Executive Summary:

The overall objective of OPARUS project is to identify ways to develop an open architecture for the operation of unmanned air-to-ground wide area land and sea border surveillance platforms in the EU. The architecture is based on concepts and scenarios for aerial surveillance developed in close relationship with the Users community (Frontex, Guardia Civil, Polish Border Guards, Guardia Di Finanza, Latvia border Guard, Armed force of Malta, South Coast Partnership). This User community provided requirements based on their experiences of surveillance operations at the beginning of the project and on many comments during the whole project thanks to workshops or direct meetings. It shall be noted that end-users that collaborated with the project are focused mainly on illegal immigrants crossing land or sea borders. As a result, the architectures defined in OPARUS are optimized for illegal immigrants detection, identification and tracking at EU borders. They can also be applicable to other point of interest or specific area with some adaptations.

Architecture was also defined taking into account the developing legislation for insertion of unmanned aerial systems into controlled and uncontrolled civil airspace in the EU. Today, flying remotely piloted aircraft in EU countries is very limited by legislation and lack of appropriate technical solutions. While some countries have developed their own legislation for UAS, the basic position is that except in restricted (segregated) areas or at very short range (flying visual line of sight) it is not possible to fly Remote Piloted Aircraft (RPA) in Europe. It shall be noted that UAS for state operation (such as border surveillance) shall follow state rules and not civil rules but with due regard for the safety of all civil traffic. To be as generic as possible, OPARUS study considers civil rules as well as applicable state rules. One of the main challenges is the collision avoidance issue that is expected to be solved in future. Thanks to consortium experience, partners involvements in many other initiatives and open talks with several authorities (Polish air force, UK CAA, French DGAC, French state aviation safety authority, Eurocontrol), it is possible to estimate that in coming years, solutions for flying UAS in controlled airspace with ATC collaboration or in uncontrolled airspace with support of air traffic awareness system will exist and allow use of UAS in many operations. However, compared to manned aircraft, some limitations will remain until a certifiable collision avoidance capability is available. Only at this time, RPA will be able to fly with the same flexibility as today's manned aircraft and be able to perform all missions. To limit delay before such full flexibility, further investigations of UAS operations with specific nationals' authorities and end users shall be developed to enable real but restricted flight operations using special UAS flight procedures to be agreed.

The technical aspects of the open architecture include among others: concepts for surveillance sensors, platforms (including various take-off and landing strategies), ground control stations, secure data links and network. In addition to the identification and description of the main characteristics and parameters for each of these subsystems, some technological trends and expected evolutions were also highlighted. To control cost and maximize efficiency and effectiveness of the operation of the unmanned aircraft system, several classes of performances, functionalities and associated purchase cost have been defined. Advanced performances or functionalities have been balanced with cost to keep only the ones required by the missions. A typical example is the datalink that is very expensive in the case of beyond radio line of sight transmission (SATCOM) and much cheaper with radio line of sight solutions (even if several relay antennas need to be deployed throughout the operating area). As a result, several combinations have been assessed with their detection capability or minimum time for identification and associated purchase cost. Further analysis of other cost factors should be performed in close coordination with end-users to better estimate life cycle cost of UAS and to influence future developments that will lead to required cost reductions.

The open architecture also introduced a new organization (Global UAS operator center) that deals with specificities of UAS mission preparation in coordination with ATC. It shall be noted that no mission preparation standard exists today. Communication standards between UAS and local command center also needs be agreed. It shall be noted that each country / end-users has its own national standard associated to security aspects for command center. OPARUS proposed to use ASTERIX standard (in development in PERSEUS project for surveillance means) or existing standard such as STANAG 4609. Further standardization developments would be required in order to get fully interoperable solutions in long term.

From this study, it is recommended to encourage acceleration of legislation development at EU level, and to perform further investigation of UAS operation with specific nationals' authorities and end users with real flight operations according to national rules. A number of key technological developments, especially certified collision avoidance system and high reliability secured datalinks, shall be strongly supported. Costs shall be reduced by advanced developments such as automation of mission functions, advanced sensors and associated processing, and a service operation approach in order to share mutual capabilities between several end-users. Finally, harmonization of UAS flight procedures and standardization of interfaces with end-users command center will allow real interoperability across European airspace.

Project Context and Objectives:

OPARUS is a FP7 Coordination and Support Action project under control of European Commission DG Entreprise. This project is based on the statement that EU border protection using comprehensive and improved methods of border observation should be carried out by means of a coordinate policy and procedure connected to national surveillance system or European Border Surveillance System (EUROSUR).

The goal of this 21-months study, started in September 2010, is to propose and elaborate an open architecture for the operation of unmanned air-to-ground wide area land and sea border surveillance platforms in the European Union to offer a major increase in the capabilities of border surveillance agencies by improving effectiveness and minimizing the cost of surveillance.

The OPARUS consortium is made of 14 partners from 7 different nations: Sagem Défense Sécurité acting as coordinator, BAE systems, Dassault Aviation, DLR, CASSIDIAN, IAI, INTA, ISDEFE, ITWL, ONERA, Selex Galileo, THALES Communication and security SA, Thales Systèmes Aéroportés, Tony Henley Consulting Ltd.

A User Advisory Board constituted of main European End-users, in charge of border surveillance, provided valuable comments and therefore influenced the definition of consortium solutions. OPARUS project is directly aligned to end-users needs.

Project development is based on several workpackages respectively covering: concept and scenarios, legislation, technical analysis (including surveillance sensors, platforms, secure datalink, ground stations), open architecture definition and information exchange.

Following objectives were defined:

Workpackage 1 :

- Assess applicability of currently defined scenarios to border surveillance.
- Assess current operational needs to be covered by the study. Current operated scenarios for border surveillance are primarily manned and therefore, one of the tasks of this group will be to understand the scenarios for the manned operations and adapt them to the UAS operations.
- Develop new scenarios according to stakeholder suggestions and needs.
- Develop operational concepts for border surveillance operations that include UASs capabilities.
- Provide the other workpackages of the project with suitable scenarios and concepts baseline for further assessment and architecture definition.
- Validate proposed open architectures with respect to the defined scenarios and concepts.
- Provide a vision of future scenarios for 2015 and validate the open architecture, without the limitations and shortfalls found in WP2, 3 and 4 for short term.

Workpackage 2 :

- Brief assessment of the legislation being elaborated for the UAS operation in Europe

- Analysis of how the legislation impacts on the scenarios defined and derivation of modifications to align the scenarios with the legislation
- Propose modification to the scenarios to accommodate them to the legislation and identify requirements for the technology

Workpackage 3.1 :

- To identify functionalities to be covered by the surveillance sensors, based on assessed operational needs.
- To identify a set of adequate surveillance sensors for threat detection.
- To define a set of potential technical solutions for surveillance sensors.
- To perform a cost analysis to determine the best sets of technical solutions for the border surveillance missions derived from the scenarios.

