



**An Enhanced Common Information Sharing Environment for Border  
Command, Control and Coordination Systems**

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## Executive Summary

The dissemination level of this document is Public. The purpose of the deliverable D7.10 Standardization Report is to provide an analysis and recommendations for ANDROMEDA standardization.

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# 1. The role of Standardization

## 1.1 European Commission Standardization Policy

Standards stimulate and enable innovation and competitiveness in Europe and support market-based competition and help ensure the interoperability of complementary products and services. They reduce costs, improve safety, and enhance competition. The EU has an active standardization policy that promotes standards as a way to better regulation and enhance the competitiveness of European industry. Standardization is a powerful and strategic tool for improving the efficiency of European policies. The Commission pays special attention to standardization because standards can influence most areas of public concern such as the competitiveness of industry, the functioning of the single market, the protection of the environment and of human health, not to forget the enhancement of innovation. Although standards and standardization activities have much wider benefits for the European economy, they are used as policy instruments to ensure, inter alia, the interoperability of networks and systems, a proper functioning of the Single market, a high level of consumer and environmental protection, and more innovation and social inclusion. In addition, standardization brings efficiency and trust to industry and consumers. Across the Joint Research Centre (JRC)<sup>1 2</sup>, three-quarters of EC work contributes to supporting the standardization system in areas spanning from environmental monitoring to critical infrastructure protection and from food safety to nuclear safety and security. Concretely EC work on standards includes:

- Pre-normative research in areas such as health and life sciences, bio and eco-technologies and nanotechnology
- Measurement standards and quality assurance tools in industrial sectors, nuclear safeguards, and food and environment control
- Harmonized methodologies
- Certification
- Foresight studies on the need for standards development and preparation of standards.

The JRC also supports European and worldwide standards in areas such as clean transport, water and renewable energies. In many international settings, the JRC represents the European position from a scientific and technical stand point. It is essential for the EU economy that European standardization adapts continuously to the fast-changing global developments as well as to the new technological developments. Standards are an integral part of Horizon 2020, the EU's Framework Programme for research and innovation.

According to the European Commission, “standards are technical specifications defining requirements for products, production processes, services or test-methods. These specifications are voluntary. They are developed by industry and market actors following some basic principles such as consensus, openness, transparency and nondiscrimination. Standards ensure interoperability and safety, reduce costs and facilitate companies' integration in the value chain and trade”<sup>3</sup>. Furthermore, according to the EU Joint Initiative on Standardization, “standards are key for innovation and progress in the Single Market<sup>4</sup>, and are essential to supporting European competitiveness, jobs and growth. They also allow Europe to maintain its leadership in technical development and global trade as the European hub for global standardization.”<sup>5</sup>. Furthermore, the Directorate-General for Communications Networks, Content and Technology (DG CONNECT<sup>6</sup>) is the

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<sup>1</sup> [Joint Research Centre | European Commission \(europa.eu\)](https://ec.europa.eu/jrc/)

<sup>2</sup> <https://crm.jrc.ec.europa.eu/s/18/About-us>

<sup>3</sup> [https://ec.europa.eu/growth/single-market/european-standards/policy\\_en](https://ec.europa.eu/growth/single-market/european-standards/policy_en)

<sup>4</sup> [https://ec.europa.eu/growth/single-market\\_en](https://ec.europa.eu/growth/single-market_en)

<sup>5</sup> [http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item\\_id=8852](http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8852)

<sup>6</sup> [https://ec.europa.eu/info/departments/communications-networks-content-and-technology\\_en](https://ec.europa.eu/info/departments/communications-networks-content-and-technology_en)

Commission department responsible to develop a digital single market to generate smart, sustainable and inclusive growth in Europe. DG Connect also has a research program which invests around 1 billion euro annually on topics like 5G, telecommunications, cloud computing, internet of things and cybersecurity. Standardization plays an important role in many of its projects<sup>7</sup>. The vision of DG Connect is that “researchers will consider standardization more and more not just for publication or patenting their research results, but also to integrate standardization into their research process from the very beginning. Standardization is a quite complex field, and it is important from young people to bring their new ideas into the standardization field, to take leading positions in standards committees and to be the drivers of the future standards.”<sup>8</sup>. Summarizing, standardization can provide significant advantages as<sup>9</sup>:

- Ensure comparability, compatibility, and interoperability
- Ensure trust between the partners involved enabling clear and transparent exchanges of data or services
- Contributes to a country’s economic growth on a macroeconomic level as well as to develop new markets
- Is able to boost profitability for individual companies or organizations
- Is able to build and nurture international networks, based on principles of openness and transparency
- Ensure co-creation process of standardization supports open innovation and cross-industry innovation

## 1.2 European Standards Organizations

European standards are developed through one of the three European Standards Organisations (ESOs): the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardisation (CENELEC), and the European Telecommunications Standards Institute (ETSI). The European Standardisation Organisations are officially recognized by Regulation (EU) No 1025/2012<sup>10</sup> as providers of European standards. CEN, CENELEC, and ETSI have been working with the European Commission since 1984, when a cooperation agreement was signed.

The European Committee for Standardization (CEN)<sup>11</sup> brings together the national standardization bodies of 33 European countries. It provides a platform for the development of European standards and other technical documents on various types of products, materials, services, and processes. These include air and space, chemicals, construction and more. The European Committee for Electrotechnical Standardization (CENELEC)<sup>12</sup> is responsible for standardization in the electro-technical engineering field. Voluntary standards prepared by CENELEC help facilitate trade between countries, access new markets, cut compliance costs, and support the development of the EU single market. The European Telecommunications Standards Institute (ETSI)<sup>13</sup> produces globally-applicable standards for information and communications technology (ICT). These standards also include fixed, mobile, radio, converged, broadcast, and internet technologies. ETSI’s purpose is to produce and maintain the technical standards required by its members.

In the case of ETSI, industry can get involved directly in the process of standards development. However, industry can only access CEN and CENELEC through the national standardization bodies.

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<sup>7</sup> <https://www.standardsplusinnovation.eu/dgconnect>

<sup>8</sup> <https://www.standardsplusinnovation.eu/dgconnect>

<sup>9</sup> <https://www.standardsplusinnovation.eu>

<sup>10</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012R1025>

<sup>11</sup> <https://www.cen.eu/Pages/default.aspx>

<sup>12</sup> <https://www.cenelec.eu>

<sup>13</sup> <https://www.etsi.org>

The close collaboration between CEN and CENELEC was consolidated at the start of 2010 by the creation of a common CEN-CENELEC Management Centre (CCMC)<sup>14</sup> in Brussels. By setting common standards that are applied across the whole of the European single market, CEN and CENELEC ensure the protection of consumers, facilitate cross-border trade, ensure the interoperability of products, encourage innovation and technological development, include environmental protection and enable businesses to grow. Products and services that meet these European Standards (ENs) can be offered and sold in all of the participating countries. CEN and CENELEC bring together the national standards agencies of 34 countries. On the other hand, ETSI provides members with an open, inclusive and collaborative environment supporting the timely development, ratification and testing of globally applicable standards for ICT-enabled systems, applications and services.

Key EU legislative instruments (the directive on web accessibility<sup>15</sup>, the European accessibility<sup>16</sup> act, the public procurement directives) refer to the possible use of accessibility standards. The Commission encourages the participation of all relevant stakeholders in these processes, including persons with disabilities. The EU also works together with other key players in the field of accessibility standardization to support accessibility at the international level.

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<sup>14</sup> [CEN-CENELEC Management Centre \(CCMC\) - CEN-CENELEC \(cencenelec.eu\)](http://cencenelec.eu)

<sup>15</sup> [EUR-Lex - 32016L2102 - EN - EUR-Lex \(europa.eu\)](http://eur-lex.europa.eu)

<sup>16</sup> [European accessibility act - Employment, Social Affairs & Inclusion - European Commission \(europa.eu\)](http://ec.europa.eu/equality/equality-act/)

## 2. European border surveillance information exchange frameworks

### 2.1 The CISE principle as European standard for interoperable systems

The Common Information Sharing Environment (CISE) is an EU initiative which aims to make European and EU/EEA Member States surveillance systems interoperable to give all concerned authorities from different sectors access to the classified and unclassified information they need to conduct missions at sea<sup>17</sup>. Maritime CISE is to increase the efficiency, quality, responsiveness and coordination of surveillance operations in the European maritime domain and to promote innovation, for the prosperity and security of the EU and its citizens. It also ensures, that information collected by one maritime authority and considered necessary for the operational activities of other authorities can be shared instead of being collected and produced several times. Cross-sectorial and cross-border interoperability is one of CISE principles. The CISE main characteristics are the following:

- Is a voluntary collaborative process in the EU seeking to further enhance and promote relevant information exchange between authorities involved in maritime surveillance
- Is promoting a decentralized framework for these exchanges
- Is able to bring added value and complementarity to existing maritime data systems, services and sharing processes, while avoiding duplication. It should be seen as part of a more comprehensive information and exchange framework across the EU and its implementation should work towards coherence with this framework

The CISE paradigm initiated via the EUCISE2020 project<sup>18,19</sup>. The CISE roadmap process that started with the definition of the CISE principles is shown in Figure 1. As from April 2019, European Maritime Safety Agency (EMSA)<sup>20</sup> is engaged in the setting up and enabling, in close coordination with the Member States, the Transitional Phase, ensuring a coherent evolution of the CISE network and to achieve an operational CISE.

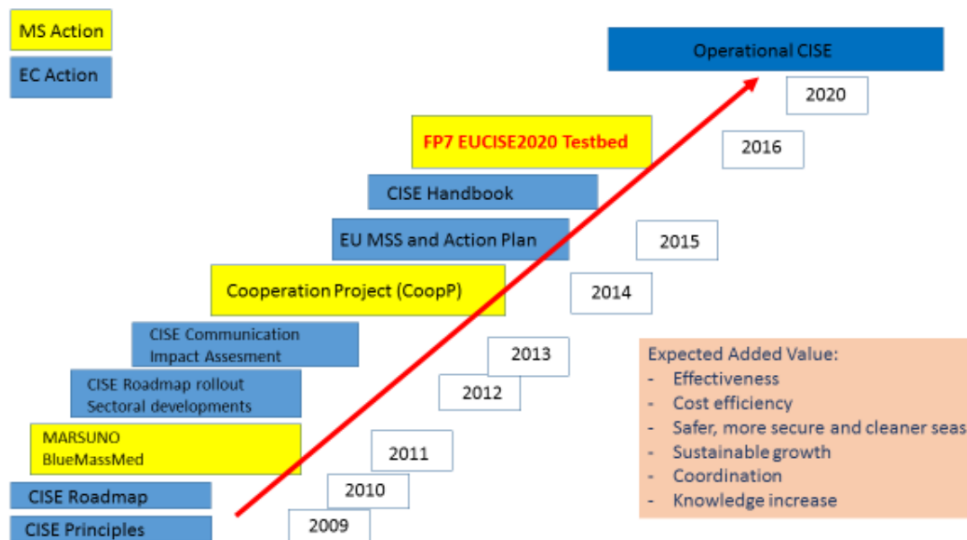


Figure 1: CISE Roadmap<sup>21</sup>.

