

# **Border Security Challenges and Research Topics**

## **-for mid and long term-**

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at the External Borders of the Member States  
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## 1. Introduction

Today, border control authorities of the Member States of the European Union are facing various challenges of a different nature, which are not only due to the abolishment of EU internal borders, ever-growing migratory pressures and ever-changing irregular migration patterns, but also due to economic and political situation at the national level of EU Member States.

One of the mandates of Frontex is to follow up and to contribute to the development of research relevant for the control and surveillance of external borders that could facilitate or alleviate tackling these challenges. Since planning and conducting research and development endeavours is a time consuming task, in particular taking into account that the potential useful outcomes might not be delivered or visible in a short term, good and thorough understanding of mid- and long-term challenges of the border control end-user community is of paramount importance.

### 1.1. Objective

The general objective of this report is to provide:

- an up-to-date summary of the most urgent challenges border control authorities in the Member States of the European Union and Schengen-associated countries are facing today and will be facing in a mid- and long-term perspective,
- ideas on related potential research topics that could be addressed in a mid- and long-term perspective in order to tackle these challenges,
- prioritization of the aforementioned challenges and research topics in terms of their importance, impact, urgency and need for transnational approach.

### 1.2. Motivation

The main rationale for creating this report was threefold.

Firstly, since the main task of the Frontex Research & Development Unit is to follow up and contribute to the research and development relevant for the control and surveillance of the external borders, an up-to-date summary of the challenges and research topics related to those challenges constitute crucial knowledge which could help to plan and prioritize activities of the Unit.

Secondly, information provided in this report could be used to better embrace the needs of border control authorities in border security-related research programmes, particularly European Commission's new research and development funding programme Horizon 2020<sup>1</sup>.

Finally, challenges and potential research topics presented in this report could help in raising awareness among research community and technology providers about the priorities present in border security-related research and development.

### 1.3. Background Information & Related Work

EU-level civil security research started in 2004 when the European Commission launched its three-year Preparatory Action for Security Research (PASR) with a budget of €45 million for 2004-2006. PASR's purpose was to test the idea of using EU funding for security R&D projects. This prepared the ground for the European civil security research theme in the EU's 7th Framework Programme for research (FP7) for 2007-2013, which was allocated a budget of €1.4 billion and in which specific Border Security themes were embraced.

The preparation of both PASR and the Framework Programme 7 (FP7) Security theme was supported by high-level strategy groups: the 2004 Group of Personalities (GoP) for Security Research and the European Security Research

<sup>1</sup> Horizon 2020: [http://ec.europa.eu/research/horizon2020/index\\_en.cfm](http://ec.europa.eu/research/horizon2020/index_en.cfm)

Advisory Board (ESRAB)<sup>2</sup> whose strategic report<sup>3</sup> in 2006 helped shape the scope and implementation of these programmes. In particular, the ESRAB report included enumeration of areas that needed improvement, thus, fields for potential border security R&D initiatives, including, i.a., (a) surveillance systems to improve situational awareness and detect anomalous behavior of people and platforms, (b) Identity management systems including documentation, equipment and supporting databases to accurately identify and authenticate individuals, goods and platforms, (c) Information management systems to fuse data from disparate systems in order to improve decision-making, (d) Secure communication systems for improved cooperation between national and international border control authorities, (e) Positioning and localisation systems to track and trace individuals, goods and platforms, (f) Advanced training methods, tools and systems based on true representation simulation systems, and (g) Improved architectures, processes and systems for border security including extending the legal borders to departure points outside of the EU perimeter.

In addition, in 2007, the European Security Research Innovation Forum<sup>4</sup> (ESRIF) was set up with the aim to provide further strategic mid-to long term direction for the implementation of EU-funded security research. In its final report<sup>5</sup> published in December 2010, ESRIF formulated European Security Research and Innovation Agenda (ESRIA) for the next 20 years by identifying needs for capabilities based on an analysis of security risks and challenges and represented in terms of different level of "technology readiness" (from low requiring basic scientific research to medium requiring advanced/applied research to high requiring immediate industrial implementation). In the context of Border Security, seven major mid/long term challenges were identified: (a) unlawful movement of persons and goods at border crossing points, (b) people seeking access on the basis of false identity/documents, (c) detection of aircraft flying low and slow, (d) affordable and user friendly equipment for Border Guards, (e) interoperability, (f) detection, identification and tracking of small craft at sea, and (g) detection/Investigation of anomalies at sea.

It should be noted that operational needs of border control end-users (border control authorities) in ESRIF were represented mainly by Frontex Capacity Building Division. Member States' border guard authorities as a whole were not directly involved in the definition of the challenges and priorities. Industry representatives played a considerable role in influencing the results of the forum.

Since the FP7 funding budget expired in 2012, a new funding programme is now being discussed in the form of earlier mentioned Horizon 2020 initiative that is being defined along the strategic lines already developed by ESRIF. The Horizon 2020 general R&D budget, even though still under negotiations is estimated to be 80 billion EUR, with 3.6 billion EUR dedicated to the activities aiming to strengthen security through border management, fighting against crime and terrorism, the provision of cyber security, the increase of Europe's resilience to crises and disasters and the enhancement of the societal dimension of security.

In order to acquire the most up-to-date picture as regards the challenges and needs of border control authorities, Frontex Research & Development Unit in the period 2009-2011 has carried out a "Information R&D" project consisting of visits to Member States and Schengen-associated countries and meetings with national experts. These visits allowed to gather knowledge on the most recent challenges these MS face in the context of border control and surveillance, which helped in the process of the elaboration of potential research topics.

This report builds on top of the aforementioned "Information R&D" initiative, and the reports prepared by ESRAB and ESRIF.

#### 1.4. Methodology

In order to meet the objective, as specified in Section 1.2, Frontex has established an Advisory Group on Border Security Research composed of representatives of the border control authorities from the following Member States and Schengen-associated countries (22): Austria, Belgium, Bulgaria, Croatia, Denmark, Estonia, Finland, France, Germany, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, and United Kingdom.

The main role of the Advisory Group is to advise Frontex on priorities for Border Security Research in a long-term nature. The Advisory Group has been set up as an informal entity in that sense that it does not take any formal

<sup>2</sup> ESRAB was composed of 50 representatives including public authorities, industry, research institutes and think tanks, five Members of the European Parliament and representatives from 14 European Commission services - was supported by the involvement of some 300 people who contributed to the discussions and the development of a capability-based approach to European security research.

<sup>3</sup> [http://ec.europa.eu/enterprise/policies/security/files/esrab\\_report\\_en.pdf](http://ec.europa.eu/enterprise/policies/security/files/esrab_report_en.pdf)

<sup>4</sup> A Joint DG ENTR and DG JLS (now HOME) initiative, the ESRIF was a forum launched on 26 March 2007 to foster the development of Public-Private Dialogue in the area of EU security research and innovation. It was Composed of a plenary of 65 members from 32 countries including independent representatives from industry, public and private end-users, research establishments and universities, as well as non-governmental organisations and EU bodies and supported by more than 600 experts

<sup>5</sup> [http://ec.europa.eu/enterprise/policies/security/files/esrif\\_final\\_report\\_en.pdf](http://ec.europa.eu/enterprise/policies/security/files/esrif_final_report_en.pdf)

decisions, but rather provides advice and recommendations in written and/or oral form and acts as group of experts representing a “collective” view.

Two meetings of the Advisory Group have been organized in 2013, during which all participating Member States presented the challenges they are facing and expect to face in the future at national level, and provided some ideas on potential research topics in this context. Subsequently, this information has been fused with the in-house knowledge gathered by Frontex Research & Development Unit in other meetings held with experts from the Member States. Next, the Advisory Group and Frontex jointly elaborated on the potential research areas and topics. Finally, after concluding the elaboration of the challenges and research topics, the Advisory Group was asked to rank the “Relevance”, “Impact”, “Urgency” and the “Need of Transnational Approach” of each challenge and research topic.

It is important to note that the challenges and research topics provided in this report is a “union” of the feedback received from each particular member of the Advisory Group, i.e., research topics that have been proposed by at least one member of the Advisory Group were included. Furthermore, as regards certain specific challenges it has been acknowledged that there is no need for conducting concrete border security-related research, but for the sake of completeness these challenges are included in this report since tackling those challenges might be partially solved through some harmonization and standardization work.

The material presented in this report has certain limitations and might provide an incomplete picture. Firstly, there are some Member States that are not present in the Advisory Group on Border Security Research, namely: Czech Republic, Greece, Hungary, Ireland, Island, Italy, Lithuania and Luxemburg. Although Frontex has reiterated the invitation to the aforementioned Member States to join the Advisory Group, feedback from two important EU Member States facing significant irregular migration problems, namely, Greece and Italy is not included in this report (as well as from other Member States not represented in the Advisory Group). Furthermore, the feedback on the prioritization was provided so far by 18 out of the 22 Member States represented in the Advisory Group. Finally, the selection of potential research topics has not yet been discussed with the research community, whose input might have been a valuable contribution and would most likely put certain consideration under a different light.

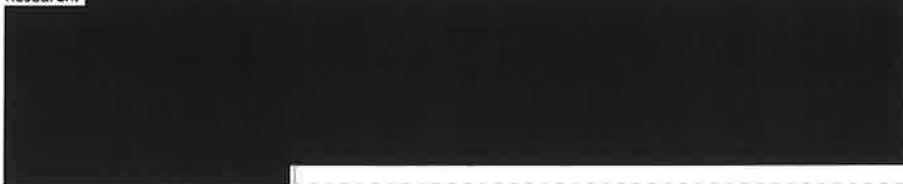
It is also important to note that the report focuses solely on providing a compendium of knowledge of the known existing challenges Border Guard authorities are facing and potential research topics that could be addressed to solve or alleviate these challenges, without identifying and assessing the overlaps of the research topics already being covered by the ongoing EU-funded projects.

### 1.5. Structure of the Report

The remaining part of the report is structured as follows. First, Section 2 provides a list of challenges and related potential research topics. Subsequently, Section 3 gives an overview of the prioritization of the challenges and research topics. Finally, the report ends with some conclusions and outlines some recommendations in Section 4. Annex 1 provides a short overview of the EU-funded R&D projects relevant to border control.

### 1.6. Acknowledgements

The creation of this report would not have been possible without the input from the Advisory Group on Border Security Research.



**Commented [BW1]:** Text contains personal data. The disclosure of such information would harm the privacy of the individual. In this regard the text is not disclosed pursuant to the exception laid down in the Article 4(1)(b) of Regulation (EC) 1049/2001.

## 2. Challenges and research topics for border security research

### 2.1. Outcome

This Section provides a list of the challenges elaborated by the Advisory Group together with Frontex RDU. For each challenge one or more concrete scenarios are provided in order to give more concrete examples, where each scenario is accompanied by a list of related potential research topics that could be addressed.

**CHALLENGE 1 (C1):** An ever-increasing number of people coming to the EU poses a challenge of having less time for the entire process of person identity verification and document authentication, and efficiently detecting the ones, which should undergo a more thorough check.

**SCENARIO:** In the context of airport border crossing points efforts have already been undertaken to facilitate the travel of bona-fide passengers and simultaneously to safeguard a high level of security. In particular, the deployment of biometric-based approaches for person identity verification led to significant advances as regards making the border control processes more efficient and secure, however, based on the experience of some Member States a deterioration in terms of efficiency has been reported too, e.g., the use of fingerprint verification in the VIS context might lead to slowdowns (due to difficulties for the passengers to place their fingers on the reader in the right way). According to the forecast, the traffic to/from EU will steadily grow in the forthcoming years<sup>6</sup>, which will require further improvement of the person identity verification process in terms of time efficiency and security, in order to facilitate non-EU citizens in crossing EU external borders.

#### POTENTIAL RESEARCH TOPICS:

- (RT 1.1) Methods for assessment of the vulnerabilities of the current border control processing chain and the deployed equipment could be elaborated.
- (RT 1.2) It could be explored whether it is possible to use other biometric data (potentially already used in another context and in another domain) than fingerprint, iris or picture to store in the e-Passport chip, which guarantees the same or higher level of security, is more accurate and can be retrieved in a more efficient manner than in the case of the conventionally used biometric data types. For instance, inter alia, feasibility of storing DNA-string in the e-Passport chip and capturing the DNA on a glass plate or a capturing filter could be researched. While the introduction of new biometric-based modalities in the process of person identification might lead to making this process more accurate and efficient, an integral part of the research should embrace related ethical, societal and data protection aspects.
- (RT 1.3) It could be explored whether fully contactless passport controls would be possible in the future and whether secure ways of "encoding" e-Passports in mobile devices are possible. Similarly, a feasibility of electronic VISA encoded in the chip of the passport could be studied.
- (RT 1.4) In the same spirit, it could be explored, whether there are possibilities to make the finger print verification with regard to VIS fully contactless.
- (RT 1.5) New models for the entire border control process at the airport could be elaborated, studied and compared i.e., going beyond the e-gates model, inclusion of new elements, e.g., pre-screening passengers at the port of departure in third countries (both for TCNs and EU citizens), considering broader context and more information that could be gathered on a person from additional sensors prior to reaching the Border Crossing Point, or having a one-stop check.
- (RT 1.6) One way of speeding up the border control process could be potentially achieved through the utilization of passenger risk profiling. In particular, passenger risk profiling models could be elaborated, explored and compared, which could also embrace inclusion of new, previously unexplored, type of information (e.g., closed vs. open source information - social media for identity verification as additional information). Furthermore, risk profiling models should allow for fine-grained classification of passengers, e.g., to identify not only persons that are candidates for more thorough check, but also victims of human trafficking, potential asylum seekers, etc.
- (RT 1.7) Since document fraud has been considered as an ever-growing phenomenon a feasibility of an EU passport could be considered. Also new methods to combat identity fraud could be studied.
- (RT 1.8) While utilization of passenger information (API) received from airlines prior to passenger arrival is being practiced at the airports in various Member States, elaboration of similar concept in other scenarios could be considered, e.g., API on passengers travelling by train, buses or maritime means.
- (RT 1.9) As of today API considers only biographical data of travellers. A feasibility of inclusion of biometric data in API could be explored.
- (RT 1.10) It could be explored whether cross-analysis of information sources brings added value in terms of improving the accuracy of identifying threats.
- (RT 1.11) New ways of predicting detailed air traffic flows and forecasting trends in the mid- and long term could be elaborated in order to better allocate resources.