Workpackage 3.2 :

- To list and classify platforms which might be suitable for an Unmanned Air System performing Border Surveillance within Europe.
- To examine Vehicle Performance Requirements to satisfy selected UAV missions related to Border Surveillance.

Workpackage 3.3 :

- To list and describe the current secure data link technologies and communication network solutions.
- To classify them by their common characteristics and performances by building a matrix of generic characterisitics to help the WP4 build the architecture.
- To identify the performance improvements that can be expected in the future to take into account the specificity defined by the WP1 and WP4 in the Architecture, the Concepts and the Scenarios.

Workpackage 3.4 :

- Technical Analysis of Ground Control Stations for Unmanned Aircraft Systems (UAS)
- Definition of a generic Ground Station, irrespective of the platform-type
- Interaction with other elements of Workpackage 3: 3.1 Sensors, 3.2 Platforms, 3.3 Secure Data Link
- Provision of Information for work package 4: Open Architecture Definition

Workpackage 4 :

- Identification of the potential open architecture solutions to perform border surveillance missions taking into account the context of UAS insertion into the non-controlled airspace.

- Identification of a set of technical solutions (platform, sensors, ground station and secure data link) compatible with the operational procedures for every scenario defined, clearly addressing how both, scenario and technical solution fits into the regulatory framework.

- A coarse cost analysis will be performed to determine the best sets of technical solutions and operational procedures for the border surveillance missions derived from the scenarios, based on mission efficiency and needed resources.

Workpackage 5 :

- To produce a dissemination plan to guide the discussion and dissemination of the results with/to the stakeholders.
- To interact with the stakeholders through the workshops and the secure web site, and to gather and disseminate information from them.
- To promote the achievements of the project within the related stakeholders community.
- To produce public documents for external use, like brochures and info-packages.

Project Results:

1 WORKPACKAGE 1

1.1 Achievements

One of the intended purposes of the OPARUS program first stage was to compile a complete description of requirements. End users requirements were collected and classified by categories (8 requirements for operational/functional ; 6 requirements for capabilities ; 2 requirements for performances ; 3 requirements for communications ; 4 requirements for security ; 2 requirements for legacy issues ; 1 requirement for system acquisition).

Three scenarios were selected as the major representatives of the geographical areas that were considered as the most problematic zones due to their geographical situation and characteristics, weather conditions, points of interest density, borders issues, etc and identified by Frontex as hot spots for illegal activities along borders (especially illegal immigration).

North Poland Land borders : representative of Middle-East Europe land border.

South Mediteranean Sea : representative of sea border with short distances between North Africa and Southern european countries (Italy, Malta, Spain). Within this scenario, three were the specific areas of interest:

- Area between Tunis-Libya & Lampedusa
- Area between Tunis & Benghazi to Malta and Sicily
- Straits of Gibraltar & east from Morocco to Spain
- Canary Islands : representative of sea border with large distances with West Africa coasts.

Three different missions were defined for each maritime scenario:

- Boat Patrol Support Mission: UAS support the surveillance missions of boat patrols
- Coast Support Mission: UAS support the surveillance missions close to the south European coasts and operate in combination with surveillance radars, as is the case of SIVE in Spanish coasts.
- High Seas Italy/Spain Support Mission: UAS operate throughout the Mediterranean Sea beyond the Spanish or Italian maritime territory.
- Validations of the study results were based on following assessments:
- Technology performance of sensors, platforms, data link and control station.
- Legal, regulatory and ethical aspects applicable to the missions in each scenario.
- Operational efficiency of the open architectures.

Functional simulation was also performed for the most constrained area (between Italy, Malta, Tunisia and Lybia). The simulations involved several MALE RPA flights, patrol boats path, illegal boats path taking into account ATM events.

1.2 Proposals

This section summarises some general proposals to be considered for performing operations. For the proposals, four missions have been considered.

1.2.1 Land border surveillance mission

The points of interest are people, cars and trucks. Objectives of mission are to detect, identify and track POI. Detection of POI is a difficult task due to forest areas that are not suitable for radar use. Mission starts after mission preparation activities (flight plan, checks). Large fixed wing RPA take-off from Ketrzyn Wilamowo or Bialystok Krywlany airfield. Following ATC instructions and applicable legislation, RPA transit to border to perform surveillance activities. According to air insertion possibilities, either that RPA perform all tasks or share them with another RPA operated from mobile control station. RPA operated from mobile station are limited in range and altitude and as a result are used for final identification and tracking. Operations of RPA are performed with several procedural controls due to lack of radar. After completing mission, RPA transit to landing area and land. Post flight activities are performed according to legislation and manufacturer's manual in preparation for its next flight.

1.2.2 Sea border - boat support mission

The points of interest are small/medium size ships. Objectives of mission are to identify and track POI. Detection is performed by boat radar. RPA, limited in size by carrier boat, is launched to fly directly to POI coordinates, mainly at low altitude in VLOS. Once the mission is completed, the small RPA is recovered by the Offshore Patrol Vessel established by position of the OPV at the moment of recovery.

1.2.3 Sea border - coast support mission

The points of interest are small/medium size ships. Objectives of mission are to complement coastal surveillance system, especially by early identification and tracking of already detected POI. For the development of this mission flight takes place mainly at low altitudes (under VLOS) or in segregated airspace (defined and approved several days in advance by NOTAM) from take-off to landing. The range is limited by visual line of sight or data link range associated to the flight altitude. After mission completion the RPA will fly back to landing site.

1.2.4 Sea border - high seas mission

The points of interest are small/medium size ships. Objectives of mission are to detect, identify and track POI. Considering air insertion limitations, this mission should be coordinated with the boat support mission for final identification and tracking. MALE RPA flies at high altitudes to operate radar sensor (offering long range and wide area surveillance capability). Take-off and landing of this fixed wing RPA shall be performed in safe condition (mainly in segregated airspace and time slot segregated airfield).

2 WORKPACKAGE 2

2.1 Status

Key regulatory constraints which today limit the use of unmanned aircraft in non-segregated airspace include the need for:

- Certified Collision Avoidance function,
- VFR Separation' function when operating in Class G airspace, where separation is not provided by ATC,
- Airworthiness, which is specifically related to the risk to people and property on the ground in contrary of manned aircraft,
- Control Datalink integrity/availability,
- Ability to detect and avoid significant hazardous weather.

