I2C Report Summary

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Periodic Report Summary 3 - I2C (Integrated System for Interoperable sensors & Information sources for Common abnormal vessel behaviour detection & Collaborative identification of threat)

Project Context and Objectives:
I2C is a 4-year European research integrated project funded by the European commission under the 7ème Framework Programme, which started the 1st of October 2010.

The project, coordinated by DCNS, is involving 20 European partners including 5 research centres, 6 industrial companies, and 9 SMEs as well as representatives from operational organisations such as the CeCLAD-M, Gendarmerie Maritime, Affaires Maritimes, etc.

In the framework of EUROSUR (European external border surveillance system) programme guidelines, I2C project aims at setting-up and experiment an end to end integrated innovative maritime surveillance system. This project allows to:

- Test ways of data fusion from a set of new (i.e.; long range & detection of small boats) and conventional sensors deployed ashore and offshore on assets, and a many other available information such as meteorological forecasts, vessel and harbour files, regulated zones and geo data, vessel black listings, intelligence, etc. to set up and share permanent multi layered standardised intelligent situational picture including documented alerts on detected suspicious vessel behaviours.
- Develop and integrate innovative capabilities to issue alerts on detected suspicious vessel behaviour from operational rules modelling known illegal and criminal modus operandi and suite of tools for identification of the most plausible associated threats to early report to decisional authority for relevant actions.

With this integrated project, in the future, scaling studies / designs can be performed that propose the functional architecture of advanced generation of maritime surveillance systems at any specific shore / offshore locations, so authorities can commission their end to end information system based on the I2C project innovative capabilities, the operational architecture, campaign exercises feedbacks and data model to share information and intelligence.

Project Results:
Core (innovative) I2C capacities are for detection of suspicious vessel behaviours (BEAN) and identification of plausible threats (USE). These two capacities are based on previous existing capacities. In the I2C framework, they are upgraded and extended to all EUROSUR defined missions.

For new sensors; HFSW (High Frequency Surface Wave Radar) and FMCW (Frequency Modulation Continuous Wavelength) radars, first prototypes have been already deployed and previously extensively tested. So, in I2C, more powerful second versions are operated and the challenges are more to firstly get the emission agreement (from governmental Agency allocating frequencies) and secondly to fuse the HFSW and FMCW radars vessel tracks with other operational acquired vessel tracks (AIS, cameras and conventional FURUNO radar), to generate the common operational traffic picture (COTP).
For safety, I2C radars (HFSW, FMCW and FURUNO) are installed in secured coastal Navy sites where existing set of sensors are already operating. The main drawback is to guarantee the electromagnetic compatibility and avoid potential interferences between all of these sensors when operating together (existing ones and deployed for I2C project).

To share data, information and intelligence between I2C processing centre and the user centers, DVB (Digital Video Broadcast) satellite telecommunication links, secured 3G and Internet links are configured in a dedicated and secured I2C Virtual Private Network (see D6.1.1 deliverable).

Also, for security purposes, all data bases (i.e.; vessel files, threat reports, port departures and arrivals, etc.) are centralised in the I2C processing centre (secured room with access control) and not accessible from any external networks excepting from the secured and administrated I2C Virtual Private Network.

The I2C coastal sensors have been deployed mostly in user sites, such as:

• SESDA (Navy) site where the FMCW radar, Furuno radar, AIS receiver, Cameras and two satellite telecommunication antennas (ASTRA2Connect) have been installed and operated. Such as installations have required to rent the piece of ground (contract with DGA TN), to get emission agreements (for the FMCW and Furuno radars) from the National Frequency Agency and to connect the sensors to local UPS (Uninterrupted Power Supply).
• CROSS MED communication sites (Néoulos and Pic de l’Ours) to deploy two AIS receivers and 3G communication link devices. Agreement has been negotiated with France Telecommunication, owner of the two sites, to install these sensors (AIS receivers and antennas, computers and 3G devices) and connect them to local UPS.
• Fos sur Mer harbour office to install an AIS receiver with connection to Internet network (I2C secured VPN).
• Marseille Gendarmerie Maritime to install AIS receiver with connection to Internet network (I2C secured VPN).
• DGA (Direction Générale de l’Armement) Levant Island where the HFSW radar is deployed and connected to local UPS.