<sup>6</sup> According to Eurocontrol's study on long term forecast for the next 20 years, an increase from 400 million in 2009 to 720 million border crossings at the air borders are expected in 2030.

- (RT 1.12) Feasibility of an EU-own centralized PKI could be elaborated as way to provide an easy way to exchange certificates for passport authentication.

**SCENARIO 2:** One of the particular factors that impact the increase in cross-border traffic is the introduction of specific local traffic and VISA freedom agreements with certain third countries. However, it is not known what the exact impact of such arrangements with third countries on border control processes is or might be in the future.

**POTENTIAL RESEARCH TOPICS:**

- (RT 1.13) It could be explored how existing and planned VISA freedom arrangements with third countries (e.g., agreement between Finland and Russia) impacted and/or might impact border control, i.e., how to control people within the area they are allowed to stay? how to re-organize border control processes in the affected areas?, how and whether to use ABCs in such scenarios? Furthermore, it could be explored whether there would be a need for closer collaboration with other authorities (e.g., Customs). On top of it an impact on internal security and cross-country comparisons could be studied as well.

**SCENARIO 3:** It has been acknowledged that carrying out border checks in an environment with low/bad connectivity or frequent interruptions in connectivity, where the time for carrying out the border checks is very limited (in particular for processing and retrieving information related to a person being checked) poses a serious challenge. This applies in particular to border checks at railway Border Crossing Points (movement of the train over long distance), in sea ports, buses (with high number of TCNs who are obliged to have VISA) and small airports, where the specific connectivity conditions might severely impact the performance in terms of extended time needed to carry out the checks. An additional important aspect in this context is the requirement of retrieving information from numerous information systems, not necessarily available at hand at all, and whose obtaining is time critical.

**POTENTIAL RESEARCH TOPICS:**

- (RT 1.14) Mobile equipment, e.g., mobile document readers, mobile devices to retrieve information from border security-related databases/systems, are already on the market and are being successfully deployed in various Member States by border control authorities. Therefore there is no particular need for carrying out research that would lead to development of such devices. However, an elaboration of a concept, development and testing of an "all-in-one" border checks mobile terminal and related "infrastructure" that would be needed in order to: (a) reduce the information processing and retrieval time and, (b) alleviate the problem of bad connectivity, could be carried out. Also, flexibility aspects could be addressed, i.e., taking into account the integration/linking to existing, emerging national and EU-level information systems (e.g., Entry/Exit System), and any future systems.

**SCENARIO 4:** Due to an ever-increasing traffic of third-country nationals to the Member States of the European Union and the identified modi operandi used to enter the EU zone in an irregular manner, it has been acknowledged that an efficient way of detecting people hidden in containers/transportation means (vehicles) will become more important in the future. This observation applies to all EU Member States, including also Northern Member States. The particular challenge is to extend the screening - usually done in order to detect dangerous cargo, to include the detection of humans, in order to perform the entire task in one go.

Current technology for detecting people hidden in transportation means has its own drawbacks. Some of them result from errors caused by the environment in which the detection process is carried out. For instance, heart beat detectors might provide erroneous results when the detection is done in environment prone to vibrations, wind, etc. Furthermore, the presence of specific goods in the trucks where persons might be hidden might impact the performance of the detector, e.g., CO2 detectors are affected by the presence of vegetables. Finally, certain technologies for the detection are dangerous to human beings (e.g., X-ray scanners).

**POTENTIAL RESEARCH TOPICS:**

- (RT 1.15) It could be explored whether health-safe, secure, more environment-independent and accurate solutions to container/transportation means screening could be elaborated/developed (i.e., obtaining a complete image of the contents of the container/vehicle) in order to detect at the same time dangerous substances and human beings (e.g. detection and identification in no more than 60 seconds from the commencement of uploading/offloading the container to/from the ship).
- (RT 1.16) Data mining solutions could be explored to automatically detect anomalies in container/transportation means traffic in order to assess them with respect to the probability of including human beings therein, thus, making the border control process more efficient.
- (RT 1.17) Since the purpose of screening cargo and vehicles is not only related to border security it could be explored how cross-sector cooperation in this context could be further streamlined.

**CHALLENGE 2 (C2):** Surveillance of certain types of borders can not be done effectively without the deployment of non-stationary equipment. This is mainly due to either: (a) high vulnerability of the specific border, (b) terrain topography and weather conditions, and (c) lack of basic infrastructure (e.g., roads, electricity, etc.).

**SCENARIO 1:** The proximity of certain third countries to the EU Member States in Southern Europe imposes on the Coast Guard authorities in these MSs a serious challenge in terms of short reaction time to potential crisis situations. For instance, Syria and Lebanon, two Member States highly vulnerable as regards outbreaks of potential crisis situations, are relatively close to Cyprus, which can be reached by small boats from those countries relatively quickly. An additional challenge in this particular example emerges from the lack of any control by Turkey to travellers from these countries to Turkey, to the occupied Northern part of Cyprus. In other areas of Southern Europe irregular migration facilitators use fast boats or jet skis to bring third country nationals to EU territory. In certain areas (e.g., Aegean Sea in the vicinity of Turkey) the entire trip, disembarkation of the immigrants and returning back can take less than 15 minutes. The timely detection and classification of insignificant-in-size maritime means are used by third-country nationals to enter into the EU in an irregular manner is critical.

**POTENTIAL RESEARCH TOPICS:**

- (RT 2.1) The ways to improve the capacity to detect small maritime objects and to optimize the border surveillance processes in areas with high border vulnerability could be explored. Since a vast bulk of research on techniques for detection of small maritime objects has already been carried out in the past or is in progress, future research in this area should look into alternative and cost-efficient solutions that go beyond deployment of expensive methods, such as satellite imaging technology.
- (RT 2.2) New methods for early detection of potential threats that impact border vulnerability<sup>7</sup>, e.g., crisis in third countries, could be studied. In particular, ones that do not necessarily solely rely on the deployment of conventional and expensive air and maritime surveillance means.
- (RT 2.3) It could be explored whether the performance of Remote Piloted Aircraft Systems in bad weather conditions can be improved, e.g., safe landing of an RPA on a vessel/ship in stormy/windy weather, detection of facilitators during the night, etc.

**SCENARIO 2:** A significant part of the Eastern EU land borders is characterized by the lack of any kind of basic infrastructure in place or is not suitable for the deployment of stationary border surveillance equipment (all weather condition). This is mainly due to high costs involved or terrain topology. Furthermore, investments in certain areas in stationary systems are not considered efficient due to 'seasonal' vulnerability of the particular border. Hence, cost-efficient, flexible and mobile solutions are more appropriate.

**POTENTIAL RESEARCH TOPICS:**

- (RT 2.4) Mobile equipment-based border surveillance models for the different type of land borders could be elaborated and explored in order to optimize the performance and reduce the costs involved.
- (RT 2.5) Feasibility of alternative solutions on low-cost stationary equipment for deployment in such scenarios could be studied.

**CHALLENGE 3 (C3):** An increasing field-cooperation between Border Guard authorities of (neighbouring) EU Member States is often hindered by non-compatible mobile secure communication networks that could be used to exchange data of various kinds (videos, images, text) in a straightforward and efficient manner. Additional challenges in this context are posed by the ever-growing need to transfer high volumes of data over mobile networks and use of mobile communication networks in areas with low connectivity.

**POTENTIAL RESEARCH TOPICS:**

(RT 3.1) Various technologies that facilitate interconnecting incompatible secure mobile communication networks are already on the market. Therefore, there is no need for any border security-specific research in this area. However, a feasibility study on a EU-wide mobile Network for public safety and security organisations could be conducted, although one has to consider that work on harmonisation of mobile communication standards in this regard is already being carried out by various groups<sup>8</sup>.

**CHALLENGE 4 (C4):** An ever-growing need to exchange border security-related information of various kinds at the EU-level poses a challenge in terms of: (a) making existing systems interoperable, (b) willingness to share information "across the sectors and borders", (c) having a common understanding of the content to be shared

**SCENARIO 1:** It has been acknowledged that creating an "Airport Common Situational Picture" system, to which EU airports are connected and share real-time information on what is happening at any given moment (e.g. detection of faked documents with details, different cases of law infringement, other crisis situations, etc.) might contribute to the improvement of border control activities at the airports.

**POTENTIAL RESEARCH TOPICS:**

- (RT 4.1) The feasibility of such airport-specific system could be explored, i.e., what particular information could be shared, how it could be shared and for what particular purpose it could be used, e.g., to facilitate the process of automating risky flight detection and crisis management. Since some EU-level information

<sup>7</sup> In particular in the context of creating a Common Pre-frontier Intelligence Picture under the umbrella of EUROSUR.

<sup>8</sup> For instance by the Public Safety Communication Europe Forum (PSCE) - <http://www.psc-europe.eu/>



systems in the domain of border control already exist and some are being contemplated, the feasibility study should explore: (a) potential “overlappings” with existing systems in terms of information that could be shared, and (b) potential solutions, including considering the inclusion of desired functionalities in an existing or planned EU-level information system. Furthermore, the need of cross-sectoral approach should also be assessed.

**SCENARIO 2:** At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level.

#### **POTENTIAL RESEARCH TOPICS:**

- (RT 4.2) It could be studied whether the number of such EU-level systems could be significantly reduced in the future and whether such systems could be easily made interoperable.
- (RT 4.3) Ergonomic and more user-friendly interfaces to the existing systems could be explored and elaborated, in particular, interfaces that would serve as one gateway to all “thematically related” systems.

**CHALLENGE 5 (C5):** The ever-growing amount of heterogeneous border security-related data stemming from different sources of varying reliability makes it difficult to efficiently process, analyse, fuse and convert it into actionable knowledge

**SCENARIO 1:** In the context of border surveillance the amount of sensors (e.g., cameras, radars, unattended ground sensors) and type of information (e.g., images, intelligence, etc.) used is growing. The proper assessment of the situation requires analysis of this information which is available, which might pose a problem for humans to process due to the size and heterogeneity.

#### **POTENTIAL RESEARCH TOPICS:**

- (RT 5.1) It could be explored how to fuse surveillance-related information, in order to present only the most relevant information to the human in order to facilitate the decision making process (including automated alerts). Furthermore, it could be studied whether inclusion of additional information at all improves the accuracy of border surveillance, and if so, what is the contribution of including the specific type of additional information.

**SCENARIO 2:** Nowadays, a continuously growing amount of publicly accessible information is being transferred and/or published via the web. Various security-related organizations and agencies, in particular in the area of law enforcement, have acknowledged the relevance of gathering information from such open sources for intelligence purposes (e.g., evidence) and for predicting certain threats. Open sources constitute for the border control authorities yet another and relatively cheap source of information, whose importance has been acknowledged, but whose real value has neither been thoroughly and consistently explored nor studied yet in the domain of border security.

#### **POTENTIAL RESEARCH TOPICS:**

- (RT 5.2) It could be explored what particular type of open source information, including, i.a., online news, social media, blogs, web-based services provided by security-related and other organizations, could be utilized for border security-related intelligence gathering process. Furthermore, one could study in the context of the border security domain: (a) how to automatically assess the usefulness and complementarity of open source information, (b) how to automatically assess the credibility of open source information, and (c) how to best merge/fuse it with closed source information in order to make the best value out of it, and (d) the added value of open source intelligence versus utilization of other technologies already deployed.

**CHALLENGE 6 (C6):** Various new technologies with border control application potential are emerging, however, their integration into the border control processing chain poses administrative, technical, societal, privacy and human-machine optimization issues.

**SCENARIO 1:** Border Control authorities are and will be confronted in the near future with a problem of having less staff to carry out border control tasks and will have less financial means. Despite the aforementioned austerity measures new technologies are emerging that are aimed at supporting border control authorities in carrying out border control and surveillance tasks. Having “less people and financial means”, but “new tools and machines” requires a well-thought strategy and establishment of mechanisms to improve decision making processes in the context of planning resources allocation, in particular, in the context of optimal combination of humans and machines.

#### **POTENTIAL RESEARCH TOPICS:**

- (RT 6.1) Research could be done in order to conceptualize and develop (or adapt) methodologies and tools that would facilitate: (a) planning cost- and performance-efficient allocation of assets and human resources to border control tasks, and (b) exploration of how to best combine humans with new technologies, e.g., through simulations, virtual environments.
- (RT 6.2) It could also be explored how the introduction of new technologies affects the border guards and travellers and how emerging technologies are perceived by them, e.g., whether and to what extent are they

creating fears among border guard staff. Furthermore, it could be studied how to hire new staff in the future in the light of the emergence of new technologies and related changes in the border control processes and the border control organizations environment.

### 3. Prioritization of challenges and research topics

In order to prioritize the challenges and the corresponding research topics the Advisory Group was tasked to rate each of them in terms of their “Relevance”, “Impact”, “Urgency” and the “Need of Transnational Approach”. To be more precisely, for each of the aforementioned criteria each Member State represented in the Advisory Group was asked to give a score ranging from 1 to 5, where the following semantic of the scoring was used: 1 - very low, 2 - low, 3 - medium, 4 - high, 5 - very high. 18 out of 22 Member States responded and provided the required scorings. The summary of the results of the prioritisation exercise are presented in this Section.

#### 3.1. Prioritization of challenges

For the sake of readability the table in Figure 1 provides a short overview of the main challenges that were identified (see Section 2). Without delving into the results of the prioritization one can observe that there has been a slight shift from border surveillance-related challenges to challenges that are more related to border checks, in particular challenges related the cooperation between Border Guard authorities, difficulties in exchanging information and problems that may emerge by using new technologies. The challenge 2 is the only one strictly related to border surveillance.

CHALLENGE 1: An ever-increasing number of people coming to the EU poses a challenge of having less time for the entire process of person identity verification and document authentication, and efficiently detecting the ones, which should undergo a more thorough check.
CHALLENGE 2: Surveillance of certain types of borders can not be done effectively without the deployment of non-stationary equipment. This is mainly due to either: (a) high vulnerability of the specific border, (b) terrain topography and weather conditions, and (c) lack of basic infrastructure (e.g., roads, electricity, etc.).
CHALLENGE 3: An increasing field-cooperation between Border Guard authorities of (neighbouring) Member States is often hindered by non-compatible mobile secure communication networks that could be used to exchange data of various kinds (videos, images, text) in a straightforward and efficient manner. Additional challenges in this context are posed by the ever-growing need to transfer high volumes of data over mobile networks and use of mobile communication networks in areas with low connectivity.
CHALLENGE 4: An ever-growing need to exchange border security-related information of various kinds at the EU-level poses a challenge in terms of: (a) making existing systems interoperable, (b) willingness to share information “across the sectors and borders”, (c) having a common understanding of the content to be shared
CHALLENGE 5: The ever-growing amount of heterogeneous border security-related data stemming from different sources of varying reliability makes it difficult to efficiently process, analyse, fuse and convert it into actionable knowledge.
CHALLENGE 6: Various new technologies with border control application potential are emerging, however, their integration into the border control processing chain poses administrative, technical, societal, privacy and human-machine optimization issues.

