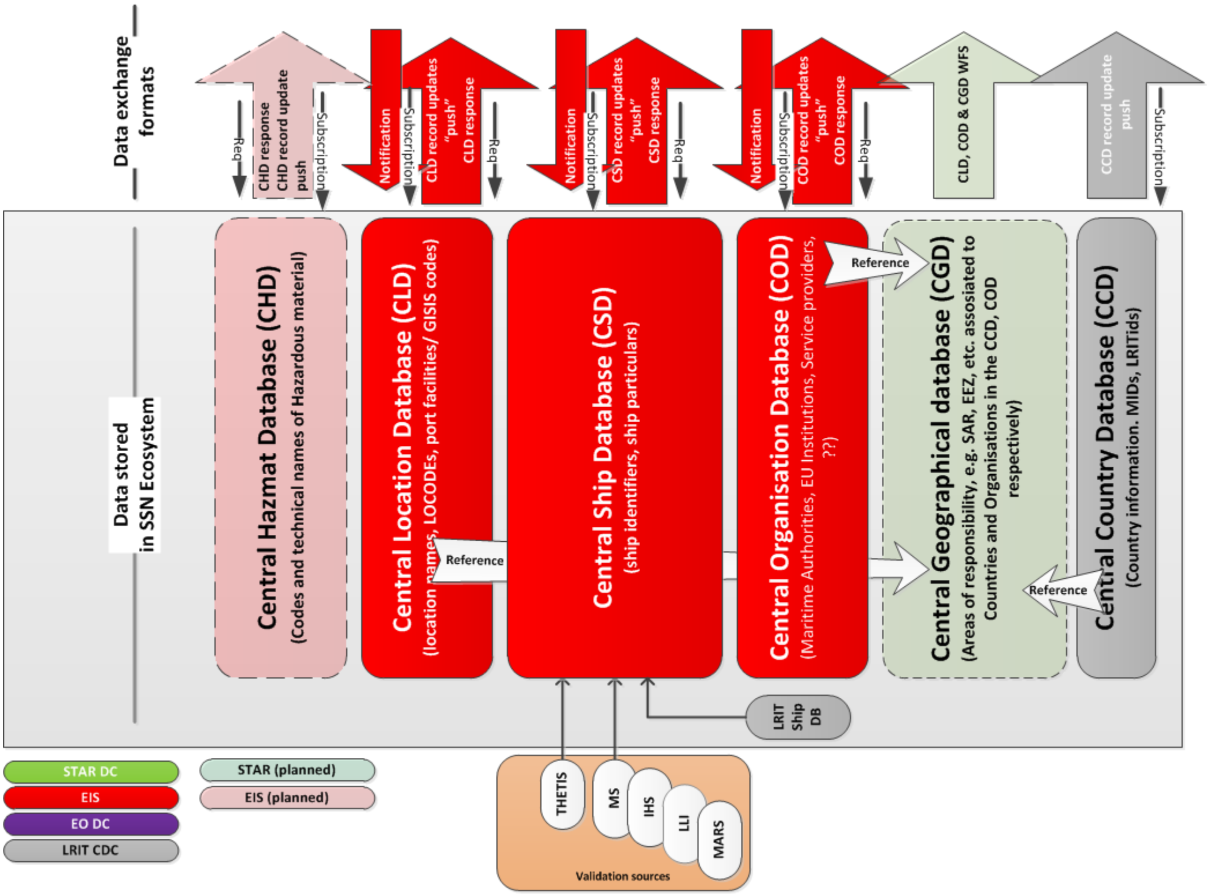


Figure 5 SSN Ecosystem - Reference databases

The reference databases are:

- Central Ship Database (CSD)[6]: The main objective of this database was to facilitate the identification of ships reporting their positions via the AIS transponders installed on board.
- Central Country Database (CCD)[7]: this database used by EMSA to identify in a unique way “countries, dependencies, and other areas of particular geopolitical interest”. In addition to the countries and territories as defined by ISO, the CCD includes also the so called Virtual Countries, Regional Agreements and International Organisations.
- Central Location Database (CLD): this database shall be the central repository of information related to geographical locations utilised by EMSA applications. It will include a central reference list of LOCODEs used by the Agency to identify ports and other locations that are relevant to all Maritime Applications.
- Central Organisations Database (COD): This database shall be the central repository of information related to the administrative entities that have relationships with EMSA. These

[6] Currently designated as Reference Vessel database and only used by SSN.

