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DELIVERABLE SUMMARY SHEET

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Short Description
The objective of this document is to formulate recommendations for the promotion of efficiency in maritime transport by using telematics and the implementation of MSML (XML application). Recommendations for the use of MSML (XML application) for exchanging safety related messages have been made for the attention of EMSA, EC, IACS, and other maritime stakeholders.

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EXECUTIVE SUMMARY

Many services offered today in the waterborne transport sector are impossible without automated processing based on electronic exchange of data, e.g. world-wide monitoring of cargo or container movements ("tracking and tracing"). Legal institutions require electronic exchange of data, e.g. customs manifests or dangerous goods information. However, the degree of integration between administrative authorities is often very low and this necessitates the multiple sending of the same data.

In the future many stakeholders will be integrated into the waterborne supply chain by electronic means. The most important among these include Governmental bodies responsible for monitoring and control of the waterborne traffic and the inspection of ships under Port State Control, and accidents and emergencies.

New mechanisms for encryption, authentication and authorisation allow the secure transmission of legal documents. Formats to handle different media, such as XML, can be used to transmit both legal documents as well as electronic data for automated processing within one message. There is also a tendency to increase automation in the logistics chain. For example the messages transmitted between trading partners do not act just as information bearers but as triggers to automatically initiate business processes within the IT systems of the corresponding partner.

The suitability of XML and MSML (XML application) as an intermediate format makes it the primary solution for combined B2B and EAI (Enterprise Application Integration) projects, i.e. linking external and internal integration. This is also the reason why XML is the first choice for many integration platforms such as BizTalk (Microsoft).

MANATEE has addressed a number of issues including reporting, information transfer, transfer protocols, crisis and safety management, repair and maintenance, and interfaces with existing systems, all based on MSML (XML application). MANATEE has also acknowledged the Community vessel traffic monitoring and information system and the SafeSeaNet network, as well as national and local reporting systems.

Any future implementation of an e-work platform using MSML (XML application) will need a suitable network to enable the messages to be exchanged by the Internet. A review has therefore been made of existing networks. These networks have included the former and upgraded HISBEL systems, the Central broker System (CBS) regional network, the SafeSeaNet system, the proposed MANATEE system, and the HF Telex system.

The MANATEE project has demonstrated that information can be exchanged electronically, efficiently and reliably as MSML (XML application) instances. The particular applications considered were for scenarios related to repair and maintenance, including aspects of relevance to Port State Control inspections.

Recommendations:

A number of recommendations have been made for the use of MSML (XML) for exchanging safety related messages and these are indicated below. These recommendations have been made for the attention of EMSA, EC, IACS, and other maritime stakeholders:

1 MSML (XML application)

a) The use of MSML (XML application) for data exchange relating to Port State Control inspections and surveys is recommended. PSC Authorities, Port Authorities and Classification Societies are important stakeholders in this process as they would be exchanging data relating to surveys and certificates.

b) As the integration of various sub-system databases of VTS/VTMIS are already partially implemented using XML, both for internal and external communications, the use of

MSML (XML application) is recommended for data relating to maritime safety and environmental protection

c) The provision of information from VTS/VTMIS for emergency situations to assist an intervention request from a vessel is recommended, using MSML (XML application) messages. This would provide details about current or past emergencies, information concerning availability of support vessels and equipment, radio communications and apparatuses.

d) Registrations of onboard inspections and certificates are currently updated manually. It is recommended that in the future, the Classification Societies should take advantage of automatic maintenance procedures for updating inspection and certificates, using MSML (XML application).

e) In view of the importance of the MSML schema for exchanging safety related messages and other types of messages, it is recommended that the European Commission should require all future IST research projects in the maritime sector related to electronic exchange of messages, to adopt the use of MSML (XML application).

f) Current XML applications may be used in parallel with MSML (XML application) to structure other types of information that is only partially related to maritime safety or related to more commercial applications. Further integration and use of MSML (XML application) with related technology is therefore recommended and alliances formed, particularly with SafeSeaNet network.

2 SafeSeaNet

a) The MANATEE Network for exchanging messages using MSML (XML application) anticipates a future integration with the SafeSeaNet (SSN) system and this would provide an e-work platform for more maritime stakeholders. The idea of integrating SafeSeaNet with other regional and European networks should therefore be recommended to EMSA and Maritime Administrations.

3 ISO TC8/SC10 & SafeSeaNet

a) The MSML Schema and application description has been prepared as a proposed standard to ISO. A new work group is now being set up under the auspices of ISO TC8/SC10 to develop a new Electronic Port Clearance" XML message standard, based on MSML and/or other formats already in use. As this topic is considered to be of importance, it is recommended that SafeSeaNet or EMSA and other suitable organisation should participate in this work group.

b) As MANTEE ‘s MSML (XML application) schema for exchanging safety related messages is similar to SafeSeaNet’s XML messages, it is recommended that EMSA is made aware of it, with the view of adopting it, or incorporating it, for use within SafeSeaNet.

4 HF Telex

a) With declining use of Narrow band Direct-printing (NBDP), IMO is seeking alternatives to NBDP, currently used within the Global Maritime Distress and Safety System (GMDSS). The use of MSML (XML application) is proposed as a possible replacement for HF radio telex (NBDP). Furthermore, presentations should be made to EMSA and Administrations to this effect and to the next COMSAR meeting, due to take place at IMO in February 2005.

1. INTRODUCTION

Information technology is now an essential element of many safety systems, but its full potential has yet to be realised. Initially it was regarded as a useful supplement but it has now become an integral part of such systems. This has the advantage of improved and extended functionality for different components of the safety system. For example: control and communications systems integration (such as VTMIS), processing of data, and retrieval and transfer of safety-critical information, such as port notification and port clearance procedures, and hazardous cargo-related information, and integration with business to business systems.

The design of common safety system is subject to a number of requirements. For a European-wide implementation, it is necessary to have a system that is standardised, reliable and to a large extent - platform-independent. It must also provide reasonable compatibility with existing systems. Security is also a critical factor. The core technology in such a system must therefore be sufficiently versatile to allow for different applications and allow for a high degree of integration, whilst being user-friendly and easy to develop.

In order to provide a basis for a standard system of this kind the MSML (Maritime Safety Markup Language), a derivative of XML, has been developed within MANATEE. This provides the basis of an e-platform for the further development of integrated web services, by means of other XML-based components, such as XML Protocols.

A number number of issues have been addressed, including reporting, information transfer, transfer protocols, crisis and safety management, repair and maintenance, and interfaces with existing systems, all based on MSML (XML application). EMSA's Community vessel traffic monitoring and information system and the SafeSeaNet network have been acknowledged, as well as national and local reporting systems.

MANATEE has provided the basis for an e-work platform for the exchange of information between the ship and the maritime stakeholders, such as the Port Authorities and the Maritime Administrations. This platform provides a simplified access to ship borne and shore based information and databases by users aboard and ashore for decision support. This exchange of information includes onboard onshore administrative systems, documents, and requests for assistance etc. for improving the connectivity between the on board and the on-shore information systems and stakeholders.

Many of the services offered today in the waterborne transport sector are impossible without automated processing based on electronic exchange of data However, the degree of integration between administrative authorities is often very low and this necessitates the multiple sending of the same data. With the introduction of XML based messages such as MSML (XML application), and the increasing use of satellite communications on ships, it will soon be possible for all maritime stakeholders to be integrated into the waterborne supply chain by electronic means.

As any future implementation of an e-work platform using MSML (XML application) will need a suitable network to enable the messages to be exchanged by the Internet, a review has been made of existing networks. The networks considered have included the former and upgraded HISBEL systems, the Central broker System (CBS) regional network, the SafeSeaNet system, the proposed MANATEE system and the HF Telex system.

The EC Directive 2002/59/ for establishing a Community vessel traffic monitoring and information system has also been reviewed to examine the information that has now to be exchanges, particularly as this Directive puts more emphasis on electronic delivery of the information. Furthermore, as this Directive relies on SafeSeaNet for its implementation this system is also considered together with the information items available within the SafeSeaNet system.

Finally recommendations are made to EMSA, Member States and other maritime stakeholders. These recommendations include the identification of specific areas where further development would be valuable, improvements for the end-users, and ways of ensuring the adoption of electronic information exchange for all major stakeholders in the maritime sector. The recommendations also cover aspects of interoperability, interconnectivity and standardisation of current and future maritime information technologies.

2. BACKGROUND

Many services offered today in the waterborne transport sector are impossible without automated processing based on electronic exchange of data [1], e.g. world-wide monitoring of cargo or container movements ("tracking and tracing"). Legal institutions require electronic exchange of data, e.g. customs manifests or dangerous goods information. However, the degree of integration between administrative authorities is often very low and this necessitates the multiple sending of the same data.

In the future many stakeholders will be integrated into the waterborne supply chain by electronic means. The most important among these include Governmental bodies responsible for monitoring and control of the waterborne traffic and the inspection of ships under Port State Control, and accidents and emergencies. The recent Directive 2002/59/EC [2] for establishing a Community vessel traffic monitoring and information system has now provided the basic framework for an integrated communication network for the shipping sector.

Electronic Data Interchange (EDI) is the technology that has traditionally been used in the shipping sector to interchange information with each other. There are two principal types of EDI, X12 and EDIFACT. The X12 is the American standard and EDIFACT is the international standard endorsed by the United Nations. Both types have several versions releases of their message formats, and compatibility between versions is not always straight forward. XML e-commerce is currently even more diversified, with proposed standards that use XML only and others that use XML-EDI hybrids. These include cXML and *Biz Talk*.

New mechanisms for encryption, authentication and authorisation allow the secure transmission of legal documents. Formats to handle different media, such as XML, can be used to transmit both legal documents as well as electronic data for automated processing within one message. There is also a tendency to increase automation in the logistics chain. For example the messages transmitted between trading partners do not act just as information bearers but as triggers to automatically initiate business processes within the IT systems of the corresponding partner.

The integration in the waterborne transport sector has been carried out mainly via Electronic Data Interchange (EDI). However, EDI in addition to its complexity and high investment cost to implement EDI solutions, it is batch oriented and designed for asynchronous data exchange. It is therefore not suitable for application integration or transactional systems. The complexity of EDI is mainly caused by its data oriented nature and its difficulty to realise real-time integration. EDI deals with integration on data level and is more or less a direct communication between the databases, where normally four conversions ("mappings") are necessary.

The use of XML on the other hand has high potential for an intermediate format to link external and internal integration, or to form a unified internal document format for Enterprise Application Integration (EAI) solutions. It is also an inexpensive alternative to EDIFACT solutions. However, the lack of standardisation is often given as an argument against implementation of XML solutions for external integration. Standardisation of XML is currently only established regarding the description language itself, [3]. The relatively high data overhead of XML compared to EDI is another factor. This large overhead may lead to problems when mass data has to be transmitted, e.g. cargo movements, but XML is capable of transporting both metadata and information content

Nevertheless, XML can be easily parsed and transformed into arbitrary formats. It is an excellent intermediate format to exchange content between different proprietary data types. XML is also ideally suited for event driven and real-time oriented systems and the provision of functionalities with Web services.