Figure 1 - The list of Challenges

The diagrams in Figure 2,3,4 and 5 provide a summary of the prioritisation of the challenges in terms of relevance, impact, urgency, and need of trans-national approach respectively. The bars in the diagrams reflect the number of Member States that ranked each challenge as high (green), medium (yellow) and low (red) according to the various criteria<sup>9</sup>.

Looking at all the diagrams in Figure 2,3,4 and 5 it can be inferred that challenge 1, i.e., ever-decreasing time for the entire process of person identity verification and document authentication can be considered as the one with the highest priority (i.e., the highest number of Member States ranking it as high) in terms of relevance (although 2

<sup>9</sup> The scores provided by the Member States in the range of 1-2 were interpreted as “low”, score of 3 is interpreted as “medium”, and scores in the range of 4-5 are interpreted as “high”.

Member States ranked the relevance as low), impact, urgency and need of trans-national approach. Challenge 2, related to the need of deployment of non-stationary equipment for the surveillance of certain types of borders, can be considered as the one with the second-highest overall priority in terms of the number of Member States ranking the challenge as "high". The four remaining challenges scored more or less equally with some minor differences. Looking at each of the priority criteria separately (see Figures 3,4,5 and 6) one can conclude:

- The relevance of all challenges was ranked by the majority of the Member States as "high"
- The impact of solving all challenges was ranked by the majority of the Member States as "high", with an exception of challenge 5 (slightly below 50% of "high" scores)
- The urgency of solving challenges 1,2 and 4 has been ranked by the majority of the Member States as "high" (slightly more "high" scores than "medium"), whereas as regards challenges 3,5 and 6 the majority of the Member States rated the urgency as "medium"
- The need of transnational approach in tackling all challenges was ranked as very "high"
- There is no challenge which scored on average "low" for any of the criteria evaluated

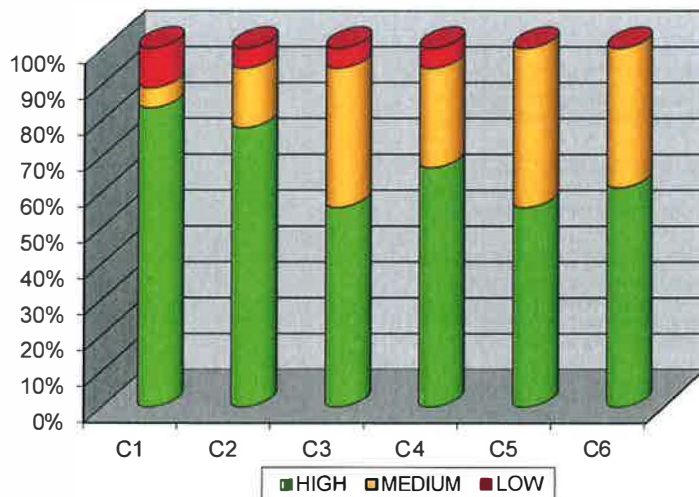


Figure 2 - Prioritization of the challenges from the point of view of "Relevance". The bars reflect the number of Member States that rated the various criteria as high, medium and low respectively

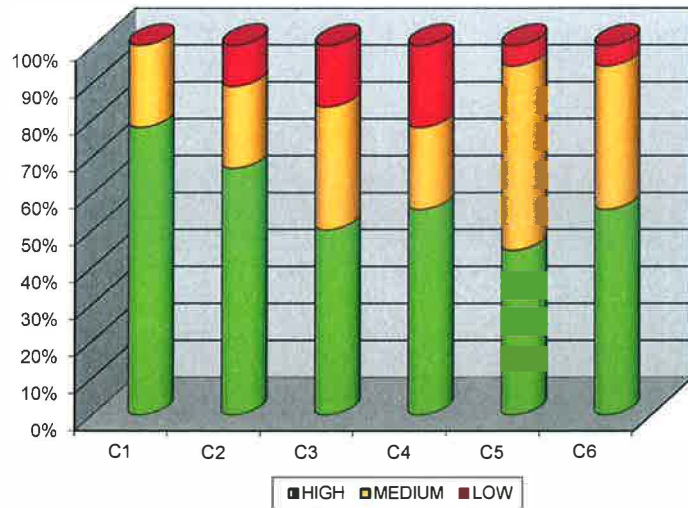


Figure 3 - Prioritization of the challenges from the point of view of "Impact". The bars reflect the number of Member States that rated the various criteria as high, medium and low respectively

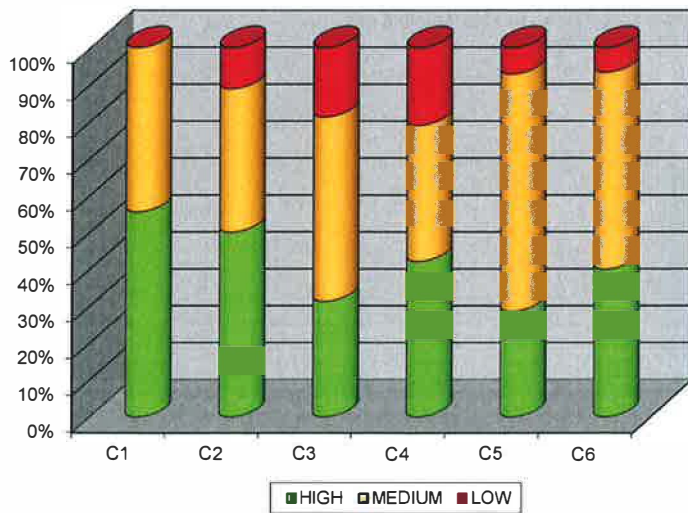


Figure 4 - Prioritization of the challenges from the point of view of "Urgency". The bars reflect the number of Member States that rated the various criteria as high, medium and low respectively

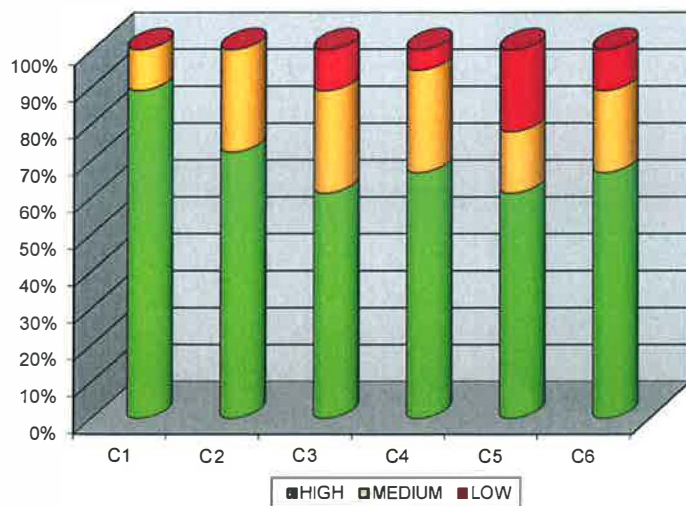


Figure 5 - Prioritization of the challenges from the point of view of "Need of Transnational Approach". The bars reflect the number of Member States that rated the various criteria as high, medium and low respectively

To provide a more global picture the average relevance scores for all challenges were compared with the corresponding average scores for impact, urgency and the need of transnational approach. The result of this comparison is depicted in Figures 6, 7 and 8 respectively. Once again one can observe that challenges 1 and 2 stand out from the entire pool of challenges. There is no challenge which ranks "low" in terms of any of the criteria considered.

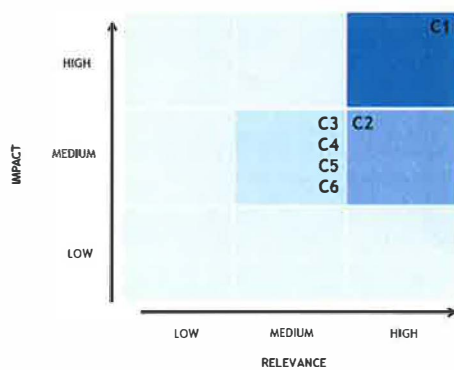


Figure 6  
relevance and impact scores of all challenges

- Comparison of the

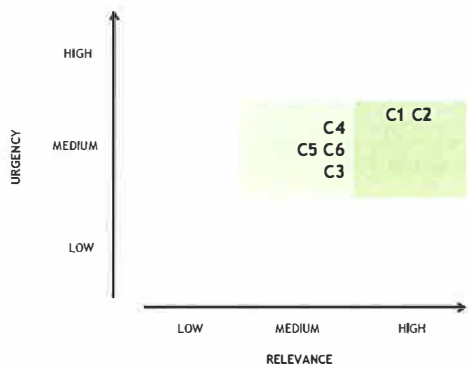


Figure 7 - Comparison of the relevance and urgency scores for all challenges

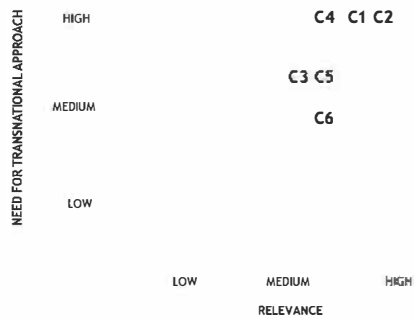


Figure 8 - Comparison of the relevance and need for transnational approach scores for all challenges

Figures 9, 10 and 11 provide the results of the prioritisation of the challenges in terms of relevance, impact and urgency for the specific geographical areas: (a) Atlantic and Mediterranean Member States (Portugal, France, Spain and Croatia), (b) Eastern European Member States with EU-external land borders (Poland, Slovakia, Romania, Bulgaria and Hungary), (c) Northern European Member States (UK, Denmark, Norway, Sweden, Finland and Estonia) and (d) Western European Member States (Belgium, Netherlands, Germany and Switzerland). However, it has to be emphasized that these results provide only a limited and incomplete picture since information from some relevant Member States is not available. Nevertheless, overlooking the differences between the priorities and problems that are presented in the regions would pose a risk by itself. As regards the relevance (see Figure 9) most discrepancies can be observed in the context of challenge 3 and 4. In particular 1/3 of the Member States in the Atlantic and Mediterranean zone ranked the relevance of these challenges as "low". We can also observe (see Figure 10) that 50% of the Member States in the Atlantic and Mediterranean zone ranked the impact of the challenge 3 and 6 as low, whereas 50% of the Member States in the same region ranked the urgency of solving challenge 3, 4, 5 and 6 analogously as "low". Also, in the context of urgency, large fraction of Northern Member States ranked challenge 2 and 3 as "low". Furthermore, challenge 2, not surprisingly, scores highest in all three categories among Eastern European Member States.

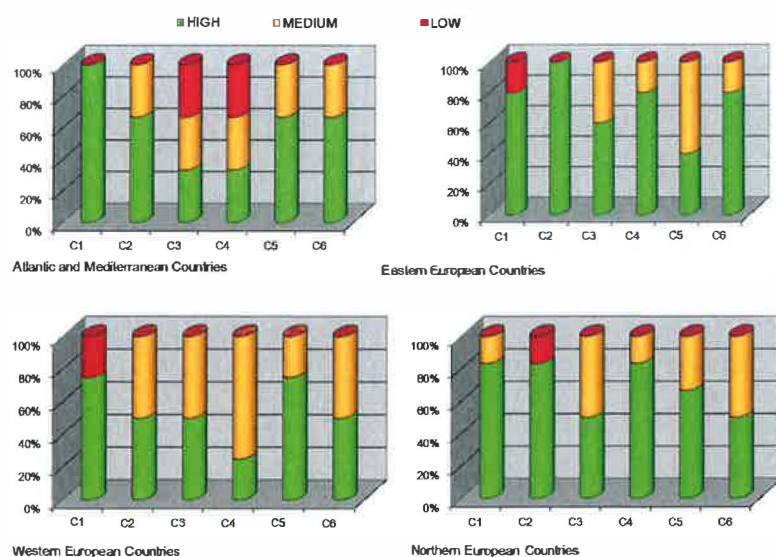


Figure 9 - Regional Prioritization of challenges in terms of relevance.



# Border Security Challenges and Research Topics

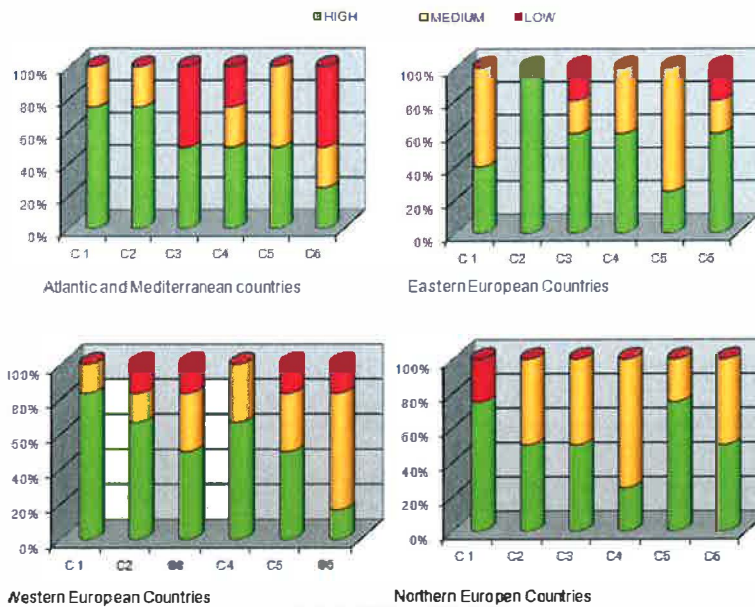


Figure 10 - Regional Prioritization of challenges in terms of impact.