[7] Currently ready but not in production.

include: international and national organizations, bodies, associations, ministries, offices, ports, public and private companies etc. The COD has the primary goal to identify in a unique way one of these entities and to share its attributes with all EMSA applications.

Planned or scheduled:

- Central Geographical Database (CGD): This database shall be the central repository of areas at EMSA. Geographical areas are being used by several Maritime Applications as a tool to enforce data entitlement rules, set up watch-dogs, trigger alerts, program satellite image acquisition, compute statistics etc. The Base Registry provides a reference database whenever a user needs to use (or re-use) an existing polygon or to create/update polygons.
- Central Hazmat Database (CHD): the aim of this database is to improve the data quality of HAZMAT notifications, to minimise the administrative burden for the reporting party and to support the Member States emergency response services to provide effective response to maritime incidents. The CHD will serve as a reference to manufacturers, shippers, reporting parties and member state authorities and as a verification tool for competent authorities and EMSA services to cross-check and validate the correctness of the HAZMAT data.

1.4 Horizontal Services - Future Architecture

The integration effort at the horizontal services level should include all the maritime applications hosted at EMSA, critical and not critical. This is necessary since all applications share middleware resources and this can, in addition to functional integration issues, imply performance variability and reduced agility as regards to change.

It is nonetheless important that a number of basic horizontal services should continue to evolve / be upgraded and implemented. In this respect the most notable service components are:

a. The identity management system of the Agency (based on IdM – OIM/OAM) and a unique database of human users of EMSA maritime applications and services
b. A unique database of Organisations encompassing Authorities/ International and EU Bodies and service providers[8]
c. A unique database of systems (internal / external) exchanging data with EMSA maritime applications. This will be more important for larger initiatives such as for Copernicus and CISE.
d. A Maritime Application Portal application[9] acting as a single entry point to all maritime applications

The following diagram sketches the “would be” architecture for integration at horizontal services level.

As indicated in the Figure 6:

[8] The procurement for this database was initiated in 2013, and the implementation currently on-going.

[9] Design specifications is available, the procurement for the implementation was launched few days ago