The suitability of XML and MSML (XML application) as an intermediate format makes it the primary solution for combined B2B and EAI (Enterprise Application Integration) projects, i.e.

linking external and internal integration. This is also the reason why XML is the first choice for many integration platforms such as BizTalk (Microsoft).

EDI users can extend its capabilities by installing XML-EDI translators on their Web servers. XML-EDI translators are already available, many relying on proprietary technology and unique scripting languages. Other, including XML Solutions' XEDI *Translator* use XSL to specify the transformation. Although XSL is most commonly used to transform XML into HTML for presentations, it is perfectly well suited to transform XML into any representation, including EDI; it is also an open standard.

XSL on the other hand cannot be used directly for the inverse conversion, as it can only transform from XML. The solution is an intermediate translation from the foreign notation to the markup language. This translation only changes the representation of the document, not the meaning. The XSL can then be applied to perform more powerful transforms. An EDI parser would be the intermediate translator; this would make a message out of the EDI by replacing EDI codes with their full names and making XML elements out of the EDI segments and elements.

Once the message is a well formed XML document, XSL can transform it into various XML-EDI message standards, such as cXML or Biz Talk. Because there are many kinds of XML and many kinds of EDI, an EDI–XML translator is not a one-to-one system, but rather a many-to-many system. Such a translator can therefore also serve as an XML to XML translator and an EDI to EDI translator.

The EC Directive 2002/59/EC [2] for establishing a Community vessel traffic monitoring and information system encourages the use of XML for electronic messages and this will eventually replace the use of EDI. In the meantime Member States have to provide for the conversion of data between systems using XML or EDIFACT syntax, based on Internet or X.400 communication facilities.

XML is likely to be the basis for most structured information interchange in the future. However, a combination of XML and EDI solutions can also be expected to be used by the maritime stakeholders for some time to come.

3. NETWORKS FOR INFORMATION EXCHANGE

3.1. HISBEL System

The HISBEL system, ("Hazmat Implementation System Belgium") [4], was established in 1998 for a "regional" implementation of the Hazmat Directive (93/75) [5]. It was based on the 1995 Hazmat Memorandum of Understanding (MoU) for exchanging information electronically in the most efficient way. The countries involved were Norway, Belgium, Germany, The Netherlands and Spain. The HISBEL system is illustrated in Figure 1; this system has now been upgraded in relation to SafeSeaNet.

HISBEL was based on the exchange between countries on a National Competent Authority (NCA) to National Competent Authority (NCA) level. The NCAs then connected with their own Local Competent Authorities (LCA's). These connections were based on a X.400 network, and used EDIFACT messages.

The former HISBEL system implemented the Hazmat NCA node, and connected with the other NCA's and then with the LCA's (for example, the Flemish ports of Zeebrugge, Oostende, Antwerp and Ghent). A fax procedure was used as a back-up for the EDIFACT lines. HISBEL system is a stand-alone system and not connected to the VTS or to any other system. All communication is only by EDIFACT and by fax but fax images could be scanned and saved as a document on the system.

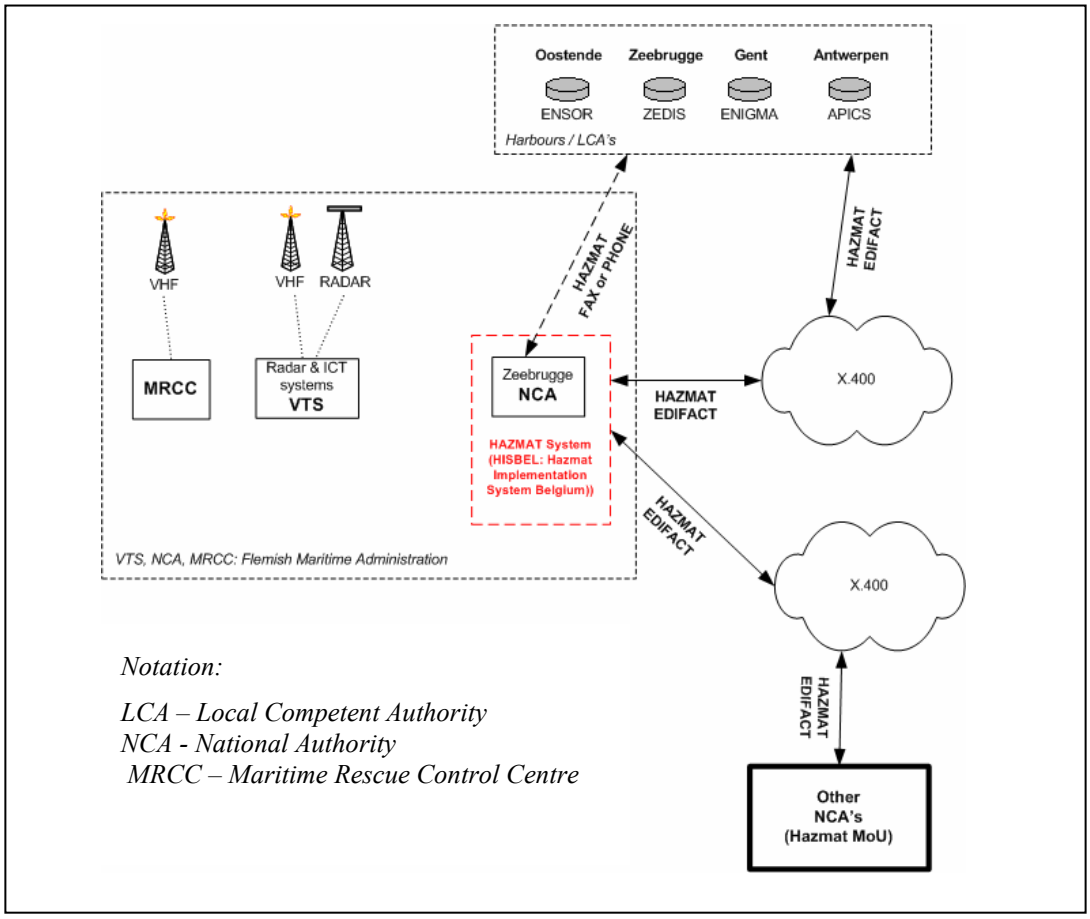

Figure 1: Former HISBEL System

3.2. Upgraded HISBEL & SafeSeaNet

The implementation of the EC Directive 2002/59/ [2], for establishing a Community vessel traffic monitoring and information system, replaces the Hazmat (Hazardous Materials) Directive 93/75 [5]. Although Hazmat messages have still to be exchanged more messages are also require to be exchanges in a more flexible way (shorter response time etc.); and will be XML-based. Furthermore, this information will ultimately be entered into the European telematic network of SafeSeaNet and thus replace the former HISBEL system – see Figure 2.

Due to the investments made by the LCA's in Belgium to implement their EDIFACT Hazmat exchange with the NCA, and their use of EDIFACT messages with their local agents and logistic partners in the port community, the use of EDIFACT system will be phase out over a period of time.

In view of this situation the HISBEL system has been upgraded for the NCA to:

- retain EDIFACT Hazmat message exchange with the LCA's, for the time being;
- anticipate a translation of the "hazmat" messages into the SafeSeaNet XML messages that have to be sent to the EC index server;
- add the Ship report messages; a dedicated link was added between the VTS database and the upgraded HISBEL system in the NCA, in order to send Ship notification messages to SafeSeaNet whenever necessary.

The required hazmat notification messages and the Ship message exchange are being sent to the EC index server.

The VTS systems are now passing information to the SafeSeaNet through the upgraded HISBEL system. This in addition to the existing information processes for Hazmat information. This process is now being automated: whereas with the former HISBEL system and the MoU, the retrieval of Hazmat information was only after an active request from on operator at one of the NCA's, this is now being automated.

For example, when a ship enters the VTS area, it is automatically investigated as to whether Hazmat information is available. This is done by contacting the LCA ('s) using the existing EDIFACT procedure and messages that are in place between the NCA and the LCA. The international EDIFACT network based on X.400 has now been eliminated.

EMSA has taken over responsibility for the SafeSeaNet system from the EC DG TREN, as from 20 October 2004.

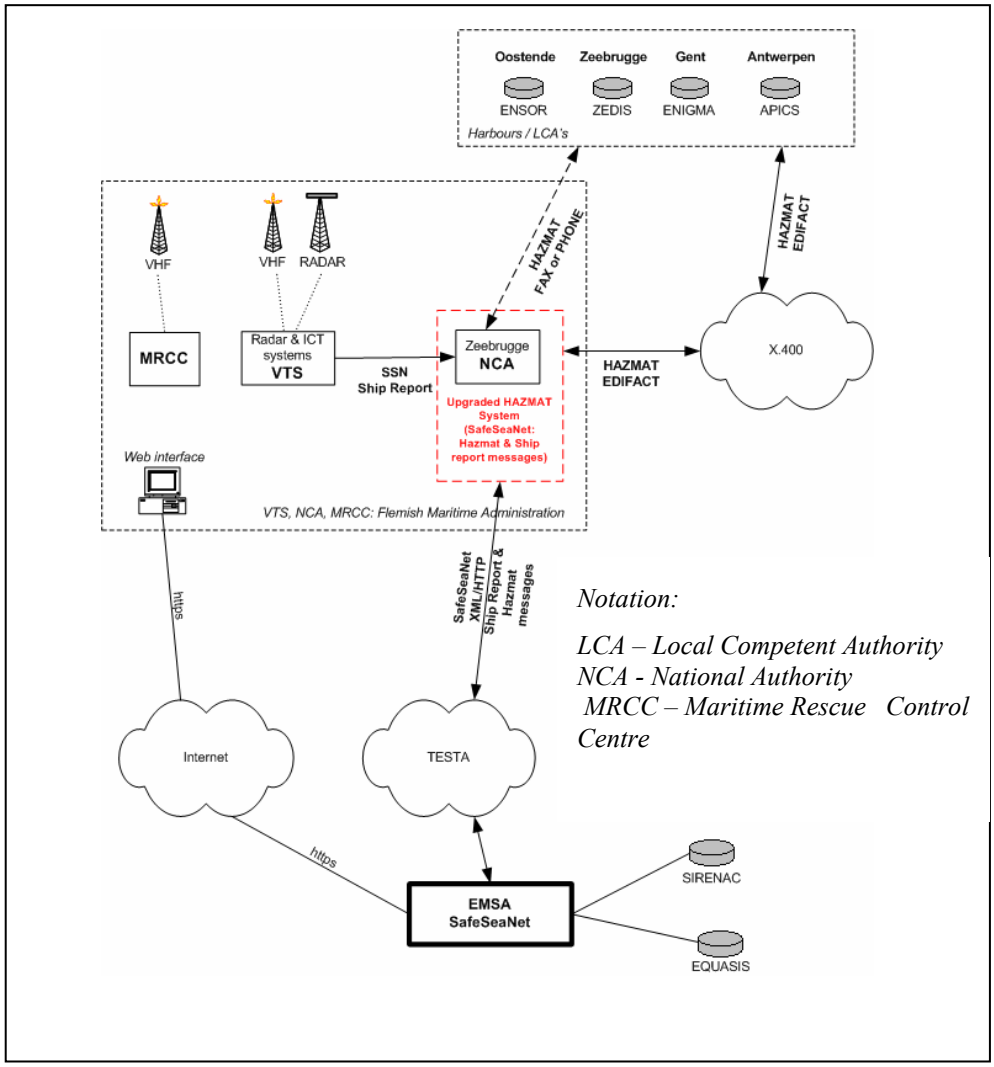

Figure 2: Upgraded HISBEL & SafeSeaNet system

3.3. Central Broker System & SafeSeaNet

In the region of the Scheldt estuary and the Flemish coastline there are additional information services besides the Flemish sea ports and the VTS authorities. These include the piloting information systems, the River Information Services (RIS centres for inland waterways both on Flemish side and on Dutch side), and the Dutch sea ports of Flushing (Vlissingen) and Terneuzen.