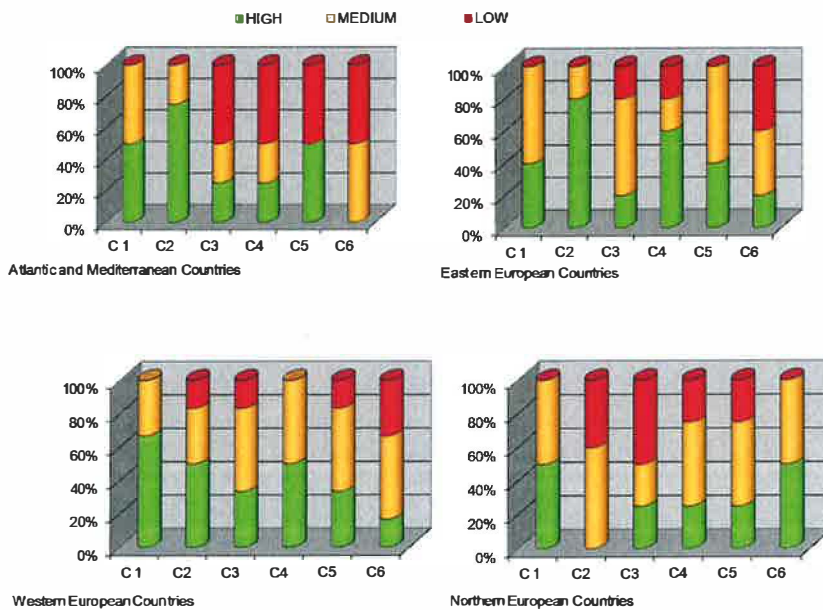


Figure 11 - Regional Prioritization of challenges in terms of urgency.

### 3.2. Prioritization of research topics

Analogously to the prioritization of challenges, this Subsection provides the results of the prioritization for the concrete research topics identified. The particular results of the prioritization of the research topics in terms of relevance, impact, urgency and need of trans-national approach are presented in Subsection 3.2.1, 3.2.2, 3.2.3 and 3.2.4 respectively.

Analyzing the prioritisation results for all four categories one can observe that there are four research topics that dominate the rankings (in the order as given below):

- Feasibility of an EU-own centralized PKI could be elaborated as way to provide an easy way to exchange certificates for passport authentication.
- At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. It could be studied whether the number of such EU-level systems could be significantly reduced in future and whether such systems could be easily made interoperable.
- While utilization of passenger information (API) received from airlines prior to passenger arrival is being practiced at the airports in various Member States, elaboration of similar concept in other scenarios could be considered, e.g., API on passengers travelling by train, buses or maritime means.
- The ways to improve the capacity to detect small maritime objects and optimization of border surveillance processes in areas with high border vulnerability could be explored. Since a vast bulk of research on techniques for detection of small maritime objects has already been carried out in the past or is in progress, future research in this area should look into alternative and cost-efficient solutions that go beyond deployment of expensive methods, such as satellite imaging technology.

Apart from the urgency scores for a couple of research topics there were no research topic scoring "low" in terms of any of the categories. Nevertheless one can infer from the results that there are several topics which score lowest compared to the others. These research topics are mostly related to: (a) specific local challenges, e.g., impact of the VISA arrangements on rearranging border control processes, use of Remotely Piloted Aircrafts in heavy-weather conditions, and (b) less studied and known technologies, e.g., new biometric data modalities, utilisation of open source intelligence.

## 3.2.1. The prioritization of the research topics from the point of view of "Relevance";

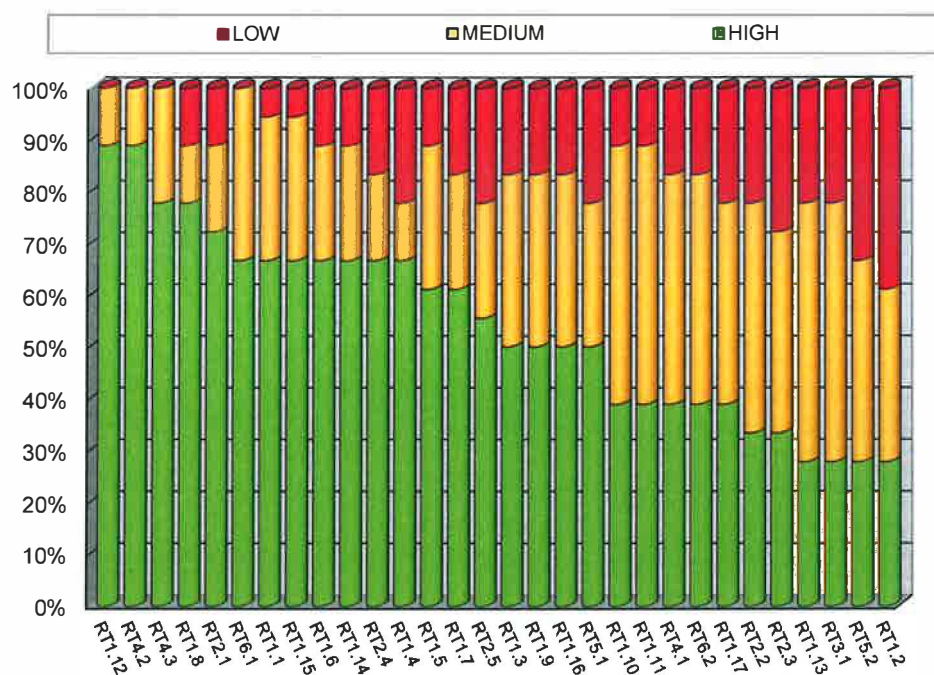


Figure 9 - Prioritization of Research Topics from the point of view of "Relevance"

A tabular view of the prioritization of the relevance of research topics is presented below. The ordering reflects the number of Member States ranking the relevance as "high". An additional colour marking of the topics is also provided. In particular, the topics, which received more than 50% of "high" scores are marked green. Topics which received less than 50% of "high" scores, but whose total amount of "high" and "medium" scores exceeds 50% of the total number of scores are marked yellow. Finally, topics, which received more than 50% "low" scores are marked red (not applicable in the case of relevance).

Code	Research topics	Order of priority (1-the highest) taking into account the no of Member States that rated relevance high
RT1.12	Feasibility of an EU-own centralized PKI could be elaborated as way to provide an easy way to exchange certificates for passport authentication.	1
RT4.2	At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. It could be studied whether the number of such EU-level systems	1

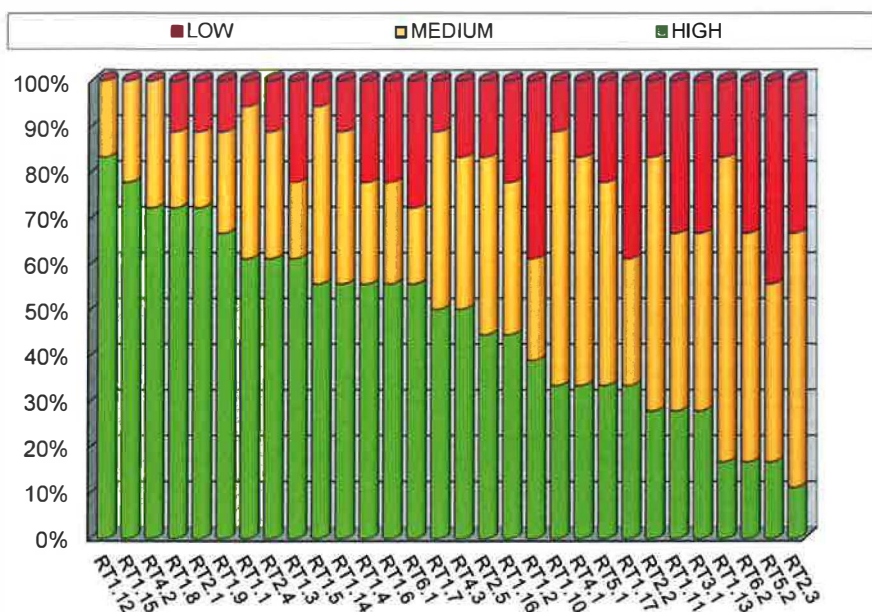
	could be significantly reduced in future and whether such systems could be easily made interoperable.	
RT4.3	<ul style="list-style-type: none"> <li>At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. Ergonomic and more user-friendly interfaces to the existing systems could be explored and elaborated, in particular, interfaces that would serve as one gateway to all "thematically related" systems.</li> </ul>	2
RT1.8	<ul style="list-style-type: none"> <li>While utilization of passenger information (API) received from airlines prior to passenger arrival is being practiced at the airports in various Member States, elaboration of similar concept in other scenarios could be considered, e.g., API on passengers travelling by train, buses or maritime means.</li> </ul>	3
RT2.1	<ul style="list-style-type: none"> <li>The ways to improve the capacity to detect small maritime objects and optimization of border surveillance processes in areas with high border vulnerability could be explored. Since a vast bulk of research on techniques for detection of small maritime objects has already been carried out in the past or is in progress, future research in this area should look into alternative and cost-efficient solutions that go beyond deployment of expensive methods, such as satellite imaging technology.</li> </ul>	4
RT6.1	<ul style="list-style-type: none"> <li>Research could be done in order to conceptualize and develop (or adapt) methodologies and tools that would facilitate: (a) planning cost- and performance-efficient allocation of assets and human resources to border control tasks, and (b) exploration of how to best combine humans with new technologies, e.g., through simulations, virtual environments.</li> </ul>	5
RT1.1	<ul style="list-style-type: none"> <li>Methods for assessment of the vulnerabilities of the current border control processing chain and the deployed equipment could be elaborated.</li> </ul>	6
RT1.15	<ul style="list-style-type: none"> <li>It could be explored whether health-safe, secure, more environment-independent and accurate solutions to container/transportation means screening could be elaborated/developed (i.e., obtaining a complete image of the contents of the container/vehicle) in order to detect at the same time dangerous substances and human beings (e.g. detection and identification in no more than 60 seconds from the commencement of uploading/offloading the container to/from the ship).</li> </ul>	6
RT1.6	<ul style="list-style-type: none"> <li>Another way of speeding up the border control process could be potentially achieved through the utilization of passenger risk profiling. In particular, passenger risk profiling models could be elaborated, explored and compared, which could also embrace inclusion of new, previously unexplored, type of information (e.g., closed vs. open source information - social media for identity verification as additional information). Furthermore, risk profiling models should allow for fine-grained classification of passengers, e.g., to identify not only persons that are candidates for more thorough check, but also victims of human trafficking, potential asylum seekers, etc.</li> </ul>	7
RT1.14	<ul style="list-style-type: none"> <li>Mobile equipment, e.g., mobile document readers, mobile devices to retrieve information from border security-related databases/systems, are already on the market and are being successfully deployed in various Member States by border control authorities. Therefore there is no particular need for carrying out research that would lead to development of such devices. However, an elaboration of a concept, development and testing of an "all-in-one" border checks mobile terminal and related "infrastructure" that would be needed in order to: (a) reduce the information processing and retrieval time and, (b) alleviate the problem of bad connectivity, could be carried out. Also, flexibility aspects could be addressed, i.e., taking into account the integration/linking to existing, emerging national and EU-level information systems (e.g., Entry/Exit System), and any future systems.</li> </ul>	7
RT2.4	<ul style="list-style-type: none"> <li>Mobile equipment-based border surveillance models for the different type of land borders could be elaborated and explored in order to optimize the performance and reduce the costs involved.</li> </ul>	8
RT1.4	<ul style="list-style-type: none"> <li>In the same spirit, it could be explored, whether there are possibilities to make the finger print verification with regard to VIS fully contactless.</li> </ul>	9
RT1.5	<ul style="list-style-type: none"> <li>New models for the entire border control process at the airport could be elaborated, studied and compared i.e., going beyond the e-gates model, inclusion of new elements, e.g., prescreening passengers at the port of departure in third countries (both for TCNs and EU citizens), considering broader context and more information that could be gathered on a person from additional sensors prior to reaching the Border Crossing Point, or having a one-stop check.</li> </ul>	10
RT1.7	<ul style="list-style-type: none"> <li>Since document fraud has been considered as an ever-growing phenomenon a feasibility of an EU passport could be considered. Also new methods to combat identity fraud could be studied.</li> </ul>	11
RT2.5	<ul style="list-style-type: none"> <li>Feasibility of alternative solutions on low-cost stationary equipment for deployment in such scenarios could be studied.</li> </ul>	12
RT1.3	<ul style="list-style-type: none"> <li>It could be explored whether fully contactless passport controls would be possible in the future and whether secure ways of "encoding" e-Passports in mobile devices are possible. Similarly, a feasibility of electronic VISA encoded in the chip of the passport could be studied.</li> </ul>	13
RT1.9	<ul style="list-style-type: none"> <li>As of today API considers only biographical data of travelers. A feasibility of inclusion of biometric data in API could be explored.</li> </ul>	13
RT1.16	<ul style="list-style-type: none"> <li>Data mining solutions could be explored to automatically detect anomalies in container/transportation means traffic in order to assess them with respect to the</li> </ul>	13