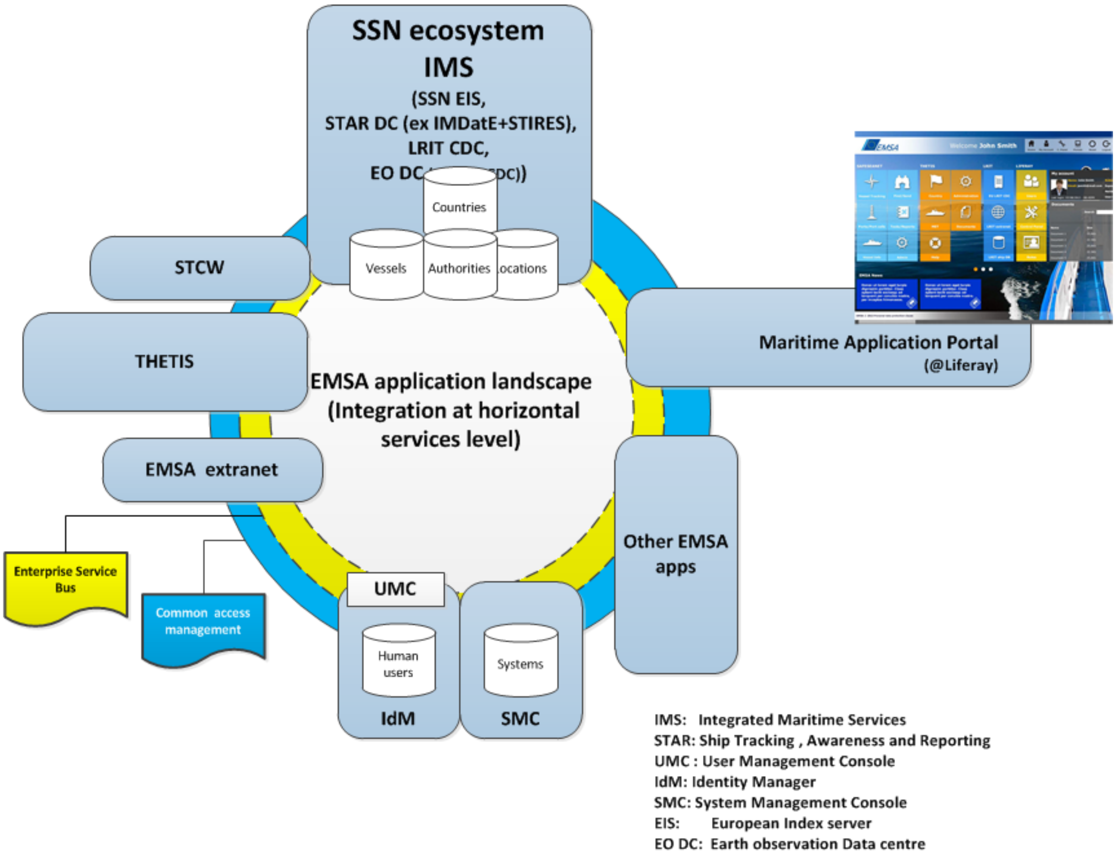


Figure 6 EMSA applications integration (Horizontal services)

1. The Oracle's IdM is the single sign-on platform for EMSA applications. Within IdM a reference database of human users shall be maintained. To facilitate implementation of user friendly workflows for user creation IdM should be upgraded (sooner than later) to interact with the reference databases for Organisations, Locations and Countries. Furthermore the User management console application shall be further improved resuming the role of IdM's front-end.
2. A System Management console should be implemented as a management utility for the reference table for system interfaces. This will be linked to the Authorities reference database and hold all the essential information about the systems interacting with EMSA applications (e.g. will hold information such as web services end-points, purpose of the interface, wsdl and xsd files and links to the documentation of each interface) [10].
3. All the EMSA applications (included the UMC) shall be accessed via the web portal that is to be implemented by the Maritime application portal (MAP) project (activity currently on-going).

2 Functionalities outlook

2.1 Introduction

This chapter provides further insight on:

[10] This table may evolve at a later stage (after 2015 and after the CISE requirements re further clarified) to a UDDI (that is a platform-independent, XML-based registry, to be used by Authorities wishing to link to EMSA systems in a CISE-based scenario to discover and extract the specifications of system interfaces offered by EMSA applications.. The implementation of a UDDI should be consider as an action for integration after the 2015. There is no urgent requirement calling for its creation at this stage.

1. The access control functionalities (those established at horizontal services level at EMSA and those to be established as part of a Common Management Console of the Ecosystem)
2. The potential solutions for establishing the access control configuration module of the common management console.
3. The core functionalities of each subsystem in the SSN ecosystem;

2.2 Access control

2.2.1 Overview

Access to the EMSA Maritime Applications must be controlled in order to avoid unauthorized use of EMSA services. All EMSA Applications require some level of access right enforcement that allows legitimate users to retrieve Maritime information while blocking other to access confidential and sensitive data.

2.2.2 (Human) User authentication

The Oracle Identity Management (IdM) system controls access to the EMSA Maritime Applications. The IdM provides a mechanism to allow or block access to the Application textual sites based on a Single Sign On (SSO) procedure.

A user wanting to access a Maritime Application needs first to perform a login to be authenticated (username and password). If the login is successful, the IdM checks the user roles and verifies if the user has been given the permission to open a specific application. Based on the user role, the IdM grants or denies access to the corresponding textual site.

Thanks to the SSO feature, after a successful login the user can enter several Maritime Applications without the need of typing every time the username and password. At the same time, the Maritime Applications have access to the same user profile.

2.2.2.1 IDENTITY MANAGEMENT (IDM SYSTEM)

The IdM system provides the centralized management of Maritime Applications users and authenticates them by means of a password protected login. The IdM also provides basic authorization by granting or denying access to specific Maritime Applications.