<sup>17</sup> <http://emsa.europa.eu/cise.html>

<sup>18</sup> <http://www.eucise2020.eu>

<sup>19</sup> EUCISE2020: Technical Specifications, Deliverable 4.3, Revision 1, Annex B: EUCISE Data Model

<sup>20</sup> <http://www.emsa.europa.eu/cise.html>

<sup>21</sup> [https://www.etsi.org/deliver/etsi\\_gs/CDM/001\\_099/002/01.01.01\\_60/gs\\_CDM002v010101p.pdf](https://www.etsi.org/deliver/etsi_gs/CDM/001_099/002/01.01.01_60/gs_CDM002v010101p.pdf)



entities such: i) movement, ii) action, iii) incident, iv) anomaly, v) metadata, vi) UID (Unique Identifier), vii) cargo, viii) vessel, ix) operational asset, x) meteo-oceanographic condition, and xi) person and organisation.



Figure 3: CISE Core Vocabulary Overview

Although such definitions are able to cover a satisfactory range of categories, there are some aspects that need to be considered in an extended version of CISE such:

- Extending the scope of the CISE Model to support land border operational information exchange. In this context, a specification of border surveillance activities are needed requiring the definition of new core entities capable of supporting the whole range of activities related to border surveillance and protection. Thus, an enrichment of CISE land border vocabulary or new introductions, to describe land assets can be occurred.
- Enhancement on CISE’s Maritime Border vocabulary to support enhanced maritime capabilities, sensors and other assets.
- Support of information exchange across possible Data Fusion Service layers and Decision Support Tools layers.

## 2.2 EUROSUR

Established in 2013, the European Border Surveillance system (EUROSUR) is a framework for information exchange and cooperation between Member States and Frontex associated with external borders. EUROSUR aims is to: i) prevent cross-border crime, ii) prevent irregular migration, and iii) contribute to protecting migrants' lives. EUROSUR covers most aspect of border management, including land maritime and air border surveillance, but also checks at border crossing points, border operations and integrated planning. The surveillance activities of EUROSUR include the monitoring, detection, identification, tracking, prevention and interception of unauthorized border crossings for the purpose of detecting, preventing and combating illegal immigration and cross-border crime and contributing to ensuring the protection and saving the lives of migrants. To achieve its general objectives, the EUROSUR Regulation specific objectives are to significantly increase: i) the situational awareness, and ii) the reaction capability of the Member States' border control authorities and of the Agency, with the ultimate aim of preventing the establishment of or, if not possible, identifying and interrupting any new route or method for irregular migration and cross-border crime shortly after such has been established<sup>26</sup>.

Although the ANDROMEDA project was not obliged to be interconnected with EUROSUR, ANDROMEDA is in line with the main pillars of EUROSUR considering: i) improved interagency cooperation by streamlining structures and interlinking systems in the law enforcement domain, ii) data fusion combined with modern technological capabilities for detecting and tracking cross-border movements, iii) the exchange of information across different sectors with other actors in the maritime and land domain, iv) exchange of data, information and intelligence in close-to-real time or real time, and whenever needed, in a secure manner, v) effective management of resources and sensors, and vi) effective measurement and re-arrangement of priorities

Finally, noted that, according to ANDROMEDA's deliverable D2.5, it has been identified that, for EUROSUR, ANDROMEDA provides a potential platform for border areas surveillance, security and information sharing. The CISE enhancements to land border by updating the data model with new land border entities enable the system usage in FRONTEX scenario. The flexibility for decentralised – centralised system and connectivity to extending legacy systems and different surveillance systems provides new dimension for FRONTEX authorities cooperation. For future understanding of the FRONTEX needs, a close collaboration with FRONTEX is mandatory.

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<sup>26</sup> [soteu2018-eurosur-evaluation\\_en.pdf \(europa.eu\)](#)

### 3. Used standards in ANDROMEDA project

#### 3.1 Standards adopted by ANDROMEDA Project

In ANDROMEDA project, each partner provides several components and tools for land and maritime assets. Each component or tool adopts existing several standards depending on the type of data that uses, the utilized sensors, etc. To summarize the standards adopted by ANDROMEDA project, the standards that each partner uses in its tool, were collected and depicted in Table 1. In Table 1, representative standards used in the tools of partner's C2 legacy systems, Data Fusion (DF) systems, and Decision Support Systems (DSS) are summarized.

Table 1: Representative used existing standards in Andromeda project utilized by tools of C2 legacy systems, Data Fusion (DF) systems, and Decision Support Systems (DSS).

System	ANDROMEDA's Partner	Partner's Tool	Adopted Standard
C2	GMV	Socrates C2	<ul style="list-style-type: none"> <li>○ NMEA 0183</li> <li>○ OGC WMS, WFS, WFS-T, WMTS, CSW, KML, KMZ</li> <li>○ OASIS Common Alerting Protocol (CAP)</li> <li>○ ASTERIX CAT249</li> <li>○ ASTERIX CAT250</li> <li>○ AIS</li> </ul>
	INW	GeoC2	<ul style="list-style-type: none"> <li>○ OGC</li> <li>○ SensorML</li> </ul>
	STWS	ENGAGE C3i	<ul style="list-style-type: none"> <li>○ IEC PAS 61162-100 (AIS)</li> <li>○ IVEF VTS Exchange Format</li> <li>○ ASTERIX CAT250</li> <li>○ NMEA 0183</li> <li>○ OGC WMS, WFS, WFS-T, WMTS, CSW, KML, KMZ</li> <li>○ NetCDF, BUFR, HDF5, GRIB1, GRIB2</li> <li>○ RTSP, SIP/VoIP</li> <li>○ Atom, RSS, GeoRSS</li> <li>○ OASIS EDXL-DE, EDXL-RM, EDXL-SitRep family</li> <li>○ OASIS Common Alerting Protocol (CAP)</li> </ul>
	ENG	SMART FENIX	<ul style="list-style-type: none"> <li>○ ASTERIX CAT250</li> <li>○ NMEA 0183</li> <li>○ CSV, KML, KMZ</li> </ul>
DF & DSS	CMCC	WITOIL	<ul style="list-style-type: none"> <li>○ OGC WMS, NetCDF</li> </ul>
	CMCC	VISIR	<ul style="list-style-type: none"> <li>○ OGC WMS, NetCDF</li> </ul>
	CMCC	OCEAN-SAR	<ul style="list-style-type: none"> <li>○ OGC WMS, NetCDF</li> </ul>
	GMV	SOCRATES DF	<ul style="list-style-type: none"> <li>○ AIS</li> <li>○ ASTERIX 250</li> </ul>
	STWS	TRITON	<ul style="list-style-type: none"> <li>○ NMEA 0183</li> <li>○ SQL-92</li> <li>○ AIS</li> </ul>
	ICCS	INUS Platform	<ul style="list-style-type: none"> <li>○ MQTT</li> <li>○ NMEA 0183</li> <li>○ MAVLink</li> </ul>

System	ANDROMEDA's Partner	Partner's Tool	Adopted Standard
			<ul style="list-style-type: none"> <li>○ WebRTC</li> <li>○ RTP - SRTP</li> <li>○ HTTPS</li> </ul>
	CDN	ESSG Framework	<ul style="list-style-type: none"> <li>○ NMEA 0183</li> <li>○ AIS</li> <li>○ HTTPS</li> <li>○ CSV, JSON</li> </ul>

In the following, a short description of each standard mentioned in Table 1 is provided:

- **NMEA 0183:** NMEA 0183 has been defined and controlled by the National Marine Electronics Association [1]. It is the successor of NMEA 0180 and 0182 standards and it is used worldwide in a variety of industry segments with the main focus in marine electronics such as echo sounders, sonars, anemometers, gyrocompasses, GPS receivers and so on. The main goal of 0183 is the definition of electrical signal requirements, data transmission protocol and time, and specific sentence formats for a 4800 baud serial data bus. An ASCII serial communication protocol is used which defines how data are transmitted from one and only talker to multiple listeners at a time. Therefore, it supports one-way serial data transmission. There is also 0183 HS (High Speed) standard where a 38.4K baud serial data bus is defined.
- **OGC WMS/WFS/WFS-T/WCS/WMTS:** Open Geospatial Consortium is an international voluntary consensus standards organization. One standard of interest is the Web Map Server or Service (WMS) which specifies the interface and parameters to dynamically request of maps from a server [2]. Every OGC WMS is individually configured and can serve a multitude of different maps, combination of layers and can optionally even be styled with different cartography. Google Earth is an example of proprietary standalone software that allows viewing web map services.

In contrast to the images served by WMS, Web Feature Service (WFS) communicates geographic feature information. It allows features to be queried, updated, created, or deleted by the client over the internet. Instead of sharing this geographic information at the file level using an FTP (File Transfer Protocol), WFS offers direct access to the geographic information at the feature and feature property level. A transactional web feature service (called WFS-T) enables the creation, deletion, and updating of features [3].

A Web Coverage Service (WCS) (Fig. 4) is used to transfer coverages; i.e. objects covering a geographic area [4]. These coverages can be a set of data points, a regular grid of points or pixels, a set of segmented curves (such as road paths), a set of Thiessen polygons or a TIN triangulated irregular network (such as terrain models). This standard consists of a Core and several Extensions depicted on the diagram below as well as the dependencies between them and on other OGC standards are shown, too. Unlike WMS, which portrays spatial data to return static maps (rendered as pictures by the server), WCS provides available data together with their detailed descriptions; defines a rich syntax for requests against these data; and returns data with its original semantics (instead of pictures) which may be not only portrayed but also interpreted, extrapolated and so on.

A Web Map Tile Service (WMTS) is a standard protocol for serving pre-rendered or run-time computed georeferenced map tiles over the internet. WMTS is the successor of an earlier specification

called Tile Map Service (TLS). This specification was created in order to assist the intensive on-the-fly rendering problem CPU had in the of the previous millennium for massive parallel use cases.