An initiative has recently been launched to establish a regional XML-based message exchange network: the "Central Broker System (CBS)" [4]. This initiative is from the joint Flemish-Dutch organised VTS services, originating from the establishment of a joint Flemish/Dutch Scheldt Radar Network, and based on a "Radar Treaty" signed between Belgium and The Netherlands.

This regional network will in the future be able to replace the existing point-to-point dedicated links and message exchange protocols between maritime partners in this region. It will also facilitate a detailed exchange of information between different IT systems of different authorities and stakeholders, each with their own IT system and databases, and their own vision and business processes.

This CBS network is able to exchange XML-messages between all the stakeholders involved. The network will be able to exchanges a lot more detailed messages than SafeSeaNet. For example: additional piloting information, sluice/lock planning information, hydro/metrological information, pilot on board status, reference messages to agents etc.

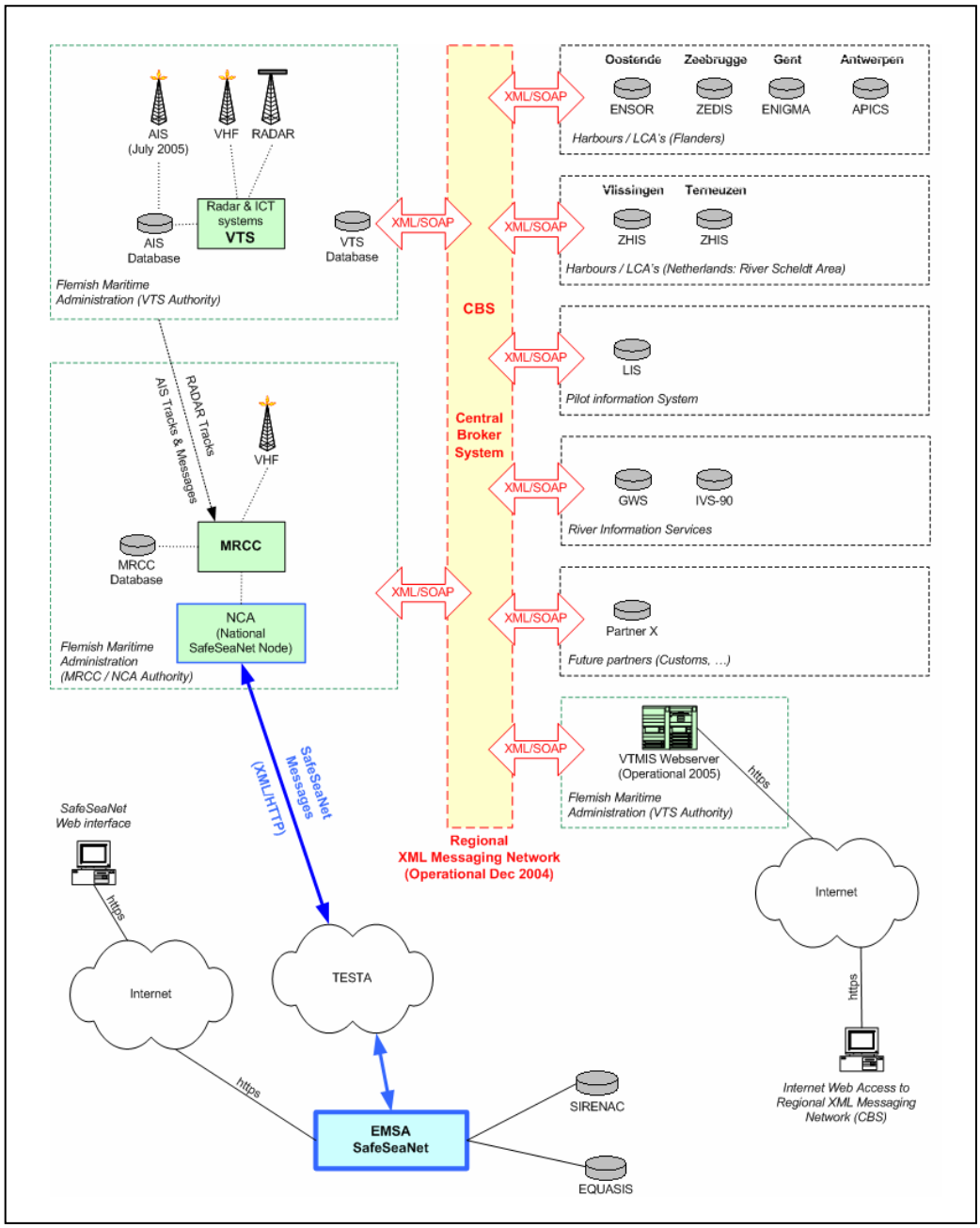

Figure 3: Central Broker System & SafeSeaNet

The CBS network illustrated in Figure 3, serves as a regional XML exchange network. Furthermore, the NCA is now also being connected to all the information needed from the network. An adapter between the NCA and the CBS network enables the NCA to send/request messages to and from all partners in the regional network. The NCA then makes the connecting

node between this regional CBS network (with specific regional XML messages) and the SafeSeaNet network (with the defined SafeSeaNet XML messages).

3.4. Community Vessel Traffic Monitoring and Information System

The Directive 2002/59/EC of the European Parliament and of the Council of 27 June 2002 [2] for establishing a Community vessel traffic monitoring and information system, replaces Directive 93/75/EEC, the Hazmat (Hazardous Materials) Directive, adopted in 1993 [5]. The Directive is similar to the Hazmat requirements, but puts more emphasis on electronic delivery of the information

This Directive has been set in place in order that a Community vessel traffic monitoring and information system can be established. This will help ensure that ships in EU waters, and their cargoes, are monitored more effectively than in the past, and that there is a more consistent approach across all EU sea areas. A number of measures on management and monitoring of marine traffic have been adopted by the Member States and amplified by Directive 2002/59/EC, which creates a framework for putting into place all the instruments currently available for vessel traffic management along the European Union's coasts.

Directive 2002/59/EC is part of the action taken in line with the Commission's second communication on maritime safety following the Erika disaster, Figure 4, (the Erika II package). In particular, severe sea and coastal pollution associated with the loss of the tankers "Erika" in the Bay of Biscay and "Prestige" off the coast of Spain, emphasised the need for action. Setting up a Community vessel traffic monitoring and information system should help to prevent accidents and pollution at sea and to minimise their impact on the marine and coastal environment, and on the economy and health of local communities.

Figure 4: The Erika disaster

The Directive stipulates that ships built on or after 1 July 2002 and calling at a port of a Member State must be fitted with an automatic identification system (AIS), as well as a voyage data recorder (VDR) system ("black box") to facilitate investigations following accidents. Notification of dangerous or polluting goods on board ships is also required.

The operator, agent or master of a ship must also notify certain information (ship identification, total number of persons on board, port of destination, the estimated time of arrival) to the port authority at least twenty-four hours in advance, where this is feasible. The complete list of information to be notified is given in Table 1. This information will ultimately be entered into the European telematic network of SafeSeaNet.

General information: (Article 4) ▪ ship identification (name, call sign, IMO identification number or MMSI number), ▪ port of destination; ▪ estimated time of arrival at the port of destination or pilot station ▪ total number of persons on board.
Cargo information: (Article 12) ▪ correct technical names of the dangerous or polluting goods ▪ address from which detailed information on the cargo may be obtained.
General information: (Article 13) ▪ ship identification (name, call sign, IMO identification number or MMSI number); ▪ port of destination; ▪ 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; ▪ total number of persons on board.
Cargo information (Article 13) ▪ the correct technical names of the dangerous or polluting goods ▪ confirmation that a list or manifest or appropriate loading plan giving details of the dangerous or polluting goods carried and of their location on the ship is on board; ▪ address from which detailed information on the cargo may be obtained
Information (Article 5): ▪ ship identification (name, call sign, IMO identification number or MMSI number) ▪ date and time, ▪ position in latitude and longitude or true bearing and distance in nautical miles from a clearly identified landmark ▪ course ▪ speed ▪ port destination and estimated time of arrival ▪ cargo and, if dangerous goods present on board, quantity and IMO class ▪ address for the communication of cargo information ▪ total number of persons on board ▪ various information: o characteristics and estimated quantity of bunker fuel, for ships carrying more than 5000 tons of bunker fuel, o navigational status.
The master of the ship must forthwith inform the competent authority or port authority concerned of any change to the information notified pursuant to this Annex

Table 1: List of Information to be notified for the Community Vessel Traffic Monitoring and Information System

Member States have to 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.

An "Interface Control Document" is being developed 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 will be detailed, as well as data interchange protocols and parameters. The Interface Control Document will also specify the data content of the required message functions and describe those messages.

These procedures and infrastructure should incorporate, whenever practicable, reporting and information exchange obligations resulting from other Directives, such as Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues [6].

The shipper is required to deliver a declaration containing certain information (correct technical names of the dangerous or polluting goods, address from which detailed information on the cargo may be obtained) to the master or operator prior to taking the goods on board.

Member States must take all appropriate measures consistent with international law to deal with incidents or accidents at sea and to require the parties concerned (the operator, the master of the ship and the owner of the dangerous or polluting goods carried on board) to cooperate fully with them with a view to minimising the consequences of the incident.

In addition, the master of a ship must immediately report:

- any incident or accident affecting the safety of the ship,
- any incident or accident which compromises shipping safety,
- any situation liable to lead to pollution of the waters or shore of a Member State,
- any slick of polluting materials and containers or packages seen drifting at sea.

Furthermore, cooperation must be arranged between the European Commission and the Member States with a view to the future development of the European monitoring, control and information system for maritime traffic. It will cover the development of telematic links between coastal stations and port authorities, and extension of the coverage of the European monitoring system. Efforts must also be made to improve the management of shipping information, which is one of the tasks of the European Maritime Safety Agency.

Member States will have to cooperate to ensure the interconnection and interoperability of their national information systems, in order that the requisite information on the ship or its cargo can be exchanged electronically at any time.

3.5. SafeSeaNet System

SafeSeaNet [7] is a European system to store and retrieve safety related information about vessels in European waters. The system is based on the earlier EC-HAZMAT system designed for authorities to exchange information on hazardous materials on board vessels. The earlier system was based on EDIFACT messages. The main objective the SafeSeaNet (SSN) project was to provide a tool for the implementation of Directive 2002/59/EC [2] establishing a Community vessel traffic monitoring and information system. Subsequently, SafeSeaNet was developed as an interchange data system, based on the traffic monitoring framework, which:

- organises the community of users,
- standardises the data,
- enables the exchange/share of data by locating, displaying, retrieving and transmitting the information,
- creates a secure network.