The IdM shall be maintained as the SSO platform for EMSA Maritime Applications. To facilitate implementation of user friendly workflows for user creation and update, the IdM should be upgraded to increase the usability of the user creation workflow as well as to interact with the reference databases for Organisations, Locations and Countries.

2.2.2.2 USER MANAGEMENT CONSOLE

To address some of the limitations of the currently implemented IdM version , the User Management Console (UMC) was implemented in 2013. The UMC is a tool that provides a direct and complete visualization of the user information stored in the IdM. It is possible to show the full list of users, regardless of the Maritime Application they have access to. The UMC displays all user details and it provides a direct link to the IdM user management forms.

The current version of the UMC is mainly used by the MSS Operators and EMSA Administrators. The future development of the UMC should take into consideration all the limitations of the current IdM system as well as the development of a Common Management Console for the SSN ecosystem applications (refer below).

2.2.3 Common Management Console (CMC)

The Common Management Console (CMC) shall be the access point for enforcing access control policies for all the users accessing the SSN ecosystem applications as well as for the management of all EMSA reference databases.

The CMC will be implemented as a composite service including the following service components:

1. Access rights policies configuration for SSN ecosystem users
2. User Management Console
3. Management utilities of the CSD
4. Management utilities of the COD
5. Management utilities of the CLD
6. Management utilities of the CCD
7. Management utilities of the CGD

The CMC services shall be accessible via the Maritime Application portal implemented as a single entry point for all EMSA maritime application in Liferay[11] .

The following sections provide a preliminary analysis concerning the access rights management for SSN ecosystem users.

2.2.3.1 ACCESS RIGHTS MANAGEMENT – A FUNCTIONAL OVERVIEW

Figure 7 indicates an example of access rights management model (based on the current SSN system). The definition and agreement of a common entitlement model is currently on-going.

[11] https://portal.emsa.europa.eu/group/cmc/user-management-console

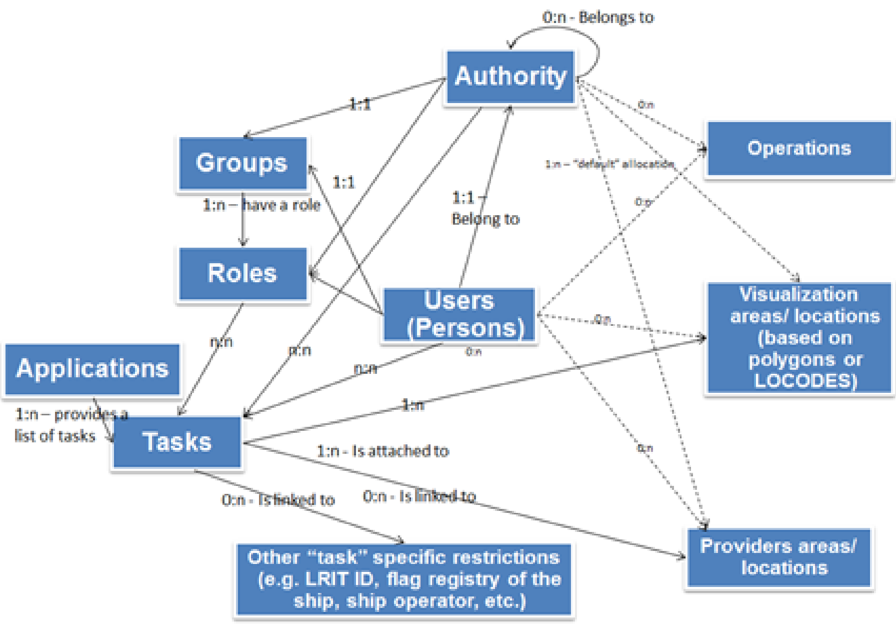


Figure 7: Example of SSN access rights model

The following shall be noted for the presented model:

