

Application of surveillance tools to Border Surveillance 'Concept of Operations'

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DISCLAIMER

This document does not implicitly or explicitly represent either the views of the European Commission or those of the Agencies mentioned in it.

The purpose is to serve as orientation material to guide proposals for the FP calls 2012 with respect to activities related to Border Surveillance, taking into account the role of relevant stakeholders, lessons learned from R&D projects and other activities in the area.

The objectives set in the document correspond exclusively to the authors' views on how a system could look like in the foreseeable future, based on their understanding of the available current technology capabilities, which may differ from the reality.

By no means should the information herewith be interpreted as the draft or final specifications for future operational services. Bidders have the freedom to propose enhancements as well as indicate limitations due to technology or budgetary constraints to achieve the indicative set or sub-set of services described in this document.

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1. Introduction

The purpose of this document is to provide a high-level conceptual description of possible services for the common applications of surveillance tools at EU level (satellites, UAVs, aerostats, etc) in support to Border Surveillance. In the future, this could potentially allow FRONTEX to provide National Coordination Centres (NCCs) via the EUROSUR network with surveillance information on their external borders and the pre-frontier area on a frequent, reliable and cost-efficient basis (ref. Chapter 3). These services could be established gradually, starting with initial services as of 2013 and to be followed by extended services as of 2015 (ref. Chapter 4).

The present version of the CONOPS is "**work in progress**" and will be further developed and extended at working level. Its purpose is to:

- Serve as a basis for developing and testing a pilot service between Frontex, EUSC and EMSA, to be established within the framework of the "big pilot" on the EUROSUR network as of January 2012;
- Serve as a guideline for related FP7 Space and Security activities in response to calls for proposals to be published in the 2nd half of July 2011;

2. Background

2.1 Relevant initiatives

2.1.1 EUROSUR

Since 2008, based on a Communication from the Commission¹, work has been ongoing to establish a European Border Surveillance System (EUROSUR) to reinforce the control of the Schengen external border, especially the southern maritime and eastern land borders. The priority awarded to EUROSUR has been confirmed by Council Conclusions of June 2008 and February 2010,² as well as by the Stockholm Programme and most recently by the European Council in June 2011.

EUROSUR shall establish an information sharing and cooperation mechanism enabling Member States' border control authorities and Frontex to collaborate at tactical, operational and strategic level in order to:

- 1) Reduce the number of irregular migrants entering the Schengen area undetected;
- 2) Diminish considerably the unacceptable death toll of migrants at sea;
- 3) Increase internal security of the EU by preventing cross-border crime.

For this purpose, EUROSUR will provide Member States with a common technical (infrastructure) and operational framework (workflow) in order to increase the *situational awareness* at their external borders and improve the *reaction capabilities* of their national authorities surveying the EU borders.

¹ Communication examining the creation of EUROSUR, COM (2008) 68 final of 13.02.2008.

² JHA Council Conclusions of 5-6.06.2008 and of 25-26.02.2010.

In its 2008 Communication, the Commission proposed a roadmap for the gradual development of EUROSUR in 8 separate, but interlinked *steps*:³

Steps	Objectives
1	Setting up of a single <i>national coordination centre</i> (NCC) and of a single <i>national border surveillance system</i> in each of the MS located at the eastern land and southern maritime external borders of the EU.
2	Setting up of a secured <i>communication and information system</i> to coordinate activities between the NCCs as well as with Frontex, enabling electronic data exchange in order to send, receive and process non-/classified information 24/7 close to real-time.
3	Providing increased EU financial and logistical support (infrastructure, equipment, training) to selected <i>neighbouring third countries</i> to enhance their capacity to manage their own borders, fight cross-border crime and fulfil SAR responsibilities. Step 1 concepts should be applied.
4	Exploitation of <i>R&D (FP7)</i> to improve the performance/use of surveillance tools, in particular to identify and track small boats. Use for testing and validating the concepts developed under other steps with regard to technical feasibility and cost-benefit ratio.
5	Setting up of <i>common applications of surveillance tools</i> (satellites, UAVs, aerostats, etc) to provide NCCs with surveillance information on their external borders and on the pre-frontier area on a more frequent, reliable and cost-efficient basis. Frontex should act as a facilitator.
6	<i>Common pre-frontier-intelligence picture</i> : Frontex providing the NCCs in a frequent, reliable and cost-efficient manner with effective, accurate and timely intelligence on irregular migration and cross-border crime in the pre-frontier area.
7	Creation of a <i>common information sharing environment</i> for border control and internal security purposes covering the Mediterranean Sea, Canary Islands and the Black Sea.
8	In the long-term, creation of a <i>common information sharing environment</i> for the whole EU maritime domain, covering all maritime activities (border control, law enforcement, maritime safety, marine environment, customs, fisheries control, defence, etc.).

The basic elements of the EUROSUR framework (national coordination centres, network) shall be fully operational on a pilot basis as of 2011-2012. Based on a legislative proposal tabled by the Commission in December 2011, the basic EUROSUR framework should be consolidated by 2013.

It is planned that surveillance tools will be embedded in the EUROSUR *technical framework*.

³ In 2009, the Commission presented a report on the progress made in implementing the EUROSUR roadmap (SEC (2009) 1265 final of 24.9.2009). Another progress report will be presented at the end of 2010.

2.1.2 GMES

GMES is a joint initiative of the European Commission and the European Space Agency, which aims at achieving an autonomous and operational Earth observation capacity.