Unless these limitations can be mitigated, it is not possible to demonstrate that UAS operations can be acceptable safe. Therefore today the operation of UAS is limited to restricted areas where other traffic is excluded or closely monitored and controlled. Alternatively Visual Line Of Sight operations (VLOS) may be used for very short range activities in which the pilot or an observer maintains direct visual contact with the UA in order to ensure collision avoidance. Airworthiness and datalink limitations have the potential to increase the risk of collision with the ground and therefore even in segregated airspace flight over or near people are subject to additional restrictions.

2.2 Achievements

The OPARUS UA mission scenarios (from a regulatory perspective) can be summarised as follows:

- Operation over very large areas of sea in international airspace (Canary Islands & Mediterranean) or areas of forest in national airspace (Poland)
- Preferred Surveillance flights at altitude of 5000 feet or at higher altitude with descents to 5000feet to enable identification. (Detections is possible from higher altitude but identification requires shorter range sensors)
- Operation In Class G airspace i.e. without ATC separation service to allow full mission flexibility
- Additional Short to medium range patrol boat or car launched operations

Before the regulatory authorities can allow operations to take place, they must be assured that they are acceptably safe which can be demonstrated by conformance with existing rules, adapted to the specifics of UAS. Today, because of the limitations of UA summarised in 2.1.2 above and the lack of specific rules applicable to UA, it is difficult to demonstrate adequate safety for unrestricted operations.

However the key safety requirements are:

- Acceptable Risk to people on Ground
- Acceptable Risk to other airspace uses
- Acceptable impact on the Air Traffic Control Systems (no or small increase in ATC workload, no or few special ATC procedures, full compliance with ATC instructions, no restriction of access to other airspace users. Etc)

The OPARUS approach for the mid-term was to slightly modify the preferred mission by imposing operational and system constraints which would allow the case to be made to the regulators that the operation would be acceptably safe even if they were not fully compliant with the existing rules.

2.2.1 Short term solutions

As a consequence of the issues presented above, today only two types of operation would be acceptable to the relevant authorities. These are:

- Operations in segregated airspace from which all other traffic is excluded. For over sea scenarios the risk to people on the ground could be made acceptably low by operating procedures. However in Poland there would remain a risk to persons on the ground : as a consequence the segregated airspace would have to exclude flight over urban areas. In practice however segregated airspace can only be declared within national airspace not over the high sea even under the state's ATC control.
- The alternative today is to use short range Visual Line of sight VLOS operations, this could be done using boat or car launched small UAs but could only cover very small amount of the required area. This technique does have value once the area of the search can be localised and high resolution information is required.

Neither of these approaches would meet the users requirements except over very small high risk areas. They require no change to today's regulatory framework.

2.2.2 Mid-term solutions

The approach for the mid-term (defined as from about 2014 until full detect and avoid capability is available) is to use two UA types. The first, a medium altitude long endurance UA operating in class C airspace to provide initial detection and tracking of points of interest. The second, a small UA launched from a patrol boat or car to provide identification and interception support operating in a declared danger/ restricted area in class G airspace at 500 feet.

For the Canary Island and Mediterranean scenarios, the medium altitude operations would use airfields in low density, in class C airspace, located very near to coast and would fly at the lowest level of class C airspace under ATC control. With agreement of ATC, the flight level over the operational area which has a low density of normal traffic can be kept clear of other traffic. The UA will follow a pre-planned flight path with the option to negotiate flight plan modification with ATC if necessary to follow a POI

For Poland the same approach is used but because the class G / class C airspace boundary is lower, the UA can operate at 10000 feet rather than 20000. Because the operation is over the land, although this is mostly forest and farmland, special consideration will need to be given to airworthiness because of the proximity to people especially during takeoff and landing.

The low altitude identification operation would fly at 500 feet in a danger area defines as sea level to 1000 feet. Although danger areas in international airspace do not prohibit access to other traffic, they provide a warning that potentially hazards may exist and provide advice on how to keep clear. The low level operation would only be used in a beyond visual line of sight mode outside of territorial waters (12 Nautical miles for the coast) where traffic density at low altitude is extremely low. In Poland a very low level restricted area of airspace can be defined for the identification missions.

2.2.3 Long-Term solutions

It is anticipated that in the longer term UAS will be demonstrated to have sufficient integrity and operational flexibility enabling routine access to the airspace both under ATC control and in uncontrolled airspace where full responsibility for collision avoidance rests with the UAS. It is probable that this will require significant new technology, approaches to airworthiness and certification, datalink technology and regulatory processes.

3 WORKPACKAGE 3.1

3.1 State-of-the-art

The sensors appropriate to an Unmanned Aircraft System performing Border Surveillance within Europe including Electro-Optic / Infra-Red / Land radar / Maritime Radar have been classified according to their performance into low end, medium end and high end.

Surveillance sensors such as Electronic Warfare detection systems, and radar Ground Motion Target Indicator (GMTI) were also assessed..

Imagery sensors can be divided in two main classes:

- EO/IR (Electro-optic / Infrared) sensors able to provide POI identification information in their domain, limited by weather conditions.
- Radar Side Aperture Radar (SAR) which provides imagery in day and night operations with only limited loss of performance due to weather depending on frequency band used.

Atmospheric effects that are important and need to be taken into account when assessing sensor performance include:

- Temperature and dew point temperature (humidity)
- Relative humidity, along with aerosol and visibility, is used to compute the extinction coefficient.
- Winds may affect the area of interest for all EO sensors.
- Rain: precipitation reduces the visibility and the Radar range (signal attenuation).

- Rain clutter
- Snow: precipitation reduces the visibility and the Radar range (signal attenuation).
- Thick clouds
- Thin clouds
- Hail
- Dust

Detection performance of maritime and air to ground radars can deteriorate significantly in rainy weather, particularly for small targets. Simple ways of reducing adverse effects of rain have been described.

Finally, the study has identified ways of improvement of sensors performance and emerging technologies in terms of new videocamera devices, new thermal imager generators, new phase array SAR antenna, SAR radar and the related improvement of power calculation and computational speed in the emerging data processing systems.

4 WORKPACKAGE 3.2

4.1 State-of-the-art

Work package 3.2 collected and tabulated data on more than 250 unmanned air vehicles of various types. The majorities of these vehicles was fixed-wing aircraft, but vertical take-off and lighter than air were also considered. Important parameters such as Launch, Recovery & Logistics, Payload Fraction and Maximum Altitude Capability have been analysed for the UAVs. The information has been structured into an easy to use spreadsheet database.

With so many air vehicles, the platforms design space is very well populated, and it has been possible to examine some important correlations for the UAV set as a whole, such as the relationship between payload mass and overall vehicle mass. The database could be used in several ways: either UAVs could be classified into generic classes, as has been done for other work packages, or requirements such as payload mass and operating altitude could be used as filters for the aircraft in the database. Both of these methods were available for WP4 work on architectures.