1. It allows defining two types of users:
   - Authorities (organisations accessing SSN ecosystem services usually via a system-to-system interface
   - Persons (usually accessing system via the web textual or graphical interface)
2. In an effort to model the organisational models applied by Maritime Authorities, the SSN Authorities are organised hierarchically. An Authority belongs to a Supervisor Authority (while a person must be attached to a unique Authority. The enforcement of these policies will use data stored in COD level for the Authorities.
3. It should not be possible in SSN ecosystem to create a human user without allocating it to an "Authority" user.
4. Both types of users in SSN ecosystem (authorities and persons) might access SSN ecosystem via more than one interface. An NCA, for example, may access SSN ecosystem via the XML/SOAP interface (to notify and request information related to ship calls, incidents etc.) and via the SSN SI (to stream AIS raw data to STAR and potentially, if so configured, to receive AIS information "enriched" with other useful data maintained in SSN ecosystem).
5. An Authority can also be assigned a password to access the system via the web interface. The latter is particularly useful, for back-up purposes, to ensure that Authorities submitting notifications via a system2system interface could update them via the web in case of failure of the system2 system interface.
6. Persons can access SSN ecosystem via any of the textual/graphical interface that shall be made available to them. The behaviour should be the same. If, for example, a user can request and receive Hazmat details via the textual interface of the EIS, he (she) should request/ receive the same information by accessing the system via the STAR web interface.
7. It shall not be mandatory to assign a system to system interface to an authority.
8. Based on the configuration made in the CMC, the users shall access resources provided by all the distinct applications within SSN ecosystem. Access to the resources is controlled by "tasks" that could be allocated to users by a system administrator.

9. The “task” is a fundamental concept for service composition representing elementary resources that could be subsequently grouped by Administrators and assigned to users.
10. Tasks are defined as a set of specific actions that a user perform in an application and essentially represent elementary “services” that could be allocated to a user.
11. The allocation of tasks to a user shall stem from well-defined operational or legal obligations. A new task should be added/ created in the CMC every time new functionality is added in a subsystem.
12. The provisioning of tasks to users is made via the CMC.
13. Tasks can be further restricted by applying a combination of constraints:
    - the position and/ or flag of the vessel that relates to a notification a user creates or visualise/ receives
    - the operational location of the user providing the data
    - the user accessing the data
    - Other criteria to be defined such as an operation a user is assigned to.
14. The geographical restrictions are applied by assigning one or more “visualisation” and “data provision” areas to users. “Areas” could be defined in an “abstract” way (e.g. an “Norwegian SAT-AIS” data area) related to a specific data set, and/ or by polygons covering sea regions and/ or a set of specific locations (identified by their LOCODEs) belonging to one or more countries..
15. The tasks can be grouped into roles. One may note that although tasks are specific application dependent, the roles can be defined independently from applications.
16. Roles are grouped under groups. The group shall be understood as a general profile reflecting the kind of activities a user is able to execute based on the agreements made by the MS. For instance the MS_POR group in EIS is aiming to group all the roles that relate to system activities possible for maritime port Authorities and the MS_PSC for port state control Authorities etc.

2.2.3.2 SYSTEM TO SYSTEM INTERFACES MANAGEMENT (SYSTEM MANAGEMENT CONSOLE)

As presented in the section 1.4, a System Management Console (SMC) should be implemented to manage the information related to system interfaces made available by EMSA to other EMSA applications and external systems.

The principal idea is to collect and manage the information concerning available system interfaces and the way these interfaces are currently set-up in a single database. In the database will be stored information like:

- Interface specifications (e.g. xsd/ wsdl files)
- Reference of the Authorities using a specific interface and information on the way the interface to a specific system is set-up

It should be also considered, as a medium or longer term action, exposing the information concerning system interfaces using a standard XML mechanism. In this respect UUDI specifications[12] could be utilised as a basis. UDDI is a platform-independent, XML-based registry, and could be utilised in a CISE-context of interoperability with external entities. The implementation of a UDDI should be considered as an action for integration after the 2015. There is no urgent requirement calling for its creation at this stage, based on the information currently made available to the authors.

[12] https://www.oasis-open.org/committees/uddi-spec/doc/tcspecs.htm

The complete analysis related to the SMC has been considered by the authors as out of scope of the present document, however, should Management will consider it useful, relevant details could be included in a subsequent release of this report.