The objective is to rationalize the use of multiple-sources data to get a timely and quality information, services and knowledge, and to provide autonomous and independent access to information in relation to environment and security.

By aggregating both space and in-situ data based on observations with global-reach over land, seas and atmosphere, GMES services can make an important contribution to serve EU security needs. This has been demonstrated through a series of EU and National R&D projects, in particular in the domains of border surveillance (including maritime surveillance), humanitarian aid missions, conflict early warning and prevention, and others. In fact, GMES provides information and tools for monitoring land, marine and the atmospheric environment which can form the basis for a service package required for security applications which will yet need to be individually defined and validated. Also, synergies with a planned GMES Emergency Response service are evident.

Responding to the political demand for a deeper inter-institutional dialogue in sectoral areas, the EU Institute for Security Studies held a seminar on the security dimension of GMES in March 2007. A number of areas were identified where GMES could have a relevant role to play. In addition, it was acknowledged that services should meet specific requirements in terms of timeliness (data available when needed, even at short notice), guaranteed quality and traceability, and confidentiality of sensitive information.

Security threats are unpredictable, and areas being addressed today rely on the best assessment of potential threats where space may have a role to play, also considering the evolution of technology and the ability to assess risk from space.

2.2 Actors, roles and responsibilities

2.2.1 Frontex

Frontex is the European Agency which coordinates the operational cooperation at the external borders of the Member States of the European Union.

The Frontex Regulation⁴ stipulates as a Frontex' objective, *'to facilitate and render more effective the application of existing and future Community measures relating to the management of the external borders'*

Frontex may ensure the coordination of Member States' actions in the implementation of those measures, thereby contributing to an efficient, high and uniform level of control on persons and surveillance of the external borders of the Member States.⁵

⁴ Council Regulation (EC) No 2007/2004 of 26 October 2004 establishing a European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union, L 349/1 (Frontex Regulation)

⁵ Art 1 Frontex Regulation

2.2.2 National coordination centres (NCCs)

The NCC's should coordinate 24/7 the activities of all national authorities carrying out external border surveillance tasks and should exchange information with other NCCs and Frontex by:

- a. Providing risk analysis indicating targets, *modi operandi* and areas of interest for geospatial intelligence and surveillance requirements;
- b. Providing lessons-learned;
- c. Receive analysis.

2.2.3 The European Union Satellite Centre

The Satellite Centre shall, in coherence with the European Security Strategy, support the decision-making of the European Union in the field of the CFSP, in particular of the CSDP, including European Union crisis management operations, by providing, as appropriate, products resulting from the analysis of satellite imagery and collateral data, including aerial imagery, and related services.”

The EUSC is an Agency of the European External Action Service. It is one of the key assets for European Union's Common Security and Defence policy (CSDP). The staff of the Centre consists of experienced image analysts, geospatial specialists and supporting personnel from EU member countries. EUSC's know how in delivering Geospatial Intelligence, including within the GMES context, associated with the experience on handling sensitive information for Member States and EU security users is useful for supporting border surveillance activities and future developments, in particular over coastal and land areas.

2.2.4 The European Maritime Safety Agency

The European Maritime Safety Agency (EMSA) provides technical assistance and support to the European Commission and Member States in the development and implementation of EU legislation on maritime safety, pollution by ships and maritime security. It has also been given operational tasks in the field of oil pollution response, vessel monitoring and in long-range identification and tracking of vessels. EMSA operates and manages a suite of systems which receive, process, and distribute information on vessel traffic reports (LRIT, SafeSeaNet), satellite monitoring (CleanSeaNet), and Port State Control (THETIS).

These services are also useful to obtain a clearer picture in support of activities in the maritime domain, building a common picture in support of EU maritime interests. Enabling governmental and institutional organisations to make use of EMSA's systems will help avoid duplication of effort, overlapping infrastructures and expenditures.

3. Scope

Border surveillance is conducted at tactical, operational and strategic level and different sensors and platforms are applied within the several levels. Tactical and partially operational surveillance is under the responsibility of the Member States whereas Frontex could add value to operational and in particular strategic surveillance. Since reaction time decreases from strategic to tactical level, surveillance activities have to correspond, providing close-to-real situational awareness whenever needed.

In close cooperation with the EUSC, EMSA and other relevant Agencies, Frontex could provide identified services for operational and strategic border surveillance to the national coordination centres in the Member States, allowing them to receive information on their external borders and the pre-frontier area on a frequent, reliable and cost-efficient basis.

4. Implementation aspects of EUROSUR

4.1 Initial services (2011-2013)

As of 2011-2012, initial services should be set up on a pilot basis between Frontex and the national coordination centres to request and receive via the EUROSUR network surveillance information on selected areas of their external borders and on the pre-frontier area on a frequent, reliable and cost-efficient basis.

Under these initial services a workflow based on existing systems and platforms shall be implemented, as well as working arrangements between the various stakeholders.

In 2012-2013, FP7 projects (e.g. 2011 FP7 Space projects Simitisys, Nereids and Dolphin; 2012 FP7 Space projects and the FP7 Security research projects Oparus, SeaBILLA, I2C and Perseus) could be used to test and validate selected components and requirements identified in the pilot project.

These FP7 projects will be interlinked with EUROSUR via the Frontex-chaired *FP7 implementation group on border surveillance*.

4.2 Extended services (as of 2014/2015)

The initial services should be consolidated and extended to cover additional areas and use additional common surveillance tools in an even more frequent manner. This will include operational services whose specifications could also stem from R&D activities initiated in response to this CONOPS.