5 WORKPACKAGE 3.3

5.1 State-of-the-art

The study considered available technologies for datalink in radio line of sight and beyond radio line of sight used for command and control link and sensors data links. To well understand datalink and network capabilities, key parameters have been included in the first deliverable. Up to now, neither communication equipment nor standard frequencies bands used by UAS are defined. As many initiatives are running, things could evolve in coming years. In the absence of current standard, each country and UAS manufacturer has developed their own solutions for the UAS datalink.

For RLOS link, short range and long range possibilities have been addressed. In fact, 2 types of solutions exist with associated cost (short range- from 100k to 500k ; long range - from 500k to 2500k). It shall be kept in mind that typical maximum RLOS range is between 80 and 200km. Simulation of datalink range were performed during the OPARUS project to provide estimates of datalink range according to local area and flight altitude. To be able to cover area wider than maximum RLOS range, either relay or BRLOS solutions may be used. The relay could be either through ground antennas network or through other aircraft. That type of solutions has already been proven in military UAS.

BRLOS solutions allow much wider coverage. Available satellite technologies have been split in 2 classes: low data rate (suitable for command and control link, still images, low quality and delayed videostream) and high datarate (suitable for command and control link, high quality videostream). Purchase cost of BRLOS devices is more expensive than RLOS ones (several M). Moreover, service cost is also very expensive for high datarate (several 10M). Additionally, BRLOS link have higher latency (especially highdata rates) that makes them difficult for direct control of the remote aircraft. As a result, it is recommended for take off and landing to have RLOS link.

From network point of view, many possibilities are available thanks to IP technologies. Widespread in civil world, that technology is usually already used by end-users for their communication network. Implementation for UAS will require some adaptations to adjust possible bandwidth (especially to cope with highdata rate stream) and latency (especially for command and control link). Many solutions exist either at IP protocol level (in IPv6) or at application level to ensure that networks are compliant with security policies and avoid any lost information or unwanted foreign access the RPA command and control.

6 WORKPACKAGE 3.4

6.1 State-of-the-art

The study assessed more than 35 ground control stations. Ground Control Stations were organized according to three classifications, functionality, performance and range of cost.

Classification 1: Functionalities includes

- Mission Management in real-time - Capability of modifying the Mission Plan data.
- Real-time Control and Monitoring of the UAV - Capability of controlling and monitoring the vehicle in real-time
- Payload Monitor and Control - Capability of controlling and monitoring payload in real-time.
- Number of Operators - no. of operators required to operate GCS.
- C4I Interface - compliance with NATO STANAG 4586
- User Training Support - Provision for training personnel to operate GCS.

Classification 2: Performance

- Transportability

- Stand alone system (or specific to a particular UAV)
- Type of UAV the GCS can control
- Easily deployable
- Automation
- Capability to be operated from ship
- Ability to Collaborate with other GCS
- Security Protection

Classification 3: Cost Range

- Micro / Mini (e.g. Birdeye) GCS stations : Euro 20 - 35 thousand
- Medium (e.g. Hunter, Searcher) GCS stations : Euro 1 - 1.8 million
- Large (e.g. Heron, Predator) GCS stations : Euro 2.3 - 3.4 million

Using these classifications it was possible to recommend the GCS types which met the list of requirements in order to propose future solution for Open Architecture and Cost Assessment.

Almost all Ground Control Stations designed till now are considered to be an integral component of the UAS system such that it is tied by an eternal knot to the particular vehicle it was designed to operate. Therefore, the Ground Control Stations recommended within OPARUS are considered to be generic of nature represented by a series of minimum requirements so as to be able to operate the vehicles chosen for each scenario. These requirements were derived from the functions of the relevant associated platforms as they were defined so as to propose efficient open architectures alternatives.

For the present, the regulators will not permit a Ground Control Station to operate more than one vehicle

As SATCOM are very expensive, most end-users don't consider that solution and prefer RLOS solutions. In case operating range is beyond RLOS range, communications would be supported by the ground infrastructure network based on the following two possible options:

- One GCS but several ground D/L infrastructures connected to the GCS (no handover requirement)
- Several GCS with associated D/L infrastructure controlling the same UAV in different moments of the flight (handover capabilities will be needed)

Ground Control Stations on-board maritime patrols will require special software to allow the take-off and landing of the platform from a moving surface.

6.2 Workpackage 4

Achievements

The methodology used for the definition and assessment of the Open Architecture implied collaboration with the rest of the tasks carried out in OPARUS.

The definition and assessment methodology consisted in a two - phase process:

1st Phase: This first phase coincided with OPARUS D4.1 deliverable. In this phase the first results of WP1, WP2 and WP3 were considered.

- WP1 provided the first scenarios and missions based on the end users' requirements (EUR).
- WP2 provided a list of legislation references enabling or hindering the operation of UAS performing border surveillance missions.
- WP3 provided with the technical information needed to develop the open architecture. Technical information consisted on listings, analyses, classification and coarse costs of the existing surveillance sensors (WP3.1), platforms (WP3.2), data links (WP3.3) and control stations (WP3.4).

All this information was then assessed from four different perspectives:

- Operational efficiency - based on information from WP1 and WP3
- Regulations - based on information from WP1, WP2 and WP3
- Technological performance - based only on information from WP3
- Costs - based only on information from WP3. It has to be noted that the costs include the total number of UAS to fulfill the mission and only include acquisition costs.

The assessment helped to propose a set of draft solutions to the open architecture that were presented to the User Advisory Board (UAB) during the second workshop (Workshop 2).

2nd Phase: The second phase constituted D4.2 deliverable. In this phase the comments from the UAB together with the update on the scenarios and missions, legislation and classification and analyses made in WP1, WP2 and WP3 respectively were assessed from the same four perspectives as in the first phase. Results of the assessment were incorporated in the draft of the solutions to the open architecture and a final solution was issued and presented again to the UAB in the third workshop (WS3) for final validation of the open architecture for border surveillance UAS.

Three scenarios were considered for the purpose of defining the open architecture, namely: North Poland Land Borders, South Mediterranean and Canary Islands. Each of these scenarios was split into different missions. It shall be noted that South Mediterranean and Canary Islands are very similar and can be considered as Maritime missions.

Additionally each mission was considered for different timeframes: short term, mid-term and long term.

In the following sections the architectures proposed for each scenario and mission are summarised. It has to be noted that the architecture for each scenario is composed of different combinations of platforms, sensors, data link and networks as well as control stations, considering the limitations imposed by them such as:

- Control stations are not stand alone products but associated to specific platforms.
- Once a UA is selected, its parameters are fixed, i.e. if the maximum weight for payload of a given platform is 6 kg, it cannot be equipped with a sensor weighting 100 kg even if its performances is better. In the same manner the endurance of a platform limits the mission time.
- Radars have the drawback that they cannot penetrate foliage. Therefore, in the North Poland Land Borders scenario or other land scenarios where there are forests, radars are unsuitable for the operation.