For the record, there are other various standards in this family such as the Web Processing Service (WPS) and Web Coverage Processing Service (WCPS). The former one provides rules for standardizing inputs/outputs for invoking geospatial processing services as a web service The latter one defines a protocol-independent language for the extraction, processing, and analysis of multi-dimensional coverages representing sensor, image, or statistics data.

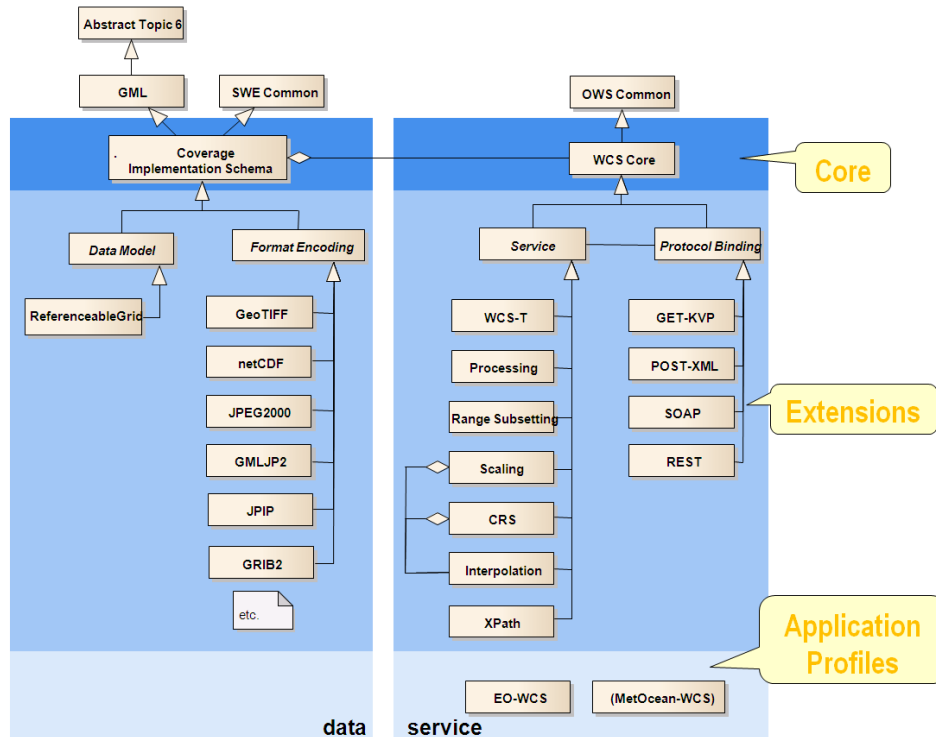


Figure 4: Core and Extensions of WCS. Dependencies on other OGC standards are also depicted.

- OGC KML/KMZ:** Keyhole Markup Language (KML) was submitted by Google to OGC and was involved within its consensus process with the ultimate goal to produce KML version 2.2 adopted as an OGC implementation standard [5] KML is an XML notation for expressing geographic annotations and visualizations within 2D and 3D map browsers. There are four main objectives for this standard: 1) That there be one international standard language for expressing geographic annotation and visualization on existing or future web-based online and mobile maps (2d) and earth browsers (3d), 2) That KML be aligned with international best practices and standards, thereby enabling greater uptake and interoperability of earth browser implementations, 3) That the OGC and Google will work collaboratively to ensure that the KML implementer community is properly engaged in the process and that the KML community is kept informed of progress and issues, 4) That the OGC process will be used to ensure proper life-cycle management of the KML Standard, including such issues as backwards compatibility. A KMZ is a compressed (zipped) version of a KML file.
- SensorML:** Sensor Model Language [6] provides a robust and semantically tied means of defining processes of components associated with the measurement and transformation of observations [7]. Its objective is to enable interoperability at syntactic and semantic level so that sensors and processes can be

better understood by machines. This standard is also produced by OGC described in the previous paragraphs. Aims of SensorML include: i) Provide descriptions of sensors and sensor systems for inventory management, ii) Provide sensor and process information in support of asset and observation discovery, iii) Support the processing and analysis of the sensor observations, iv) Support the geolocation of observed values (measured data), v) Provide performance and quality of measurement characteristics (e.g., accuracy, threshold, etc.), vi) Provide general descriptions of components (e.g. a particular model or type of a sensor) as well as the specific configuration of that component when its deployed, vii) Provide a machine interpretable description of the interfaces and data streams flowing in and out of a component, viii) Provide an explicit description of the process by which an observation was obtained (i.e., it's lineage), ix) Provide an executable aggregate process for deriving new data products on demand (i.e., derivable products), and x) archive fundamental properties and assumptions regarding sensor systems and computational.

- **OASIS Common Alerting Protocol (CAP) & EDXL:** This protocol described a general format for hazard-related emergency alerts and public warnings exchange over different types of networks [8]. It is an XML-based data format and provides a template for effective warning messages based on best practices of academic research and real-world lessons learnt. Among the offered capabilities CAP format is compatible with are:
  - geographic targeting using latitude and longitude shapes,
  - multilingual and multi-audience messaging,
  - phased and delayed effective times and expirations,
  - enhanced message update and cancellation features,
  - template support for framing complete and effective warning messages,
  - digital signature compatibility,
  - facility for digital images and audio.

Emergency Data Exchange Language (EDXL) is developed by OASIS International Open Standards Consortium and it is a suite of XML-based messaging standards allowing government entities to share critical information with emergency related parties. By standardizing messaging formats, communication between parties becomes an easier, faster and more qualitative task.

- **ASTERIX:** This standard stands for “All Purpose Structure Eurocontrol Surveillance Information Exchange” and is used for air traffic services (ATS) information developed by European ATS organization Eurocontrol [9]. There are different categories which include various kind of information. Target reports from surveillance sensors such as radars as well as processed information such as aircraft track and various system status messages are included. Each system/sensor using the ASTERIX data format is assigned a unique identifier composed of two 8 bit values, the System Area Code (SAC) and the System Identification Code (SIC). The ANSP selects the SIC, but the SAC is assigned globally to system operators by Eurocontrol. CAT249 and CAT250 are the two main categories used in some of ANDROMEDA's C2 tools and fall into the general area of civil and military non-standard applications (CAT241-255). More information about specification for surveillance data exchange can be found in [10].
- **AIS/ IEC 61162-100:** Automatic Identification Systems (AIS) are designed to be capable of providing information about the ship to other ships but also to coastal authorities automatically. These functionalities are succeeded by installing transponders on ships which are operated by vessel traffic services. AIS

information complements marine radar which is still the primary method of collision avoidance for water transport. In [11], the underlying potential and the benefits of using AIS to ship and maritime administration has been covered. The impact on shore-based services, port management and an effective AIS network is highlighted. The origin goal of AIS was collision avoidance but other applications include fishing fleet monitoring and control, maritime security, aids to navigation, search and rescue, accident investigation, ocean current estimates, infrastructure protection, fleet and cargo tracking and so on. International Maritime Organization (IMO) adopted a new requirement for all ships to carry AISs in order to be able to provide information about the ship to other ships and authorities automatically. This regulation in brief required that all AISs provide information including the ship's identity, type, position, course, speed, navigational status and other safety related information. It also requires the ability of receiving automatically such information from other ships, monitor and track them and finally exchange data with shore-based facilities. The IEC 61162-1 is an International Standard being prepared by the International Electrotechnical Commission (IEC) technical committee for maritime navigation and radiocommunication equipment and systems [12].

- **VTS Data Exchange:** Known as open Inter VTS Exchange Format (IVEF), it is the result of standardization efforts for exchanging information between vessel traffic services (VTS) and maritime control centers. Application of IVEF has been included to various areas such as sharing valid traffic images, sharing plan information, performing simulations [13] and so on. It is customizable and comes with a software development kit useful for rapid software development across various operating systems. The architecture layout and description can be found in [14]. VTS middleware research [15] is also based on IVEF protocol.
- **NetCDF:** This standard is usually used in GIS applications, climatology, meteorology and oceanography. NetCDF (network Common Data Form) is a set of interfaces for array-oriented data access and a freely-distributed collection of data access libraries for C, Fortran, C++, Java, and other languages. The netCDF libraries support a machine-independent format for representing scientific data. Together, the interfaces, libraries, and format support the creation, access, and sharing of scientific data. In other words, NetCDF is a set of software libraries with machine-independent data formats that support the creating and sharing of array oriented scientific data [16]. These libraries are developed by the University Corporation for Atmospheric Research (UCAR) [17].
- **BUFR-GRIB:** World Meteorological Organization (WMO) has produced two binary data formats called BUFR (Binary Universal Form for the Representation of meteorological data) and GRIB (General Regularly-distributed Information in Binary form). BUFR (see Fig. 5) has been designed to achieve efficient exchange of meteorological and oceanographic data as well as it is characterized for its flexibility when it comes for huge volumes of data. It encodes in situ and satellite observations and it can also represent forecast data. However a major disadvantage of this format is its dependence on external tables [18]. Several guides on how to use BUFR tables, compress data and software tools, examples and routines exist in various documentation articles [19]. GRIB on the other hand is designed to encode data produced by numerical weather prediction models and it can also represent observations, but on a regularly distributed coverage.

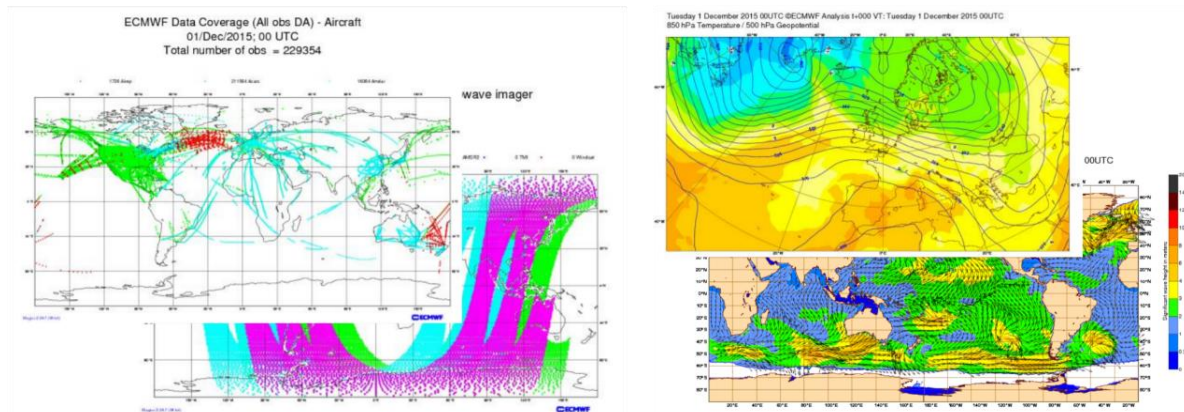


Figure 5 BUFR (left) & GRIB (right) data representation.