	probability of including human beings therein, thus, making the border control process more efficient.	
RT5.1	<ul style="list-style-type: none"> <li>It could be explored how to fuse surveillance-related information, in order to present only the most relevant information to the human in order to facilitate the decision making process (including automated alerts). Furthermore, it could be studied whether inclusion of additional information at all improves the accuracy of border surveillance, and if so, what is the contribution of including the specific type of additional information.</li> </ul>	14
RT1.10	<ul style="list-style-type: none"> <li>It could be explored whether cross-analysis of information sources brings added value in terms of improving the accuracy of identifying threats.</li> </ul>	15
RT1.11	<ul style="list-style-type: none"> <li>New ways of predicting detailed air traffic flows and forecasting trends in the mid- and long term could be elaborated in order to better allocate resources.</li> </ul>	15
RT4.1	<ul style="list-style-type: none"> <li>The feasibility of such airport-specific system could be explored, i.e., what particular information could be shared, how it could be shared and for what particular purpose it could be used, e.g., to facilitate the process of automating risky flight detection and crisis management. Since some EU-level information systems in the domain of border control already exist and some are being contemplated, the feasibility study should explore: (a) potential "overlapping" with existing systems in terms of information that could be shared, and (b) potential solutions, including considering the inclusion of desired functionalities in an existing or planned EU-level information system. Furthermore, the need of cross-sectoral approach should also be assessed too.</li> </ul>	16
RT6.2	<ul style="list-style-type: none"> <li>It could also be explored how the introduction of new technologies affects the border guards and travelers and how emerging technologies are perceived by them, e.g., whether and to what extent are they creating fears among border guard staff. Furthermore, it could be studied how to hire new staff in the future in the light of the emergence of new technologies and related changes in the border control processes and the border control organizations environment.</li> </ul>	16
RT1.17	<ul style="list-style-type: none"> <li>Since the purpose of screening cargo and vehicles is not only related to border security it could be explored how cross-sector cooperation in this context could be further streamlined.</li> </ul>	17
RT2.2	<ul style="list-style-type: none"> <li>New methods for early detection of potential threats that impact border vulnerability, e.g., crisis in third countries, could be studied. In particular, ones that do not necessarily solely rely on the deployment of conventional and expensive air and maritime surveillance means</li> </ul>	18
RT2.3	<ul style="list-style-type: none"> <li>It could be explored whether the performance of Remote Piloted Aircraft Systems in bad weather conditions can be improved, e.g., safe landing of an RPA on a vessel/ship in stormy/windy weather, detection of facilitators during the night, etc.</li> </ul>	19
RT1.13	<ul style="list-style-type: none"> <li>It could be explored how existing and planned VISA freedom arrangements with third countries (e.g., agreement between Finland and Russia) impacted and/or might impact border control, i.e., how to control people within the area they are allowed to stay? how to re-organize border control processes in the affected areas?, how and whether to use ABCs in such scenarios? Furthermore, it could be explored whether there would be a need for closer collaboration with other authorities (e.g., Customs). On top of it an impact on internal security and cross-country comparisons could be studied as well.</li> </ul>	20
RT3.1	<p>Various technologies that facilitate interconnecting incompatible secure mobile communication networks are already on the market. Therefore, there is no need for any border security-specific research in this area. However, a feasibility study on a EU-wide mobile Network for public safety and security organisations could be conducted, although one has to consider that work on harmonisation of mobile communication standards in this regard is already being carried out by various groups.</p>	20
RT5.2	<ul style="list-style-type: none"> <li>It could be explored what particular type of open source information, including, i.a., online news, social media, blogs, web-based services provided by security-related and other organizations, could be utilized for border security-related intelligence gathering process. Furthermore, one could study in the context of the border security domain: (a) how to automatically assess the usefulness and complementarity of open source information, (b) how to automatically assess the credibility of open source information, and (c) how to best merge/fuse it with closed source information in order to make the best value out of it, and (d) the added value of open source intelligence versus utilization of other technologies already deployed.</li> </ul>	21
RT1.2	<ul style="list-style-type: none"> <li>It could be explored whether it is possible to use other biometric data (potentially already used in another context and in another domain) than fingerprint, iris or picture to store in the e-Passport chip, which guarantees the same or higher level of security, is more accurate and can be retrieved in a more efficient manner than in the case of the conventionally used biometric data types. For instance, inter alia, feasibility of storing DNA-string in the e-Passport chip and capturing the DNA on a glass plate or a capturing filter could be researched. While the introduction of new biometric-based modalities in the process of person identification might lead to making this process more accurate and efficient, an integral part of the research should embrace related ethical, societal and data protection aspects.</li> </ul>	22



### 3.2.2. The prioritization of the research topics from the point of view of "Impact":

Figure 10 - Prioritization of Research Topics from the point of view of "Impact"



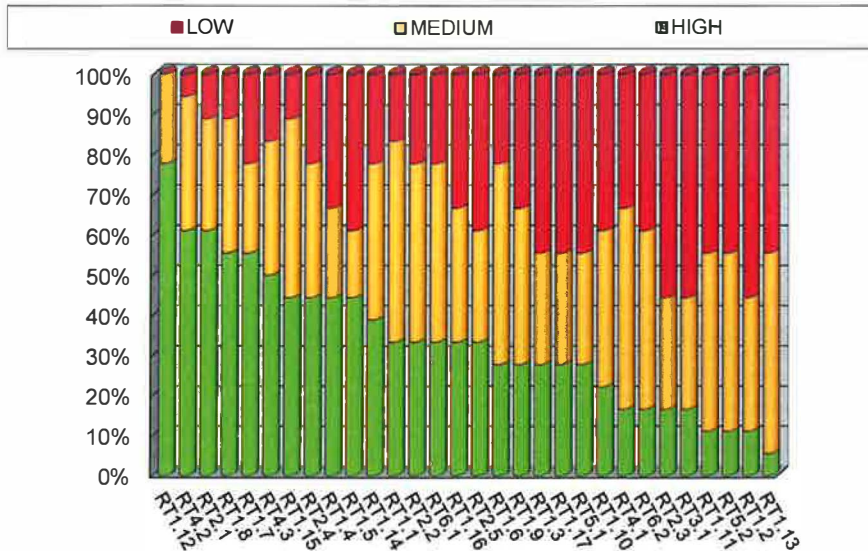
	elaborated/developed (i.e., obtaining a complete image of the contents of the container/vehicle) in order to detect at the same time dangerous substances and human beings (e.g. detection and identification in no more than 60 seconds from the commencement of uploading/offloading the container to/from the ship).	
RT4.2	<ul style="list-style-type: none"> <li>At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. It could be studied whether the number of such EU-level systems could be significantly reduced in future and whether such systems could be easily made interoperable.</li> </ul>	3
RT1.8	<ul style="list-style-type: none"> <li>While utilization of passenger information (API) received from airlines prior to passenger arrival is being practiced at the airports in various Member States, elaboration of similar concept in other scenarios could be considered, e.g., API on passengers travelling by train, buses or maritime means.</li> </ul>	4
RT2.1	<ul style="list-style-type: none"> <li>The ways to improve the capacity to detect small maritime objects and optimization of border surveillance processes in areas with high border vulnerability could be explored. Since a vast bulk of research on techniques for detection of small maritime objects has already been carried out in the past or is in progress, future research in this area should look into alternative and cost-efficient solutions that go beyond deployment of expensive methods, such as satellite imaging technology.</li> </ul>	4
RT1.9	<ul style="list-style-type: none"> <li>As of today API considers only biographical data of travelers. A feasibility of inclusion of biometric data in API could be explored.</li> </ul>	5
RT1.1	<ul style="list-style-type: none"> <li>Methods for assessment of the vulnerabilities of the current border control processing chain and the deployed equipment could be elaborated.</li> </ul>	6
RT2.4	<ul style="list-style-type: none"> <li>Mobile equipment-based border surveillance models for the different type of land borders could be elaborated and explored in order to optimize the performance and reduce the costs involved.</li> </ul>	7
RT1.3	<ul style="list-style-type: none"> <li>It could be explored whether fully contactless passport controls would be possible in the future and whether secure ways of "encoding" e-Passports in mobile devices are possible. Similarly, a feasibility of electronic VISA encoded in the chip of the passport could be studied.</li> </ul>	8
RT1.5	<ul style="list-style-type: none"> <li>New models for the entire border control process at the airport could be elaborated, studied and compared i.e., going beyond the e-gates model, inclusion of new elements, e.g., prescreening passengers at the port of departure in third countries (both for TCNs and EU citizens), considering broader context and more information that could be gathered on a person from additional sensors prior to reaching the Border Crossing Point, or having a one-stop check.</li> </ul>	9
RT1.14	<ul style="list-style-type: none"> <li>Mobile equipment, e.g., mobile document readers, mobile devices to retrieve information from border security-related databases/systems, are already on the market and are being successfully deployed in various Member States by border control authorities. Therefore there is no particular need for carrying out research that would lead to development of such devices. However, an elaboration of a concept, development and testing of an "all-in-one" border checks mobile terminal and related "infrastructure" that would be needed in order to: (a) reduce the information processing and retrieval time and, (b) alleviate the problem of bad connectivity, could be carried out. Also, flexibility aspects could be addressed, i.e., taking into account the integration/linking to existing, emerging national and EU-level information systems (e.g., Entry/Exit System), and any future systems.</li> </ul>	10
RT1.4	<ul style="list-style-type: none"> <li>In the same spirit, it could be explored, whether there are possibilities to make the finger print verification with regard to VIS fully contactless.</li> </ul>	11
RT1.6	<ul style="list-style-type: none"> <li>Another way of speeding up the border control process could be potentially achieved through the utilization of passenger risk profiling. In particular, passenger risk profiling models could be elaborated, explored and compared, which could also embrace inclusion of new, previously unexplored, type of information (e.g., closed vs. open source information - social media for identity verification as additional information). Furthermore, risk profiling models should allow for fine-grained classification of passengers, e.g., to identify not only persons that are candidates for more thorough check, but also victims of human trafficking, potential asylum seekers, etc.</li> </ul>	11
RT6.1	<ul style="list-style-type: none"> <li>Research could be done in order to conceptualize and develop (or adapt) methodologies and tools that would facilitate: (a) planning cost- and performance-efficient allocation of assets and human resources to border control tasks, and (b) exploration of how to best combine humans with new technologies, e.g., through simulations, virtual environments.</li> </ul>	12
RT1.7	<ul style="list-style-type: none"> <li>Since document fraud has been considered as an ever-growing phenomenon a feasibility of an EU passport could be considered. Also new methods to combat identity fraud could be studied.</li> </ul>	13
RT4.3	<ul style="list-style-type: none"> <li>At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. Ergonomic and more user-friendly interfaces to the existing systems could be explored and elaborated, in particular, interfaces that would serve as one gateway to all "thematically related" systems.</li> </ul>	14

RT2.5	<ul style="list-style-type: none"> <li>Feasibility of alternative solutions on low-cost stationary equipment for deployment in such scenarios could be studied.</li> </ul>	15
RT1.16	<ul style="list-style-type: none"> <li>Data mining solutions could be explored to automatically detect anomalies in container/transportation means traffic in order to assess them with respect to the probability of including human beings therein, thus, making the border control process more efficient.</li> </ul>	16
RT1.2	<ul style="list-style-type: none"> <li>It could be explored whether it is possible to use other biometric data (potentially already used in another context and in another domain) than fingerprint, iris or picture to store in the e-Passport chip, which guarantees the same or higher level of security, is more accurate and can be retrieved in a more efficient manner than in the case of the conventionally used biometric data types. For instance, inter alia, feasibility of storing DNA-string in the e-Passport chip and capturing the DNA on a glass plate or a capturing filter could be researched. While the introduction of new biometric-based modalities in the process of person identification might lead to making this process more accurate and efficient, an integral part of the research should embrace related ethical, societal and data protection aspects.</li> </ul>	17
RT1.10	<ul style="list-style-type: none"> <li>It could be explored whether cross-analysis of information sources brings added value in terms of improving the accuracy of identifying threats.</li> </ul>	18
RT4.1	<ul style="list-style-type: none"> <li>The feasibility of such airport-specific system could be explored, i.e., what particular information could be shared, how it could be shared and for what particular purpose it could be used, e.g., to facilitate the process of automating risky flight detection and crisis management. Since some EU-level information systems in the domain of border control already exist and some are being contemplated, the feasibility study should explore: (a) potential "overlapping" with existing systems in terms of information that could be shared, and (b) potential solutions, including considering the inclusion of desired functionalities in an existing or planned EU-level information system. Furthermore, the need of cross-sectoral approach should also be assessed too.</li> </ul>	19
RT5.1	<ul style="list-style-type: none"> <li>It could be explored how to fuse surveillance-related information, in order to present only the most relevant information to the human in order to facilitate the decision making process (including automated alerts). Furthermore, it could be studied whether inclusion of additional information at all improves the accuracy of border surveillance, and if so, what is the contribution of including the specific type of additional information.</li> </ul>	20
RT1.17	<ul style="list-style-type: none"> <li>Since the purpose of screening cargo and vehicles is not only related to border security it could be explored how cross-sector cooperation in this context could be further streamlined.</li> </ul>	21
RT2.2	<ul style="list-style-type: none"> <li>New methods for early detection of potential threats that impact border vulnerability, e.g., crisis in third countries, could be studied. In particular, ones that do not necessarily solely rely on the deployment of conventional and expensive air and maritime surveillance means</li> </ul>	22
RT1.11	<ul style="list-style-type: none"> <li>New ways of predicting detailed air traffic flows and forecasting trends in the mid- and long term could be elaborated in order to better allocate resources.</li> </ul>	23
RT3.1	<p>Various technologies that facilitate interconnecting incompatible secure mobile communication networks are already on the market. Therefore, there is no need for any border security-specific research in this area. However, a feasibility study on a EU-wide mobile Network for public safety and security organisations could be conducted, although one has to consider that work on harmonisation of mobile communication standards in this regard is already being carried out by various groups.</p>	23
RT1.13	<ul style="list-style-type: none"> <li>It could be explored how existing and planned VISA freedom arrangements with third countries (e.g., agreement between Finland and Russia) impacted and/or might impact border control, i.e., how to control people within the area they are allowed to stay? how to re-organize border control processes in the affected areas?, how and whether to use ABCs in such scenarios? Furthermore, it could be explored whether there would be a need for closer collaboration with other authorities (e.g., Customs). On top of it an impact on internal security and cross-country comparisons could be studied as well.</li> </ul>	24
RT6.2	<ul style="list-style-type: none"> <li>It could also be explored how the introduction of new technologies affects the border guards and travelers and how emerging technologies are perceived by them, e.g., whether and to what extent are they creating fears among border guard staff. Furthermore, it could be studied how to hire new staff in the future in the light of the emergence of new technologies and related changes in the border control processes and the border control organizations environment.</li> </ul>	25
RT5.2	<ul style="list-style-type: none"> <li>It could be explored what particular type of open source information, including, i.a., online news, social media, blogs, web-based services provided by security-related and other organizations, could be utilized for border security-related intelligence gathering process. Furthermore, one could study in the context of the border security domain: (a) how to automatically assess the usefulness and complementarity of open source information, (b) how to automatically assess the credibility of open source information, and (c) how to best merge/fuse it with closed source information in order to make the best value out of it, and (d) the added value of open source intelligence versus utilization of other technologies already deployed.</li> </ul>	26
RT2.3	<ul style="list-style-type: none"> <li>It could be explored whether the performance of Remote Piloted Aircraft Systems in bad weather conditions can be improved, e.g., safe landing of an RPA on a vessel/ship in stormy/windy weather, detection of facilitators during the night, etc.</li> </ul>	27



### 3.2.3. The prioritization of the research topics from the point of view of “Urgency”:

Figure 11 - Prioritization of Research Topics from the point of view of “Urgency”



A tabular view of the prioritization of the urgency of research topics is presented below. The ordering reflects the number of Member States ranking the urgency as “high”. An additional colour marking of the topics is also provided. In particular, the topics, which received more than 50% of “high” scores are marked green. Topics which received less than 50% of “high” scores, but whose total amount of “high” and “medium” scores exceeds 50% of the total number of scores are marked yellow. Finally, topics, which received more than 50% “low” scores are marked red.