6.3 North Poland Land Borders Scenario

To fulfill the missions two types of UAS operating in the area, labeled as UA1 and UA2, are needed.

6.3.1.1 Short Term Architecture

Two UA1 are needed for detection, identification and tracking together with its control station:

- UAS1a covering the Northern border through a RLOS link flying between 800 ft. and 10.000 ft.
- UAS1b covering the Eastern border through a RLOS link flying between 800 ft. and 10.000 ft.

Twenty UA2 distributed along the border are needed for identification and tracking for areas where UA1 cannot descent.

- UA2 are commanded and controlled from a single control station on board a patrol car. Every UA2 has its own control station.
- UA2 fly under Visual Line of Sight in class G airspace.

Each UA is equipped with electro optical/infrared sensors.

- Eleven ground data link stations (GDLS) distributed along the border are needed to provide RLOS coverage to UA1 for flights between 800 ft. to 10.000 ft. altitude.

Each UA2 has its own GDLS to provide RLOS coverage.

Different combinations of platforms and sensors are possible with different capabilities.

3.1.2 Mid Term Architecture

In the mid-term, the architecture is similar to the one in the short term, however there are some differences:

- UA1 will be certified to overfly over population.
- UA1 will be under ATC control flying at 10.000 ft.
- Additional traffic situation awareness means will exist, either on ground (Ground Based Traffic Situation Awareness or GBTAS) or very preliminary airborne means (Airborne Based Sense and Avoid or ABSSA).

In this case, the number of GDLS is reduced due to the flights take place at 10.000 ft altitude.

A larger surveillance area, compared to the short term, can be covered permanently; however the area depends on the range and altitude covered by the GBTAS.

Larger surveillance periods will be possible, compared to manned aircraft, due to no on-board pilot flying time restrictions.

6.3.1.3 Long Term Architecture

In the long term, the architectures are similar to the ones in the mid-term with the following differences:

- An advanced traffic awareness means exists: UA1 is equipped with a certified airborne sense and avoid. UA2 may be also equipped with such capability enhancing coordination between UA2 flying in the same sector.
- UA1 could also perform identification and tracking tasks instead of UA2, thus potentially reducing the total number of UAS.

In this case the number of GDLS is the same as in the short term as UA could descent to perform identification and tracking tasks.

In the long term with full flexibility, longer surveillance periods will be possible, compared to manned aircraft, due to no on-board pilot flying time restrictions.

The possibility of hyper spectral sensors will enhance detection capabilities in forest areas.

6.3.2 South Mediterranean and Canary Islands Scenarios

As mentioned above the South Mediterranean and Canary Islands Scenario are split into three different missions. In fact, the three missions are the same. Due to the fact that these two scenarios are focused on the same point of interest (illegal immigrants) and that they are both maritime scenarios, the defined architecture are the same for the South Mediterranean and Canary Islands scenarios. The following sections briefly summarize the architecture developed. When there is any difference between both scenarios, it is explicitly mentioned.

6.3.2.1 Patrol Boat Support Mission

6.3.2.1.1 Short Term Architecture

The type of platforms to be used in this type of missions needs to be as small as possible to be embarked in the patrol boat. Flying VLOS limits the range and the elapsed time between detection (made by the patrol boat radar) and identification. Three UA of the same type are needed assuming the existence of 3 patrol boats in the area capable of embarking UAS. Thus three GDLS on the patrol boat are needed; one per UA/patrol boat.

Different combinations of platforms and sensors are possible with different capabilities.

In the short term, the fact that the operations take place under VLOS limits the operational interest for covering a wide area. Therefore the use of UAS for patrol boat support mission does not provide significant advances with regards to the use of current manned aircraft.

6.3.2.1.2 Mid Term Architecture

In the mid-term, the architecture is similar to the one in the short term, however there are some differences. It is assumed that patrol boat radar could provide other aircraft detection (GBTAS). With GBTAS support the flight can take place beyond VLOS limits.

The time elapsed between detection and identification is considered as the time the UA would need to reach the PoI supposing the PoI remains static once it is detected and it does not include the time to deploy systems or any aspect related to coordination with ATC.

In the mid-term UAS operations will be feasible in larger volumes of airspace, however the range will be limited by the range of the GBTAS.

6.3.2.1.3 Long Term Architecture

The architecture in the long term will be similar to the one in the mid-term, however there are some differences. A certified airborne sense and avoid system (ABSAA) - with an estimated weight of 25kg - exists which enables to fly beyond VLOS.

The time elapsed between detection and identification is considered as the time the UA would need to reach the PoI supposing the PoI remains static once it is detected and it does not include the time to deploy systems or any aspect related to coordination with ATC.

In the long term, full flexibility will exist and longer surveillance periods will be possible compared to manned aircraft due to no on-board pilot flying time restrictions. Since the UA can also identify the PoI, as it can descent, the patrol boat does not need to move towards the PoI in case it is not an illegal PoI.

6.3.2.2 Coast Support Mission

6.3.2.2.1 Short Term Architecture

In the coast support mission the point of interest detection is made by the coast radars. There exist two solutions that can be standalone or combined ones.

- Two UAS of the same type if they are launched from a near airfield
- Six UAS of the same type if they are launched from a mobile position in the coast. These UA fly under VLOS.

The rationale for selecting the type and number of UAS is the coast size.

The time elapsed between detection and identification is considered as the time the UA would need to reach the PoI supposing the PoI remains static once it is detected and it does not include the time to deploy systems or any aspect related to coordination with ATC.

Flying VLOS limits the range of flight beyond the coast. Since control stations are located in the coast, the range does not provide significant advances compared to the current situation, especially in those Mediterranean areas where EO/IR sensors are used in the coast.

6.3.2.2.2 Mid Term Architecture

In the mid-term, the architecture is similar to the one in the short term, with the following differences:

It is assumed that there is a ground based traffic awareness system installed on the coast that enables the flight to happen beyond visual line of sight. The increase in the range reduces the type of UA capable of complying with such range.

The time elapsed between detection and identification is considered as the time the UA would need to reach the PoI supposing the PoI remains static once it is detected and it does not include the time to deploy systems or any aspect related to coordination with ATC.

In the mid-term UAS operations will be feasible in larger volumes of airspace, however the range will be limited to the range of the GBTAS, but it will be still greater than in the short term.

6.3.2.2.3 Long Term Architecture

The architecture in the long term is similar to the one in the mid-term considering the following differences. A certified airborne sense and avoid, with an estimated weight of 25 kg, exists. It enables to fly beyond visual line of sight.

From all the options for platforms launched from a mobile position in the coast only the medium VTOL is capable of carrying an ABSAA due to weight constraints.