SafeSeaNet considers four types of stakeholders:

- Coastal Stations
- Port Authorities
- Local Competent Authorities
- National Competent Authorities

Since 1993, and particularly after the accident of the cargo ERIKA off the French coast in 1999, the European Union has adopted several Directives and Regulations for improving the prevention of accidents at sea and the fight against marine pollution. These Directives and Regulations are: Directive 2002/59/EC [2] for establishing a Community vessel traffic monitoring and information system, Directive 2000/59/EC [6] on Port Reception Facilities, Directive 1999/35/EC [8] on Mandatory surveys for Ro-Ro ferries and high speed passenger craft, Directive 95/21/EC [9] on Port State Control and the amending Directive 2002/84/EC [10], and Regulation 1406/2002 [11] establishing a European Maritime Safety Agency.

The implementation of these Directives requires the collection and distribution of various kinds of data: vessel traffic monitoring, dangerous cargo details, results of ship inspections, information related to ship waste and cargo residues. At the moment, their exchange is hampered by a lack of standardisation and a profusion of transfer mechanisms - from phone or fax to electronic messages (often via EDIFACT), which considerably limits an efficient implementation of the EC maritime safety legislation.

SafeSeaNet is a network based on standard Internet protocols and XML [8]. In each European country a NCA (National Competent Authority) is appointed. Each NCA is connected to SafeSeaNet. The NCA sends a set of notification messages, which are stored in a central index. When required, any NCA can request for information, and SafeSeaNet responds information on the vessel by means of the central index.

SafeSeaNet's technical architecture and characteristics of the system are described in Annex 1.

VOYAGE : **(Information emitted by ships)**	**ALERT MESSAGES:** **(Information emitted by shore authorities)**
Port Reporting (Entry of a vessel into the SafeSeaNet system) **Ship Reporting** (Provides refreshing of ETAs Enables to create history of ship's voyage) **AIS** (idem+ Provides up-dated information of ship's position and movements in accordance with IMO Resolution A.917(22)) **Hazmat** (Enables transmission of cargo details, directly through local/national database or manifest attached) **Security** (Informs relevant authorities of the security status of a ship).	**SITREP** (Search & Rescue report) **POLREP** (Pollution report) **WASTE** (PRF alert messages) **CONTAINERS LOST/FOUND** OTHERS (to be developed) : **DEFREP** (Deficiencies report) **INFRINGEMENT TRAFFIC RULES** (VTS/Traffic Separation Scheme reports), etc

Table 2: Information items available in the SafeSeaNet system

The system used is a network/Internet solution based on the concept of a distributed database. Once fed into the SafeSeaNet system, data does not have to be transferred, copied or duplicated.

The SafeSeaNet system actually keeps track of the data location, through a so-called Central Index which stores pointers (references) to the actual data location. Access is provided to the authorized persons via well-defined messages. Whenever access to the data is needed by one of the participants, this data can be requested through a well-defined message, and the SafeSeaNet system will locate it. The system will then retrieve the data from wherever it is stored and present it to the requester, again in a well-defined message.

The core of the SafeSeaNet architecture consists of the SafeSeaNet XML Messaging System acting as a secure and reliable "yellow pages" index system and as a "hub and spoke" system

for sending requests to and receive notifications and responses from participants identified as data requesters and data providers.

The SafeSeaNet System presented in Figure 5 relies on a distributed architecture made of three levels.

These three levels are:

- Local Competent Authorities (LCA) that can range from Port Authorities, Coastal Stations to Harbour Organisation;
- National Competent Authorities (NCA) that acts as a point of contact at national level;
- The central index, which is currently located at the Informatics Directorate (DI) in Luxembourg.

Each NCA is connected to the Central Index through an Internet or TESTA connection. There can be more than one NCA per country and some member states will have a few LCAs directly connected to the central index. These will be handled as isolated NCAs with no LCA connected to them.

All factual information is stored locally. Whenever the information changes (information added, updated, removed) a notification is sent to the European Index. Thanks to these notifications, the European Index knows the location of the information.

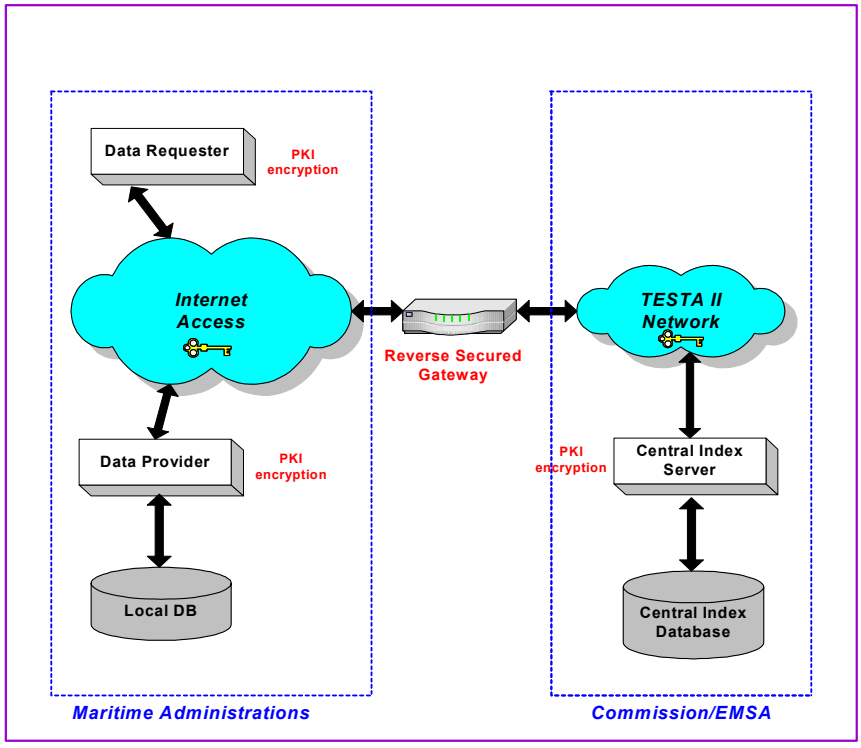

Figure 5: General Architecture of SafeSeaNet

3.6. MANATEE Network

The proposed MANATEE Network for exchanging messages anticipates a future integration with the SafeSeaNet (SSN) system as the SSN stakeholders may not want to implement a new system. The MANATEE system will integrate with the SSN without major changes will therefore be more acceptable by the SSN stakeholders.

The MANATEE network system will use Web Servers communicating via messages over the Internet. In this system a node has to react to an incoming message with a proper response message and a central node offers a single point of contact to the system. This is used for user authorisation and data lookup. It would also be possible to use the central node for storing all MSML instances transmitted, or to cache information for short response times.

Shipping companies for example, will be able to select the best suitable communication link between their head office and their vessels. However, a public IP address has to be used on the web server, providing information when other nodes request information from their system. Since vessels may use a dial-up Internet connection, support for message delivery by e-mail is essential. An overview of the proposed MANATEE Network system is shown in Figure 6. This illustrates how a vessel can be connected to the Internet via a WAN link of its own choice. This connection may also be a VPN link between the vessel and the shipping company for secured communication between the two stakeholders.

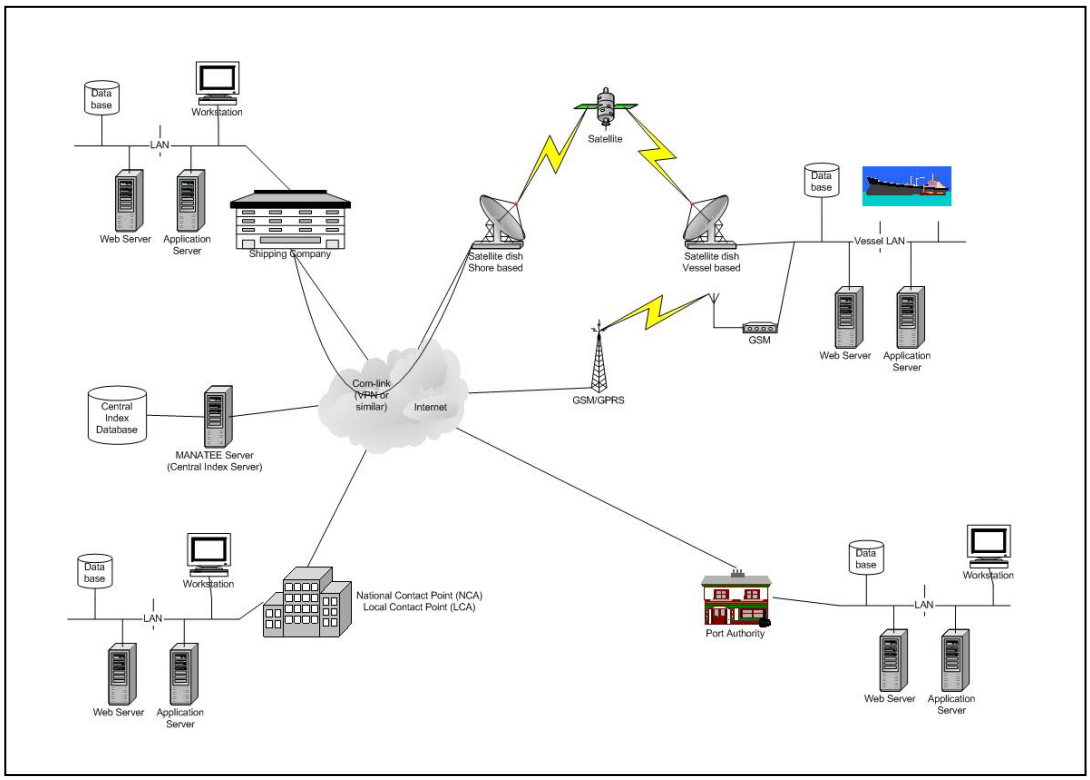

Figure 6: MANATEE Network Architecture Overview

3.7. HF Telex System

The IMO Sub-Committee on Radiocommunication and Search and rescue (COMSAR) has recently considered two proposals for new technologies for transmission and reception of data and e-mail [13]. Due to the increased demand for data exchange at High Frequency (currently there is on average 10,000 ships around the world using such systems, and growth is increasing) and the declining use of Narrow band Direct-printing (NBDP), IMO is seeking alternatives to NBDP, currently used within the Global Maritime Distress and Safety System (GMDSS).

The first of the two proposals is the Globe e-mail HF Communication system (www.globewireless.com). This uses a network of 23 sites in different countries around the world. Communications are fully automated. No operator skills are required and shore based methodology is followed.

The second proposal is the Norwegian HF system. This system is capable of data communications, including e-mail. Distress communications may also be considered. It would also supplement and partly replace satellite systems and is seen as a future replacement for HF radio telex (NBDP) in the GMDSS. The HF-mail would send e-mail using the "wavemail" software via HF radio.

MSML on the other hand is also seen as a potential replacement for HF radio telex (NBDP) within GMDSS. This is in view of MSML's versatility in its ability to be extended and to tag documents and other relevant information. Once distress signals have been sent by GMDSS, additional important information could then be sent via the internet using standardised MSML messages.