2.3 LRIT CDC

2.3.1 Functionalities & interfaces

The LRIT Data Centres (DC) collect, store and provide LRIT information (ship position reports) to users worldwide through an Internet based network.

The EU LRIT CDC (European Union LRIT Cooperative Data Centre) provides the tracking service for the ships flying a flag of the EU Member States and is hosted by EMSA.

Mandatory LRIT position reports

The main function of the EU LRIT CDC is the regular worldwide tracking of EU ships with a periodic rate of one **position report every 6 hours**. The EU LRIT CDC provides a continuous data stream of positions reports that can be received and processed by authorized users.

The periodic transmission rate can be increased for a specific ship up to a position every 15 minutes.

Poll

The EU LRIT CDC allows the user to request the c**urrent position of a ship**. The "Poll" request is sent to the LRIT shipborne equipment and the position report is delivered to the user within few minutes (in average less than 5 minutes).

SAR SURPIC

Search & Rescue services use the LRIT SAR SURPIC function to receive the position of ships that were located within an area in the last 24 hours. The function is free of charge.

The function is very useful in remote areas where there is no T-AIS coverage and LRIT is currently the only source of information.

The LRIT SAR SURPIC is currently being enhanced on the IMDatE platform by adding to the LRIT data also the Satellite-AIS position.

Interfaces

The EU LRIT CDC provides two interfaces to the users:

a. **Web Interface**: a web based GIS application where users can visualize LRIT positions, submit LRIT requests and monitor the LRIT reporting status of their ships.
b. **XML Interface**: a Web Service interface for a secure System-to-System data exchange. All LRIT functions described above are accessible via the XML Interface. External Systems are authenticated using SSL Certificates.

2.3.2 LRIT CDC service categories

The service provided by the EU LRIT CDC can be divided in four main categories:

1. Management of LRIT ship reporting
2. Archive and distribution of LRIT ship positions
3. Request of LRIT position
4. Visualization of LRIT ship positions

Management of LRIT ship reporting

The management functions of the mandatory LRIT ship reporting are a very important tool for EMSA and the Member States Flag Administrations. They allow the monitoring of the LRIT ship integration process, the troubleshooting in case of malfunction of the LRIT on-board equipment, and statistical analysis of the ship reporting status.

Archive and distribution of LRIT ship positions

The EU LRIT CDC receives the LRIT position reports of the EU fleet from an external provider (EU LRIT ASP). The information is archived and made available to the Member States and to other international Data Centres connected to the worldwide LRIT network.

The EU LRIT CDC also distributes the LRIT position reports to Member States using a system-to-system interface.

The EU LRIT CDC database is also the source of information for the LRIT Consumption Tool that was recently deployed.

Request of LRIT Positions

The EU LRIT CDC allows to request LRIT ship positions through the Web Interface and the system-to-system interface.

The request types are:

- SAR SURPIC
- Poll
- Periodic
- Most Recent Position Report
- Archive Request

Visualization of LRIT Positions

The EU LRIT CDC displays the LRIT ship position in a dedicated web interface.

2.4 Earth Observation DC (ex-CSN DC)

2.4.1 Functionalities & interfaces

The bidder shall make reference to the information provided within the context of this FWC in particular Appendices B and C.

2.5 SSN European Index Server (EIS)

2.5.1 Functionalities & interfaces

SSN EIS currently one of the applications comprising what is defined in the SSN Interface Control Document (IFCD) as the SSN central system. It supports the exchange of the following "mandatory" information:

1. **Port call information:** Pre-arrival information sent to ports 24 hours in advance and information on ship arrivals and departures (as per Article 4 of Directive 2002/59/EC as amended and Articles 9 and 24 of Directive 2009/16/EC). In addition, 72 hours pre-arrival information if no other national arrangement is in place.
2. **Hazmat information:** Information on the carriage of dangerous and marine polluting goods (as per Articles 4, 13 and 14 of Directive 2002/59/EC as amended).
3. **Incident information:** Information on accidents and incidents which have occurred at sea (as per Articles 16, 17 and 25 of Directive 2002/59/EC as amended) and information on ships

which have not delivered their ship-generated waste and cargo residues (as per Articles 11.2.d and 12.3 of Directive 2000/59/EC).