These services shall be extended and integrated into the EUROSUR network and systems and services that are currently under development with the aim to create a common platform for exchanging surveillance information.

4.3 Added-value of GMES in the Implementation of EUROSUR

GMES comprises both development activities and operations. Security applications in GMES are an important part of the initiative. It is commonly agreed that Europe will benefit from the use of space and *in-situ* assets in support of the implementation of services responding to the challenges which Europe is facing in the security field, notably border control, maritime surveillance and support to Union external actions.

In addition to the **development** activities financed under the space and security thematic area included in the Seventh Framework Programme, Union action is also necessary in the period 2014 onwards to establish **operational** services in support of security applications on a more permanent basis in areas of sufficient technical maturity with a proven potential.

The FP7 call 2012 under the Space-GMES Work-programme contemplates the financing of two projects in support to EUROSUR and the Security Theme work-programme foresees a project for the pre-operational validation (POV) at EU level for the common application of surveillance tools.

The current challenge is to bridge the gap between research and the operational set-up envisaged in the Concept of Operations for GMES support to EUROSUR. Developments in this area will have to be integrated in the stakeholders' processes taking into consideration actual working practices, methodologies and timeliness of information that will be required in a future operational environment. As such, it is expected that the projects running during 2013-14/5 will contribute to:

- Identification of relevant sources of data/information, which can be complemented by space-borne data;
- Definition of criteria and mechanisms for data acquisition and satellite-tasking based on dynamic border surveillance intelligence and risk-assessment requirements;
- Definition and testing of mechanisms for integration of space-based data with other relevant sources of surveillance data for improved border permeability risk-analysis and intrusion detection, along the communication channels in place, whenever possible, or using ad-hoc mechanisms if necessary;
- Definition and testing of the workflow between stakeholders;
- Testing and validation trials, which will include assessment of added-value, cost-effectiveness and user up-take;
- Outlook of future services based on evolution and availability of technology;
- Drafting the specifications of a full operational system (phased approach 2014-15 onwards);
- Identification of areas where further research is needed to contribute to the objectives of EUROSUR.

The applicability of the service described in the CONOPS has to be **tested and verified** in operational, technical and economic terms before it can possibly be implemented as an **operational service** as of 2014-2015.

5. Surveillance phases and Service description

Depending on the area (maritime/land) the surveillance activities can be grouped in distinct progressive phases based on the following three levels:

	Strategic level	Operational level	Tactical level
What is it	Pertaining to the planning of sequences of operations, the resources needed for the operations, and the collection and analysis of information needed to make that planning.	Pertaining to the planning and running of operations. An operation is a sequence of actions in a pre-planned framework of assets, personnel and time.	Pertaining to executing the elements of an operation, choosing the elementary actions and reactions in (almost) real time – or as close to real time as possible.
Typical timescale for planning ahead	Months to years	Weeks to months	Hours to days
Shortest timescale to change plans	Weeks. E.g., decision to start collecting information from a certain area.	Days. E.g., the decision to call off a planned operation, or to substitute one available asset by another.	Seconds (immediate). E.g., decision to apprehend persons, or save people from a boat in immediate danger.
Maximum allowed delay of information	A month. E.g. statistics of arrivals and analysis of methods used by illegal immigrants.	Days. E.g. information on the appearance of new tracks in the land border region, or information on boat arrivals in a new area.	Fraction of an hour. E.g. information about last sighting of a truck or a group of people, or locations of unknown boats.
Radius of interest	Semi-global	Region / basin	< several 10 km

The same products may be used in each level, but in a different way. The level is primarily a property of the service, not of the product.

5.1 Maritime phases

Phase 1	Phase 2	Phase 3	Phase 4
Strategic	Operational	Operational	Tactical
Pre-departure and departure towards an EU external border	In waters at least 200nm from EU	Within EEZ and outside shore-based radar surveillance range ⁶	Within shore-based radar surveillance range

All of the above phases are triggered by intelligence. An additional requirement is to observe at least 80 % of vessels within a designated area without prior intelligence and based on risk assessment after a crisis situation occurs.

5.1.1 Maritime surveillance – Phase 1

Phase 1 covers the **strategic level**:

§ Pre-departure and departure towards an EU external border

a) Definition:

This service can be divided into two objectives.

- The 1st objective is to monitor a specific third-country port with the aim to determine if/when the vessel, which based on intelligence has already been identified as being used for illegal migration into EU territory, has departed;
- The 2nd objective is to punctually monitor selected third-country coasts with a distance of more than 40 nautical miles from the coasts of EU Member States⁷. Based on intelligence processed in the CPIP (for example, through HUMINT gathered in Joint Operations), the coastal areas to be monitored have been identified as regular departure points for small boats⁸ (below 15m) used for irregular immigration and cross-border crime. The analysis collected through this process would be used to update the CPIP and various risk analysis products.

b) Requirements:

- Recognise preparatory activities such as the erection of tents, huts, gathering of vehicles, boats placed on the beach.

Precision: objects of interest are identifiable down to 3 m in size;

- Establish if the identified vessel is equipped with a cooperative system;

⁶ Approximately up to 40 - 50nm from the coastline.

⁷ Beyond the reach of coastal radar stations.

⁸ E.g. wooden cayucos, rubber boats and speed boats.

- Recognise the disappearance of boats identified based on intelligence (from those recognised as previously present) in order to indicate recent departures.
- Ships in ports must be discernable from each other and from the docks/piers.