- **HDF:** Hierarchical Data Format (HDF) [20] is a set of file formats specifically designed to store and organize large amounts of data. There are two main types; HDF4 and HDF5. HDF supports n-dimensional datasets and each element in the dataset may itself be a complex object. HDF is characterized for its portability, no vendor lock-in and a self-describing file format which means that all data and metadata can be passed along in one file. HDF is a cross platform application with high performance I/O. On the other hand, several issues [21] have been documented such as: i) High risks of data corruption, ii) bugs and crashes in the HDF5 library and in the wrappers, iii) Poor performance in some situations, iv) Limited support for parallel access, x) Impossibility to explore datasets with standard Unix/Windows tools, xi) Hard dependence on a single implementation of the library, vii) High complexity of the specification and the implementation, and viii) Opacity of the development and slow reactivity of the development team.
- **RTSP:** The Real Time Streaming Protocol (RTSP) is a control protocol for initiating and directing delivery of streaming multimedia from media servers [22]. RTSP does not deliver data, though the RTSP connection may be used to tunnel RTP traffic for ease of use with firewalls and other network devices. RTP and RTSP will likely be used together in many systems, but either protocol can be used without the other. The RTSP specification contains a section on the use of RTP with RTSP. RTSP is very important for interoperability on streaming systems which involve many components (such as encoders, players and servers) that must share common mechanisms. Protocols like RTSP are necessary to achieve end to end interoperability.
- **SIP/ VoIP:** VoIP is a broad term which refer to any phone call made over the internet and not over the traditional telephone lines. As a result, VoIP depends on data connectivity to transmit data packets instead of public switched telephone network (PSTN). Session Initiation Protocol (SIP) is a signaling protocol used to handle communication sessions in VoIP applications (initiation, maintenance and termination). Using only VoIP can bring several functionalities and drawbacks summarized below:

  - Low initial investment cost.
  - Ongoing cost savings with predictable, flat rate monthly billing.
  - VoIP systems are highly portable and don't need on-site installation.
  - Many basic VoIP service plans offer limited features such as caller ID, call waiting, and call forwarding.
  - Most VoIP providers do not require long-term service contracts.
  - Requires bandwidth for service availability and sufficient call quality of service (QoS).

- Some basic VoIP services may not offer mobile integration or mobile apps.
- Voice-only service lacks support for multimedia communications.

Whereas, VoIP usage along with SIP can bring advantages and disadvantages as follows:

- Offers the potential for immediate cost savings on business applications by allowing companies to consolidate technologies into unified communications.
  - Provides failover to employee mobile devices if data connectivity is lost.
  - Can provide extreme flexibility in pricing by allowing businesses to purchase add-on features and lines by need.
  - Includes user-friendly administrative tools for adding lines and features.
  - Can seamlessly integrate with cloud applications for Unified Communications implementations.
  - May offer built-in integration with common business applications and software for enhanced productivity.
  - Could be integrated with existing PRI lines to create a hybrid phone system.
  - SIP requires sufficient internet bandwidth to support quality service.
  - The quality of service offered by SIP providers can vary.
  - SIP over a public internet service, as opposed to dedicated fiber-optic internet service offered by the same vendor as your SIP carrier, could present quality and security risks.
- **RSS, GeoRSS, Atom:** Rich Site Summary or Really Simple Syndication is a standardized web feed exchange through the internet using extensible markup language (XML). Atom is an XML-based file format used to syndicate content and it is developed as an alternative to RSS 2.0. GeoRSS [23] is a specification for encoding location as part of a web feed. GeoRSS proposes a standardized way in which location is encoded with enough simplicity and descriptive power to satisfy most needs to describe the location of Web content. GeoRSS may not work for every use, but it should serve as an easy-to-use geotagging encoding that is brief and simple with useful defaults but extensible and upwardly-compatible with more sophisticated encoding standards. These feeds are consumed by geographic software such as map generators. There are currently two encodings of GeoRSS:
    - GeoRSS-Simple is meant as a very lightweight format that developers and users can quickly and easily add to their existing feeds with little effort. It supports basic geometries (point, line, box, polygon) and covers the typical use cases when encoding locations.
    - GeoRSS GML is a formal GML Application Profile, and supports a greater range of features, notably coordinate reference systems other than WGS-84 latitude/ longitude.

Both formats are designed for use with Atom 1.0, RSS 2.0 and RSS 1.0, although it can be used just as easily in non-RSS XML encodings.

- **SQL-92:** Structure Query Language (SQL) is a cross-platform domain-specific programming language and it is used for managing data held in a relational database management system. SQL-92 is the third major revision of the SQL database query language.
- **MQTT:** MQTT is an OASIS standard messaging protocol for the Internet of Things (IoT) [24]. It is designed as an extremely lightweight publish/subscribe messaging transport that is ideal for connecting remote devices with a small code footprint and minimal network bandwidth. MQTT today is used in a wide variety of industries, such as automotive, manufacturing, telecommunications, oil and gas, etc. The

design principles are to minimise network bandwidth and device resource requirements whilst also attempting to ensure reliability and some degree of assurance of delivery. These principles also turn out to make the protocol ideal of the “Internet of Things” world of connected devices, and for mobile applications where bandwidth and battery power are at a premium.

- **MAVlink:** MAVLink is a very lightweight messaging protocol for communicating with drones and between onboard drone components [25]. MAVLink follows a modern hybrid publish-subscribe and point-to-point design pattern: Data streams are sent / published as topics while configuration sub-protocols such as the mission protocol or parameter protocol are point-to-point with retransmission. Messages are defined within XML files . Each XML file defines the message set supported by a particular MAVLink system, also referred to as a "dialect". The reference message set that is implemented by most ground control stations and autopilots is defined in common.xml (most dialects build on top of this definition).
- **WebRTC:** WebRTC (Web Real-Time Communication) is a technology which enables Web applications and sites to capture and optionally stream audio and/or video media, as well as to exchange arbitrary data between browsers without requiring an intermediary [26]. The set of standards that comprise WebRTC makes it possible to share data and perform teleconferencing peer-to-peer, without requiring that the user install plug-ins or any other third-party software. WebRTC consists of several interrelated APIs and protocols which work together to achieve this.
- **RTP-SRTP:** The Secure Real-Time Transport Protocol (SRTP) is an Internet standards-track security profile for RTP used for encryption, message authentication/integrity, to provide confidentiality and to replay protection for RTP traffic [27].
- **HTTPS:** HTTP is a protocol which allows the fetching of resources, such as HTML documents, etc [28]. It is the foundation of any data exchange on the Web and it is a client-server protocol, which means requests are initiated by the recipient, usually the Web browser. A complete document is reconstructed from the different sub-documents fetched, for instance text, layout description, images, videos, scripts, and more. Hyper Text Transfer Protocol Secure (HTTPS) is the secure extended version of HTTP providing encryption.
- **CSW:** Catalogue Service for the Web (CSW) or Catalogue Service - Web, is a standard for exposing a catalogue of geospatial records in XML on the Internet (over HTTP). The catalogue is made up of records that describe geospatial data (e.g. KML), geospatial services (e.g. WMS), and related resources. Catalogue services support the ability to publish and search collections of descriptive information (metadata) for data, services, and related information objects. Metadata in catalogues represent resource characteristics that can be queried and presented for evaluation and further processing by both humans and software. Catalogue services are required to support the discovery and binding to registered information resources within an information community [29].
- **CSV:** CSV is a simple format for representing a rectangular array (matrix) of numeric and textual values. A CSV file is a delimited text file that uses a comma to separate values. Each line of the file is a data record [30]. Each record consists of one or more fields, separated by commas. A CSV file typically

stores tabular data (numbers and text) in plain text, in which case each line will have the same number of fields.

As described above, there are a plenty of standards (more than 20) that are adopted by Andromeda project for maritime and land border assets (e.g., surveillance, sensors and radars, maritime reporting systems, command and control systems and GUI, data visualization in maps, communications and messaging systems, etc) ensuring compatibility and interoperability. Concerning the data sharing among organizations and systems, the Andromeda project has adopted the CISE standards, and in particular the extended e-CISE which is described in section 3.2.

## 3.2 ANDROMEDA e-CISE Proposed Interoperability Standard

### 3.2.1 e-CISE Data Model

As stated in Section 2.1, there is a need to extend the CISE Model in order to support land border operational information exchange as well as to enhance CISE's Maritime Border vocabulary to support enhanced maritime capabilities, sensors and other assets. Andromeda project proposed the Enhanced CISE Model, namely e-CISE model. Figure 6 shows the transition from CISE to e-CISE. The e-CISE Data Model is based on the latest version of the CISE Data Model v1.5.3 demonstrated in the EUCISE2020 Project, which was initially based on the CISE Data Model version 1.0, as defined for the Cooperation Project. Here, some of the main enhancements of the e-CISE are provided. For more detailed information, a dedicated deliverable of ANDROMEDA has been submitted "D.3.1 e-CISE Data Model description"<sup>27</sup> which is freely available. The main enhancements of the e-CISE Data Model are:

- Provides enrichments to the vocabulary of the CISE Data Model regarding the maritime and land domains by introducing new entities associations, capabilities and richer set of types in several enumerations.
- Enriches the set of vessel types, AIS and radar sensor definitions, maritime and land anomaly with a broader set of anomaly types and rules, new classification and detection capabilities of entities.
- Defines the vocabulary required to support all functional blocks and architecture of the ANDROMEDA borders command and control systems. Regarding land border surveillance, several new entities are introduced such: i) operation, ii) mission, iii) task entities to define all border surveillance activities, iv) subject entity to define the main focus of those activities, v) sensor entity to support legacy sensors of ANDROMEDA (camera, radar, AIS), and iii) report entity representing the reporting process of surveillance activities.
- Identifies the data model entities used for information exchange of Andromeda Data Fusion and Decision Support services. For the integration and interoperability of the Data Fusion Services, the e-CISE Rule entity is designed, acting as the configuration model of those systems. Finally, regarding Decision Support Tools (DST), the entities Simulation Request & Simulation Response are defined acting as the exchange model between an Andromeda C2 and the DST.