In order to pursue this idea proposing the use of MSML as a possible replacement for HF radio telex (NBDP) a presentation should be made by MANATEE at the next COMSAR meeting that is due to take place at IMO in February 2005.

4. MSML (XML APPLICATION) ASSESSMENT & USE

4.1. MSML's Potential & Limitations

The strengths of MSML are now more obvious. This is because during its development XML, the Extensible Markup Language, has become the preferred tool for information structuring and information exchange by several players, including leading companies such as Microsoft and IBM. It is therefore a relatively safe investment to have critical information marked up with MSML. This is because as more and more systems are being adapted to handle it, it is likely to be standardised as an XML application for maritime safety. Furthermore, XML is already widely accepted internationally, including the EU SafeSeaNet system.

Additional factors contributing to MSML's potential are its relatively user-friendliness (XML documents are in plain text format), its extensibility (making it easy to include new areas or combine existing schemas), that XML is an open standard and does not involve licence costs etc., that it has support for version control and security, and that it clearly separates contents and presentation layout (as opposite to HTML).

There are of course also limitations, many of which can however be reduced by disseminating the knowledge to the appropriate users. It should be noted that the target users are system developers and information administrators, not primarily ship-owners or crew. A wide-spread acceptance of MSML requires standardisation, which is under development, and its use in safety-related applications, now facilitated by the current trend of using XML as the preferred Markup tool.

The limitations of the language itself are the tendency to add voluminous overhead information to the payload which requires large band-width for transmission of the information. For the intended applications this is not a severe problem as safety-related messages are usually relatively short. The MSML Schema must however be handled in an appropriate way, and this has been addressed in Deliverable 4.1 - System Requirements.

Other possible limitations of MSML (XML application) are that the Schema cannot handle every conceivable piece of information with designated XML tags, that information will always or for considerable time will be formatted in different ways and have to be included as attachments rather than sent and stored with standardised MSML Markup, and that systems must be adapted for handling MSML or XML instances. The latter problem becomes less important as the acceptance of XML increases.

4.2. MSML Integration and Connectivity

MSML (XML application) can be used to structure all relevant information that is safety-critical in the maritime sector. This will provide a very efficient information processing and transfer, which is both secure and streamlined. However, it will require extensive efforts to integrate various functions and proprietary solutions into the MSML (XML application) system. The components in such an integrated system include: onboard diagnostic and automation tools, such as sensors, bus systems, evaluation and monitoring devices and software, VTS/VTMIS, VDR and AIS equipment etc., and administrative software etc.

The process of integration is supported by the use of XML, of which MSML is an application, since it has become the preferred tool for structuring information by several important system developers, including Microsoft, IBM and Sun Microsystems. Bus systems like PROFIBUS and CAN, used in many maritime networks, already use XML for diagnostics and communication. For PROFIBUS/PROFInet environments a framework for the standardisation of XML usage has been developed, called XML@PROFIBUS. This XML application is intended to work smoothly in combination with other applications like MSML.

Further integration with related technology should be encouraged, in particular in conjunction with the SafeSeaNet network and different navigational, diagnostic, maintenance and other auxiliary tools, which are now becoming more and more XML-based or at least XML compatible.

The use of MSML is being considered for the next generation of the AMOS system by Xantic, in the field of repair and maintenance. The AMOS Replication Module can perform extraction of information from the AMOS vessel database. This information will be presented to the MANATEE system in the form of an XML-file, which can be used for further processing by the MANATEE system.

5. FUTURE VISION AND MSML DEVELOPMENT

5.1. Future Vision

The ultimate realisation of a marine safety and vessel information system, would be would be to provide a common information technology system for all the maritime stakeholders. Such a system would provide both safety information and access to business to business processes. It would also include links to ports, Classification Societies and ship repair yards etc., and other transport modes. This can be achieved on a common e-work platform as an exchange mechanism, emphasising the progress made during the last few years.

MANATEE has developed and applied a uniform European data language MSML in one key maritime application in the field of repair and maintenance and safety management. This case study has demonstrated the usefulness of exchanging MSML (XML application) messages and its potential for use within a maritime e-work platform. The MANATEE system can be considered as a tool for decision support as information from several systems is accessible at one location.

The long-term objective for an integrated ship based e-work platform would be to eliminate the manual processes. This would allow different stakeholders to exchange information directly from their internal applications. MSML (XML application) could undoubtedly be used in an e-work platform that automates safety related messages, business processes and workflow, between stakeholders and trading partners. Automatic transfer and logging of information will ultimately enable operators to focus on their main tasks and reduce the flow of paper work.

The exchange of MSML (XML application) messages between stakeholders, both safety related and for business processes, will need to make use of suitable networks to provide a suitable platform for the electronic delivery of the information. There are a number of options for such a network including MANATEE's proposed system and making use of the SafeSeaNet system.

A strategic vision is that MSML (XML application) may be used to structure all relevant information that is safety-critical in the maritime sector. This will allow for very efficient, secure and streamlined information processing and transfer, but it will also require extensive efforts in integrating various functions and proprietary solutions into the system. Components in this system include diagnostic and automation tools onboard, such as sensors, bus systems, evaluation, monitoring devices and software, VTMIS and AIS equipment, administrative software etc.

In the USA, Boeing has recently successfully tested real-time data communication and high-quality video teleconferencing from a ship to the shore using a broadband Internet connection via satellite. In the future broadband on ships will allow operators to explore business solutions and services that have previously not been feasible. This will enable the maritime community to have a much wider selection of applications, new networking solutions and services, providing improvements in vessel safety and operation.

5.2. Future Development of MSML

As MSML is an XML application it is therefore extensible and may easily be amended as needed for new areas. It is primarily intended to cover issues related to maritime safety, and when fully developed should be fairly complete in this respect. Other XML applications may be used in parallel with MSML to structure other types of information that is not or only secondarily related to maritime safety. Examples of such applications are MTML, the Marine Trading Markup Language, and future foreseen XML Schemas, for example: information related to GIS (Geographical Information Systems) and tracking and tracing.

Further integration with related technology should be encouraged, in particular in conjunction with the SafeSeaNet network and different navigational, diagnostic, maintenance and other auxiliary tools, which are now becoming more and more XML-based or at least XML compatible.

The information contained in the SafeSeaNet system, as mandated by the control and safety at sea legislation, is often similar or even identical to information requested or required by other authorities. This demand could lead to a broadening of the SafeSeaNet scope to include information of interest to VTS/VTMIS, Customs and Border Police. The concept and inherent benefits of the SafeSeaNet system could also be quite valuable for different information providers, the other maritime stakeholders (master mariners, ship agents or economic operators) who, for various administrative or economic reasons, spend an increasing amount of time providing information to different authorities and/or entering data into different systems.

5.3. Standardisation Issues

During 2004 the MSML Schema and application description has been prepared as a proposed standard to ISO. It was proposed to ISO TC8 (Ships and Marine Technology) as a new work item, which was approved by its Advisory Group at the 38th meeting in June 2004 (Resolution 55 to publish MSML as PAS (Public Available Specification) and Committee Draft, and to develop an XML standard for Electronic Port Clearance).

ISO TC-8 is responsible for standardization of design, construction, structural elements, outfitting parts, equipment, methods and technology, and marine environmental matters, used in shipbuilding and the operation of ships, comprising sea-going ships, vessels for inland navigation, offshore structures, ship-to-shore interface and all other marine structures subject to IMO requirements.

Thus there will be a new work group under the auspices of ISO TC8/SC10 (SC10 is in charge of Computer Applications within TC8), with the mandate to develop a new Electronic Port Clearance XML message standard, based on MSML and/or other formats already in use.

For this activity, it is considered very important that the EU through SafeSeaNet, EMSA or another suitable organisation participate. Preliminary expressions of interests have come from the US (US Coast Guard), Japan, Korea and China (including Hong Kong).

SafeSeaNet provides an XML message-based interface to enable the National Competent Authorities' applications of the Member States to communicate with the SafeSeaNet system. The XML message-based interface consists of a set of XML messages fulfilling the needs of both *data requester* and *data provider*. These XML messages are being defined by EMSA in SafeSeaNet: XML Messaging Referencing Guide [12].

6. DISCUSSION

With the introduction of Directive 2002/59/EC establishing a vessel traffic monitoring and information system, procedures have been set in place for the electronic transfer of numerous safety-related messages to various authorities.

Future development is envisages for the European monitoring, control and information system for maritime traffic. This will cover the development of telematic links between coastal stations and port authorities, extending the coverage of the European monitoring system. An effort to improve the management of shipping information, which is one of the tasks of the European Maritime Safety Agency, is also needed.

At present there is an abundance of information and data available from various maritime stakeholders, particularly in the commercial sector, but it lacks accepted procedures and definitions for data collection, an integrated information flow and a communication network for the transfer of either voice information, or multimedia data.

The MANATEE project has demonstrated that information can be exchanged electronically, efficiently and reliably as MSML (XML application) instances. The particular applications considered were for scenarios related to repair and maintenance, including aspects of relevance to Port State Control inspections. A discussion of the use of MSML (XML application) for exchanging safety related messages, which form the basis of the recommendations, is given below.

6.1. MSML (XML application) Applications for Data Exchange

6.1.1. Port State Control Inspections

The use of MSML (XML application) for data exchange relating to Port State Control inspections and surveys would be more efficient and improve maritime safety. PSC Authorities, Port Authorities and Classification Societies are important stakeholders in this process as they would be exchanging data relating to surveys and certificates.

As a result of Port State Control (PSC) inspections a report is created, including the certificate status and verification of the vessel certificates. This report is then added to the SIRNAC information system. The port authority needs an updated certificate status of the vessel upon receiving a notification of port clearance. In order to evaluate this status a requested is made to the Classification Society.

All the above information is included in MSML: certificate status and arrival/departure notifications. The data exchange relating to Port State Control inspections and surveys, Port clearance and Classification Societies is illustrated in Figure 7.