Precision: vessels of interest are identifiable down to 5 m in size;

- Detect and verify patterns of irregular migration present in the selected coastal area based on risk analysis (routes, hubs, stop-overs, points of departure and *modi operandi*).

c) Platform/ sensor selected:

- Satellite
 - Ø Optical/IR imagery;
 - Ø SAR imagery (coherence detection);
 - Ø Transponder based (AIS, LRIT).

d) Location:

Specific ports and stretches of third countries initially identified, and then updated, by intelligence sources and/or risk analyses through interactive analysis processes conducted by Frontex and Member States.

Monitored areas to be modified or validated at least every three months based on intelligence and risk analysis.

5.2 Maritime surveillance – Phase 2 & 3

This chapter covers the **operational level** in:

- § Waters at least 200nm from EU (Phase 2)
- § Within EEZ and outside shore-based radar surveillance range (Phase 3)

a) Definition:

The intention is to track and intercept a medium to large vessel coming from a distant third-country port (at least 200 nautical miles) and heading for EU territorial waters. This vessel has been identified before departure or at an early stage of its journey as being used for irregular migration, cross-border crime or as posing a threat to the internal security of the EU Member States.

This service heavily depends on the use of cooperative systems like AIS, LRIT and VMS.

It is extremely difficult to track small vessels (smaller than 8 m) utilizing optical imagery and SAR but these sensors should be used to verify the information received by the cooperative systems.

One single platform cannot alone provide sufficient coverage to track any type of vessel, therefore a combination of platforms and sensors has to be established.

The Maritime Patrol Aircraft (MPA) traditionally plays an important role in maritime surveillance. Usually equipped with a variety of sensors, an MPA can be tasked to patrol large areas to discover migration activities or to relocate a vessel or boat based either on intelligence information or on dead-

reckoning if it was previously under surveillance. The tasking of an MPA is under the responsibility of Member States.

UAV technology has emerged during recent years and its potential for use in border surveillance activities has been recognised. To date, there is limited experience in deploying UAVs in support of border surveillance, mainly because of their limitation of operating only in segregated airspace. Tactical UAVs could be used to detect and track suspicious vessels based on intelligence. Until UAVs can be regularly deployed for border surveillance, some important questions such as an analysis of cost and benefits will need to be answered.

b) Requirements:

- Detect, track and punctually re-locate vessels of interest (that may have gone out of surveillance in subsequent observations);
- Estimate speed and heading;

c) Functional requirements:

- Sufficient reporting frequency and reaction-time to enable tracking.

d) Platform/ sensor selected (M-mandatory, O-optional):

- Satellite (M),
 - Ø Transponder based (AIS, LRIT);
 - Ø Optical/IR imagery (limited);
 - Ø SAR imagery.
- Unmanned Aerial Vehicles / Unmanned Aerial Systems (including Aerostats) (O),
 - Ø Radar systems
 - Ø Visual spectrum camera
 - Ø Infrared camera
- Maritime Patrol Aircraft (O),
 - Ø Transponder based (AIS)
 - Ø Radar systems
 - Ø Visual spectrum camera
 - Ø Infrared camera

e) Location:

- Ø Mediterranean Sea and Atlantic Ocean.

5.3 Maritime Surveillance – In designated area

a) Definition:

- The intention is to **detect, classify and identify at least 80 % of all vessels of interest within a predefined designated area of fixed size** using different platforms and sensors. Such areas would be designated based on risk analysis (e.g. when a crisis - political unrest/ natural disaster - may trigger migration flows towards Europe). The 80% criterion for detection and classification may be achieved through the fusion of both

space (satellites) and aerial (MPA/UAV) earth-observation assets. Identification should be provided for vessels larger than 12 m.

- Anomaly detection services should also be provided for such areas.

b) Requirements:

- Detect, track and punctually re-locate vessels of interest (that may have gone out of surveillance in subsequent observations);
- Recognise abnormal behaviour of vessels which pose a potential border threat;

c) Functional requirements:

- Sufficient reporting frequencies to enable fusion of surveillance from different assets.
- Well-defined designated area of fixed size.
- Clear specification of “vessels of interest” (the 100% coverage).

d) Platform/Sensor selected (M-mandatory, O-optional):

- Satellite (M),
 - Ø Transponder based (AIS, LRIT);
 - Ø Optical/IR imagery (limited);
 - Ø SAR imagery.
- Unmanned Aerial Vehicles / Unmanned Aerial Systems (including Aerostats) (O),
 - Ø Radar systems
 - Ø Visual spectrum camera
 - Ø Infrared camera
- Maritime Patrol Aircraft (O),
 - Ø Transponder based (AIS)
 - Ø Radar systems
 - Ø Visual spectrum camera
 - Ø Infrared camera

e) Location:

- Ø Mediterranean and Atlantic.

5.4 Land phases

Phase 1	Phase 2	Phase 3
Strategic level	Strategic/ operational level	Operational/ tactical level
Static – reference maps (prerequisite for Phase 2)	Low-time critical – background changes	Punctual monitoring – volume/flux of actual crossings

5.4.1 Land Surveillance – Phase 1 & 2

This chapter covers the strategic/operational level:

- § Static – reference maps (Phase 1; prerequisite for Phase 2)
- § Low-time critical – background changes (Phase 2)

a) Definition:

This service is intended to contribute to the **elaboration of intelligence and/or risk analyses** through interactive analysis processes conducted by Frontex and Member States (third-country monitoring in the pre-frontier area) in support of the planning of border control activities.