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<sup>27</sup> ANDROMEDA project Deliverable D3.1 "D.3.1 e-CISE Data Model description", Public deliverable, (31.3.2020), <https://www.ANDROMEDA-project.eu/downloads/index.html>



Andromeda Hub features can be summarized as follows: i) compliant with CISE standards and supporting the e-CISE broader vocabulary, ii) supports service model of CISE, iii) distinguishes between an ANDROMEDA or a CISE Service, iv) implements both REST and SOAP interfaces, v) supports participants such as C2 or DSTs, vi) service discovery, and vii) acts as a forwarding agent of messages between C2s.

For instance, the e-CISE adapter of the INUS platform implements the interconnection of the: i) Intelligence Officer's workstation and the UAV Metadata with the DF/SA Service Bus, and ii) Pilot's workstation mission planner and C2 (via DF/SA service bus in transparent mode). Table 2 shows the ANDROMEDA's endpoints systems provided by several partner's tools and associated interfaces in which their interconnection was expressed in an e-CISE adapter manner.

*Table 2: ANDROMEDA's endpoints systems provided by several partner's tools and associated interfaces in which their interconnection was expressed in an e-CISE adapter manner.*

System	Responsible Partner	Tool	Interface Name	Endpoint systems
C2	GMV	Socrates C2	Data Fusion Engine Interface	Socrates C2 – Data Fusion Engine
			ANDROMEDA Hub Interface	Socrates C2 – ANDROMEDA Hub
			Video Streaming Interface	Socrates C2 – Video Camera Component
	INW	GeoC2	GeoC2 Sensing Interface	Sensing API
			GeoC2 Data API Interface	Data API
			Media Server Interface	Web Client
	STWS	ENGAGE C3i	Andromeda Hub	ENGAGE e-CISE Network Adaptor to Andromeda HUB Service
			Data Fusion Gateway Interface	ENAGE C3i to Data Fusion Gateway Interface
			DST	ENGAGE e-CISE Network Adaptor to OCEAN-SAR
			DST	ENGAGE e-CISE Network Adaptor to VISIR
			DST	ENGAGE e-CISE Network Adaptor to WITOIL
	ENG	SMART FENIX	Vessels e-CISE Interface	SMART e-CISE Adaptor – ANDROMEDA Hub
MaritimeAnomalies e-CISE Interface			SMART e-CISE Adaptor – ANDROMEDA Hub	
DF & DSS	CMCC	WITOIL	Oil Spill Simulation Interface	CMCC e-CISE Adaptor – C2
	CMCC	VISIR	Ship Navigation Simulation Interface	CMCC e-CISE Adaptor – C2
	CMCC	OCEAN-SAR	Drifting Simulation Interface	CMCC e-CISE Adaptor – C2
	GMV	SOCRATES DF	Data Fusion Engine Interface	Data Fusion Engine – Socrates DF
	STWS	TRITON	Data Fusion Gateway Interface	TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Raw Vessels)
TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Raw Persons)				

System	Responsible Partner	Tool	Interface Name	Endpoint systems
				TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Raw Vehicles)
				TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Tracked Vehicles)
				TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Tracked Persons)
				TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Fused Vehicles)
				TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Fused Persons)
				TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Radar Tracked Vessels)
				TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Fused Vessels)
				TRITON Kafka Client – Data Fusion Gateway (Kafka Topic – Fused Vehicles)
				TRITON Kafka Client – Data Fusion Gateway (Kafka Topic - Anomalies)
	ICCS	INUS Platform	Intelligence Officer’s Workstation eCISE Interface	INUS Intelligence Office Workstation - Data Fusion Gateway
			Pilot’s Workstation eCISE Interface	Pilot Control Center – Data Fusion Gateway
			Video Streaming Interface	INUS Intelligence Office Workstation Media Proxy Server – C2
	ENG	SMART FENIX	Vessels eCISE Interface	SMART e-CISE Adaptor – ANDROMEDA Hub
			MaritimeAnomalies eCISE Interface	SMART e-CISE Adaptor – ANDROMEDA Hub
	INOVAWORKS	ANDROMEDA HUB	Adaptors’ Interface	ANDROMEDA hub – ANDROMEDA Components
CDN	ESSG Framework	Anomalies eCISE Interface	SMART -C2	
		Data Fusion Gateway Interface	ESSG Kafka Client – Data Fusion Gateway (Kafka Topic – Fused Vessels)	

Summarizing, the outcome of ANDROMEDA’s initiative is the e-CISE Data Model, which is fully based on the CISE Data Model, not only by re-using, when sufficient, the already defined CISE entities, but also by applying the same Data Model design principles of CISE Data Model. The outcome of e-CISE is the following:

- A fully functional CISE Data Model supporting land and maritime border operational information exchange.
- A data model capable of integrating Data Fusion and Decision Support services.
- A data model easily understandable for companies familiar with CISE.
- A data model which is backwards compatible with CISE Data Model, meaning that converting from e-CISE to CISE and vice versa is straightforward.
- A data model which could be furtherly enhanced to support information exchange in other operational sectors.

## 4. ANDROMEDA's project activities for pre-standardization

The ANDROMEDA Consortium recognized that standardizations aspects needed to be addressed early on and during the project's design phase in order to increase the exploitation potential of e-CISE. Towards to this direction several activities were addressed by the ANDROMEDA consortium described in the following sections. Such activities include pre-standardization activities and methodology as well as activities for promoting e-CISE as a possible new standardization item.

### 4.1 Pre-standardization activities – Methodology

In the context of the ANDROMEDA project, a methodology that incorporates several pre-standardization activities was carried out aiming to increase the exploitation potential of e-CISE. The basic steps of these pre-standardization activities are depicted in Fig. 7. Initially, the existing standards used by ANDROMEDA's partner tools of C2 legacy systems, data fusion systems, and decision support systems were summarized. This summary helped to ensure that ANDROMEDA's partner tools were able to adopt well known standards in several domains such surveillance, sensors and radars, maritime reporting systems, command and control systems and GUI, data visualization in maps, communications, and messaging systems, etc. As next step, the CISE framework was analysed and defined (see section 2.1) verifying that the CISE paradigm is an appropriate and efficient as an information exchange framework for maritime border control operations. According to such analysis, some aspects like the support of land border operational information exchange, the enhancement on CISE maritime border vocabulary, and the support of information exchange across data fusion service layers and decision support tools layers, that currently are not considered in CISE, were defined.

The Enhanced CISE Model, namely e-CISE model (see section 2.1) based on the CISE Data Model, was defined and described in details (see section 3.2). Indeed, a dedicated deliverable of Andromeda has been submitted "D.3.1 e-CISE Data Model description"<sup>28</sup> which is freely available. Such detailed description of the e-CISE and its free availability, highlight its flexibility (e.g., converting from e-CISE to CISE and vice versa is straightforward), its further scalability, and its ability to be understandable for individuals familiar with CISE. Throughout the ANDROMEDA project, a constant support from experts was provided as well as the results of the project and the utility of the e-CISE were evaluated is a constant basis. More specifically, the results of the projects and the e-CISE were presented in Andromeda technical meetings, plenary meetings, advisory board, end-user, and meetings with relevant experts and stakeholders, utilizing the among others the Andromeda user community established within the project.

In parallel, in order to ensure that e-CISE has a potential for further exploitation and standardization, a representative from JRC-Unit E.5 Transport and Border Security (as JRC are the originators of the CISE Data Model) was actively and deeply involved in the review process of D.3.1 (as an external reviewer and member of the Advisory Board) and definition of the e-CISE data model.

More specifically during the definition of the e-CISE data model, an internal document was used where the representative from JRC provided a written feedback for each e-CISE entity of service or data (either remained same entity from CISE, either enhanced CISE entity, either new core entity) in a constant basis till its final definition. The detailed comments of the representative from JRC and the exchanged information between this cooperation had as a result a mature e-CISE model that could support not only the ANDROMEDA's trials but also to be a basis for other research projects, operational use, and other extensions.

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<sup>28</sup> ANDROMEDA project Deliverable D3.1 "D.3.1 e-CISE Data Model description", Public deliverable, (31.3.2020), <https://www.ANDROMEDA-project.eu/downloads/index.html>

As next step, suitable pre-standardization channels for interaction and extroversion activities were identified. The channels that were identified were:

- i) EMSA CISE stakeholder group<sup>29</sup>
- ii) ETSI ISG-CDM, i.e., INDUSTRY SPECIFICATION GROUP (ISG) EUROPEAN COMMON INFORMATION SHARING ENVIRONMENT SERVICE AND DATA MODEL (CDM)<sup>30</sup> and
- iii) JRC

Although each channel refers to a somewhat different domain from the rest, the combination of them strengthens and support liaison activities and introduction of e-CISE. This was achieved as some end-users of ANDROMEDA (ITN, PTN, HMOD, HCG and EAMA) are members of the EMSA CISE stakeholder group (see also ANDROMEDA's deliverable D2.5). On the other hand, the ANDROMEDA's partners, SATWAYS and INOVAWORKS, are members of the ETSI ISG Group while the external advisor, representative from JRC, is member of JRC. Finally, the e-CISE has been successfully implemented and demonstrated in real operational conditions during the ANDROMEDA's trials.

