EUCISE2020: EUROPEAN TEST BED FOR THE MARITIME COMMON INFORMATION SHARING ENVIRONMENT

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Abstract- Main goal of this paper is to illustrate the activities of a project named EUCISE2020, founded in the framework of the 7th Framework Programme. The project represents an important step towards the accomplishment of the European roadmap for the Common Information Sharing Environment for Maritime Surveillance in Europe (CISE) to enhance and promote awareness over the European maritime domain, for the prosperity and security of the EU and its citizens.To illustrate the main architecture of EUCISE202,an operational scenario concerning an antipollution situation is described.

Indexterms- Common Information Sharing Environment CISE, Maritime Surveillance, European Digital Market, Electronic Data Interchange.

I. INTRODUCTION

For the last decade, national Administrations in Europe have developed their own capacities (maritimesurveillance systems, data bases, statistical tools, threat analysis tools, …); in the same time, the operationalEuropean agencies developed sectorial capacities based on centralization of information owned by theadministrations belonging to the main sectorial communities. Thanks to all these new capabilities a huge amountof information now exists, but is not available to all the interested users and is under-used.The European Union is strongly committed at implementing the Integrated Maritime Policy which supportsimproved efficiency of the Maritime Situational Awareness by the competent authorities, through networking andinteroperability of maritime surveillance systems in Europe [1] and with the implementation of a Common Information Sharing Environment (CISE)[2].The state of accomplishment of the CISE Roadmap is depicted in the diagram shown in Fig.1.

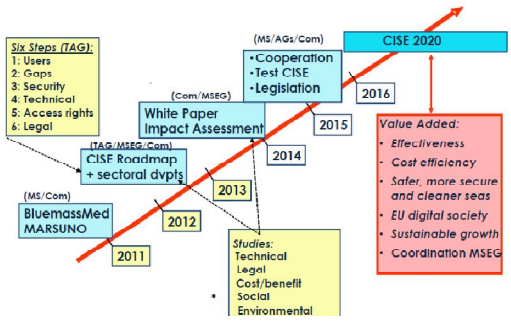


Figure 1: CISE Roadmap.

The pilot projects MARSUNO [3] and BluemassMed have been carried out during 2009-2012 and their results provide essential insights on the best European long-term strategy to establish CISE and aiming at creating the requested operational and technical conditions for the implementation of a common maritime surveillance network. All together 14 maritime EU Member States, and 1 European Economic Area State, joined both projects with a total of 58 maritime authorities representing all the CISE User Communities. The projects have seen the direct involvement of the national maritime authorities, with contributions by national legacy surveillance systems and analyzing technological operational and legal constraints, in order to identify agreed solutions to implement the CISE Roadmap. At the end of the pilot projects, in 2010 DG MARE promoted and co-funded the Cooperation Project (CoopP) [5] that delivered a set of well-defined use cases. Results from the project provided a complete functional description of information services supporting the selected use cases, a list of purposes for information exchange, a generic access rights matrix covering the use cases and information services identified, a complete description (semantics and format) of data elements used in the different information services identified and the analysis of the added value of selected use cases (including long-term improvements).

Outside the national and the EU sectorial communities, maritime authorities are generally willing to share their own maritime information, subject to the following conditions:

- their own roles and responsibilities are maintained with regards to the subscription to third parties data;
- no further responsibility is assumed due to the data sharing with regards to their data subscribers;
- selective data access and data distribution can be granted to different categories of Users, according tonational regulations and sectorial agreements;

- a responsibility-to-share policy is enforced so that the overall exchange of information is inherently balanced.

EUCISE 2020 is an important step towards the accomplishment of the European roadmap for CISE; the project attains the widest possible experimental environment of innovative and collaborative processes between European maritime institutions.The scope of the project is to manage in parallel the elaboration of the action plan for the operational validation of new elements of R&D need to develop CISE, the development of an open European test bed for incremental advancement of CISE in the medium-long term, the independent Verification & Validation of the new elements of R&D, as well as the assessment of organizational instruments necessary to sustain the appropriate governance structure and to stimulate public-private cooperation.EUCISE 2020 is an FP7 funded project started on the 1st December 2014, lasting 33 months. The activities of EUCISE2020 are implemented and managed by a consortium of 37 partners from 15 different European countries; the project coordinator is the Italian Space Agency (ASI). Maritime authorities, universities, research institutes and other different organizations are involved. The project attains the widest possible experimental environment of innovative and collaborative processes between European maritime institutions.