The time elapsed between detection and identification is considered as the time the UA would need to reach the PoI supposing the PoI remains static once it is detected and it does not include the time to deploy systems or any aspect related to coordination with ATC.

In the long term full flexibility will exist and longer surveillance periods will be possible, compared to manned aircraft, due to no on-board flying pilot restrictions. Additionally the EO/IR range achieved by the sensors on-board will be greater than the ground EO/IR sensors range. Therefore sensor fusion between UAS EO/IR sensors and coast radars is an advantage compared to the current situation.

6.3.2.3 High Seas Surveillance Mission

6.3.2.3.1 Short Term Architecture

Detection, identification and tracking tasks are made by the same UA. For detection purposes the UA flies at higher altitudes than in other missions. Also for detection tasks the UA is equipped with maritime radar.

Due to the fact that high seas surveillance missions take place beyond 12 NM from the coasts and that at this point the airspace no longer belongs to any national authority, it is not possible to segregate a portion of airspace, either class C or class G. Additionally it is impossible to fly under visual line of sight at high altitudes either.

Therefore it is unfeasible to carry out high seas surveillance missions using UAS in the short term, being necessary to operate with manned aircraft as it is done today. Only a High Altitude Long Endurance (HALE) UAS would be feasible but not realistic due to the high costs of the system.

There would be an exception in the Alboran Sea area in the south of Spain due to the existence of military training areas that could be used for surveillance activities in close coordination with the Spanish Air Forces. Notwithstanding, these areas are small compared to the large surveillance area needed and would be necessary to segregate air corridors from the coast to reach the areas of interest. These air corridors could not be permanently segregated.

In the same manner, in the south of the Canary Islands there exist airspace areas used for military training and bombing exercises that could be used in close coordination with the Spanish Air Forces. However, these areas are small compared to the large surveillance area needed, therefore there are not advantages compared to the current situation with manned aircraft. In addition, it is difficult to segregate an air corridor from the Canary Islands to the areas of interest. Notwithstanding, these air corridors are possible as demonstrated during the Minerva Operation carried out by Guardia Civil.

6.3.2.3.2 Mid Term Architecture

In the mid-term the situation is different with regard to the short term:

It is possible to fly in coordination with ATC at the lower limit of Class C airspace.

A dedicated ATC controller may be needed to specifically control the UAS if there is high air traffic in the relevant sector, during the time the UA is flying through that sector.

There are three possible options (options A1, A2 and A3) to perform high seas surveillance in the area between Italy/Malta and North Africa in the South Mediterranean scenario and between the Canary Islands and West African countries in the Canary Islands scenario. In addition in the Canary Islands scenario, a fourth option (option A4) exists to cover also the south of the Mauritanian Coasts.

Option A1 comprises the use of three UAS:

- UA1: A large tactical FW UA or a Small MALE RLOS UA. The latter is equipped with a maritime radar (for detection purposes) and with EO/IR sensors (for identification and tracking). The former can be only equipped with a maritime radar for detection due to maximum payload weight constraints, thus being needed to complement this UA with a smaller one operating from a patrol boat, for example, to perform identification and tracking.

- UA2: A small MALE BRLOS equipped with maritime radar and EO/IR sensors.
- UA3: A medium MALE BRLOS equipped with maritime radar and EO/IR sensors.

Option A2 comprises the use of three UAS too:

- UA1 and UA2: Small MALE RLOS covering different areas equipped with maritime radars and EO/IR sensors.
- UA3: A Medium MALE RLOS covering different areas equipped with maritime radars and EO/IR sensors.

This option introduces the possibility of using one UA (UA2) as relay for communications (for UA3).

Option A3 comprises the use of two UAS in which UA1 and UA2 are Medium MALE BRLOS equipped with maritime radars and EO/IR sensors.

Option A4 comprises the use of one Medium MALE BRLOS equipped with maritime radars and EO/IR sensors, only to provide surveillance in the south of the Mauritanian Coasts down to Noadhibou.

The large differences between options is due to the use of BRLOS data link (especially in options A1 and A3)

It will be possible to perform PoI detection from the lower limit of class C airspace following a fixed trajectory agreed with ATC. However if it is necessary to modify the trajectory, a negotiation with ATC will be needed. This negotiation will take time and PoI will be probably lost. Additionally, in case it is needed to descent, the UA will enter into class G airspace, not being possible to fly without an airborne sense and avoid installed on board the UA (or under very special considerations).

6.3.2.3.3 Long Term Architecture

In the long term, the architecture is similar with regard to the one in the mid-term. The only difference is that UA are equipped with a certified Airborne Based Sense and Avoid which allows the UA to fly in class G airspace.

Costs are also the same as in the mid-term, due to the fact that ABSAA costs are not included because it is a technology not developed.

Therefore in the long term full flexibility will exist and longer surveillance periods will be possible compared to manned aircraft due to no on-board pilot flying time restrictions.

7 RECOMMENDATIONS

7.1 Legislation

Subject to specific national legislation several opportunities exist today to fly UAS. As defining new segregated areas takes time, it would help to predefine areas where UAS activities may be required so that they could be segregated.

Flight of UAS shall be agreed by ATC based on submitted flight plan according to international and national procedures. Additionally to normal flight plan, back-up solutions shall be considered during the whole flight to cope with failure. To cope with link loss event, automated programmed flight plan and backups shall be fitted in RPA control system. In case of failure in link loss situation, backup flight plan shall direct RPA to the most suitable landing site and performed automatic recovery in case the control link is not restored before.

During flight, RPA shall follow ATC instructions in order to maintain separation from other air traffic. ATC communication is enabled via a two way communication link with the remote piloted station. In case of lost link event, RPS shall provide to ATC information about the automated reversionary flight.

At midterm, several additional possibilities such as those presented in OPARUS, may be applicable thanks to regional initiatives for common regulation and air traffic insertion at EU level.

For further legislation development, the path is:

- Prioritisation of UAS in ICAO at least in so far as to get agreement on the total system safety' approach and the acceleration of the ICAO guidance material and (with the engagement of the ICAO panels) SARPS development,
- Agreement between EASA, (JARUS), FAA, and other regulators on quantitative safety requirements starting with a global definition of Catastrophic' in the context of UAS,
- Definition of Interoperability and performance requirements (including apportionment of Safety Objectives to various system elements by the relevant EUROCAE (or equivalent RTCA) working groups,
- Strong support for the existing EU initiative which is building on the UAS panel activity of 2011/12. A key goal for this should be harmonized European legislation overcome national fragmentation.

7.2 Technological

Although a generic open architecture for border surveillance UAS is possible, there are still possibilities for improvement by removing existing limitations.