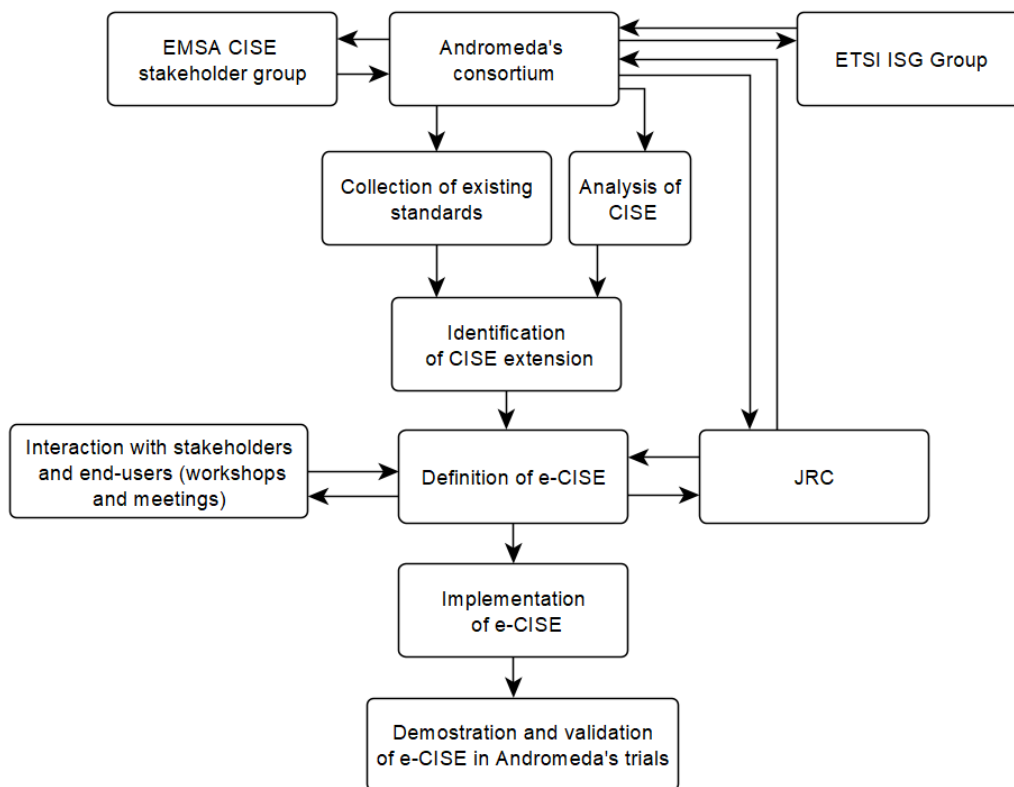


Figure 7: ANDROMEDA's consortium methodology that incorporates pre-standardization activities for the exploitation potential of e-CISE.

## 4.2 Promoting e-CISE as a possible new standardization item and future plans

ANDROMEDA's consortium aims to promote e-CISE as a possible new standardization item. In this context several activities have been carried out. Firstly, the e-CISE specifications and its detailed definition have been already freely available to general public and relevant stakeholders at the dedicated deliverable. By this way,

<sup>29</sup> <http://www.emsa.europa.eu/transitional-phase/stakeholders.html>

<sup>30</sup> <https://www.etsi.org/about/our-operations>

the structure of e-CISE, as well as its enhancements compared to CISE are highlighted, made it a ready to use enhanced maritime and land border operational information exchange paradigm. A significant dissemination activity of e-CISE was carried at the 1<sup>st</sup> (September 2020) and 2<sup>nd</sup> (June 2021) ANDROMEDA's workshops, where, among other results of the project, the progress of the definition and the final version of e-CISE were presented to ANDROMEDA's consortium, end-users, experts, and other H2020 R&D projects, etc. In the 1<sup>st</sup> ANDROMEDA workshop, it was verified that the existing CISE data model used in CISE network supports only maritime domain as well as that ANDROMEDA's e-CISE data model includes both maritime and land border data (see also ANDROMEDA's deliverable D2.5). However, existing CISE nodes are not capable to use the land border entities such as defined in e-CISE data model and in other related information sharing models. In the 2<sup>nd</sup> ANDROMEDA workshop, it was concluded that the standardization of e-CISE will be achieved with the support of ETSI customized according to the end-user needs. It is very important to be supported and promoted from the end-users. Thus, it should be lightweight and capable to support a series of plug-ins that are compatible and interoperable to help relevant sectors. Another dissemination action of e-CISE was its successful usage at the three real operational ANDROMEDA's trials (Iberian Maritime Border Trial, Greece-Bulgaria Land Border – Maritime Trial, Ionian-Adriatic Maritime Border Trial). For all the trials, the interconnection between the ANDROMEDA systems was expressed with e-CISE models proving that e-CISE has great potential to be a new a standardization item to support enhanced maritime and land border operational situations. Further, a liaison activity was also carried out between ANDROMEDA project and the EFFECTOR project<sup>31</sup>. As a result of this activity, the EFFECTOR project decided to adopt the e-CISE model. Furthermore, the end-partners of ANDROMEDA that are the same with the EFFECTOR, have expressed strong willingness to promote e-CISE. Another awareness raising activity was the participation of ANDROMEDA's partners to the "Workshop on Horizon Border Security projects" in 28 May 2021<sup>32</sup> organized by FRONTEX. Furthermore, ANDROMEDA project was selected as relevant for standardization as means of valorisation of R&I results. In this context a survey questionnaire according EC for standardization activities for H2020 R&D projects was submitted (see Annex A).

Lat but not least the ANDROMEDA Coordinator has received from the Industry Specifications Group in June an expression of interest towards the ANDROMEDA results and in particular to the potential contribution to the CISE model by extending the land domain according to the e-CISE specifications. The specific request from ISG was to use ANDROMEDA as a starting point for their efforts to extend the CISE standardization to the land domain. Hence in the light of the ISG CDM meeting held on July 20, ISG asked to share ANDROMEDA the operational scenarios and the use cases involved for the trials.

In order to ensure that the e-CISE paradigm will continue to evolve, several activities are aimed after the end of the project. Firstly, the e-CISE is already been as dissemination priority in each ANDROMEDA's partner exploitation plan strategy. By this way the e-CISE will be further established in ANDROMEDA's partner tools in order to be ready for other projects. Finally, new working groups within ETSI ISG Group and EMSA CISE stakeholder group are aimed to be formed associated with e-CISE. Such new working groups will be driven not only from industry partners (such SATWAYS and INOVAWORKS) but also from several end-users.

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<sup>31</sup> <https://www.effector-project.eu>

<sup>32</sup> <https://frontex.europa.eu/future-of-border-control/eu-research/news-and-events/workshop-on-horizon-border-security-projects-20-21-may-2021-lkgt15>

## 5. Conclusions

In this deliverable, a standardization report is provided in the terms of the ANDROMEDA project. Initially, the role of the standardization is provided under the scope of the European Commission standardization policy and then, the established European Standards Organizations are listed afterwards. The ANDROMEDA Consortium recognized that standardizations aspects needed to be addressed early on and during the project's design phase in order to increase the exploitation potential of e-CISE. Towards to this direction, several pre-standardization activities were addressed in the adopted methodology such: i) the collection of existing standards used by ANDROMEDA's partner tools of C2 legacy systems, data fusion systems, and decision support systems, ii) the analysis and definition of CISE framework, iii) the identification of CISE extension, and iv) the definition of the enhanced CISE (e-CISE). Also, suitable pre-standardization channels for interaction and extroversion activities were identified. The channels that were identified were: i) EMSA CISE stakeholder group, ii) ETSI ISG Group, and iii) JRC. Although each channel refers to a somewhat different domain from the rest, the combination of them strengthens and support liaison activities and introduction of e-CISE. Furthermore, several dissemination activities of e-CISE have been carried out such: i) the 1<sup>st</sup> (September 2020) and 2<sup>nd</sup> (June 2021) ANDROMEDA's workshops, ii) the successful use of e-CISE at the three real operational ANDROMEDA's trials, iii) liaison activity between Andromeda project and the EFFECTOR project, request for participation to the ISG CDM meeting in July 2021. The aforementioned activities are strongly support the ANDROMEDA's consortium aim, i.e., to promote e-CISE as a possible new standardization item.

## 6. References

1. [https://www.nmea.org/content/STANDARDS/NMEA\\_0183\\_Standard](https://www.nmea.org/content/STANDARDS/NMEA_0183_Standard).
2. <https://www.ogc.org/standards/wms/introduction>
3. <https://desktop.arcgis.com/en/arcmap/latest/extensions/production-mapping/data-editing-with-wfs-services.htm>
4. <https://www.ogc.org/standards/wcs>
5. <https://www.ogc.org/standards/kml>
6. <https://www.ogc.org/standards/sensorml>
7. N. Chen and C. Hu, "A sharable and interoperable meta-model for atmospheric satellite sensors and observations," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 5, no. 5, pp. 1519-1530, 2012
8. A. Botterell and J. Westfall, "Common Alertin Protocol Version 1.2," OASIS, 2010
9. <https://www.eurocontrol.int>
10. A. Engel, "Eurocontrol specification for surveillance data exchange - Part 1," EUROCONTROL, 2016.
11. B. Berking, "Potential and benefits of AIS to ships and maritime administrations," *WMU journal of maritime affairs*, vol. 2, no. 1, pp. 61-78, 2003.
12. International Electrotechnical Commission, 2002. Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 100: Single talker and multiple listeners – Extra requirements to IEC 61162-1 for the UAIS. Reference number IEC/PAS 61162-100.
13. P. Namje, "Implementation of inter-VTS data exchange format protocol based on mobile platform for next-generation vessel traffic service system," *International Information Institute (Tokyo). Information*, vol. 17.10 (A), p. 4847, 2014.
14. [http://openivef.org/?page\\_id=74](http://openivef.org/?page_id=74)
15. K. Taekyeong and N. Park, "Design of J-VTS middleware based on IVEF protocol," *International Conference on Grid and Pervasive Computing*, pp. 723-729, 2013
16. <https://www.ogc.org/standards/netcdf>
17. <https://www.ucar.edu/>
18. J. Caron, "On the suitability of BUFR and GRIB for archiving data," in *AGU Fall Meeting Abstracts*, 2011.
19. M. Dragosavac, BUFR User's Guide, European Centre for Medium-Range Weather Forecasts, 2008
20. <https://www.hdfgroup.org/>
21. <https://cyrille.rossant.net/moving-away-hdf5/>
22. H. Schulzrinne, A. Rao and R. Lanphier, "RFC2326: Real time streaming protocol (RTSP)," 1998.
23. OGC white paper an introduction to GeoRSS: a standards based approach for geo-enabling RSS feeds, 2006, Open Geospatial Consortium and others.
24. <https://mqtt.org/>
25. <https://mavlink.io/en/>
26. <https://webrtc.org/>
27. Alexander, A., L., et al., 2009. An Evaluation of Secure Real-time Transport Protocol (SRTP) Performance for VoIP. Proc. of the 3<sup>rd</sup> Int. Conference on Network and System Security.
28. Shiranzaei, and A., Khan., R.Z. 2015. Internet Protocol Versions – A Review. Proc. of the second International Conference on Computing for Sustainable Global Development.

29. <https://www.ogc.org/standards/cat>
30. <https://www.loc.gov/preservation/digital/formats/fdd/fdd000323.shtml>

## 7. Annex A: Submitted survey questionnaire to EC for standardization activities for H2020 R&D projects

# Code of Practice for Researchers on Standardisation

Fields marked with \* are mandatory.