II. EUCISE2020 PROJECT OBJECTIVES

Pursuing the cooperation started with previous pilot projects, the overall objective of EUCISE2020 is to progress towards establishing a forward operating vision of CISE more stable and innovative, functionally and geographically larger, and more shared by different communities of European public and private stakeholders. CISE supports further cross-border and cross-sector operational cooperation between public authorities -including EU Agenciesin the execution of the defined maritime functionalities, with a focus on information sharing across sea-basins. EUCISE2020 project takes its steps from the lessons learnt both from BluemassMed and MARSUNO pilot projects, at functional, operational and technical and technological level, both from European projects completed or in progress, at sectorial level or at cross-sectorial basin-wide. Besides, EUCISE2020 includes the results of other projects defining use cases, data model and information services for data exchange; the value of the tangible experiences of participants is crucial for the success of this follow-up project. In its preliminary phase the project took into account a number of concept papers, lessons learned, recommendations and best practices that the Commission made available on these specific subjects:

- Access rights.
- Non-functional requirements to consider.
- Infrastructure of the interoperability environment.
- The common data model and services specifications from CoopP.
- Governance.
- Lessons learned.

Through the development of a Pre Op Validation Test Bed (POV) instrument, EUCISE2020 has pursued a proper full-scale project definition phase, addressing specific areas where joint research and validation is needed, such as the adoption of architectural solution for dual use systems' interconnection, the detailed design of the information protection mechanism, the definition of the operational governance at program, network and configuration management level, the establishment of the topology of the network, the harmonization and further specifications of added value common services and algorithms based on a cost-benefit perspective, and the cooperative development of technological solutions and standards in order to ensure a full life cycle management of the future full-scale infrastructure.Taking into account the inclusion of CISE as element of the European Digital Agenda, the project team has established relationships with the national authorities in charge of the fulfilment of the national Digital Agendas to maintain the compliance between the technological developments and the global framework.The Project has two components with synergistic effects:

1) Networking and coordination activities: for public bodies in Europe to cooperate in the innovation of their public services through a strategy that includes POV.
2) Joint research activities: related to validating the POV strategy jointly defined by the public bodies participating in the action. This includes the exploration of possible solutions for the targeted developments towards a prototype for CISE, and the testing of the proposed solutions against a set of jointly defined concepts of operations and performance criteria.

In full compliance with the FP7 Cooperation Work Programme, the specific objective of this project is to have atest-bed network of information platforms connecting participating public authorities, developed for cross sectorialdata exchange and tested in particular to assess, in the context of CISE:

• the technical feasibility of option(s) for the Common Information Sharing Environment at sea;
• the identification of technological alternatives for the achievement of the set of user defined operational objectives;
• the demonstration that there are existing innovative solutions (services) which provide the required capabilities;

• the feasibility of the integration of the proposed solution, taking into consideration the limitations imposed by the existing surveillance systems;
• the performance under realistic operational and formal conditions of the test bed developed;
• the reusability of solutions as components of an open source platform, made available using open source software licences, as, for example, the EUPL [6];
• the demonstration of end-to-end information exchanges, i.e. between existing systems;
• the definition of performance indicators appropriate to assess costs and benefits of the option(s) tested;
• the identification of the maturity level showed by the solution(s) in order to promote short/mid-term utilisation;
• the definition of innovative applications, business models and procurement schemes that can facilitate the migration to these new solutions from the existing tools;
• the evaluation of the experimentation results promoting their widening to future solutions;
• the definition of advisable technical management structure for the full life-cycle management of CISE.

As part of the project activities, the industry has been called to provide solutions to test and validate according to the concept developed by the consortium participants, based on CISE definitions and rules provided by the European Commission in due time before testing and validation.

III. EUCISE2020 ARCHITECTURE FRAMEWORK

An Architecture Framework (AF) defines the standard set of key business and technical information that provide for the development of architectures. The key aspects for a successful realization of an Architecture compliant to any AF, are therefore a comprehensive understanding of the meaning of each View and Subview defined by the AF, of their relations with other Views, and the availability of a process for the modeling of each required element (be it a Capability, a System or a Service) with the proper element of the Data Model associated with the AF, and used on the appropriate Subview.The NATO has developed its architecture framework, the "NATO Architecture Framework" (NAFv3), expanding the existing MoDAF as response to the need to manage its Architectures both in terms of complexity and user perspectives [7].The NAF distinguishes between seven Views, each containing a number of Subviews. When addressing the description of EUCISE 2020 architecture, the first issue was the selection and harmonization of NAFv3 Views which are necessary to support the scope of the Project Definition. Thus, the process for the development of EUCISE 2020 Architecture was decomposed in three stages (Backbone, Extended, Completed), each coherent and able to generate a fully consistent Architecture, but with the degree of freedom to stop after the first or second step, if no further details should be required (see Fig.2). The EUCISE 2020 Backbone Process has the scope to develop the minimum set of artifacts needed to define the EUCISE 2020 Architecture, providing a clear understanding of its Operational Behavior.So, views and subviews included in the backbone process represent the basis for the definition of End User Requirements.