Based on intelligence processed in the CPIP (for example, through HUMINT gathered at Focal Points), the **areas to be monitored** have been identified as key pre-frontier border areas used for irregular immigration and cross-border crime. The analysis collected through this process would be used to update the CPIP and various risk analysis products.

These products will be used to optimise patrolling activities according to the conditions in the area (e.g. topography, weather conditions in winter time).

This service includes following functionalities:

- Obtain a reference situational picture on the topography, transport infrastructure, routes, hubs/nexus points, stopovers etc.
- Conduct change analysis by comparison to the reference picture on a regular basis to detect any changes;
- Detect or verify the routes potentially used by illegal migrants and smugglers of contraband and to adapt border control measures (patrols, deployment of surveillance infrastructure) accordingly;
- Gather further information expanding on intelligence (e.g. on gathering points; in situation of urgent and exceptional pressure at certain external land border sections as result of a political crisis, natural catastrophes);

b) Requirements:

Static:

- Enable mapping of terrain, including topography, land cover, buildings, roads, tracks, demarcations, etc., by virtue of adequate spatial resolution (horizontal and vertical), spectral power, etc.;
- Product must be ortho-rectified and terrain geo-coded, which implies that also a DEM at the proper resolution must be available;
- Geographic features should be in vector form in order to facilitate their automatic identification, selection and query;
- Data must be in such a form that they can be combined with existing maps used by the authorities (projection, datum, format, standards).

Low – time critical:

- Recognise changes in the terrain that influence accessibility: water level in rivers and marshes, floods, freezing of water bodies, snow cover, landslides, vegetation changes that impact accessibility;
- Detect new roads or tracks or significant changes in road conditions;
- Detect new buildings, dwellings, tents;
- Find changes in demarcation (fences, walls);
- Detect unusual build-up of vehicles or people;

c) Functional requirements:

- In the case of routine monitoring, the repeat frequency of the observation should be on a regular basis (frequency to be determined individually by the concerned national coordination centre on the basis of risk analysis and intelligence), observations can be requested far in advance while the results should be available within 6 hr after measurement.
- d) Platform/ sensor selected:
- Satellite,
 - Ø Optical/IR imagery;
 - Ø SAR imagery (coherence detection).
- e) Location:
- Strip along the EU external land border. Selected 3rd country territories.

5.4.2 Land Surveillance – Phase 3

This chapter covers the operational/tactical level:

§ Punctual monitoring – volume/flux of actual crossings

a) Definition:

This service is intended to provide situational awareness to enhance operational reaction capability with respect to build-up of illegal migrants at the immediate pre-frontier area and to gauge changes in flow (flux) of migrants towards the border area which poses a threat to border security and the capacity to perform border management. This service will be used to optimise patrolling activities according to the conditions in the area (e.g. changes in third-country border management activities, current weather conditions in winter time).

This service includes following functionalities:

- Detect the time critical changes in routes used by illegal migrants and smugglers of contraband, which would have an effect on operational and tactical reactive capability, in order to enable changes in border control measures (patrols, deployment of surveillance infrastructure);
- Gauge volumes, changes in flow, build-up of potential migrants;
- Detect changes in conditions in the pre-frontier area that would impact border control (e.g. changes in third-country border management activities, current weather conditions in winter time).

b) Requirements:

- Estimate (approximate) flux along roads or tracks via changes in route conditions;
- Situational awareness with respect to congregations of vehicles or people;
- Provide information on weather-related phenomena that influence accessibility (e.g. water level in rivers and marshes, floods, freezing of water bodies, snow cover);

c) Functional requirements:

- Regular time-critical monitoring is to be instigated punctually following detections of significant changes in Phase 2. The frequency of observation is higher than in Phase 2.
- d) Platform/ sensor selected:
- Satellite,
 - Ø Optical/IR imagery;
 - Ø SAR imagery (coherence analysis /change detection).
- e) Location: Strip along the EU external land border

Annex A

Information on products & services

A 1.1 Introduction

The main document has given descriptions for a number of **services**. These services were coupled to scenarios and phases. For each service, the objectives, requirements, sensors and work flow were specified.

In this Annex, the service requirements are further quantified along a number of attributes, and the information **products** that should be able to satisfy the service demands are described in some more detail. This is mostly done in the table in section A 1.4.

The two next sections contain descriptions of concepts and systems which are essential when reading the table. In section A 1.4:

- Section A 1.2 defines the **terminology**.
- Section A 1.3 outlines key characteristics of the common surveillance tools that are expected to be used for EUROSUR under GMES.

After the service-product table in section A 1.4, section A 1.5 discusses the requirements of static reference data, which mostly comes down to reference maps.

A 1.2 Terminology

The purpose of this section is to clarify some of the terms used in this document.

Services, products, tools

A **service** should satisfy a high-level information need of the Border Guards at local, regional, national or EU level (Frontex). It will use information products to do so. Considering that the subject here is the application of common tools, services will mostly pertain to the higher levels (EU and national level).

An **information product**, or product for short, is a set of meaningful and interpreted information⁹. A product is made by combining and analysing a number of different inputs. In the context of this CONOPS, only those products are considered here in which the common application of surveillance tools, and in particular Earth Observation data collected under GMES, have a significant contribution.

As data from different sources is processed, analysed, combined, value-added, etc., and as they go through different hands, one can recognise products at every level. The output product of one actor in the chain is the input for another who makes a higher-level product. In this text, only the highest level products that are used in the services are considered.

⁹ The meanings used here are consistent with the definitions of data and information in the EUROSUR Guidelines (23 November 2010).