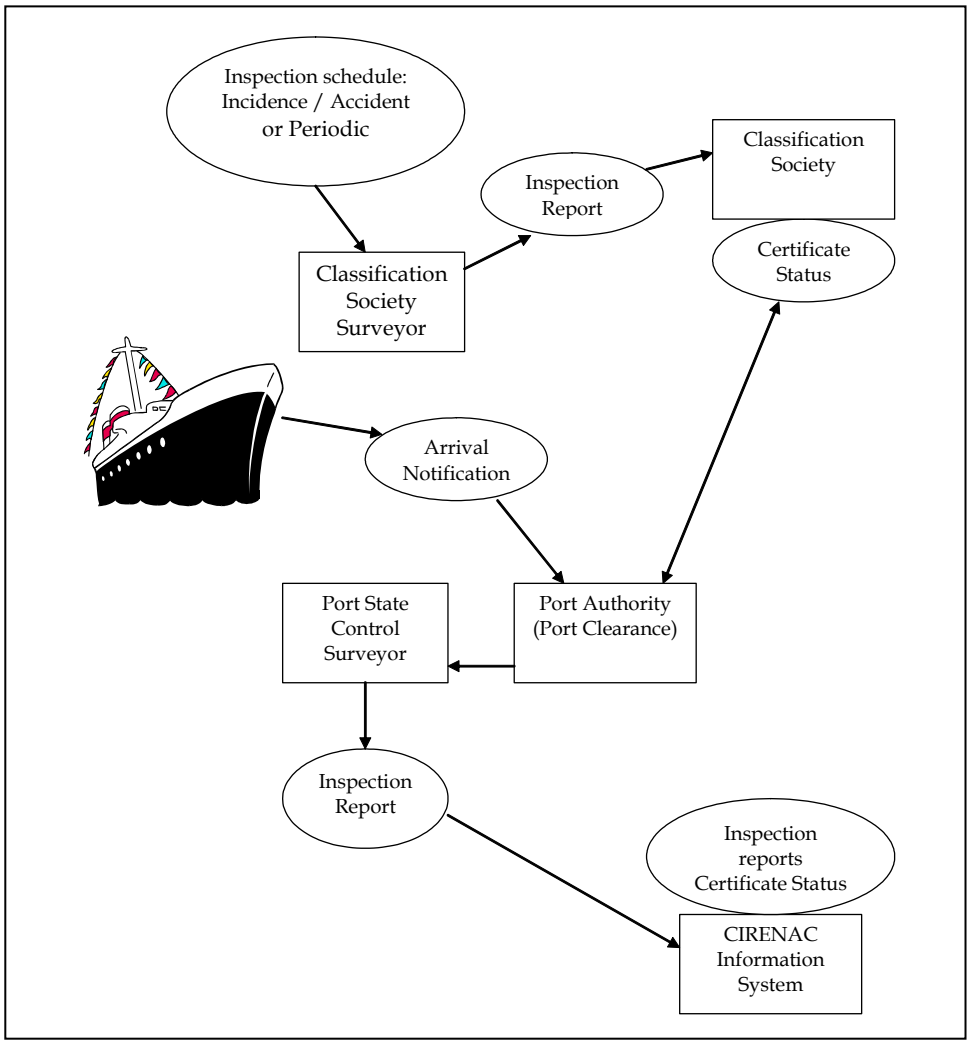

Figure 7: MSML (XML application) application related to Port State Control

6.1.2. VTS/VTMIS: Integration of Sub-systems

As the integration of several sub-system databases of VTS/VTMIS are already partially implemented using XML, both for internal and external communications, the use of MSML (XML application) could be used for data relating to maritime safety and environmental protection. The sub-systems involved include:

- VTS: the Ship Tracking database includes positioning and dynamic data about Naval, Commercial, Leisure and Support Units.
- NISAT: its database includes data about the current Meteo situation, existing Anti-pollution devices, Oils and Polluting substances, TROCS Guide definition and recommendations, Taskforces and Intervention Teams, Naval, Private and Support Units.
- FISHING BOATS RADIO-LOCALISATION: the system database includes data about Boats localisation and Alarms.
- SHIPPING CIVIL REGISTER: includes and maintains data about Ships and Boats Certifications.

- SARE: its database includes data about Radio apparatuses (onboard and ashore), Radio frequencies, Maintenance centres and Maintenance interventions.

In addition, data concerning Repair and Maintenance needs, planning and requests could also be integrated into the VTS/VTMIS database, using MSML (XML application).

6.1.3. Intervention Request Assistance

The provision of information from VTS/VTMIS for emergency situations to assist an intervention request from a vessel could use MSML (XML application) messages to good effect. This would provide details about current or past emergencies, information concerning availability of support vessels and equipment, radio communications and apparatuses. This information should be made available to all relevant stakeholders.

The information exchanged in this procedure has already been considered for inclusion in the MSML data model.

A procedure for this intervention request is described in Deliverable D5.1 and illustrated in Figure 8.

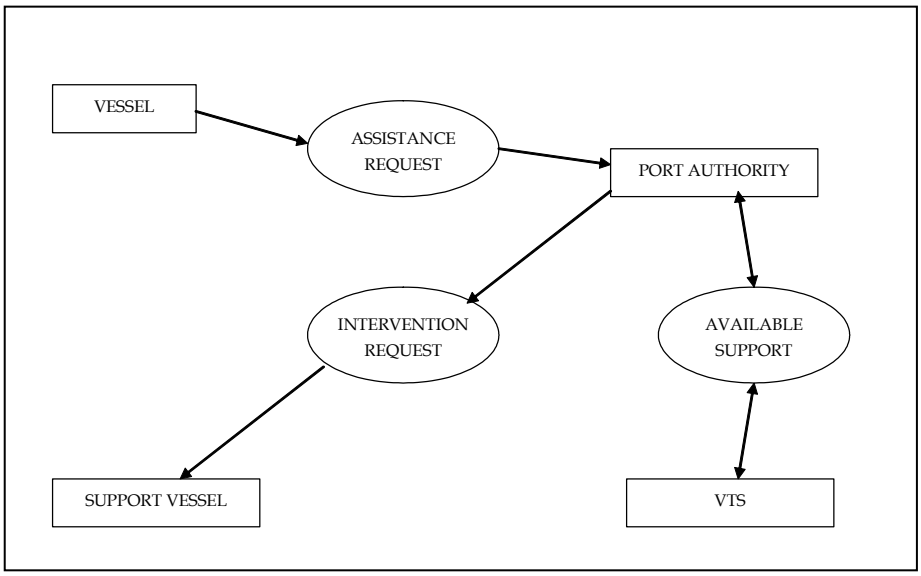

Figure 8: Intervention Request using MSML (XML application) messages

6.1.4. Automatic Procedure for Updating Inspections and Certificates

In the future, the Shipping Civil Register should take advantage of automatic maintenance procedures for updating inspection and certificates, MSML (XML application), to improve safety. Currently, the registrations of onboard inspections and certificates are updated manually. The stakeholders involved for updating inspection and certificates include the Classification Society, the crew of the vessel, the local Port Authority and to competent Area VTS Centre.

The information exchanged in this procedure has already been considered for inclusion in the MSML data model.

A scenario for an automatic procedure for updating inspections and certificates using assistance intervention request is described in Deliverable D5.1 and illustrated in Figure 9.

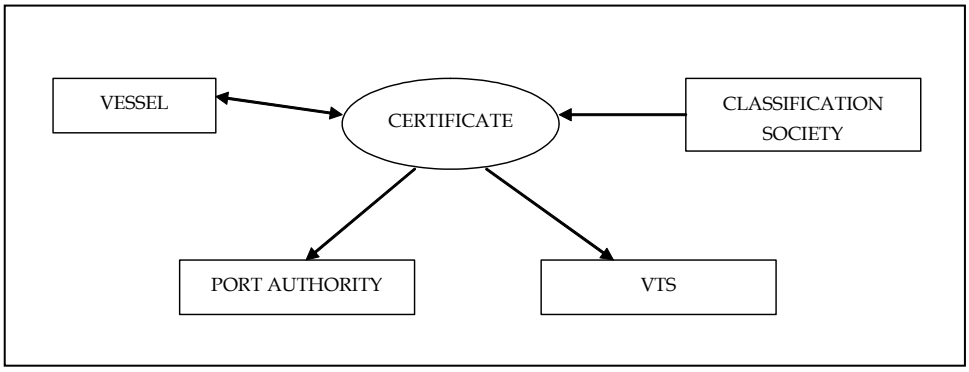

Figure 9: Automatic procedure for updating inspection and certificates

6.1.5. MSML (XML application) for IST Projects

In view of the importance of the MSML schema for exchanging safety related messages and other types of messages, the European Commission should consider the use of MSML (XML application) in all future IST research projects in the maritime sector, related to electronic exchange of messages.

6.1.6. MSM (XML application) Integration

As MSML is an XML application it is therefore extensible and may easily be amended as needed for new areas. It is primarily intended to cover issues related to maritime safety, and environmental protection. However, current XML applications may be used in parallel with MSML (XML application) to structure other types of information that is only partially related to maritime safety or related to more commercial applications. Examples of such applications are MTML, the Marine Trading Markup Language, and future foreseen XML Schemas, for example: information related to GIS (Geographical Information Systems) and tracking and tracing.

Further integration and use of MSML (XML application) with related technology should therefore be considered. This could be achieved through alliances, particularly in conjunction with the SafeSeaNet network, and different navigational, diagnostic, maintenance and other auxiliary tools, which are now becoming more and more XML-based, or at least XML compatible.

6.1.7. Automated and Electronic Messages

The long-term objective on an integrated ship based e-work platform would be to eliminate the manual processes. This would allow different stakeholders to exchange information directly from their internal applications. MSML (XML application) could be used to automates safety related messages, business processes and workflow, between stakeholders and trading partners.

With the introduction of satellite communications onboard ships it would be desirable to require all safety messages to be exchanged electronically, similar to Norway's proposals for their ships. This underlines the need for standardised procedures and definitions for data collection, an integrated information flow and a communication network for the transfer of either voice information, or multimedia data. The use of MSML (XML application) schema could therefore assist this process.

6.2. SafeSeaNet

The exchange of MSML (XML application) messages between stakeholders, both safety related and for business processes, needs to make use of suitable networks to provide a suitable platform for the electronic delivery of the information. The most important network for vessel traffic monitoring and information is the SafeSeaNet system. However, although this system for the mandatory used for an extensive range of safety related messages, it is primarily for the use by Maritime Administrations and EMSA, rather than for a wider range of maritime stakeholders.

The MANATEE Network for exchanging messages using MSML (XML application) anticipates a future integration with the SafeSeaNet (SSN) system and this would provide an e-work platform for more maritime stakeholders. The idea of integrating SafeSeaNet with other regional and European networks should therefore be discussed with EMSA and Maritime Administrations.

The Flemish-Dutch services initiative to establish a regional XML-based message exchange network: the "Central Broker System (CBS)" is similar in concept to the MANATEE network, as both would integrate with SafeSeaNet. This CBS network will also be able to exchange XML-messages between all the stakeholders involved more detailed messages than SafeSeaNet.

EMSA and Maritme Admistrations should encourage the connection and integration of regional networks systems, with SafeSeanet. The additonal stakeholders that would benefit from exchanging information electronically in this way would include: VTS/VTMIS, Classification Societies, Port State Control surveyors, Police, Customs, Pilots, Shipping Agents, Ship repair yards, remote diagnostics, and repair and maintenance.

6.3. MSML(XML application) ISO Standard

The MSML Schema and application description has been prepared as a proposed standard to ISO. It has now been approved by the Advisory Group of ISO TC8 (Ships and Marine Technology). A new work group is now being set up under the auspices of ISO TC8/SC10 (SC10 is in charge of Computer Applications within TC8), with the mandate to develop a new Electronic Port Clearance XML message standard, based on MSML and/or other formats already in use.

As this topic is considered to be of importance, SafeSeaNet or EMSA, and other suitable organisation participate in this work group. Preliminary expressions of interests have come from the US (US Coast Guard), Japan, Korea and China (including Hong Kong).

As MANTEE's MSML (XML application) schema for exchanging safety related messages is similar to SafeSeaNet's XML messages, it is important that EMSA is made aware of it, with the view of adopting it, or incorporating it, for use within SafeSeaNet.