## 1 Introduction

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Dear Project beneficiary,

As part of the implementation of the Communication on 'A new ERA for Research and Innovation' DG Research and Innovation (DG R&I) is developing Guiding Principles for knowledge valorisation as set out by Action 7 of the Communication. A set of codes of practice have been proposed in order to implement these Guiding Principles. One of these codes of practice will be a Code of Practice for researchers on standardisation. This code will be co-created with relevant stakeholders to ensure its usefulness, relevance and create ownership. As part of this exercise, DG R&I is launching a comprehensive on-line survey to collect and understand the experiences and views of beneficiaries on the role of standardisation in valorising R&I results.

By investigating the nature and the extent to which Horizon 2020 projects have made use of standards or have proposed or contributed to the development of new standards as part of their activities, the survey will provide important input to the code of practice on standardisation.

Following the analyses of project data of Horizon 2020, your project has been selected as relevant for standardisation as means of valorisation of R&I results. In order to facilitate the design of the code, DG R&I would appreciate if you could contribute to this work by responding the survey questionnaire. If your project is ongoing, please respond to the survey in relation to your expectations for the project as a whole. Bearing in mind the specificities of some questions you may deem it necessary to involve project partners. Responses should be completed before 31 May 2021.

Your answers will be saved automatically as you enter them. All individual responses will be treated as confidential and will not be reported in an attributable format without your permission.

## 2 About your organisation and consortium

---

- \* 2.1 Please indicate the number of your project.

833881

- \* 2.2 What type of organisation is the project coordinated by?

- University  
 Research and Technology Organisation

1

- 
- Company other than SME  
 SME  
 National standardisation body (NSB) or standard development organisation (SDO)  
 Other

- 2.3 If other, please specify.

Public authority

- \* 2.4 What kind of organisations is the consortium composed of? Multiple indication is possible.

- University  
 Research and Technology Organisation  
 Company other than SME  
 SME  
 National standardisation body (NSB) or standard development organisation (SDO)  
 Other

- 2.5 if other, please specify.

Public Authorities

• 2.6 In which countries are the consortium members of your project located? Multiple indication is possible.

- |  |  |  |
|--|--|--|
| <input type="checkbox"/> Austria             | <input type="checkbox"/> Germany           | <input type="checkbox"/> Poland              |
| <input type="checkbox"/> Belgium             | <input checked="" type="checkbox"/> Greece | <input checked="" type="checkbox"/> Portugal |
| <input checked="" type="checkbox"/> Bulgaria | <input type="checkbox"/> Hungary           | <input type="checkbox"/> Romania             |
| <input type="checkbox"/> Croatia             | <input type="checkbox"/> Ireland           | <input type="checkbox"/> Slovakia            |
| <input type="checkbox"/> Republic of Cyprus  | <input checked="" type="checkbox"/> Italy  | <input type="checkbox"/> Slovenia            |
| <input type="checkbox"/> Czech Republic      | <input type="checkbox"/> Latvia            | <input checked="" type="checkbox"/> Spain    |
| <input type="checkbox"/> Denmark             | <input type="checkbox"/> Lithuania         | <input type="checkbox"/> Sweden              |
| <input type="checkbox"/> Estonia             | <input type="checkbox"/> Luxembourg        | <input type="checkbox"/> Associated country  |
| <input checked="" type="checkbox"/> Finland  | <input type="checkbox"/> Malta             | <input checked="" type="checkbox"/> Other    |
| <input type="checkbox"/> France              | <input type="checkbox"/> Netherlands       |  |

2.7 Please specify:

United Kingdom, Israel, Montenegro

### 3 About your project

---

• 3.1 Under which thematic section of Horizon 2020 has your project been funded?

- |  |  |
|--|--|
| <input type="radio"/> Marie Skłodowska-Curie Actions                 | <input type="radio"/> Secure, Clean and Efficient Energy                                 |
| <input type="radio"/> Research infrastructures                       | <input type="radio"/> Smart, Green and Integrated Transport                              |
| <input type="radio"/> Leadership in Enabling Industrial Technologies | <input type="radio"/> Climate Action, Environment, Resource Efficiency and Raw Materials |

- Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing and Biotechnology
- Information and Communication Technologies
- Access to Risk Finance
- Innovation in SMEs
- Europe in a changing world – Inclusive, innovative and reflective societies
- Secure societies
- Spreading Excellence and Widening Participation
- Enhanced European Innovation Council Pilot (FET, SME Instrument, Pathfinder, Accelerator)
- Health, Demographic Change and Wellbeing
- Euratom
- Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy
- Science with and for Society

• 3.2 In which domain has your project been running?

- Agriculture and forestry
- Bio-based industries, biodiversity
- Biotechnology
- Construction Energy
- Circular economy
- Food, fisheries and healthy diet
- Health
- ICT including digital transformation
- Key Enabling technologies
- Raw materials
- Security
- Space
- Transport
- Water resources
- Water, air and soil quality
- Other

• 3.4 Under what type of action has your project been funded?

- Research and Innovation action
- Innovation Action
- Coordination and support action
- Marie Skłodowska-Curie action
- European Research Council (ERC)
- ERA-NET Cofund
- Pre-commercial Procurement (PCP)
- Public Procurement of Innovative Solutions (PPI)
- SME instrument, EIC pilot

3.5 Which level of readiness describes your technology at the start and at the end of your project?

	At the start	At the end
TRL 1 – basic principles observed	<input type="checkbox"/>	<input type="checkbox"/>
TRL 2 – technology concept formulated	<input type="checkbox"/>	<input type="checkbox"/>
TRL 3 – experimental proof of concept	<input type="checkbox"/>	<input type="checkbox"/>
TRL 4 – technology validated in lab	<input type="checkbox"/>	<input type="checkbox"/>
TRL 5 – technology validated in relevant environment	<input type="checkbox"/>	<input type="checkbox"/>
TRL 6 – technology demonstrated in relevant environment	<input checked="" type="checkbox"/>	<input type="checkbox"/>
TRL 7 – system prototype demonstration in operational environment	<input type="checkbox"/>	<input type="checkbox"/>
TRL 8 – system complete and qualified	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3

TRL 9 – actual system proven in operational environment	<input type="checkbox"/>	<input type="checkbox"/>
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• 3.6 Has your project delivered new services and/or products on the market during the project or beyond the end date?

- Yes
- No

3.7 If yes, which ones:

- Developed the Extended CISE Data Model specification (eCISE)
- Developed four (4) Border Surveillance (Land & Maritime) Command, Control & Coordination Systems compatible with CISE/eCISE
- Developed various Data Fusion & Analytics Services
- Developed a set of Decision Support Tools in the Maritime Domain
- Developed a Maritime Surveillance Fast Speed Boat equipped with various Sensors
- Developed a Coastal Station for Maritime Surveillance equipped with various Sensors
- Developed a Mobile Surveillance Unit (MSU) equipped with various Sensors
- Developed a UAV system for Land Border Surveillance

## 4 About the collaboration with standards development organisations

A National Standardization Body (NSB) is a one stop shop for all stakeholders and is the main focal point of access to the concerted standardisation system. Besides the NSB Standard Developing Organisations (SDOs) focus on developing, publishing, or disseminating technical standards using a consensus-based standards development process. SDOs are any official organisation that can provide the infrastructure for developing standards in compliance with the same procedures the NSB uses. A Technical Committee (TC) is a group responsible for the development and drafting of standards which are then ratified by European Standards Organisations.

4.1 Has your project liaised with standards developing organisation (SDO), national standardisation body (NSB) or technical committee (TC)?

	Yes	No
• SDO	<input checked="" type="radio"/>	<input type="radio"/>
• NSB	<input type="radio"/>	<input checked="" type="radio"/>
• TC	<input checked="" type="radio"/>	<input type="radio"/>

4.2 If yes, which ones?

ETSI, INDUSTRY SPECIFICATION GROUP (ISG) EUROPEAN COMMON INFORMATION SHARING ENVIRONMENT SERVICE AND DATA MODEL (CDM)

4.3 At what stage did you liaise with SDOs, NSBs or TCs? What did you expect from the collaboration?

4

From the early beginning of the project we joined the ETSI ISG CDM Group (actually we joined the 2nd year of the group's Workplan).  
 The target was to standardize CISE (Use Cases, User Requirements, Architecture, Service and Data Models) and also built on the ANDROMEDA developments (enhancements and extensions) for its evolution and contribution in the Land Border Surveillance Domain.  
 The results of the above efforts were the official extension of the ISG CDMs Workplan in additional 2 years where the focus will be to exploit ANDROMEDA results for the specification of the 2nd versions of the standards and extension in other domains than Maritime.

• 4.4 Have there been a SDO, SNB or TA directly involved in the consortium?

- Yes
- No

4.5 How did you choose cooperation with the SDO, NSB or TCs?

ETSI already had in place the ISG CDM group with primary mission to standardize the Maritime CISE. So it was a natural choice to join this group.

4.6 How did the SDO, NSB or TC contribute to the methodology of the work package relevant for standardisation?

Timewise, ISG Group activities were running in parallel with the project's standardization actions, so we were able to get synched and get advantage of its results at project level.

• 4.7 Did the implication of the SDO or NSB impact technological choices in any way?

- Yes
- No

• 4.9 Have you been in collaboration with SDOs or NSBs outside the project?

- Yes
- No

4.10 If yes, which ones:

DIN, AUSTRIAN STANDARDS, OASIS

• 4.11 To what extent was the external standardisation entity involved in the project?

- Not involved
- Very little involved
- Little involved
- Somewhat involved
- Highly involved

4.12 Has the SDO / NSB / TC been involved as:

- Directly partner
- Third party
- Advisory body

4.13 Have you had any contact with CEN-CENELEC or ETSI?

	Yes	No
* CEN-CENELEC	<input type="radio"/>	<input checked="" type="radio"/>
* ETSI	<input checked="" type="radio"/>	<input type="radio"/>

4.14 If yes, what for?

To define technical standards to allow data exchange among different maritime legacy systems in a cooperative network. Enhancing information exchange between maritime surveillance authorities is one of the key strategic objectives of the European Union under the Integrated Maritime Policy with increased coordination between different policy areas (transport, environmental protection, fisheries control, border control, general law enforcement, customs and defense).

4.16 If yes, what have been the main differences in terms of collaboration if you compare with collaboration European standardisation organisations?

## 5 About addressing standardisation in your project

---

\* 5.1 How important do you consider standardisation in your project?

- Of no importance
- Of little importance
- Of some importance
- Of major importance

\* 5.2 In your project standardisation activities have been addressed:

- In a dedicated work-package
- In a dedicated task
- As a transversal issue in different work packages
- As a transversal issue in different tasks
- Other (e.g. by setting-up an Advisory Group)

\* 5.3 Did the consortium members advocate for the incorporation of standardisation activities in the project?