A surveillance **tool** is a system that produces data to be used in an information product. A surveillance tool can be a reporting system (e.g., LRIT) or an observation system (sensor/platform combination). More details are given in section A1.3.

Surveillance and earth observation

Surveillance pertains to objects, or targets as they might be called in a military context. The aim of surveillance is to gather information about objects and their properties and behaviour within a certain area.

Earth observation pertains to the environment, the background of the objects. Its aim is to gather information about the terrain, land cover (including vegetation, roads, built-up areas), coast lines, water levels, etc., and also meteorological and oceanographic conditions (wind, rain, waves, currents, etc.).

Detect, classify, identify, recognise, verify

- **Detect:** To establish the presence of an object and its geographic location, but not necessarily its nature.
- **Classify:** To establish the type (class) of object (car, van, trailer, cargo ship, tanker, fishing boat, ...).
- **Identify:** To establish the unique identity of the object (name, number), as a rule without prior knowledge.
- **Recognise:** To establish that a detected object is a specific pre-defined unique object.
- **Verify:** Given prior knowledge on the object, can its presence/position be confirmed.

Resolutions

The following abbreviations for resolution are used, with a different indicative numerical meanings for optical and radar:

Acronym	stands for:	Optical satellite imagery	Radar satellite imagery
VHR	Very High Resolution	≤ 1 m	< 5 m
HR	High Resolution	1 – 3 m	5 – 25 m
MR	Medium Resolution	3 – 10 m	25 – 75 m

A 1.3 Indicative Performance Requirements

Attribute	Optical	Radar	Remarks
Resolution	50 cm – 5 m	1 m – 50 m	Higher resolutions are classified. Lower resolutions are not used for surveillance.
Image size	For the highest resolution, 10 x 10 km. For lower resolutions, up to 60 x 60 km.	For the highest resolution, 10x10 km. For lower resolutions, up to 400x400 km.	The higher the resolution, the smaller the image.
Tasking time	Normal: 12h to days before overpass. Fast: asap to 12h before overpass.	Normal: several days ahead. Fast: 6 to 24 h ahead	Precise times vary per satellite operator. Orders at short notice are (much) more expensive.
Delivery time (after image acquisition)	Normal: 1 day. Fast: few hours	Normal: up to 1 day. Fast: up to 30 min	Precise times vary per satellite operator. Very fast times can be obtained only for a few images, not for all. VHR data may be intentionally delayed on national security laws. Faster delivery is more expensive.
Processing and analysis time	<i>Over land:</i> Fast analysis: 1-3 hr. Full analysis: 1 day. <i>Ship detection at sea:</i> Fast analysis: 1 hr. Full analysis: 6 hr.	<i>Over land:</i> Fast analysis: 1-3 hr. Full analysis: 1 day. <i>Ship detection at sea:</i> Fast analysis: 30 min. Full analysis: 1h – 1h30 min.	The time depends on the area of interest within the image that needs to be analysed, the density of objects, the exact nature of the analysis, etc.

A 1.4 Table of services and products

After the technical remarks in the preceding two sections, this table provides a summary overview of some key attributes and requirements for each of the services mentioned in the main document.

- **Column 1** lists the service, one per line. In some cases, the service from the main document has been split in two, namely when different elements of that service lead to substantially different requirements.
- **Columns 2 and 3** repeat the main aims and targets of the service.
- **Columns 4-8** specify those requirements for the service that are particularly relevant to the use of satellite sensors.
- **Columns 9-12** propose the main surveillance tools and information products that can contribute to satisfying the service needs, plus possible providers and funding of the service and products.

Within some services, a further sub-division is made into fast delivery ('**FD**', a preliminary, incomplete but fast result) and final delivery (a final, complete product '**CP**' that takes more time).

Service	Information required	Targets (size, type, ...)	Area of interest (a)	Planning lead time	Delay after recaption of image/data	Update period	Hours of the day	Surveillance Tools	Product	In cooperation with	Support by
<u>Maritime Ph. 1</u> 1. Punctual monitoring of neighbouring 3 rd country ports	FD: Detect presence of specific vessel(s) in port area and/or major changes in port activity* CP: in addition, less evident vessels and more subtle changes	Vessels > 5 m	5 km	month (r) day (e)	FD: 1 hr CP: 24 hr	few days - week	irrelevant	VHR optical sat Ship reporting systems	FD: Text with # suspect boats, changes with regard to. before, mention of most evident developments. CP: Interpreted and annotated satellite images, fused with ship reporting data. Description of port ship traffic from AIS. Alerts on particular AIS of interest.	EUSC+ EMSA	FP7- GMES
<u>Maritime Ph. 1</u> 2. Punctual monitoring of neighbouring 3 rd country beaches	FD: # boats, changes in # boats, important changes CP: in addition, recognise preparatory activities, gauge and quantify build-up	Detect & classify tents, huts, road network, vehicles, boats, > 3 m	10 km	month (r) day (e)	FD: 2 hr CP: 24 hr	few days - week	irrelevant	VHR optical sat VHR SAR sat, normal and interferometric. Ship reporting systems	FD: Text with # boats, change in # boats, mention of most evident developments. CP: Interpreted and annotated satellite images. Change detection images (coherent or incoherent).	EUSC	FP7- GMES