Code	Research topics	Order of priority (1-the highest) taking into account the no of Member States that rated H
RT1.12	Feasibility of an EU-own centralized PKI could be elaborated as way to provide an easy way to exchange certificates for passport authentication.	1
RT4.2	At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. It could be studied whether the number of such EU-level systems could be significantly reduced in future and whether such systems could be easily made interoperable.	2
RT2.1	The ways to improve the capacity to detect small maritime objects and optimization of border surveillance processes in areas with high border vulnerability could be explored. Since a vast bulk of research on techniques for detection of small maritime objects has already been carried out in the past or is in progress, future research in this area should look into alternative and cost-efficient solutions that go beyond deployment of expensive methods, such as satellite imaging technology.	3

RT1.8	<ul style="list-style-type: none"> <li>While utilization of passenger information (API) received from airlines prior to passenger arrival is being practiced at the airports in various Member States, elaboration of similar concept in other scenarios could be considered, e.g., API on passengers travelling by train, buses or maritime means.</li> </ul>	4
RT1.7	<ul style="list-style-type: none"> <li>Since document fraud has been considered as an ever-growing phenomenon a feasibility of an EU passport could be considered. Also new methods to combat identity fraud could be studied.</li> </ul>	5
RT4.3	<ul style="list-style-type: none"> <li>At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. Ergonomic and more user-friendly interfaces to the existing systems could be explored and elaborated, in particular, interfaces that would serve as one gateway to all "thematically related" systems.</li> </ul>	6
RT1.15	<ul style="list-style-type: none"> <li>It could be explored whether health-safe, secure, more environment-independent and accurate solutions to container/transportation means screening could be elaborated/developed (i.e., obtaining a complete image of the contents of the container/vehicle) in order to detect at the same time dangerous substances and human beings (e.g. detection and identification in no more than 60 seconds from the commencement of uploading/offloading the container to/from the ship).</li> </ul>	7
RT2.4	<ul style="list-style-type: none"> <li>Mobile equipment-based border surveillance models for the different type of land borders could be elaborated and explored in order to optimize the performance and reduce the costs involved.</li> </ul>	8
RT1.4	<ul style="list-style-type: none"> <li>In the same spirit, it could be explored, whether there are possibilities to make the finger print verification with regard to VIS fully contactless.</li> </ul>	9
RT1.5	<ul style="list-style-type: none"> <li>New models for the entire border control process at the airport could be elaborated, studied and compared i.e., going beyond the e-gates model, inclusion of new elements, e.g., prescreening passengers at the port of departure in third countries (both for TCNs and EU citizens), considering broader context and more information that could be gathered on a person from additional sensors prior to reaching the Border Crossing Point, or having a one-stop check.</li> </ul>	10
RT1.14	<ul style="list-style-type: none"> <li>Mobile equipment, e.g., mobile document readers, mobile devices to retrieve information from border security-related databases/systems, are already on the market and are being successfully deployed in various Member States by border control authorities. Therefore there is no particular need for carrying out research that would lead to development of such devices. However, an elaboration of a concept, development and testing of an "all-in-one" border checks mobile terminal and related "infrastructure" that would be needed in order to: (a) reduce the information processing and retrieval time and, (b) alleviate the problem of bad connectivity, could be carried out. Also, flexibility aspects could be addressed, i.e., taking into account the integration/linking to existing, emerging national and EU-level information systems (e.g., Entry/Exit System), and any future systems.</li> </ul>	11
RT1.1	<ul style="list-style-type: none"> <li>Methods for assessment of the vulnerabilities of the current border control processing chain and the deployed equipment could be elaborated.</li> </ul>	12
RT2.2	<ul style="list-style-type: none"> <li>New methods for early detection of potential threats that impact border vulnerability, e.g., crisis in third countries, could be studied. In particular, ones that do not necessarily solely rely on the deployment of conventional and expensive air and maritime surveillance means</li> </ul>	13
RT6.1	<ul style="list-style-type: none"> <li>Research could be done in order to conceptualize and develop (or adapt) methodologies and tools that would facilitate: (a) planning cost- and performance-efficient allocation of assets and human resources to border control tasks, and (b) exploration of how to best combine humans with new technologies, e.g., through simulations, virtual environments.</li> </ul>	13
RT1.16	<ul style="list-style-type: none"> <li>Data mining solutions could be explored to automatically detect anomalies in container/transportation means traffic in order to assess them with respect to the probability of including human beings therein, thus, making the border control process more efficient.</li> </ul>	14
RT2.5	<ul style="list-style-type: none"> <li>Feasibility of alternative solutions on low-cost stationary equipment for deployment in such scenarios could be studied.</li> </ul>	15
RT1.6	<ul style="list-style-type: none"> <li>Another way of speeding up the border control process could be potentially achieved through the utilization of passenger risk profiling. In particular, passenger risk profiling models could be elaborated, explored and compared, which could also embrace inclusion of new, previously unexplored, type of information (e.g., closed vs. open source information - social media for identity verification as additional information). Furthermore, risk profiling models should allow for fine-grained classification of passengers, e.g., to identify not only persons that are candidates for more thorough check, but also victims of human trafficking, potential asylum seekers, etc.</li> </ul>	16
RT1.9	<ul style="list-style-type: none"> <li>As of today API considers only biographical data of travelers. A feasibility of inclusion of biometric data in API could be explored.</li> </ul>	17
RT1.3	<ul style="list-style-type: none"> <li>It could be explored whether fully contactless passport controls would be possible in the future and whether secure ways of "encoding" e-Passports in mobile devices are possible. Similarly, a feasibility of electronic VISA encoded in the chip of the passport could be studied.</li> </ul>	18

RT1.17	<ul style="list-style-type: none"> <li>Since the purpose of screening cargo and vehicles is not only related to border security it could be explored how cross-sector cooperation in this context could be further streamlined.</li> </ul>	18
RT5.1	<ul style="list-style-type: none"> <li>It could be explored how to fuse surveillance-related information, in order to present only the most relevant information to the human in order to facilitate the decision making process (including automated alerts). Furthermore, it could be studied whether inclusion of additional information at all improves the accuracy of border surveillance, and if so, what is the contribution of including the specific type of additional information.</li> </ul>	18
RT1.10	<ul style="list-style-type: none"> <li>It could be explored whether cross-analysis of information sources brings added value in terms of improving the accuracy of identifying threats.</li> </ul>	19
RT4.1	<ul style="list-style-type: none"> <li>The feasibility of such airport-specific system could be explored, i.e., what particular information could be shared, how it could be shared and for what particular purpose it could be used, e.g., to facilitate the process of automating risky flight detection and crisis management. Since some EU-level information systems in the domain of border control already exist and some are being contemplated, the feasibility study should explore: (a) potential "overlapping" with existing systems in terms of information that could be shared, and (b) potential solutions, including considering the inclusion of desired functionalities in an existing or planned EU-level information system. Furthermore, the need of cross-sectoral approach should also be assessed too.</li> </ul>	20
RT6.2	<ul style="list-style-type: none"> <li>It could also be explored how the introduction of new technologies affects the border guards and travelers and how emerging technologies are perceived by them, e.g., whether and to what extent are they creating fears among border guard staff. Furthermore, it could be studied how to hire new staff in the future in the light of the emergence of new technologies and related changes in the border control processes and the border control organizations environment.</li> </ul>	21
RT2.3	<ul style="list-style-type: none"> <li>It could be explored whether the performance of Remote Piloted Aircraft Systems in bad weather conditions can be improved, e.g., safe landing of an RPA on a vessel/ship in stormy/windy weather, detection of facilitators during the night, etc.</li> </ul>	22
RT3.1	<ul style="list-style-type: none"> <li>Various technologies that facilitate interconnecting incompatible secure mobile communication networks are already on the market. Therefore, there is no need for any border security-specific research in this area. However, a feasibility study on a EU-wide mobile Network for public safety and security organisations could be conducted, although one has to consider that work on harmonisation of mobile communication standards in this regard is already being carried out by various groups.</li> </ul>	22
RT1.11	<ul style="list-style-type: none"> <li>New ways of predicting detailed air traffic flows and forecasting trends in the mid- and long term could be elaborated in order to better allocate resources.</li> </ul>	23
RT5.2	<ul style="list-style-type: none"> <li>It could be explored what particular type of open source information, including, i.e., online news, social media, blogs, web-based services provided by security-related and other organizations, could be utilized for border security-related intelligence gathering process. Furthermore, one could study in the context of the border security domain: (a) how to automatically assess the usefulness and complementarity of open source information, (b) how to automatically assess the credibility of open source information, and (c) how to best merge/fuse it with closed source information in order to make the best value out of it, and (d) the added value of open source intelligence versus utilization of other technologies already deployed.</li> </ul>	23
RT1.2	<ul style="list-style-type: none"> <li>It could be explored whether it is possible to use other biometric data (potentially already used in another context and in another domain) than fingerprint, iris or picture to store in the e-Passport chip, which guarantees the same or higher level of security, is more accurate and can be retrieved in a more efficient manner than in the case of the conventionally used biometric data types. For instance, inter alia, feasibility of storing DNA-string in the e-Passport chip and capturing the DNA on a glass plate or a capturing filter could be researched. While the introduction of new biometric-based modalities in the process of person identification might lead to making this process more accurate and efficient, an integral part of the research should embrace related ethical, societal and data protection aspects.</li> </ul>	24
RT1.13	<ul style="list-style-type: none"> <li>It could be explored how existing and planned VISA freedom arrangements with third countries (e.g., agreement between Finland and Russia) impacted and/or might impact border control, i.e., how to control people within the area they are allowed to stay? how to re-organize border control processes in the affected areas?, how and whether to use ABCs in such scenarios? Furthermore, it could be explored whether there would be a need for closer collaboration with other authorities (e.g., Customs). On top of it an impact on internal security and cross-country comparisons could be studied as well.</li> </ul>	25

3.2.4. The prioritization of the research topics from the point of view of the “Need of Transnational Approach”:

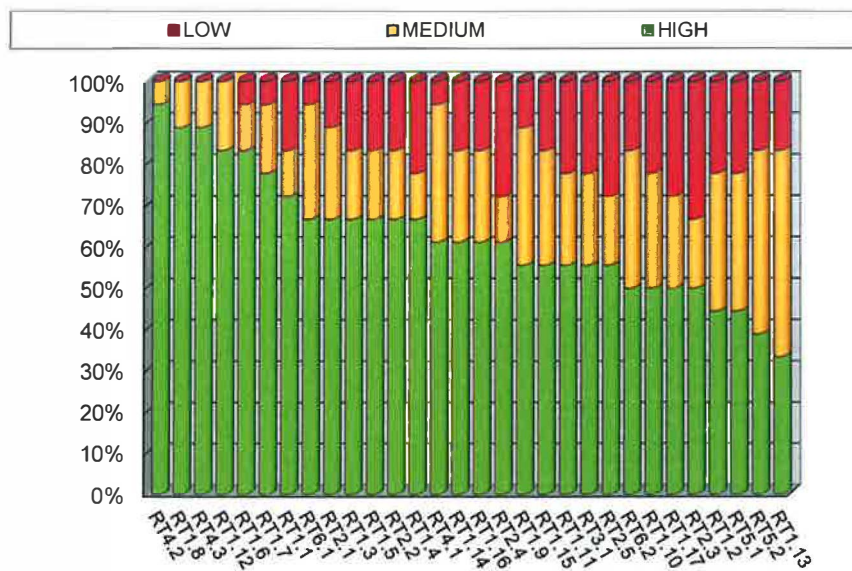


Figure12 - Prioritization of Research Topics from the point of view of “Need of Transnational Approach”

A tabular view of the prioritization of the need of transnational approach in the context of the research topics is presented below. The ordering reflects the number of Member States ranking this need as “high”. An additional colour marking of the topics is also provided. In particular, the topics, which received more than 50% of “high” scores are marked green. Topics which received less than 50% of “high” scores, but whose total amount of “high” and “medium” scores exceeds 50% of the total number of scores are marked yellow. Finally, topics, which received more than 50% “low” scores are marked red (not applicable in the case of the need of transnational approach).

Code	Research topics	Order of priority (1-the highest) taking into account the no of Member States that rated H
RT4.2	At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. It could be studied whether the number of such EU-level systems could be significantly reduced in future and whether such systems could be easily made interoperable.	1
RT1.8	While utilization of passenger information (API) received from airlines prior to passenger arrival is being practiced at the airports in various Member States, elaboration of similar concept in other scenarios could be considered, e.g., API on passengers travelling by train, buses or maritime means.	2