The type and endurance of platforms was identified as a limitation in the case of the patrol boat support missions in the Canary Islands and South Mediterranean scenarios because those platforms that have great endurance are traditionally the larger ones. This fact becomes a limitation when the platform has to be embarked (and stored) on a patrol boat due to the fact that there is not too much space available Thus results in the use of smaller platforms that have less endurance which in certain cases is not enough to meet the end-user requirements (missions duration of 4 hours). It is therefore recommended to perform further studies on miniaturization of some equipment on-board the platform such as sensors and/or communications equipment. Such miniaturization would provide more free space for either additional fuel tanks or larger electrical batteries that would help to extend flight endurance. Moreover, miniaturization would allow multi-sensors with data fusion to be mounted on smaller platforms that could fit on board a patrol boat.

In the north Poland scenario the use of radars was identified as inappropriate as these sensors cannot penetrate foliage. A potential solution is the use of newly studied hyper spectral remote sensing techniques. Hyper spectral remote sensing can passively generate over two hundred channels of images of the ground surface reflectance/emittance simultaneously with wavelengths ranging from 0.4 to 2.5 micrometres and to include the full infrared spectrum. Additionally, it is possible to extend the hyper spectral to include RF spectral for foliage penetration and the terrain profiling to support automatic navigation registration. Therefore it is recommended to carry out additional research in the field of hyper spectral remote sensing techniques to the development of these types of sensors as soon as possible.

UAS are not intended to be the only tool for border surveillance, in addition to them ground systems such as radars or electro optical/infrared sensors as well as patrols (aerial or ground) and satellite images need to be fully integrated in the surveillance system. Some of these tools have not been developed specifically to support border surveillance activities and their performances need to be assessed and improved when necessary. More specifically the use UAS as an integrated surveillance performance needs to be assessed. It is therefore recommended that further studies address the detailed integration of the different elements (platforms, sensors, data links and control stations with the objective of demonstrating that they are really suitable for border surveillance and that they can cooperate with other existing surveillance tools as mentioned above.

Moreover given the different European Member States engaged in border surveillance activities it is recommended to establish a common framework for the use of all the surveillance tools available, including UAS, so that surveillance activities within Europe are harmonised. In this way, surveillance operations carried out using UAS could be carries out by any country or operator and would enable nations and organisations to coordinate and manage the missions and assets, including cross borders operations. Having such a common framework, combined with high performance surveillance systems as explained in the previous paragraph, would also enable Member States to have surveillance information on a more frequent, reliable and cost-efficient basis.

Additionally, it is clear that UAS are a new tool in the field of border surveillance, meaning that end-users might not be prepared for them in terms of existing facilities, especially from the communications network point of view. The fact that the control station has to be connected to the control centre (local or regional), to receive information on time in order to make proper decisions, raises the problem of interfacing control stations and control centres. It is therefore recommended that further studies be undertaken related to the standardisation of such connections in order to enable any control station in Europe to interface with every control centre.

As explained in the OPARUS documents, UAS the development of UAS Activities depends on activities new technologies including:

- Certified collision avoidance system: This is a key function that would allow insertion of UAS in air traffic. MIDCAS project from EDA is on the way to develop airborne demonstrator. But it will not solve all the issues. Additional initiatives or projects should be launched to explore and improve solutions and share results amongst the community.

- High integrity datalink: for safe operation, command and control link between the control station and the remote piloted aircraft must be available, especially during critical flight phases. As any radio link may be interfered especially close to populated area, further development should be launched to improve data link integrity and availability.
- Automation of missions' functions / enhanced detection capability: thanks to UAS, sensors data will be available for any end-users. Expected result will be a huge amount of data that would make difficult and expensive to extract the required information. To avoid such issue, new developments should be launched to increase automation of missions' functions and especially automation of detection capability. Automation of data fusion would greatly reduce operator workload and increase mission effectiveness.

It is important to have a standardised interface between UAS control stations and end users' control centres to receive the information gathered by UAS sensors on time and to process it with the purpose of taking proper actions. Currently, end-users have their own network infrastructures which may not be easily interfaced, depending on the UAS considered, to the control station. Additionally, it may occur that different countries will share the same UAS, increasing complexity when interfacing the control station to the control centre as every country may use different network infrastructure. This situation could compromise the effectiveness of surveillance operations, and should be avoided by homogenizing the interface between control stations and control centres through standardisation. It is recommended to follow a two-step approach: first to carry out the necessary research and development to achieve a common view of what aspects have to be considered to develop the proposed standardisation and second to develop and integrate systems according to the resulting standard or standards that could fit in the common information sharing environment in the European Union. The second step should be considered to be addressed in EUROSUR Step 8 Creation of a common information sharing environment for the whole EU maritime domain.

Standardization should also address specifics of UAS operational procedure. That would allow not only using same sub-systems but also, reducing training and therefore operational cost.

7.3 Cost

In view of the architecture acquisition costs, it would be difficult to any end-user to acquire all the systems in one single purchase without an increase of acquisition budget or an extremely high cost reduction (from 50% to 90%) or sharing their tool with others.

Instead of acquiring all the systems in one single purchase, a step by step approach could be followed by prioritizing the missions according to surveillance needs as well as budget restrictions. It also would help to purchase individually UAS in successive years, and keep on using their current manned aircraft and helicopters.

There would not be problems to purchase the patrol boat support mission architecture alone either in the short, mid-term or long term. In the case of SIVE/coast support missions, the 6 mobile launched UAS could be acquired separately to the 2 airfield launched. An increase of 20% in the budget for acquisition of the end-users and a reduction of 20% in acquisition costs is deemed a balanced approach for high seas architecture.

For Poland, first option is to acquire only the two large UAS for detection and keep on performing the identification and tracking with the current means. In this case only a cost reduction of 5% to 10% would be needed.

The second option is that the end-user decides what areas are most interesting to survey, based on their own risk assessment and to acquire only one large UAS for detection and ten small UAS for identification and tracking. In this case also a cost reduction of only 5% to 10% would be needed.

OPARUS project was focused on illegal immigration. Many other illegal activities (drug, illegal fishing, diving) are also in scope of border surveillance. Moreover, border surveillance is only part of surveillances tasks. Multipurpose missions and end-users approaches would greatly help acceptation of UAS activities and also reduce cost to be withstood by one end-user. That would lead to consider UAS from single operational asset to operational services shared by a community.

7.4 Specific recommandations for land applications

Additionally to previous generic recommendation, especially for land application, take-off and recovery areas shall be selected in areas of low civil population density and good air traffic surveillance infrastructure. Take-off and landing operations should be performed in visual line of sight of the remote pilot and compatible with VFR procedures.