Service	Information required	Targets (size, type, ...)	Area of interest (a)	Planning lead time	Delay after recaption of image/data	Update period	Hours of the day	Surveillance Tools	Product	In cooperati on with	Support by
<i>Maritime Ph. 1</i> 3. Determine if specific vessel has left 3 rd country port	Recognise departure of specific ship	Vessel > 5 m	2 km	day	3 hours	6 hr	specific	VHR optical sat VHR SAR sat Ship reporting systems	Estimation of probability that specific vessel has left, supported by interpreted satellite image and / or ship reporting data.	EMSA + EUSC	FP7-GMES
<i>Maritime Ph. 1</i> 4. Determine if boats have left 3 rd country beach or mothership has left inshore zone	Recognise departure of boats	Boat > 3 m	2 km	day	hours	6 hr	specific	VHR optical sat VHR SAR sat Ship reporting systems	Estimation of probability that specific vessel has left, supported by interpreted satellite image and / or change detection image.	EUSC + EMSA	FP7-GMES
<i>Maritime Ph. 2/3</i> 5. Tracking of vessels over high seas > 40 nm from EU coast	Detect and recognise specific ship	Ship > 10-12 m	400 km (b)	0.5 - 1 day	hours	day	specific	Ship reporting systems HR optical sat HR-MR SAR sat HALE/MALE	Position, speed and course of ship, (maybe a limited nr of possible ships), plus next day's possible image acquisitions to re-acquire the ship based on dead reckoning	EMSA	FP7-GMES
<i>Maritime Ph. 2/3</i> 6. Indicate suspicious vessels based on anomalous behaviour > 40 nm from EU coast	Indication of suspicious behaviour in a background of normal behaviour	Detect and classify ships > 10-15 m	400 km	days	fraction of an hour	hours	all	Ship reporting systems HR optical sat HR-MR SAR sat HALE/MALE	A limited nr of suspicious boats with their attributes (position, speed, course, size, type)	EMSA	Being developed in FP7 project I2C

Service	Information required	Targets (size, type, ...)	Area of interest (a)	Planning lead time	Delay after recap-tion of image/ data	Up-date period	Hours of the day	Surveillance Tools	Product	In cooperati on with	Support by
<i>Maritime Ph. 3</i> 7. Monitoring maritime buffer area	Become aware of any ship that crosses the area toward the EU	Vessels > 5 m	60 nm x 200 nm	week	4 hr	4 hr for vessels that go at 15 kn 12 hr for vessels at 5 kn	all	Ship reporting systems MALE HR SAR sat	Position, speed, course and size / type of each unidentified vessel that crosses the buffer area towards the EU. Their ETA at the coast.	EMSA	FP7-GMES
<i>Maritime Ph. 3/4</i> 8. Maritime environmental assessment	Prediction of ambient maritime conditions, for planning of risks, assets and sensors.	Environment	100 km	day	minus 1 day (prediction)	day	all	Many low and medium resolution earth observation satellites. Meteo and oceanographic models	Wind speed and direction, dominant wave height, length and direction, precipitation, visibility, propagation of infrared, radar and VHF	Meteo services, open sources, GMES marine services. Special downstream modules for EM propagation	Frontex operational budget for routine elements. FP7-GMES for new elements.

Service	Information required	Targets (size, type, ...)	Area of interest (a)	Planning lead time	Delay after recaption of image/data	Update period	Hours of the day	Surveillance Tools	Product	In cooperation with	Support by
<i>Land Phase 1</i> 9. Updated reference maps	DEM, land cover, map. Selected areas only	Buildings, roads, tracks, demarcations, etc.	50 km	month	weeks	year	irrelevant	For DEM changes: Satellite optical stereo or radar XTI. For part inside EU: Airborne or satellite VHR optical. For part outside EU: Satellite VHR optical.	GIS with vector and raster data. Ortho-rectified images (Google-Earth-like). All in unified projection etc., at least according to INSPIRE standards.	EUSC	FP7-GMES
<i>Land Phase 2</i> 10. New ambient land features alert	Indication to changes	Land cover, vegetation, water levels, snow cover, buildings, dwellings, tents, roads, tracks, demarcations, vehicle build-up, etc.	10 km or smaller	week - month	days	no update	irrelevant	as above	Maps where relevant recent changes in the landscape are indicated.	EUSC	FP7-GMES

Service	Information required	Targets (size, type, ...)	Area of interest (a)	Planning lead time	Delay after recaption of image/ data	Update period	Hours of the day	Surveillance Tools	Product	In cooperati on with	Support by
<u>Land Phase 3</u> 11. Punctual monitoring of immediate pre-frontier or 3 rd country specific locations	Changes, activity, movements	New roads and tracks or changes in them, congregations of vehicles and people, people flux, foreign patrol activities, weather-related ambient conditions	10 km	month (r) day (e)	FD: 6 hrs CP: 24hrs	day-week	Specific	VHR sat optical VHR sat SAR	Indication of objects and events of relevance on a map background, or on an image map.	EUSC	FP7-GMES
<u>Land Phase 3</u> 12. Land environmental assessment	Prediction of ambient maritime conditions, for planning of risks, assets and sensors.	Environment	50 km	day	minus 1 day (prediction)	day	all	Many low and medium resolution earth observation satellites. Meteo and oceanographic models	Wind speed and direction, precipitation, river levels and flow, snow cover, terrain accessibility, visibility, propagation of infrared, radar and VHF.	Meteo services, open sources. Special downstream modules for EM propagation	Frontex operational budget for routine elements. FP7-GMES for new elements.

- (a) If one number is given, that is the side of a square area.
(b) The more frequent the update period, the smaller the area needs to be.
(e) For emergency monitoring.
(r) For regular, ongoing monitoring.