6.4. HF Telex Replacement

With declining use of Narrow band Direct-printing (NBDP), IMO is seeking alternatives to NBDP, currently used within the Global Maritime Distress and Safety System (GMDSS). The use of MSML messages is considered a potential replacement for HF radio telex (NBDP) within GMDSS. This is because of MSML's versatility, its ability to be extended and tag documents and other relevant information. Standardised MSML messages could be used to send important information via the internet once distress signals have been sent by GMDSS.

The use of MSML should be proposed as a possible replacement for HF radio telex (NBDP) and this should be communicated to EMSA and Administrations. A presentation should also be made by MANATEE at the next COMSAR meeting, due to take place at IMO in February 2005.

7. CONCLUSIONS

The MANATEE project has demonstrated that information can be exchanged electronically, efficiently and reliably as MSML (XML application) instances. The particular applications considered were for scenarios related to repair and maintenance, including aspects of relevance to Port State Control inspections.

A number of recommendations have been made for the use of MSML (XML application) for exchanging safety related messages and these are indicated below. These recommendations are addressed to EMSA, Maritime Administrations, and maritime stakeholders.

1 MSML (XML application)

a) The use of MSML (XML application) for data exchange relating to Port State Control inspections and surveys is recommended. PSC Authorities, Port Authorities and Classification Societies are important stakeholders in this process as they would be exchanging data relating to surveys and certificates.

b) As the integration of various sub-system databases of VTS/VTMIS are already partially implemented using XML, both for internal and external communications, the use of MSML (XML application) is recommended for data relating to maritime safety and environmental protection.

c) The provision of information from VTS/VTMIS for emergency situations to assist an intervention request from a vessel is recommended, using MSML (XML application) messages. This would provide details about current or past emergencies, information concerning availability of support vessels and equipment, radio communications and apparatuses.

d) Registrations of onboard inspections and certificates are currently updated manually. It is recommended that in the future, the Classification Societies should take advantage of automatic maintenance procedures for updating inspection and certificates, using MSML (XML application).

e) In view of the importance of the MSML schema for exchanging safety related messages and other types of messages, it is recommended that the European Commission should require all future IST research projects in the maritime sector related to electronic exchange of messages, to adopt the use of MSML (XML application).

f) Current XML applications may be used in parallel with MSML (XML application) to structure other types of information that is only partially related to maritime safety or related to more commercial applications. Further integration and use of MSML (XML application) with related technology is therefore recommended and alliances formed, particularly with SafeSeaNet network.

2 SafeSeaNet

a) The MANATEE Network for exchanging messages using MSML (XML application) anticipates a future integration with the SafeSeaNet (SSN) system and this would provide an e-work platform for more maritime stakeholders. The idea of integrating SafeSeaNet with other regional and European networks should therefore be recommended to EMSA and Maritime Administrations.

3 ISO TC8/SC10 & SafeSeaNet

a) The MSML Schema and application description has been prepared as a proposed standard to ISO. A new work group is now being set up under the auspices of ISO

TC8/SC10 to develop a new Electronic Port Clearance XML message standard, based on MSML and/or other formats already in use. As this topic is considered to be of importance, it is recommended that SafeSeaNet or EMSA and other suitable organisation should participate in this work group.

b) As MANTEE 's MSML (XML application) schema for exchanging safety related messages is similar to SafeSeaNet's XML messages, it is recommended that EMSA is made aware of it, with the view of adopting it, or incorporating it, for use within SafeSeaNet.

4 HF Telex

With declining use of Narrow band Direct-printing (NBDP), IMO is seeking alternatives to NBDP, currently used within the Global Maritime Distress and Safety System (GMDSS). The use of MSML (XML application) is proposed as a possible replacement for HF radio telex (NBDP). Furthermore, presentations should be made to EMSA and Administrations to this effect and to the next COMSAR meeting, due to take place at IMO in February 2005.

8. REFERENCES

1 WATERMAN-TS Waterborne Transport Data Exchange to Foster Traffic Management and Supply Chain Management, March 2002

2 European Communities Council 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 (OJ No L 208, 5.8.2002, p. 10).

3 World Wide Web Consortium: XML 1.0, Extensible Markup Language (XML) 1.0 (Second Edition), http://www.w3.org/TR/REC-xml, 2000.

4 Private correspondence, Lieven Dejonckheere, Flemish maritime Administration to BMT, 20 October 2004.

5 European Communities Council Directive 93/75/EEC of 13 September 1993 concerning minimum requirements for vessels bound for or leaving Community ports and carrying dangerous or polluting goods. Amended by the following measure: Commission Directive 96/39/EC of 19 June 1996;Commission Directive 97/34/EC of 6 June 1997; Council Directive 98/55/EC of 17 July 1998; Council Directive 98/74/EEC of 1 October 1998.

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11 Regulation (EC) No 1406/2002 of the European Parliament and of the Council of 27 June 2002 establishing a European Maritime Safety Agency , COM(2000) 842 - Official Journal L 208 of 05.08.2002.

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ANNEX 1: SAFESEANET: TECHNICAL ARCHITECTURE AND CHARACTERISTICS OF THE SYSTEM

1 INTRODUCTION

Since 1993, and particularly after the accident of the cargo ERIKA off the French coast in 1999, the European Union has adopted several directives for improving the prevention of accidents at sea and the fight against marine pollution.

The implementation of these Directives requires the collection and distribution of various kinds of data: vessel traffic monitoring, dangerous cargo details, results of ship inspections, information related to ship waste and cargo residues. At the moment, their exchange is hampered by a lack of standardization and a profusion of transfer mechanisms - from phone or fax to electronic messages (often via EDIFACT)[1], which considerably limits an efficient implementation of the EC maritime safety legislation.

In the framework of the trans-European network for transport, an initial project, called HAZMAT (for HAZardous MATerials), based on EDIFACT messages, and was launched in 1995 by the European Commission Directorate General - Transport and Energy (DG TREN). This was in order to harmonize the exchange of messages between five pilot Member States (i.e. Belgium, Finland, Germany, Spain and the Netherlands).

At the end of 2001, the European Commission decided to build upon the HAZMAT experience to launch the SafeSeaNet (SSN) project, whose main goal is to provide a tool for the implementation of Directive 2002/59/EC establishing a Community vessel traffic monitoring and information system. Consequently, DG TREN developed SafeSeaNet as an interchange data system, based on the traffic monitoring framework.

This system:

- organises the community of users,
- standardises the data,
- enables the exchange/share of data by locating, displaying, retrieving and transmitting the information,
- creates a secure network.

2 SAFESEANET BACKGROUND

The functions of SSN comply with the "Traffic monitoring" Directive requirements. Those requirements derive from international regulations (MARPOL, SOLAS, ..etc.), applicable to ship reporting and monitoring.

Furthermore, following discussion with National administrations, it has been agreed that SafeSeaNet should aim at going beyond the mere legal obligations, taking into consideration a wider objective as the development of a “one stop shop” concept aimed to reduce the administrative burden for ships’ masters and agents.

[1] *EDIFACT stands for Electronic Data Interchange For Administration, Commerce and Transport. This messaging protocol includes a set of internationally approved standards, directories and guidelines for the electronic interchange of structured data, such as data related to trade in goods and services between independent, computerized information systems.*

2.1 Legal obligations for Member States under the "Traffic monitoring Directive" 200/59/EC.

- **Hazmat**: Member States shall develop and maintain the necessary infrastructure to enable transmission, reception and conversion of data between their IT systems.
- The Commission shall develop and maintain, in consultation with the MS, an "Interface Control Document" which describes the system facilities, including the description of the messages.
- These procedures and infrastructure should incorporate, whenever practicable, reporting and information exchange obligations resulting from other Directives, such as Directive 2000/59/EC on port reception facilities.
- Member States had until the 5th February 2004 to take all appropriate measures to implement the Directive and thus be able of exchanging data by electronic means in accordance with the relevant provisions of the Directive.
- Exchange of information concerning ships "posing a risk".
- Exchange of information (including Hazmat) for safety reasons or in emergency situations.
- Cooperation requirements for further development of telematic links and vessel traffic monitoring.
- Set-up infrastructures for ship reporting and monitoring (to be built-up by end of 2007 and interconnected by end of 2008) and set-up AIS shore-based stations in accordance with AIS phasing-in calendar on board ships (i.e until 1 July 2007).

2.2 General objectives agreed with the Member States:

- Improved emergency response in case of incidents or pollution at sea (e.g. transmission of DG information)
- Early detection of "ships posing a risk"
- Increased efficiency of port logistics (accurate Estimated Times of Arrival (ETAs), waste handling…)
- Produce statistics for EMSA, Member States and the Commission

2.3 SSN – Basic Technical Requirements

- System available 24h/day - 365 days/year
- Capable of providing a rapid reply to any request
- Based on Internet Standard Technology (web server)
- Support message implementation in XML
- Ability to include new requirements stemming from EC legislation, new messages, new members in the network, etc.
- User-friendly
- Shall ensure a high level of security of communications

3 SAFESEANET GENERAL CONCEPT

The system used is a network/Internet solution based on the concept of a distributed database. Once fed into the SafeSeaNet system, data does not have to be transferred, copied or duplicated.

The SafeSeaNet system actually keeps track of the data location, through a so-called Central Index which stores pointers (references) to the actual data location. Access is provided to the authorized persons via well-defined messages. Whenever access to the data is needed by one of the participants, this data can be requested through a well-defined message, and the SafeSeaNet system will locate it. The system will then retrieve the data from wherever it is stored and present it to the requester, again in a well-defined message.

3.1 General Architecture

The core of the SafeSeaNet architecture consists of the SafeSeaNet XML Messaging System acting as a secure and reliable "yellow pages" index system and as a "hub and spoke" system for sending requests to and receive notifications and responses from participants identified as data requesters and data providers.

The SafeSeaNet System presented in figure 1 relies on a distributed architecture made of 3 levels.

These 3 levels are:

- Local Competent Authorities (LCA) that can range from Port Authorities, Coastal Stations to Harbour Organisation;
- National Competent Authorities (NCA) that acts as a point of contact at national level;
- The central index, which is currently located at the Informatics Directorate (DI) in Luxembourg.

Each NCA is connected to the Central Index through an Internet or TESTA connection. There can be more than one NCA per country and some member states will have a few LCAs directly connected to the central index. These will be handled as isolated NCAs with no LCA connected to them.

All factual information is stored locally. Whenever the information changes (information added, updated, removed) a notification is sent to the European Index. Thanks to these notifications, the European Index knows the location of the information.