In many areas, military UAS activities are restricted from overflight of areas of high population density. Considering risk to civil populations, such an approach should be extended to civil UAS activities. In time with increased numbers of flights and more experienced operators, procedures and systems will improve. This will allow a step by step increase in the areas opened to civil UAS activities. However with European or national authorities support, activities could be initiated today based on time slot segregated airspace using very well planned flights with safe backup solutions in case of any difficulties. To help authorities to allow UAS flights, several solutions exist today: from escort manned aircraft to Optionally Piloted Aircraft (OPA). Even though not addressed in OPARUS, these mixmode solutions can allow UAS operations to begin to replace manned operational capabilities depending of area of interest.

For the end-users, real flight operation with UAS or mixmode solutions would provide better understanding of capabilities and limitations. It would also help them to define their future requirements for this new tool, which is different from what they may have today.

7.5 SPECIFIC RECOMMANDATIONS FOR MARITIME APPLICATIONS

To be able to perform UAS flights in international uncontrolled airspace (beyond 12 Nm from coast) in a safe manner further analysis and agreements shall be performed with ICAO. In many areas, where traffic is very low (subject to careful evaluation), new rules to allow UAS safe operation may be agreed. New rules could be based on new danger areas, reserved altitude bands and corridors.

Potential Impact:

Main dissemination activities

1 OPARUS WORKSHOP 1

It was held at FRONTEX premises in Warsaw, Poland, the 8th of February 2011. The target of this first OPARUS workshop was to present a first synthesis of the selected border surveillance missions based on end-user requirements, legislation references and the technology state of the art. End users were present at the workshop, namely, FRONTEX, EDA, Polish Border Guards, CNIL and Guardia Civil. The report on the Workshop 1 is the D5.1 produced in the OPARUS project.

2 OPARUS Workshop 2

It was held at CASSIDIAN premises in Getafe, Spain, the 1st of July 2011. The target of this second OPARUS workshop was to present the first draft of the open architecture for border surveillance UAS for end users evaluation. End users were present at the workshop, namely, FRONTEX, Polish Border Guards, Latvia State Border Guard and Guardia Civil.

The report on the Workshop 2 is the D5.2 produced in the OPARUS project.

3 OPARUS Workshop 3

It was held at EUROCONTROL HQ in Brussels, Belgium, the 10th of February 2010. The target of this third OPARUS workshop was to present the final open architecture developed by OPARUS, together with the potential legislation recommendations as well as necessary modifications to current technology to enable the efficient operation of UAS for border surveillance missions. End users were present at the workshop, namely, EUROCONTROL, FRONTEX, Polish Border Guards, South Coast Partnership (UK), French State Aviation Safety Authority, Armed Forces of Malta, CNIL and Guardia Civil.

The report on the Workshop 3 is the D5.3 produced in the OPARUS project.

4 FRONTEX BORDER SURVEILLANCE WORKSHOP

OPARUS project was presented during 22nd February 2011 workshop, Warsaw, Poland. OPARUS presentation was focused on project objectives and identified areas of interest. That presentation amongst Frontex operations presensation, technologies available for border surveillance, European project activities.

Results will be also presented during 18-19th April 2012 workshop, Sofia, Bulgaria. That workshop not only will deal with European project activities but also added value of using RPAS in Frontex operational context, end-users experience and challenges in border surveillance, available solution on the market.

OPARUS presentation to those workshops can be found as annex 1.

5 RED UAS

It was celebrated at Escuela Superior de Ingenieros, Sevilla, Spain, the 30th of November 2011. RED UAS target was the sharing of skills, experiences, research and developments in the UAS arena. The participation of more than 100 participants coming from all over the world (USA, Australia, Japan, Europe) guaranteed the internationality of the event and the presentation of the last results in the UAs research. The event was structured in the following sessions dealing with: Methods for trajectories/paths generation and planning, Multi-rotor systems and applications, Regulations and applications, Education, New designs and prototypes, Navigation and control.

Isdefe, representing the OPARUS consortium, presented a paper and performed a presentation as part of the session Regulations and Operations . Presentation was welcomed by the attendees remarking the high interest of, first, moving one step further in the definition of concrete operations for UAS by proposing a set of potential architectures to perform border surveillance missions, and second, performing a deep assessment of the real viability of such operations in the current regulatory framework, addressing what is needed to research on to enable UAS operation. The paper forms part of the RED UAS proceedings, and can be found as Annex 1.

6 FP7 MARITIME BORDER SURVEILLANCE IMPLEMENTATION GROUP

This (informal) implementation group, chaired by Frontex, is set-up to structure and bring coherence among FP7 activities in maritime border surveillance, linking to EU policy and other activities related to surveillance at sea. This group includes industry representatives, different services of the Commission (ENTR, HOME, MARE) as well as European agencies (FRONTEX, EMSA, EDA). Meetings are planned to take place periodically (3X / year).

Following FP7 projects are concerned: Perseus, I2C, Seabilla, Simtisys, Nereids, Dolphin, Oparus. According to EC working paper SEC(2011) 1536 final , results of those FP7 project will be used in EUROSUR program, phase 2 / step 4 (Development of common tools for border surveillance at EU level).

This group will help for creation of a common sharing environment for the whole EU maritime domain, covering all maritime activities (border control, law enforcement, maritime safety, marine environment, customs, fisheries control, defence, etc) in the long-term.

Sagem will provide information coming from OPARUS study.

7 UVS/RPAS 2012 PARIS CONFERENCE

This conference will happen from 5th to 7th of June 2012 in Paris, France. It is an international conference and associated exhibition focusing only on RPAS and related standards, certification & air traffic management issues, programme updates, operational experience & lessons learned, as well as requirements & new system developments. Presentations by internationally recognised specialists will broaden the awareness of current non-military & military RPA operators, potential commercial operators & end-users, regulatory authorities & industry representatives.

8 UNMANNED AERIAL SYSTEMS UK CONFERENCE

This conference will happen from the 26th to the 28th of June 2012 in Bath, UK. The event is targeted to enhance UAS capability for military and civilian applications, and is supported by several universities, ministries and UAS organisations around the world. It is expected more than 50 leading speakers will illustrate and stimulate the debate on several topics like: Civil applications and their challenges, Sensors, collection and intelligence, Unmanned control and communications, Advanced unmanned platforms, Operational and Tactical Feedback, Human factors and autonomy, Propulsion, power & energy, Training & Qualification, Airspace integration challenges, Homeland security, border control and policing, Flight Safety and Policy.

Isdefe has been invited to present the results on regulatory framework on UAS achieved in a previous EC FP6 project, INOUI. Taking advantage of this slot, regulatory conclusions obtained from OPARUS may be also presented to the audience.

List of Websites:

http://www.oparus.eu

Coordinator : Mr Olivier Reichert / olivier.reichert@sagem.com / +33 1 58 11 67 26