A 1.5 Static Reference Data

This section presents the description of six types of geodata sets, which Frontex requires to be able to provide the envisaged analysis services to the National Coordination Centres.

Functional requirements

- To enable mapping of terrain, including topography, land cover, buildings, roads, tracks, demarcations, etc., by virtue of adequate spatial resolution (horizontal and vertical), spectral power, etc.;
- Imagery products must be ortho-rectified and terrain geo-coded, which implies that also a DEM at the proper resolution must be available;
- Geographic features should be in vector form in order to facilitate their automatic identification, selection and query;
- Data must be in such a form that they can be combined with existing maps used by the authorities (projection, datum, format, standards).

1. Satellite imagery (ortho-rectified and ortho-photo datasets)

- HR (multispectral RGB) satellite images for specific areas within 2km from coast sufficient for the recognition of significant factors relevant for pre-departure of vessels for illegal migration: such things as tents/huts, vehicle gathering points, small boats placed on the beach, natural boundaries and physical demarcations (fences, sand dunes, walls).
- HR satellite images for 5 km (or optimistically, 20 km) on either side of external green border.
- VHR satellite images (of radius 5km, 10x10km tiles) for specific port areas to be able to verify and/or recognize traffic and activity types. For designated pinpoint areas.
- VHR images for specific departure areas that have been identified through intelligence / risk analysis (verification of interviewee information).

2. Land-use datasets

Coordinate system: Geographic coordinate reference system: GRS80

Horizontal accuracy: Circular error with respect to GRS80 (confidence level 90%) • 15m

- Topographical vector datasets at medium (1:25 000) scale containing data classes at a **general level** of detail which would contain, for example, classes such as road networks (dual carriageway, paved, unpaved) rail networks, airports; lakes, rivers, streams and inland water bodies; inhabited places (with a population value), built-up areas, industrial areas; agricultural areas, wetlands, orchards, parks and forests.
For wide area: all external border sections and third-country coastlines of relevance (Mediterranean, western Africa, Black Sea).
- Topographical vector datasets at medium (1:25 000) scale containing data classes at a **more detailed level** of detail which would contain, for example, classes such

as types of unpaved road (navigable, footpath, tourist tracks), water body infrastructure (marina, docks, piers, offshore platforms); types of coastline (rocky, cliffs, grassy, sandy, industrial, inhabited), types of industrial areas, types of building functions.

For designated areas of highest relevance for illegal migration and cross-border crime: external land border sections with highest detections and third-country coastline with the highest number of departures.

3. Digital Elevation Model (DEM)

- Raster format with a post spacing < 50m for cross-country mobility studies / border permeability.
- Height value (float data type) accuracy CE90 < 4m coastal profiling (cliffs, natural departure points).

For same areas as above for detailed land use information.

4. Reference Maps (geo-coded databases)

- Geo-referenced demographic profiles of populations,
- Geo-referenced database of socio-economic variables (databases containing information on migration push or pull factors such as unemployment, poverty, health, economic development,
- Geo-referenced database of population ethnicities/languages/religion etc.,
- Geo-referenced information on illicit activities (hotspots), smuggling routes and human-terrain analysis (including administrative info/jurisdictions).

5. Nautical Charts

- Vector datasets containing data on: shallow areas, offshore installations, docks/drydocks, vessel routes (such as ferry services), etc.,
- Sea currents (multiband raster or vector): speed of water, direction, seasonal period (time of year),
- Territorial waters, SAR areas, EEZ

For Mediterranean, Black Sea and Atlantic Ocean (western Africa).

6. Weather data (outside the perimeter of GMES)

- average daily air temperature (day-time / night-time),
- average daily snowfall (meters per m²),
- average daily rainfall (ml per m²),
- typical cloud cover (sat image or vector with cloud coverage),

Annex B

Abbreviation	Glossary
AIS	Automatic Identification System (vessels)
CIRAM	Common Integrated Risk Analysis Model
COSI	Standing Committee for Operational Cooperation on Internal Security
CPIP	Common Pre-Frontier Intelligence Picture
CRATE	Centralised Record of Available Technical Equipment
DG HOME	Directorate-General Home Affairs (Commission)
EBF	External Borders Fund
EMSA	European Maritime Safety Agency
EO	Earth-Observation
EPN	European Patrols Network
ESP	European Situational Picture
EU	European Union
EUROPOL	European Police Office
EUROSUR	European Border Surveillance System
EUSC	European Union Satellite Centre
FSC	Frontex Situation Centre
Frontex	European Border Management Agency
GMES	Global Monitoring for Environment and Security
HUMINT	Human Intelligence
LRIT	Long Range Identification and Tracking System (vessels)
LSP	Local Situational Picture
IMINT	Imagery Intelligence
ILO	Immigration Liaison Officer
JO	Joint Operation
MS	Member State
NCC	National Coordination Centre

Abbreviation	Glossary
NSP	National Situational Picture
OSINT	Open Source Intelligence
R&D	Research & Development
RA	Risk Analysis
RABIT	Rapid Border Intervention Team
RAU	Risk Analysis Unit (Frontex)
SAR	Search and Rescue
SAR	Synthetic Aperture Radar (sensor)
SIGINT	Signals Intelligence
UAS, UAV	Unmanned Aerial System, Unmanned Aerial Vehicle
VHR	Very High Resolution
VMS	Vessel Monitoring System (fishing vessels)
VTS	Vessel Tracking System