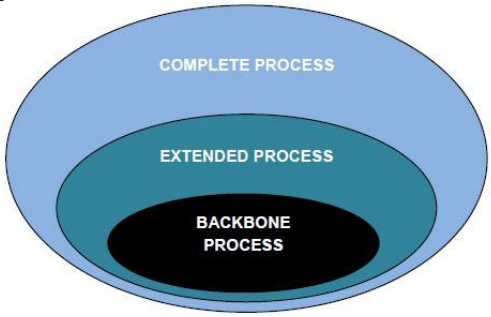


Figure 2: EUCISE2020 Architecture Approach

In order to provide a common agreement with project partners, the realization of views and subviews followed the following approach:

- Step 1: analysis of precursor projects and technical discussion with partners to collect the correct set of attributes which to be included in the backbone process views and subviews
- Step 2: creation of a reference "template" of each view / subview
- Step 3: sharing of views and subviews between partners, so that each partner can contribute to the definition of the EU CISE 2020 architecture
- Step 4: integration and harmonization of views and subviews
- Step 5: publishing of the complete set of backbone process views and subviews to collect comments and suggestions
- Step 6: revision of views / subviews and publishing on WP4 deliverables

The EU CISE 2020 Backbone Process provides all the elements and relations able to offer a clear understanding of the key aspects covered by the EU CISE 2020 Architecture.
The primary mission of EUCISE 2020 is to support the EU Maritime Situational Awareness capability by means of the definition and the realization of an Information Sharing Environment, which is able to implement adequate security measures and protocols ensuring the confidentiality, integrity and availability of the data required and transmitted in the CISE community. EUCISE 2020 is an additional system at the existing ones and will not affect functionalities of other existing data exchange methods between PA and Legacy systems.In EUCISE 2020 context there are several ways to enable the exchange of the desired information between participants. All the messaging patterns are asynchronous. It follows a pattern description:

Pull: the consumer knows the exact list of providers and asks for information, which is made available only if and when possible

Pull Unknown Recipients: the consumer does not know the exact list of providers and asks for information from all possible providers. The information is made available only if and when possible. Several responses may occur.

Push: the provider knows the exact list of consumers and sends it to them regardless of their not having previously requested such information.

Push Unknown Recipients: the provider does not know who is willing to consume, and therefore sends the information to the system that is responsible for delivering the information to a list of consumers prepared according to rules regarding community, area of interest, purpose, entity type and subscriptions.

Publish: the provider shares an information delivered as subscription by the system to a list of subscribers.

Subscribe: the consumer can subscribe to a service to automatically receive public information about an entity , area or community.

Fig. 3 represents in a pictorial way the EUCISE 2020 operational concept.

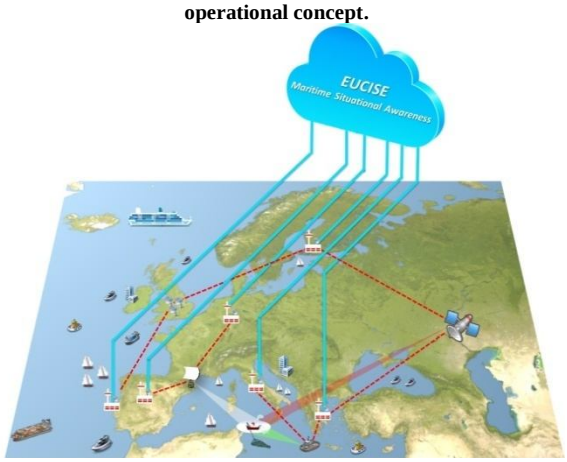


Figure 3: High Level Operational Concept: Information Sharing Environment supporting the EU Maritime Situational Awareness

The blue lines in the figure depict flows of information within the CISE community, while the red dashed lines depict flows of information within PAs legacy systems.Red dashed lines are transparent to the EUCISE2020 community and so they will not be described in the EUCISE 2020 views.EU CISE 2020 intends to connect PAs legacy systems of Member States to the CISE community by means of two components:

1) the CISE adaptor that allows a legacy systems to translate its data to the CISE data model;

2) the CISE gateway (or a rich version called node) that realize data exchange at cross-sector and/or cross-border level implementing the messaging protocol between CISE gateways.