RT4.3	<ul style="list-style-type: none"> <li>At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. Ergonomic and more user-friendly interfaces to the existing systems could be explored and elaborated, in particular, interfaces that would serve as one gateway to all "thematically related" systems.</li> </ul>	2
RT1.12	<ul style="list-style-type: none"> <li>Feasibility of an EU-own centralized PKI could be elaborated as way to provide an easy way to exchange certificates for passport authentication.</li> </ul>	3
RT1.6	<ul style="list-style-type: none"> <li>Another way of speeding up the border control process could be potentially achieved through the utilization of passenger risk profiling. In particular, passenger risk profiling models could be elaborated, explored and compared, which could also embrace inclusion of new, previously unexplored, type of information (e.g., closed vs. open source information - social media for identity verification as additional information). Furthermore, risk profiling models should allow for fine-grained classification of passengers, e.g., to identify not only persons that are candidates for more thorough check, but also victims of human trafficking, potential asylum seekers, etc.</li> </ul>	4
RT1.7	<ul style="list-style-type: none"> <li>Since document fraud has been considered as an ever-growing phenomenon a feasibility of an EU passport could be considered. Also new methods to combat identity fraud could be studied.</li> </ul>	5
RT1.1	<ul style="list-style-type: none"> <li>Methods for assessment of the vulnerabilities of the current border control processing chain and the deployed equipment could be elaborated.</li> </ul>	6
RT6.1	<ul style="list-style-type: none"> <li>Research could be done in order to conceptualize and develop (or adapt) methodologies and tools that would facilitate: (a) planning cost- and performance-efficient allocation of assets and human resources to border control tasks, and (b) exploration of how to best combine humans with new technologies, e.g., through simulations, virtual environments.</li> </ul>	7
RT2.1	<ul style="list-style-type: none"> <li>The ways to improve the capacity to detect small maritime objects and optimization of border surveillance processes in areas with high border vulnerability could be explored. Since a vast bulk of research on techniques for detection of small maritime objects has already been carried out in the past or is in progress, future research in this area should look into alternative and cost-efficient solutions that go beyond deployment of expensive methods, such as satellite imaging technology.</li> </ul>	8
RT1.3	<ul style="list-style-type: none"> <li>It could be explored whether fully contactless passport controls would be possible in the future and whether secure ways of "encoding" e-Passports in mobile devices are possible. Similarly, a feasibility of electronic VISA encoded in the chip of the passport could be studied.</li> </ul>	9
RT1.5	<ul style="list-style-type: none"> <li>New models for the entire border control process at the airport could be elaborated, studied and compared i.e., going beyond the e-gates model, inclusion of new elements, e.g., prescreening passengers at the port of departure in third countries (both for TCNs and EU citizens), considering broader context and more information that could be gathered on a person from additional sensors prior to reaching the Border Crossing Point, or having a one-stop check.</li> </ul>	9
RT2.2	<ul style="list-style-type: none"> <li>New methods for early detection of potential threats that impact border vulnerability, e.g., crisis in third countries, could be studied. In particular, ones that do not necessarily solely rely on the deployment of conventional and expensive air and maritime surveillance means</li> </ul>	9
RT1.4	<ul style="list-style-type: none"> <li>In the same spirit, it could be explored, whether there are possibilities to make the finger print verification with regard to VIS fully contactless.</li> </ul>	10
RT4.1	<ul style="list-style-type: none"> <li>The feasibility of such airport-specific system could be explored, i.e., what particular information could be shared, how it could be shared and for what particular purpose it could be used, e.g., to facilitate the process of automating risky flight detection and crisis management. Since some EU-level information systems in the domain of border control already exist and some are being contemplated, the feasibility study should explore: (a) potential "overlapping" with existing systems in terms of information that could be shared, and (b) potential solutions, including considering the inclusion of desired functionalities in an existing or planned EU-level information system. Furthermore, the need of cross-sectoral approach should also be assessed too.</li> </ul>	11
RT1.14	<ul style="list-style-type: none"> <li>Mobile equipment, e.g., mobile document readers, mobile devices to retrieve information from border security-related databases/systems, are already on the market and are being successfully deployed in various Member States by border control authorities. Therefore there is no particular need for carrying out research that would lead to development of such devices. However, an elaboration of a concept, development and testing of an "all-in-one" border checks mobile terminal and related "infrastructure" that would be needed in order to: (a) reduce the information processing and retrieval time and, (b) alleviate the problem of bad connectivity, could be carried out. Also, flexibility aspects could be addressed, i.e., taking into account the integration/linking to existing, emerging national and EU-level information systems (e.g., Entry/Exit System), and any future systems.</li> </ul>	12
RT1.16	<ul style="list-style-type: none"> <li>Data mining solutions could be explored to automatically detect anomalies in container/transportation means traffic in order to assess them with respect to the probability of including human beings therein, thus, making the border control process more efficient.</li> </ul>	12

RT2.4	<ul style="list-style-type: none"> <li>Mobile equipment-based border surveillance models for the different type of land borders could be elaborated and explored in order to optimize the performance and reduce the costs involved.</li> </ul>	13
RT1.9	<ul style="list-style-type: none"> <li>As of today API considers only biographical data of travelers. A feasibility of inclusion of biometric data in API could be explored.</li> </ul>	14
RT1.15	<ul style="list-style-type: none"> <li>It could be explored whether health-safe, secure, more environment-independent and accurate solutions to container/transportation means screening could be elaborated/developed (i.e., obtaining a complete image of the contents of the container/vehicle) in order to detect at the same time dangerous substances and human beings (e.g. detection and identification in no more than 60 seconds from the commencement of uploading/offloading the container to/from the ship).</li> </ul>	15
RT1.11	<ul style="list-style-type: none"> <li>New ways of predicting detailed air traffic flows and forecasting trends in the mid- and long term could be elaborated in order to better allocate resources.</li> </ul>	16
RT3.1	<ul style="list-style-type: none"> <li>Various technologies that facilitate interconnecting incompatible secure mobile communication networks are already on the market. Therefore, there is no need for any border security-specific research in this area. However, a feasibility study on a EU-wide mobile Network for public safety and security organisations could be conducted, although one has to consider that work on harmonisation of mobile communication standards in this regard is already being carried out by various groups.</li> </ul>	16
RT2.5	<ul style="list-style-type: none"> <li>Feasibility of alternative solutions on low-cost stationary equipment for deployment in such scenarios could be studied.</li> </ul>	17
RT6.2	<ul style="list-style-type: none"> <li>It could also be explored how the introduction of new technologies affects the border guards and travelers and how emerging technologies are perceived by them, e.g., whether and to what extent are they creating fears among border guard staff. Furthermore, it could be studied how to hire new staff in the future in the light of the emergence of new technologies and related changes in the border control processes and the border control organizations environment.</li> </ul>	18
RT1.10	<ul style="list-style-type: none"> <li>It could be explored whether cross-analysis of information sources brings added value in terms of improving the accuracy of identifying threats.</li> </ul>	19
RT1.17	<ul style="list-style-type: none"> <li>Since the purpose of screening cargo and vehicles is not only related to border security it could be explored how cross-sector cooperation in this context could be further streamlined.</li> </ul>	20
RT2.3	<ul style="list-style-type: none"> <li>It could be explored whether the performance of Remote Piloted Aircraft Systems in bad weather conditions can be improved, e.g., safe landing of an RPA on a vessel/ship in stormy/windy weather, detection of facilitators during the night, etc.</li> </ul>	21
RT1.2	<ul style="list-style-type: none"> <li>It could be explored whether it is possible to use other biometric data (potentially already used in another context and in another domain) than fingerprint, iris or picture to store in the e-Passport chip, which guarantees the same or higher level of security, is more accurate and can be retrieved in a more efficient manner than in the case of the conventionally used biometric data types. For instance, inter alia, feasibility of storing DNA-string in the e-Passport chip and capturing the DNA on a glass plate or a capturing filter could be researched. While the introduction of new biometric-based modalities in the process of person identification might lead to making this process more accurate and efficient, an integral part of the research should embrace related ethical, societal and data protection aspects.</li> </ul>	22
RT5.1	<ul style="list-style-type: none"> <li>It could be explored how to fuse surveillance-related information, in order to present only the most relevant information to the human in order to facilitate the decision making process (including automated alerts). Furthermore, it could be studied whether inclusion of additional information at all improves the accuracy of border surveillance, and if so, what is the contribution of including the specific type of additional information.</li> </ul>	22
RT5.2	<ul style="list-style-type: none"> <li>It could be explored what particular type of open source information, including, i.a., online news, social media, blogs, web-based services provided by security-related and other organizations, could be utilized for border security-related intelligence gathering process. Furthermore, one could study in the context of the border security domain: (a) how to automatically assess the usefulness and complementarity of open source information, (b) how to automatically assess the credibility of open source information, and (c) how to best merge/fuse it with closed source information in order to make the best value out of it, and (d) the added value of open source intelligence versus utilization of other technologies already deployed.</li> </ul>	23
RT1.13	<ul style="list-style-type: none"> <li>It could be explored how existing and planned VISA freedom arrangements with third countries (e.g., agreement between Finland and Russia) impacted and/or might impact border control, i.e., how to control people within the area they are allowed to stay? how to re-organize border control processes in the affected areas?, how and whether to use ABCs in such scenarios? Furthermore, it could be explored whether there would be a need for closer collaboration with other authorities (e.g., Customs). On top of it an impact on internal security and cross-country comparisons could be studied as well.</li> </ul>	24

## 4. Conclusions

This report provided an up-to-date summary of challenges border control authorities in the Member States of the European Union and Schengen-associated countries are facing today and will be facing in a mid- and long-term perspective. It also elaborated on ideas on potential research topics that could be addressed to tackle these challenges. Finally, a prioritization of the aforementioned challenges and research topics in terms of their importance, impact, urgency and a need of transnational approach was provided. The material contained in this report constitutes crucial knowledge which could help: (a) Frontex Research & Development Unit to better plan and prioritize R&D activities, and (b) European Commission in shaping the new research and development funding programme Horizon 2020, in particular as input on the needs of border control authorities in specific calls for proposals in the domain of border security and related areas.

The prioritization of the elaborated challenges revealed that the following general challenges were ranked slightly higher than the other challenges in terms of their relevance, impact, urgency and the need of transnational approach:

- An ever-increasing number of people coming to the EU poses a challenge of having less time for the entire process of person identity verification and document authentication, and efficiently detecting the ones, which should undergo a more thorough check
- Surveillance of certain types of borders can not be done effectively without the deployment of non-stationary equipment. This is mainly due to either: (a) high vulnerability of the specific border, (b) terrain topography and weather conditions, and (c) lack of basic infrastructure (e.g., roads, electricity, etc.)

Two further general observations could be inferred from the prioritization exercise. Firstly, compared to the past there is slight shift from border surveillance-related challenges to challenges that are more related to border checks, in particular challenges related to the difficulties in exchanging relevant information, the cooperation between Border Guard authorities and problems that emerge by using new technologies. Interestingly, in the context of certain challenges, e.g., interconnecting mobile secure communication systems, there is no specific need to carry out research, but rather to focus on harmonization of standards, etc.

As regards the overall (including all criteria) prioritization of the research topics enumerated in this report one could observe that the following topics stand out in the rankings:

- Feasibility of an EU-own centralized PKI could be elaborated as way to provide an easy way to exchange certificates for passport authentication.
- At the EU level various systems related to border control and surveillance have been developed (e.g., VIS, SIS II, FADO, etc.) or are currently being developed (e.g., EUROSUR) or planned (e.g., Entry/Exit system). The multitude of existing and emerging systems slows down the process of information retrieval and exchange at both national and international level. It could be studied whether the number of such EU-level systems could be significantly reduced in future and whether such systems could be easily made interoperable.
- While utilization of passenger information (API) received from airlines prior to passenger arrival is being practiced at the airports in various Member States, elaboration of similar concept in other scenarios could be considered, e.g., API on passengers travelling by train, buses or maritime means.
- The ways to improve the capacity to detect small maritime objects and optimization of border surveillance processes in areas with high border vulnerability could be explored. Since a vast bulk of research on techniques for detection of small maritime objects has already been carried out in the past or is in progress, future research in this area should look into alternative and cost-efficient solutions that go beyond deployment of expensive methods, such as satellite imaging technology.

Furthermore, some of the listed research topics suggest a cross-sector approach, i.e., considering the things from a broader perspective and elaborating solutions that will serve not only border security purposes, but also law/enforcement, etc.

The content of this report has been jointly prepared with a recently established Frontex-chaired Advisory Group on Border Security Research composed of representatives of the border control authorities from 22 EU and Schengen associated countries. It has to be emphasized that due to non inclusion and lack of feedback from some relevant EU Member States (e.g., Italy and Greece) the picture provided by this report on challenges and potential research topic might be somewhat incomplete. Furthermore, the state-the-art in research areas listed in this report has not yet been discussed with the research community, whose contribution would possibly put certain considerations in a different light. Disregarding the two aforementioned limitations, one believes that the knowledge gathered constitutes a good basis for planning Frontex R&D activities and shaping EU-funded research programmes.

## Annex 1: EU-funded R&D projects relevant to border control and surveillance

CALL	TYPE	ACRONYM	TITLE	COST EU CONTR	COORDINATOR	Description	CHALLENGE
IST-2004-2.4.3	Large-scale IP	3D FACE	3D FACE URL: <a href="http://www.3dface.org/home/welcome.html">http://www.3dface.org/home/welcome.html</a>	11 918 81 (6549 933)	SAGEM FR	3D face recognition technology research	Challenge 1
SEC-2012.3.4-6	Large-scale IP	ABC4EU	ABC Gates for Europe URL: <a href="http://www.llgal.fr/">http://www.llgal.fr/</a>	(16 817 103) (12 015 246)	INDRA SISTEMAS S.A.	Identifying the requirements for an integrated, interoperable and citizen's rights respectful ABC system at EU level	Challenge 1
ICT-2007.1.4	Collaborative	ACTIBIO	Unobtrusive authentication using activity related and soft biometrics URL: <a href="http://www.actibio.eu/">http://www.actibio.eu/</a>	4 359 418 (3 200 000)	CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS	Developing a modular, robust, multimodal biometrics security authentication and monitoring system, which uses a biodynamic physiological profile, unique for each individual, and advancements of the state of the art in unobtrusive behavioral and other biometrics	Challenge 1
SEC-2011.5.3-4	Small/Medium	ADVISE	Advanced Video Surveillance archives search Engine for security applications URL:	4 237 304 (2 989 761)	ENGINEERING - INGEGNERIA INFORMATICA SPA	Designing and developing a unification framework for surveillance-footage archive systems	Challenge 4 Challenge 5
SEC-2011.1.4-2	Small/Medium	AEROCEPTOR	UAV Based Innovative Means for Land and Sea Non-cooperative Vehicle Stop URL: <a href="http://www.aeroceptor.eu/">http://www.aeroceptor.eu/</a>	4 839 873 (3 468 859)	INSTITUTO NACIONAL DE TECNICA AEROESPACIAL	Developing innovative concept of operation to remotely and safely control, slow and stop non-cooperative vehicles in both land and sea scenarios, by the means of RPAS	Challenge 2
SEC-2007-3.3-02	Collaborative	AMASS	Autonomous maritime surveillance system URL: <a href="http://www.amass-project.eu/amassproject/">http://www.amass-project.eu/amassproject/</a>	5 465 308 (3 450 460)	CARL ZEISS OPTRONICS GMBH	Providing reliable, round-the-clock maritime monitoring solution.	Challenge 2
SEC-2007-3.3-01	Collaborative	ARGUS 3D	AIR Guidance and Surveillance 3D URL: <a href="http://www.argus3d.eu/">http://www.argus3d.eu/</a>	4 943 520 (3 262 050)	SELEX SISTEMI INTEGRATI SPA	Enhancing the security of European citizens, as well as of strategic assets by contrasting, on large areas, unpredictable and unexpected terrorist threats that can be delivered by means of small and low-flying (manned or unmanned) A/C	Challenge 2
SEC-2011.5.1-1	Small/Medium	BEAT	Biometrics Evaluation and Testing URL: <a href="http://www.beat-eu.org/">http://www.beat-eu.org/</a>	4 738 788 (3 499 784)	FONDATION DE L'INSTITUT DE RECHERCHE IDIAP CH	Operational evaluation of biometric technologies, Vulnerability analysis	Challenge 6
SEC-2012.3.1-2	Collaborative	CLOSEYE	Collaborative evaluation of border surveillance technologies in maritime Environment by pre-operational validation of innovative solutions URL: <a href="http://www.closeye.eu/">http://www.closeye.eu/</a>	12 000 000 (9 200 000)	GUARDIA CIVIL, GUARDIA NACIONAL REPUBLICANA, MARINA MILITARE, AGENZIA SPECIALE ITALIANA, CENTRO ITALIANO RICERCHE AEROSPAZIALI, ISDEFE	Providing the EU with an operational and technical framework that increases situational awareness and improves the reaction capability of authorities surveying the external borders of the EU	Challenge 3 Challenge 4