All these above sites have been networked with the I2C processing centre in Mourillon (DCNS premises) to collect, in real time, all coastal sensor data and remotely control them. Excepted, that HFSW radar data processing unit, in Levant Island, is directly connected to ONERA office in Palaiseaux (close to Paris). ONERA is connected to the I2C secured VPN to provide, quasi real time, radar HFSW detected vessel tracks.

Therefore, the users, as full I2C partners, have contributed to the deployment of I2C coastal stations along the French Riviera coast (from Spain to Italy borders) to acquire, in real time, vessel (of all types; cooperatives and non cooperatives) tracks. The following figure maps the equipped and networked coastal sites for the I2C project.

Potential Impact:
I2C is integrating data processing and exploitation capabilities for detection of all types of vessels (small, medium and large) for early identification of threats at sea in order to quickly report to authorities and plan relevant actions.

During the achieved campaigns in 2013 and 2014 (I2C third period), the I2C deployed full prototype in user centres has collected real time data from networked coastal stations, data service providers and deployed patrols at sea (aircraft, vessel, zeppelin and unmanned surface vehicle) to continuously track suspicious small boats locally and merchant / fishing ships widely over the Mediterranean basin.

Small boats are detected either from new coastal radar technology; Frequency Modulation Continuous Wavelength (FMCW) radar, or high resolution optical cameras. FMCW radar has very high angular resolution for ranging, velocity and imaging application. Also, the short wavelength of the electromagnetic fields used has excellent performance in rain, humidity, fog and dusty conditions. Two FMCW radar prototypes have been experimented in I2C (one in St Mandrier coastal station and one on board Zeppelin airship) and provided very promising results.
In the Economic Exclusive Zone (EEZ) countries have special rights therefore new sensors such as High Frequency Surface Wave (HFSW) radar is deployed. HFSWR operates using the propagation of electromagnetic energy waves, over the sea, in the HF Band by means of a Surface Wave which propagates far beyond the line of sight of current radar. I2C deployed HFSW radar prototype has been experimented and provided very good detections up to 200 nautical miles. Alternatives are patrol assets at sea (vessel, aircraft and balloon) to provide surveillance of hot spots over targeted area of interests.

As the small boat density can be high along shore lines as well as medium and large vessels density may be significant in the EEZ, I2C has developed innovative technical capability to automatically detect suspicious ones and issue alerts to users for deeper analysis and decision making. Detections are based on rules combining various conditions (on track profiles, on navigation conditions, on geographic area, on intelligence, on vessel data, etc.) on set of layered information in the maritime situational picture. These rules are edited by users from their knowledge on illegal and criminal modus operandi, for example, dangerous migrant trips (i.e.; with sea Beaufort above 6 (condition 1), mid-night without moon (condition 2), on board very old small fishing vessel (condition 3), along known migration routes (condition 4), all these conditions together define a rule. When this rule is verified by a vessel in the current situational picture, alert is raised (the vessel is flagged in the situational picture). Then, user deeply analyses this alert and report to decisional authority for action).

The deployed innovative I2C solution as end to end data, information and intelligence processing chain demonstrates that many different types of data (such as sensor output), information (such as geographical characteristic, navigation conditions, meteorological forecast, vessel history, regulation, etc.) and intelligence (warning, sensitive area, illegal and criminal modus operandi, etc.) are to be spatio temporally correlated together to be able to detect suspicious vessel behaviours and then decide how and when to react. These data, information and intelligence are structured in an “intelligent” maritime situational picture where all of them are standardised to be easily exchanged by the user community and to share a common understanding on encountered events for cooperative identification of threats and joint relevant actions.

Finally, I2C integrated project, as new generation of maritime surveillance and security solution, seeks to further enhance and promote relevant collection of standardised information, advanced exploitation of them to detect on going threats and sharing between involved users from coastguards and navies to port authorities, fisheries controls, customs authorities and environmental monitoring and control bodies. It is not replacing or duplicating, but building on top of existing surveillance systems, data provided services and communication platform.

List of Websites:
www.i2c.eu

Related information

| Documents and Publications | periodic3-booklet-i2c-mtc.pdf |

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