The CISE components are able to:

- translate the request of information coming from PAs in a common vocabulary;
- ensure the exchange of messages within the CISE Community based on a Service Oriented Architecture paradigm;
- manage access rights on information exchange based on a roles/rules based approach;
- handle classified information up to EU restricted level;
- implement a collaborative environment;
- optionally, implement advances functions to enhance the information available at PAs level.

The network topology of EUCISE 2020 is based on the CISE hybrid vision concept. Each Member State and Community can adopt one of the following paradigms:

- Single-way approach: All Public Authorities of a Member State are connected to the EU CIE 2020 Network through a single access point.
- Multiple-way approach: Public Authorities of a Member State are connected to the EUCISE 2020 Network through different access points (at least two).

Fig. 4 presents the Hybrid Architecture concept in a graphical way.

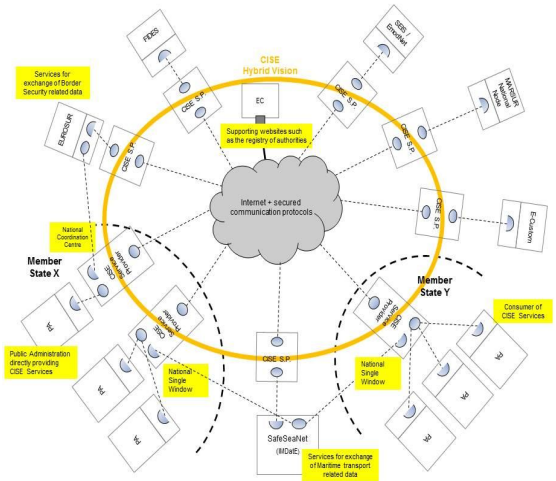


Figure 4: High Level Operational Concept: Hybrid Architecture.

IV. OPERATIONAL SCENARIOS

In order to model the operational behaviour of EU CISE 2020 architecture, 9 Operational Scenarios have been identified collecting the below Use Cases:

- Use Case 13b: Inquiry on a specific suspicious vessel (cargo related).
- Use Case 13c: Inquiry on a specific suspicious vessel (crew and ownership related).
- Use Case 25b: Investigation of antipollution situation (law enforcement).
- Use Case 37: Monitoring of all events at sea in order to create conditions for decision making on interventions.
- Use Case 44: Request for any information confirming the identification, position and activity of a vessel of interest.

- Use Case 57: Knowledge of surveillance capacities of partner authorities in a given sea area to plan basic tactical surveillance (Baseline and Targeted operations).
- Use Case 70: Suspect Fishing vessel/ small boat is cooperating with other type of vessels (m/v, Container vessel etc.).
- Use Case 85: Anti-Piracy Maritime Surveillance and free navigation control: Merchant vessels at sea (outside Territorial waters) sends an alert that it is under Piracy attack.
- Use Case 93: Detection and behaviour monitoring of IUU listed vessels.

For each of the above mentioned scenario a full set of operational views have been defined. Use cases are divided into several steps. Some steps contain actions that occur outside CISE and some others contain CISE messages exchanged between participants. Clearly only the CISE steps have been analysed. Furthermore, the patterns have been revised to match those chosen for EU CISE 2020 that differ from those of CoopP. This view is composed by one or more activity diagram that show all operational node activities and the relating of causes to the effects that they produce. This is a table that specifies each exchanged message between the operational nodes within an use-case and provide performance requirement.The table is composed by a row for each activity and the following columns:

– Actor 1:Sender User Community.
– Actor 2:Receiver User community.
– Information Exchange:Description about exchanged data.
– Performance:Expected time period to transmit information.
– Security:Is this information subject to legal regulation?
– Validity:Time of validity of the exchanged information.
– Latency: Minimum time for the transmission of the information.
– Classification/Declassification Restrictions: Data classification.
– Retention:time period after which you must remove the received data.
– Frequency:How many time in a day this information is exchanged.