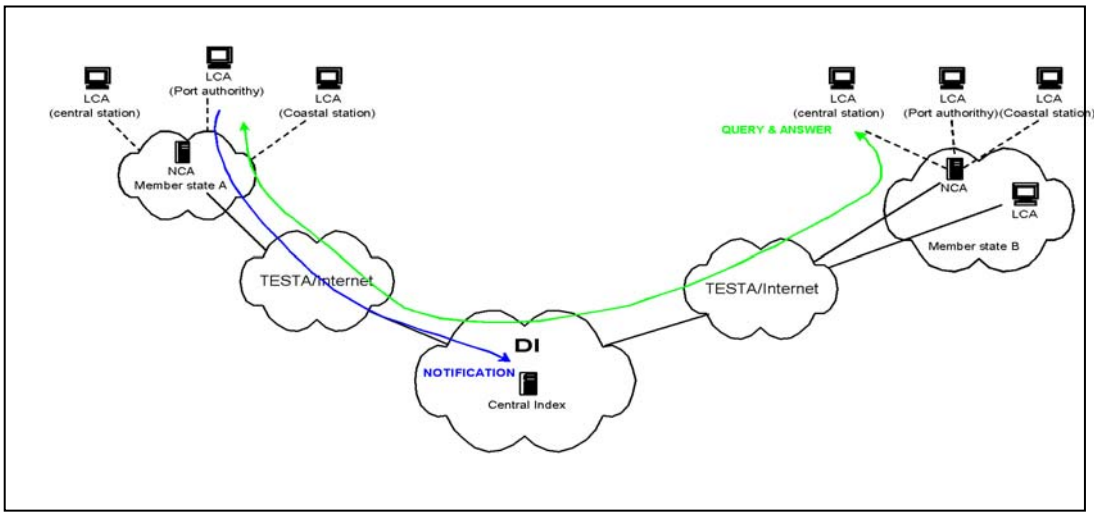

Figure 1 – General Architecture

3.2 Information Flows

3.2.1 Principle

The bulk of information remains in the Member States. When a LCA/NCA has got information about a ship, it just informs the central index about it (through a "notification" message). The

system will display that the data provider possesses a certain type of information on a certain ship[2].

For the standard messages concerning ship position and destination the system will display the name of the ship, the position transmitted, the port of destination and the ETA (Estimated Time of Arrival).

When an authority (possibly in another Member State) wishes to display more detailed information, the following occurs:

- The data requester sends a "request" message to his NCA, who forwards it to the central index;
- The central index forwards the request to the NCA of the Member State where the requested information resides, which, in turn, forwards it to the end entity that owns the information;
- The data provider that owns the information then answers with the information that is transmitted back to the requestor;

There can be variations: some Member States may decide to collect within an NCA the information that is produced by their LCAs. In these Member States, the target NCA can answer the request without involving the respective LCAs.

The flow of information is presented in Figure 2.

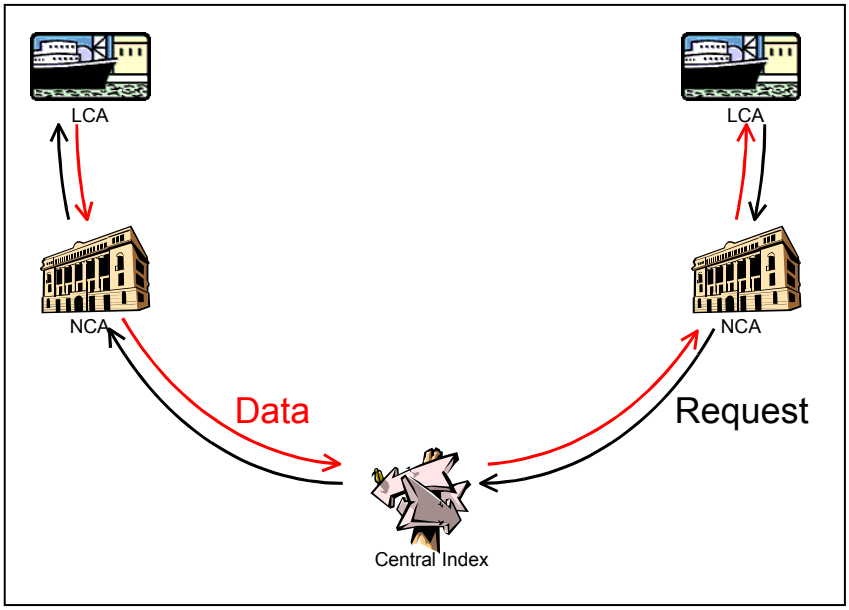

Figure 2 – Flow of information

3.2.2 Physical flows

A clear distinction must be done between the information transmitted by the ships to the shore (Ship to Shore notification) and the information transmitted by the shore to the "European Index server".

[2] *The system is also able to display information concerning a specific harbour or a particular area (see point 3.3)*

Ship to Shore

Following the international, comminatory and national regulations ship shall notify a important amount of information to the coastal or port authorities.

Ship messages refer to four main situations:

- Ships coming from a port outside or inside the Community
- and bound for a port outside or inside the Community
- Ships carrying dangerous or polluting goods
- or not carrying dangerous or polluting goods

Ships shall notify to the competent authorities:

- Notification prior to entry into ports of the Member States (Article 4 of the Directive 2202/59)
- Notification of dangerous or polluting goods on board ships (Hazmat - Article 13)
- AIS (Automatic Identification System) and VTS (Vessel Traffic Service) Ship reports

Shore to SSN

Following the international, EU and national regulations, Member States administrations have to generate a large amount of information.

Member States shall notify to the E.I.S:

- Port Notifications
- Hazmat Notifications
- Ship reports AIS and VTS
- Messages emitted by their operational services following events at sea (Search and Rescue report, Pollution report, Deficiency report…)

3.3 Main actors:

The SafeSeaNet system is the result of the cooperation between Member States and the Commission in order to develop specifications for the data exchange, to develop telematic links between ports/coastal stations, to improve links between coastal stations, to extend/improve ships' identification and monitoring by MRS, VTS and routeing systems.

3.3.1 E.U. Level:

The SSN European Index Server (EIS): is able to locate and retrieve in a Member State the information required by another Member State and forward it to the requesting Member State. At this stage the European Index Server (EIS) is hosted by the Informatics Directorate (DI) of the Commission in Luxembourg. The Commission (DG TREN) on the basis of its legal obligation will handle the general policy monitoring and EMSA will take over the operation of SSN and the production of statistics.

It is composed of:

- Central Index
- European Database (yellow pages)
- Web Server (HTTP/HTTPS protocol)

Its role is twofold:

- Collects all notification messages in its Central Index

- On request, it locates where the information is stored, retrieves it and forward it to the requesting authority.

3.3.2 National and local level:

National and local entities are the Data providers and Data requesters of the system. As far as possible, SSN shall be connected to one single contact point (SPOC) per Member State.

The Data Provider (Actor retaining and providing maritime data): the authority which locally handles the information has to notify the EIS that it possesses such information but retains the bulk of information (e.g. cargo manifest). On request the Data provider forwards the detailed information to the EIS

The Data Requester: the authority which needs the information sends a request and receives the reply from the EIS.

At national level: the National Competent Authorities (NCA) will assume the overall responsibility of the proper functioning of the system. It's a physical entity designated by Member States in charge of handling and exchanging the SafeSeaNet messages. The single point of contact within the Member State is designated as NCA in the framework of SafeSeaNet.

Local authorities or bodies could be:

- Coastal Stations: vessel traffic services, shore-based installations responsible for a mandatory reporting system approved by the IMO, bodies responsible for co-ordinating search and rescue operations or organizations in charge of pollution detection and response;
- Port Authorities authorized by Member States to receive and pass on information notified pursuant to Community legislation;
- Local Competent Authorities designated by Member States to receive and pass on information pursuant to Community legislation.

It should also be mentioned that at EU level Commission and EMSA are the Data requesters.

4 SAFESEANET FUNCTIONALITIES

SSN aims at reducing the unnecessary movements of data: the bulky data remains close to the source, therefore only short messages are transmitted to the EIS. However, such messages provide the core relevant information on ships such as position, port of destination or HAZMAT. This is the information that will be displayed by the EIS. This function covers 90% of the users needs.

Furthermore, SSN has been designed to take into account the need for integration of recent technological developments such as AIS generated data as well as new information flows or new messages.

4.1 SSN technical environment:

4.1.1 A default browser-based web interface

The Data Provider can manually send notifications to SSN (by filling in web forms) and the Data Requester can manually request detailed information (by filling in web forms and viewing results).

4.3.2 An XML message-based interface

The Data Provider/Requester communicates programmatically with the SafeSeaNet system. The national or local network handles all the relevant info at its level and transmits them

automatically to the E.I.S. Most of the MS are developing such networks including all info and commercial information.

4.3.3 Technology used

- Standard Internet protocols
- IDA PKI infrastructure
- TESTA-II network
- Internet network.

4.3.4 Security

The SSN system uses a high level of security based on user's access rights management, Public Key Infrastructure (PKI) and used of the E.U private network TESTA. As a result the level of security of the system is very similar to those found, for instance, for payment through Internet.

All the users are certified. The national administration needs to order the creation of server certificates through the Certificate Authority (Belgacom E-Trust).

PKI provide various security services as:

- Authentication: Needed to verify the identity of the person
- Confidentiality: Encryption (Public key / private key) so no third party is able to know the contents of the transaction
- Integrity: Message contents are not altered or changed during transmission
- Non-repudiation: Information cannot be disclaimed

TESTA is a secured network used in support to the E.U IDA initiative (IDA aims at facilitated and protected interchange of data between administrations).

4.4 SSN data providing and dispatching of information:

The SSN system gives access to major maritime generic messages and displays their core content. Having access to SSN, the national competent administration can automatically have an overview of ship situation. The ship characteristics, ship position, port of destination and ETA (Estimated time of arrival) are already available on screen without any request.

VOYAGE : **(Information emitted by ships)**	**ALERT MESSAGES:** **(Information emitted by shore authorities)**
Port Reporting (Entry of a vessel into the SafeSeaNet system) **Ship Reporting** (Provides refreshing of ETAs Enables to create history of ship's voyage) **AIS** (idem+ Provides up-dated information of ship's position and movements in accordance with IMO Resolution A.917(22)) **Hazmat** (Enables transmission of cargo details, directly through local/national database or manifest attached) **Security** (Informs relevant authorities of the security status of a ship).	**SITREP** (Search & Rescue report) **POLREP** (Pollution report) **WASTE** (PRF alert messages) **CONTAINERS LOST/FOUND** OTHERS (to be developed) : **DEFREP** (Deficiencies report) **INFRINGEMENT TRAFFIC RULES** (VTS/Traffic Separation Scheme reports), etc

4.5 SSN types of requests of information

Ship Search, port search and area search will give the possibility to obtain all the information transmitted by the vessels/operational services in the reporting and notification process (Port notification, VTS/AIS reports, and Hazmat notification) that have been notified by the MS.

The system will display the last five or ten messages emitted by the data providers. Therefore only the requester will be able to discriminate the useful or useless messages.

4.5.1 Ship Search:

Objectives: To inform that an/several alert message(s) concerning a specific vessel have been emitted (= ID fiche: better identification of vessels to be monitored more closely), as a messaging system: to enable transmission of alert message according to local format.

Main Users: All authorised authorities.

4.5.2 Port search:

Objective: Provides the list of all ships bound to a given port with their ETAs.

Main Users: Ports: fresh ETAs of all ships - only available to the port of destination, PSCOs: retrieve list of ships' arrivals and their ETAs which can be browsed into SIRENAC for inspection details.

4.5.3 Area Search:

Objective: to provide an overview of all alert messages emitted in a given geographical area (Atlantic, North Sea and Channel, Baltic, Med W & Med E).

Main Users: National competent authorities.