4. **Position information:** AIS[13], MRS information (as per Articles 5, 6.b, 9 and 23 of Directive 2002/59/EC as amended).
5. **Security information**: Prior to ship's entry into a port of a Member State, security information should be sent in accordance with Article 6 of Regulation (EC) 725/2004 taking into account the provisions on exemptions according to Article 7 and the Annex to Directive 2010/65/EC.][14]
6. **Waste and cargo residues information**: Prior to ship's entry into a port of a Member State, ship-generated waste and cargo residues information should be sent in accordance with Article 6 of Directive 2000/59/EC taking into account the provisions on exemptions according to Article 9][15]

The information collected and exchanged through SSN must comply with the quality and performance standards defined in this IFCD. The administration of user management and locations' codes (LOCODES) are also mandatory system functionalities.

SSN EIS provides a number of additional functionalities which are not mandatory and should they become unavailable, it would not affect the operation of the SSN system.

The additional system functionalities are related but not limited to:

- Statistics;
- Email warnings for giving an indication that there is Incident Report information available in SSN;
- Background information display (e.g. nautical charts);
- System monitoring tools, and;
- Secondary or reference data sources (e.g. SSN users contact details, ship particulars, special lists of ships).

SSN EIS also provides a number of functionalities related to major pilot projects such as the BlueBelt project and the SSN/ VMS synergies pilot.

EIS provides different alternative mechanisms to the national SSN systems in order to enable the mandatory exchange of information. These are:

- **Message-based mechanism:** A mechanism which allows individual messages to be exchanged between the national and central SSN applications. The messages (in XML format) fulfil the needs of both data users and data providers (e.g. proprietary protocol, web-services, etc.). This mechanism supports the notification, request and response functions for all types of SSN information (section 2.5.3 a).
- **Central SSN Web browser-based mechanism:** This mechanism is available for requesting information and providing Incident Reports, and may be used to provide other information as a back-up solution in the case of failure of the national or local SSN systems. It is also available for system administration.

SSN EIS also provides the THETIS system with information received from national SSN systems regarding pre-arrival, arrival or departure of ships calling at EU ports and anchorages, in accordance with Directive 2009/16/EC.

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[13]AIS positions are provided in EIS every 2 hours in XML format . Based on the currently applicable IFCD the message-based mechanism of EIS as well as the streaming mechanism are alternative ways of providing Ship AIS positions.

[14] To be implemented by 1st June 2015

[15] To be implemented by 1st June 2015

2.6 STAR

STAR will be composed of functionalities present in IMDatE and STIRES. The starting point for creating the STAR backend will be the IMDatE implementation and then certain STIRES functionalities will be transferred. The main elements are addressed in the following sections.

2.6.1 Functionalities & interfaces

2.6.1.1 IMDATE FUNCTIONS TO BE TRANSFERRED TO STAR

IMDatE is the technical platform for supporting ship tracking capabilities and processing of other data sets to support the needs of integrated maritime services. It is designed to be extensible to accommodate new requirements without having to request changes by an external contractor.

The core processing supports the processing of terrestrial AIS reports, SAT-AIS, LRIT (flag, coastal and SAR), VMS, and other tracking sources. The functionality to be transferred to STAR is:

- **Database and Data Processing architecture and functionalities**: the processing chain of standard (CDF) messages for position, voyage, ship particulars and incident data.
- **Integrated Position and Track Services and EO correlation**: the fusion service to combine of distinct reporting and detected sources.
- **Satellite AIS processing and storage**:
- **Community specific registry service**: provides the management of Operations and the ability to assign user community specific information to the tracking data.
- **Automated behaviour framework**: the component (called SA-VAS engine) that supports pluggable algorithms to detect events of interest and notify the users through different means (WUP alerts, emails, XML messages).
- **Reporting node** - Provides alerting and reports (email, PDF, XML) in support of the behaviour monitoring events.
- **Distribution engine** - Allows the distribution of maritime information (positions, voyages, incidents, ship particulars,) via system to system interfaces in a variety of formats (CDF, IEC, IVEF) and protocols.
- **Router planner** – the component that calculate the expected voyage/trajectory of a vessel based on origin and destination criteria
- **Central Geographical Database** – as described in the individual chapter on the central databases.
- **Enhanced SAR SURPIC handling** – request and processing mechanisms supporting the Enhanced SAR SURPIC functions.
- **Video and sensor coverage** – component to allow external entities/system to provide data from patrol asset campaigns (UAVs and patrol vessels).
- **3D model engine** - ability to load and process 3D vessel and infrastructure models.
- **Access rights engine** – currently based on the OES and to be decided as reflected in discussion in chapter XX.