Use Case 25b will be used in this paper to illustrates in details all the steps. The goal of this use case is an investigation of antipollution situation (law enforcement). This use case starts when a vessel is suspected of polluting (sighting by surface vessel, by aircraft or by satellite, for example). The lead actor is Marine Pollution Community, which collaborates with actors from the Maritime Safety and Defence communities.Responsible authorities are alerted of a pollution event. (System alerts to each member state of the presence of a suspicious vessel in their territorial waters).The alert may come from a number of sources e.g. AIS system, intelligence source, from other Member State or from a vessel that has directly observed some irregular activities.All the involved communities collaborate in order to enrich the information about the suspicious vessel and to plan the reaction operation.The Use Case is divided in the following steps (Fig.5):

1) Initialization: sighting of some limited oils slicks in international waters.
2) Alert: the interested Public Authorities are alerted and evaluates if an investigation action is needed.
3) Pre-investigation: the investigation is prepared collecting some data in order to have an awareness of situation in the past days and at present.
4) Investigation: the investigation action about alert starts with field operation to directly monitor the zone and collect a sample of oil slick. Several reports are exchanged.
5) Reaction: Public Authorities elaborates a Pollution Response Plan and coordinates actions with collaborative tools.
6) Enquiry: the investigation (and prosecution) of possible polluter starts
7) Notification: the polluter is identified and a notification is sent to the competent authorities.
8) Following steps: The Public Authorities share antecedents of the vessel and reports of on board inspections.

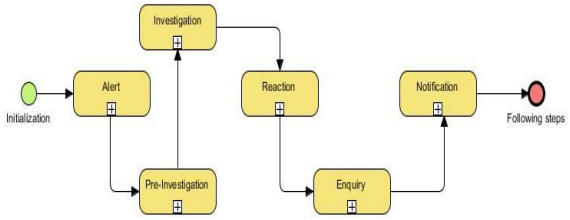


Figure 5: Steps of Use Case 25b.

The following Operational nodes can be defined to draw the Connectivity Description Diagram illustrated in Fig.6:

- Marine Environment
- Maritime Safety
- Customs
- Fisheries Control
- Defence
- General Law Enforcement
- EU Authorities: several Authorities that participate at EU level.

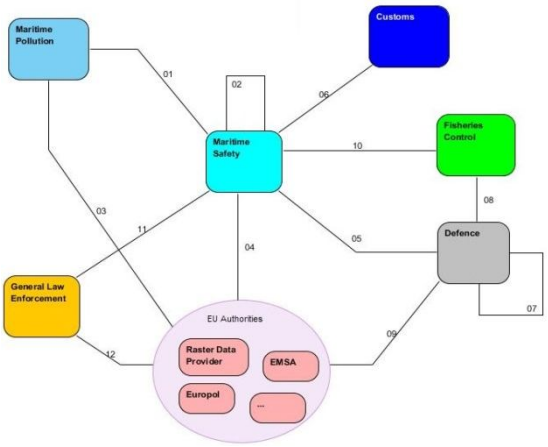


Figure 6: Connectivity Description Diagram for Use Case 25b.

Following the Connectivity Description Diagram then the 8 steps can be accomplished as follow:

1) Initialization:A vessel is suspected of polluting.

2) Alert: In this step, Maritime Safety Community Users are alerted of a suspicious pollution event by a Marine Enviroment Community User.The alert may come from a number of sources e.g. AIS system, intelligence source, from other member state or from a vessel that has observed some irregular activities.

3) Pre-investigation: In pre-investigation step, all the affected Maritime Safety Community Users investigate and collect all possible data (commercial and not-commercial satellite images, field reports, etc.) about the polluted area to evaluate the risk level.

4) Investigation: After the analysis of data, a Marine Enviroment Community User can raise and share a risk notification.Each Maritime Safety Community User could actuate with countermeasures as restriction the fishing area (PolRep).

5) Reaction: All the involved Maritime Safety Community Users elaborate a reaction plan using collaborative tools like chat and videoconference.

6) Enquiry:According to the reaction plane, the Maritime Safety Community Users collaborate to identificate the polluter enquiring information to other Community Users (own or different Community). After identification, a request are sent to all Mediterranean Port Authorities to possibly locate the polluter and hold possible departure.

7) Notification: Maritime Authority provide a legal warrant to hold vessel.

8) Following steps: Antecedent of vessel and reports of on board inspections are collected and shared.

CONCLUSION

This paper illustrated the activities of the EUCISE2020 project. The project represents an important step towards the accomplishment of the European roadmap for the Common Information Sharing Environment for Maritime Surveillance in Europe (CISE) to enhance and promote awareness over the European maritime domain, for the prosperity and security of the EU and its citizens. Since 2009, CISE is being developed by the European Commission together with the Member States including civilian and military authorities as well as the European agencies operating in the maritime field. The aim is to create a political, organizational and legal environment to enable information sharing across the seven relevant sectors/user communities (transport, environmental protection, fisheries control, border control, general law enforcement, customs and defense) based on existing and also on future surveillance systems/networks with a view to achieve a fully operational CISE by 2020.To illustrate the main architecture of EUCISE202, an operational scenario concerning an antipollution situation has been described in its main steps. More results from the Use Case will be provided in the full paper.

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