- Not at all
- Little bit
- Somewhat
- Strongly

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\* 5.4 Were any of the consortium members against implementing standardisation activities?

- Not at all
- Little bit
- Somewhat
- Strongly

\* 5.5 What were the main initial reasons for addressing standardisation in your project? Multiple indication is possible.

- Standardisation was a requirement from the market.
- It was a requirement from the legislation
- It was a requirement from your organisation
- It was a key requirement of the call for projects
- It was seen as critical to conduct the research activities during the projects (e.g. for agreeing on terminology or methodology)
- It was seen as critical to ensure the success of the project's exploitation and/or market strategy
- Other

\* 5.7 When have the standardisation activities been mainly implemented in your project?

- At the beginning of the project
- Throughout the project
- During the final phase of the project
- Other:

5.8 Were there any risks you encountered in relation to standardisation related activities?

No

5.10 Have the results of the standardisation activities in your project been followed by any specific action after the end of the project?

- Yes  
 No

• 5.12 Have the standardisation activities in your project led to specific deliverables?

- Yes  
 No

5.13 If yes, what is the nature of these deliverables?

- Common terminology  
 Harmonised research methodology  
 Recommendations and/or requirements for new or revised standards  
 One of the standardisation tools proposed by the GEN GENELEC  
 Workshop Agreements (CWAs)  
 Technical Specifications  
 Standard Operating Procedure  
 A Technical Report  
 Development of a new standard

7

- 
- Proficiency Test  
 Reference data  
 Reference material  
 Certification  
 Accreditation  
 Interlaboratory comparisons  
 Other. Please specify:

5.15 Which standard was addressed by your project?

CISE (all related documents about to be published by ETSI in a couple of months)

5.16 What were the overall costs related to standardisation activities?

• 5.17 Have you encountered specific difficulties or barriers in conducting standardisation activities during the project?

- Yes
- No

• 5.19 Have there been any disadvantages of the standardisation process that negatively impacted the project?

- Yes
- No

5.20 Are technologies that are proposed in standard development exercises also patented or have patents been applied for?

- Yes
- No

## 6 About existing standards

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• 6.1 Has your project involved a review or assessment of existing standards to understand if any would have been useful for your project?

- Yes
- No
- I don't know

• 6.2 Have you identified and made direct use of one or more existing standards as part of the project?

- Yes
- No
- No opinion

6.3 If yes, what?

ONVIF, WEBSOCKET PROTOCOL, NMEA 0183, OGC WMS, OGC WFS, OGC WMTS, OGC WFS-T, IVEF, CISE Service & Data Model

6.4 Please briefly explain how the project made use of these existing standards:

- Radar / AIS Surveillance & tracking
- Electro-optical Systems
- Maps and Charts
- Interoperability & Information Exchange

6.5 Please indicate how important the use of these standards have been for the success of your project.

- Of no importance
- Of little importance
- Of some importance
- Of major importance

6.6 To what extent has using existing standards within your project led to the following categories of benefit:

	Not at all	To a small extent	To a medium extent	To a large extent
Improved understanding of current state of the art	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Improved technical knowledge within the consortium	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Improved efficiency of the project activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Improved quality of outputs from the project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6.8 Please indicate whether any of the following wider impacts on innovation are likely as a result of your project making direct use of one or more existing standards. Please indicate all that apply:

	In the short-term	In the medium to longer term
Improved design of products, services or processes	<input checked="" type="radio"/>	<input type="radio"/>
Faster or easier market access (incl. European or international)	<input type="radio"/>	<input checked="" type="radio"/>
Improved capacity to respond to EU regulation	<input checked="" type="radio"/>	<input type="radio"/>
Improved interoperability of products, services or processes	<input checked="" type="radio"/>	<input type="radio"/>

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Improved access to public procurement	<input type="radio"/>	<input checked="" type="radio"/>
Higher confidence level of consumers	<input type="radio"/>	<input checked="" type="radio"/>
Enabling the display of a mark of product or process quality	<input type="radio"/>	<input checked="" type="radio"/>
Wider use of recognised methodologies, processes or terminology	<input checked="" type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>

## 7 About new or revised standards

• 7.1 Has your project directly involved or led to a specific recommendation or proposal for the development of new or revised standards or was aimed at supporting the development or revision of a standard already under development?

- Yes
- No
- I don't know

7.2 Was it an intention from the outset to propose or support new or revised standards as part of the project?

- Yes, definitely
- Yes, possibly
- No
- Not sure

7.3 Using the following scale, please indicate how important the proposal of standards has been for your project:

- Of no importance
- Of little importance
- Of some importance
- Of major importance

7.4 Please provide details of the new standards or revisions that were proposed (i.e. title and a brief description of scope):

- CISE Use Cases
- CISE User Requirements
- CISE Architecture
- CISE Service Model
- CISE Data Model

7.5 Please briefly explain how your project has shared or disseminated its standard proposal (i.e. how have your ideas been shared, presented or submitted to appropriate people and organisations):

10

- Promoted ISG CDM:
- in several public workshops
  - presentations in EU organizations (EMSA, FRONTEX)

7.6 Please briefly explain what has happened as a result of the standard proposal (i.e. has work to develop a standard been initiated?):

Yes. ISG CDM will publish soon the first versions of the standards.

7.7 Has your project also directly contributed to the subsequent development of the proposed standard?

- Yes
- No
- Not applicable
- I don't know

7.8 Has the standard you proposed or supported the development of been finalised and / or published?

- Yes – in development
- Yes - published
- No
- I don't know

7.9 If yes, please provide further details:

- The name of the standardisation organisation
- The name of the technical body involved
- The reference and title of the published standards

7.10 Please indicate the main benefits of standardisation for the valorisation of the project results once the proposed standard is developed and put to use:

	In the short term	In the medium term	In the long term
Improved codification of research results	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improved dissemination of research results	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opportunity to network / access complementary expertise	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7.12 Please indicate the main benefits of standardisation for market uptake once the proposed standard is developed and put to use:

	In the short term	In the medium term	In the long term

11

Improved design of products, services or processes	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easier or faster market access (incl. European or international)	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Improved capacity to respond to EU regulation	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improved interoperability of products, services or processes	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improved access to public procurement	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Higher confidence level of consumers	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Enabling the display of a mark of product or process quality	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Wider use of recognised methodologies, processes, or terminology	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## 8 Best practices

We are planning to proceed with a deep analysis of a number of projects that have led to the development of a European standard or workshop agreement. These projects will then be used by the Commission to highlight and explain these benefits to the wider research community.

• 8.1 Do you think that your project would be an interesting and useful example for a best practice case in terms of valorisation of R&I results through existing, revised or new standards?

- Yes
- No

• 8.2 Would you consider using, proposing or developing standards as part of future research projects?

- Yes  
 No

• 8.3 Would you be interested in clustering with other projects funded by the Framework Programme to work on the same standard?

- Yes  
 No

8.4 Please explain your answer further:

We will be happy to work with other Border related H2020 projects on the further enhancement of CISE standards.

• 8.5 In another R&I project would you address standardisation in another way?

12

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- Yes  
 No

8.6 If yes, how?

• 8.7 Would you start the standardisation process at another stage if you were again a grantee of a public R&I programme?

- Yes  
 No

8.8 Please explain:

It may happen that CWAs are required prior to the realization of an industry specification group.

8.9 Do you have any suggestions for how the links between research, innovation and standardisation could be strengthened?

Pre-Standardization related projects can prove valuable for strengthening the links between research, innovation and standardization. The participation of SDOs or NSBs in such projects as full partners is encouraged.

\* 8.10 Would you be willing to assist us in describing best practice cases using your project as an example (through provision of project documentation and a telephone interview)?

- Yes
- No

8.12 Please include any other comments not covered by the previous questions:

We thank you for completing this questionnaire. Please submit your answers by pressing the button below.

13

8.13 Free Text Question

8.14 Have you considered collaboration with the International Organisations for Standardisation (ISO), the International Electrotechnical Commission (IEC) or the International Telecommunication Union (ITU)?

	Yes	No
* ISO	<input checked="" type="radio"/>	<input type="radio"/>
* IEC	<input checked="" type="radio"/>	<input type="radio"/>
* ITU	<input checked="" type="radio"/>	<input type="radio"/>
* Other	<input type="radio"/>	<input checked="" type="radio"/>

## 8. Annex B: Quality Review Report

The ANDROMEDA Consortium uses the Quality Review Report process for its internal quality assurance for deliverables to assure consistency and high standard for documented project results.

The Quality Review Report is used individually by selected peer reviewers. The allocated time for the review is 7 calendar days. The author of the document has the final responsibility to reply on the comments and suggestions of the peer reviewers and decide what changes are needed to the document and what actions are to be undertaken.

### 8.1 Reviewers

Project Coordinator	Mrs. Athena Foka (MMAIP)
Management Support Team Member	Mr. Alkis Astyakopoulos (KEMEA)
Internal Peer Reviewer(s)	Giuseppe Vella (ENG) Marios Moutzouris (SATWAYS) Souzanna Sofou (SATWAYS)

### 8.2 Overall Peer Review Result

The Deliverable is:

- Fully accepted
- Accepted with minor corrections, as suggested by the reviewers
- Rejected unless major corrections are applied, as suggested by the reviewers

### 8.3 Consolidated Comments of Quality Reviewers

General Comments	
<b>Deliverable contents thoroughness</b>	Reviewers comment (...): Good Author's reply: -
<b>Innovation level</b>	Reviewers comment (...): Good Author's reply: -
<b>Correspondence to project and programme objectives</b>	Reviewers comment (...): Good Author's reply: -
Specific Comments	
<b>Relevance with the objectives of the deliverable</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> Not applicable Reviewers comment: - Author's reply: -
<b>Completeness of the document according to the its objectives</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> Not applicable Reviewers comment: -

	Author's reply: -	
<b>Methodological framework soundness</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> Not applicable Reviewers comment: - Author's reply: -	
<b>Quality of the results achieved</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> Not applicable Reviewers comment: - Author's reply: -	
<b>Structure of the deliverable with clear objectives, methodology, implementation, results and conclusions</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> Not applicable Reviewers comment: - Author's reply: -	
<b>Clarity and quality of presentation, language and format</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> Not applicable Reviewers comment: Author's reply:	
<b>Detailed Comments</b>		
<b>No.</b>	<b>Reference</b>	<b>Remark</b>
1	Page 25	An introductory paragraph on the ANDROMEDA Hub should be added
2	Page 30	Added the involvement in the ISG CDM