2.6.1.2 STIRES FUNCTIONS TO BE TRANSFERRED TO STAR

STIRES is currently the other major application of the SSN central system supporting the near-real time ship tracking capabilities of SSN. It supports the exchange of the terrestrial AIS position information but it is also used currently to capture SAT-AIS data and capture and display LRIT Data.

STIRES provides different alternative mechanisms to the national SSN systems in order to enable the mandatory exchange of information. These are:

- **The SSN Graphical interface (SSN GI):** This uses geographical information system technology to provide access to ship positions enriched with the data in the central SSN system (information on pre-arrival, arrival, Hazmat cargo, incidents, etc.), thus creating a vessel traffic image showing movements in near-real time.

- **A streaming interface** (the SSN SI): A mechanism which enables the constant flow of AIS data (based on predefined criteria) from the national systems to the central SSN system (either directly or via an AIS regional server). This mechanism is currently only available for the provision of AIS information and is an alternative to the message-based mechanism (section 2.5.3 b).

STIRES also provides a number of essential functionalities utilised for major pilot projects like the BlueBelt and VMS pilot. Worth noting in this respect is the functionality related to the detection of ship / entries and exits from EU ports.

The streaming interface is also used in the context of the IMDATE integration for the injection of SAT-AIS data which after processing and enrichment are provided to IMDATE for visualisation.

The SSN GI was recently fully refurbished for better ergonomics, performance & scalability.

2.6.2 Graphic interface implementation approach

Nowadays the existence of several graphical interfaces could be eventually justified from constraints imposed by the current integration approach. Given, however, that the back-end functionality of STIRES and IMDatE will be merged, there is no technical reason to continue developing two interfaces offering more or less similar functionality and configuration capabilities. The goal should be a single front-end platform supporting all the configurations required to cover existing legal and operational requirements.

In this respect a phased- approach has beebn adopted:

A. Phase A (2014/ 2015) Two graphical interfaces shall be maintained in operations - One best configured for “Traffic monitoring” scenarios and another for “Situation awareness and maritime Surveillance” scenarios. The Phase – out the one of the two shall only take place following the completion of the back- end integration and taking into consideration the evolving user needs by the end of 2015

During Phase A:

1. The “refurbished” SSN GI should continue evolving merely to cover the needs for SSN v3 launch
2. The IMDatE WUP should evolve merely to the extent that the currently undertaken obligations are served

B. Phase B (2016 onwards) Implementation and maintenance of a single highly configurable and performing graphical interface

2.6.3 STAR way ahead

The main highlights on the way forward for STAR are the following:

a) Merging of STIRES with IMDATE current capabilities (the back-end shall be integrated within 2015)
b) Fully re-using the software components of the SSN SI (SSN “proxy”) implementation in STAR. Further upgrading of the “outflow” capabilities of the SSN SI software in order to allow an easy configuration of the outgoing steam to include, based on the SLA with the data recipient, the inclusion of position reports having origin to SAT-AIS and/ or LRIT and/ or VMS.
c) Optimise the data processing and management components of IMDatE for improved scalability and performance
d) Implement the receipt and processing of the pushed voyage data from SSN EIS.
e) Implement periodic synchronisation mechanism with the Central Ship Database.

f) Continue and finalise, under the existing IMDatE contract, the work related with the Central Geographical Database (CGD).
g) Refactoring and re-using the STIRES reports and statistics module and SSN DW geospatial reports.
h) (Should a decision is taken to base the CMC on a COTS product) Implement the CMC in STAR module.