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SEC-2010.3.2-1	Collaborative	CONTAIN	Container Security Advanced Information Technology URL: <a href="http://cordis.europa.eu/projects/261679">http://cordis.europa.eu/projects/261679</a>	15 525 218 (10 044 904)	TOTALFORSVARETS FORSKNINGINSTITUT	Specifying a European Shipping Containers Surveillance system which will encompass regulatory, policy and standardisation recommendations, new business models and advanced container security management capabilities	Challenge 2 Challenge 4
SEC-2011.3.4-2	Small/Medium	DOGGIES	Detection of Oil factory traces by orthogonal Gas identification technology URL: <a href="http://www.fp7-doggies.eu/">http://www.fp7-doggies.eu/</a>	4 940 118 (3 499 966)	III V LAB GIE FR	Operational movable stand alone sensor for an efficient detection of hidden persons, drugs and explosives	Challenge 1
SPA-2010.1.1-05	Collaborative	DOLPHIN	Development of Pre-operational Services for Highly Innovative Maritime Surveillance Capabilities URL: <a href="http://maritimesurveillance.security-copernicus.eu/fp7-supporting-projects/dolphin">http://maritimesurveillance.security-copernicus.eu/fp7-supporting-projects/dolphin</a>	7 053 065 (3 992 375)	EGEOS SPA IT	Maritime surveillance, Processing satellite radar and optical images	Challenge 3 Challenge 5
SEC-2007-3.2-03	Collaborative	EFFISEC	Efficient integrated security checkpoints URL: <a href="http://www.effisec.eu/">http://www.effisec.eu/</a>	16 071 196 (10 034 832)	MORPHOfr	Enhancing the security and efficiency of land and maritime checkpoints through technology	Challenge 1 Challenge 6
SEC-2012.3.4-6	Large-scale IP	FASTPASS	A harmonized, modular reference system for all European automatic border crossing points URL: <a href="https://www.fastpass-project.eu/">https://www.fastpass-project.eu/</a>	15 485 790 (11 287 715)	AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH	Harmonized, modular approach for Automated Border Control (ABC)	Challenge 1 Challenge 6
SEC-2007-6.3-01	SUPPORT	FESTOS	Foresight of evolving security threats posed by emerging technologies URL: <a href="http://erovisions.eu/stoektaking/43">http://erovisions.eu/stoektaking/43</a>	971 799 (824 552)	INTERDISCIPLINARY CENTER FOR TECHNOLOGICAL ANALYSIS AND FORECASTING ISR	Identifying and assessing evolving security threats posed by the abuse or inadequate use of emerging technologies and new scientific knowledge	Challenge 4 Challenge 6
SEC-2011.3.4-1	Large-scale IP	FIDELITY	Fast and trustworthy Identity Delivery and check with ePassports leveraging Traveler privacy URL: <a href="http://www.fidelity-project.eu">http://www.fidelity-project.eu</a>	18 194 375 (12 013 194)	MORPHO FR	Developing solutions for fast, secure and efficient real-time authentication of individuals at border crossings, while protecting individual privacy; Vulnerabilities of current e-Passports lifecycle	Challenge 1 Challenge 6
SEC-2010.6.3-2	Collaborative	FOCUS	Foresight Security Scenarios: Mapping Research to a Comprehensive Approach to Exogenous EU Roles URL: <a href="http://www.focusproject.eu">http://www.focusproject.eu</a>	4 523 049 (3 407 075)	SIGMUND FREUD PRIVATUNIVERSITÄT WIEN GMBH	Developing effective long-term prediction and assessment tool; developing an IT-based Knowledge Platform for planning research and deciding priorities	Challenge 6
SEC-2007-6.3-01	SUPPORT	FORESEC	Europe's evolving security: drivers, trends and scenarios URL: <a href="http://www.foresec.eu/">http://www.foresec.eu/</a>	942 208 (942 202)	CRISIS MANAGEMENT INITIATIVEFI	Enhancing the shared vision and facilitate the emergence of a coherent and holistic approach to current and future threats and challenges for European security, through a participatory foresight process	Challenge 6

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SEC-2007-3.1-01	SUPPORT	GLOBE	European Global Border Environment URL: <a href="http://cordis.europa.eu/result/report/rcn/45818_en.html">http://cordis.europa.eu/result/report/rcn/45818_en.html</a>	999 891 (999 891)	TELVENT INTERACTIVA, S.A.	Providing a comprehensive framework in which on integrated global border management system must be developed	Challenge 3 Challenge 4
SPA.2012.1.1-03	Small/Medium	G-SEXTANT	SERVICE PROVISION OF GEOSPATIAL INTELLIGENCE IN EU EXTERNAL ACTIONS SUPPORT URL: <a href="http://externalaction.ec.europa.eu/projects-overview/g-sextant/g-sextant-nutshell">http://externalaction.ec.europa.eu/projects-overview/g-sextant/g-sextant-nutshell</a>	5 699 911 (4 000 000)	INDRA SISTEMAS S.A.	Preparation and delivery of pre-operational services, developed in the context of user-driven Support to External Action (SEA) scenarios	Challenge 2
SEC-2011.3.4-2	Small/Medium	HANDHOLD	HANDHeld Ofactory Detector URL: <a href="http://www.handhold.eu/">http://www.handhold.eu/</a>	4 580 959 (4 580 959)	THE QUEEN'S UNIVERSITY OF BELFAST	Working towards a leading edge portable CBRNE detection solution for deployment by European customs agencies, border guards, first responders, police, civil security or others operating in potentially hostile environments	Challenge 1
SIS-2007-1.2.2.3	Collaborative	HIDE	Homeland security, biometric identification and personal detection ethics URL: <a href="http://www.hideproject.org/">http://www.hideproject.org/</a>	1 244 393 (963 762)	CENTRE FOR SCIENCE, SOCIETY AND CITIZENSHIP	Setting up a platform devoted to ethical and privacy issues of biometrics and personal detection technologies which addresses transnational (European) and international problems	Challenge 6
SEC-2011.5.2-1	Small/Medium	HIT-GATE	Heterogeneous Interoperable Transportable GATeway for First-Responders URL: <a href="http://www.hit-gate.eu/">http://www.hit-gate.eu/</a>	5 052 636 (3 451 257)	THALES COMMUNICATIONS & SECURITY SA	Developing a generic gateway that allows communications across networks currently used by first responders in Europe	Challenge 4
SEC-2009-3.2-02	Collaborative	I2C	Integrated System for Interoperable sensors & Information sources for Common abnormal vessel behaviour detection & Collaborative identification of threat URL: <a href="http://www.i2c.eu">http://www.i2c.eu</a>	15 962 707 (9 869 621)	DCNS SA FR	Developing a new generation of innovative sea border surveillance end to end systems integrating key existing and in development capacities to track all vessel movements and activities to early identify and report on EUROSUR threats	Challenge 2
SEC-2007-2.3-04	Collaborative	IDETEC4ALL	Novel intruder detection & authentication optical sensing technology URL: <a href="ftp://ftp.cordis.europa.eu/pub/ftp7/security/docs/idetect4all_en.pdf">ftp://ftp.cordis.europa.eu/pub/ftp7/security/docs/idetect4all_en.pdf</a>	3 239 571 (2 298 013)	INSTRO PRECISION LIMITED UK	Addressing the urgent need for alerting technology for surveillance and intruders detection inside and in the surrounding of Critical Infrastructures	Challenge 2
SEC-2007-6.5-02	Collaborative	INEX	Converging and conflicting ethical values in the internal/external security continuum in Europe URL: <a href="http://www.inexproject.eu/">http://www.inexproject.eu/</a>	2 422 082 (1 890 248)	INSTITUTT FOR FREDSFORSKNING STINFTELSE NO	Converging and conflicting ethical values in the internal/external security in continuum in Europe	Challenge 6
SEC-2012.3.4-2	Small/Medium	INGRESS	Innovative Technology for Fingerprint Live Scanners URL:	4 252 658 (3 233 782)	Morpho	Manufacturing of innovative fingerprint scanners capable of properly sensing fingerprints of intrinsic very-low quality and/or	Challenge 1

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			<a href="http://cordis.europa.eu/projects/rcn/110929_en.html">http://cordis.europa.eu/projects/rcn/110929_en.html</a>			characterized by superficial skin disorders	
SPA.2012.1.1-02	Small/Medium	LOBOS	<i>Low time critical BOrder Surveillance</i> URL: <a href="http://lobos.bordersurveillance.security-copernicus.eu.185-4-133-10.reseller14.grserver.gr/project.php">http://lobos.bordersurveillance.security-copernicus.eu.185-4-133-10.reseller14.grserver.gr/project.php</a>	3 371 352 (2 000 000)	Infoterra LTD	Testing and validating the intelligence-driven low time-critical scenarios of the border surveillance (EUROSUR) CONOPS	Challenge 2
ICT-2007.1.4	Collaborative	MOBIO	<i>Mobile Biometry</i> URL: <a href="http://www.mobloproject.org/">http://www.mobloproject.org/</a>	3 988 090 (2 899 998)	IDiAP (FONDATION DE L'INSTITUT D'INTELLIGENCE ARTIFICIELLE PERCEPTIVE) CH	Developing new mobile services secured by biometric authentication means	Challenge 1 Challenge 3
SPA.2010.1.1-05	Collaborative	NEREIDS	<i>New Service Capabilities for Integrated and Advanced Maritime Surveillance</i> URL: <a href="http://www.nereids-fp7.eu/">http://www.nereids-fp7.eu/</a>	6 015 352 (3 999 852)	GMV AEROSPACE AND DEFENCE SA UNIPERSONAL	Providing an integrated vision of maritime policy and maritime surveillance so that the different elements of the service become useful to the different maritime domains (Illegal trafficking, illegal immigration, fisheries control)	Challenge 3
SEC-2009-3.4-01	Collaborative	OPARUS	<i>Open Architecture for UAV-based Surveillance System</i> URL: <a href="http://www.oparus.eu/">http://www.oparus.eu/</a>	1 405 309 (1 188 312)	SAGEM FR	Elaborating an open architecture for the operation of unmanned air-to-ground wide area land and sea border surveillance platforms in Europe.	Challenge 2
SEC-2007-7.0-02	Collaborative	OPERAMAR	<i>An interoperable approach to the European union maritime security management</i> URL: <a href="http://cordis.europa.eu/result/report/rcn/45616_en.html">http://cordis.europa.eu/result/report/rcn/45616_en.html</a>	669 134 (669 132)	THALES UNDERWATER SYSTEMS SAS	Providing the foundations for pan-European Maritime Security Awareness by addressing the insufficient interoperability of European and national assets with a view to generating unified data models for seamless exchange and contributing to address the discrepancies of the behavioural, organisational, and cultural issues	Challenge 4 Challenge 5
SEC-2010.3.1-1	Collaborative	PERSEUS	<i>Protection of European seas and borders through the intelligent use of surveillance</i> URL: <a href="http://www.perseus-fp7.eu/wp-content/uploads/2011/06/2011_PERSEUS_Overview_v2.6.pdf">http://www.perseus-fp7.eu/wp-content/uploads/2011/06/2011_PERSEUS_Overview_v2.6.pdf</a>	43 642 579 (27 847 579)	INDRA SISTEMAS S.A.	Developing and testing a European system for maritime surveillance through the integration of the existent European and local systems and its update and improvement using technological innovations	Challenge 2 Challenge 5
SEC-2011.1.5-1	Small/Medium	SAGRES	<i>Real Time Wide Area Radiation Surveillance System</i> URL: <a href="http://www.reward-project.eu/">http://www.reward-project.eu/</a>	4 270 883 (3 020 795)	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	Novel mobile system for real-time, wide-area radiation surveillance	Challenge 2
SPA.2012.1.1-01	Collaborative	SEABILLA	<i>Services Activations for Growing EUROSUR Success</i> URL: <a href="http://www.copernicus-sagres.eu/events/events.html">http://www.copernicus-sagres.eu/events/events.html</a>	~ 5.6 M€ (~3.5 M€.)	GMV	Testing and validating the intelligence-driven high time-critical scenarios of the border surveillance (EUROSUR) CONOPS	Challenge 2
SEC-2009-3.2-02	Collaborative	SIMTISYS	<i>Sea Border Surveillance</i>	15 558 125 (9 841 603)	SELEX SISTEMI INTEGRATI SPA	Providing additional surveillance capability for coastal	Challenge 2

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			URL: <a href="http://www.seabillio.eu/ems/">http://www.seabillio.eu/ems/</a>			surveillance to address irregular immigration, terrorism and drug trafficking	
SPA-2010.1.1-05	Collaborative	SMART	Simulator for Moving Target Indicator System URL: <a href="http://88.32.124.85/SMARTSYS/">http://88.32.124.85/SMARTSYS/</a>	2 489 926 (1 643 701)	THALES ALENIA SPACE ITALIA SPA	Supporting the use of space-borne radar mounted on single or formation-flying satellites through the development of a software simulator	Challenge 2
SEC-2010.6.5-2	Collaborative	SNIFFER	Scalable Measures for Automated Recognition Technologies URL: <a href="http://www.smartsurveillance.eu/">http://www.smartsurveillance.eu/</a>	4 191 657 (3 456 017)	UNIVERSITA TA MALTA	Evaluating the risks and opportunities inherent to the use of smart surveillance; developing number of technical, procedural and legal options for safeguards	Challenge 2
SEC-2011.3.4-2	Small/Medium	SNIFFLES	A bio-mimicry enabled artificial sniffer URL: <a href="http://www.sniffer-project.eu/">http://www.sniffer-project.eu/</a>	4 837 982 (3 493 820)	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	Developing a highly innovative one-stop shop approach to complement dogs and leverage their capabilities.	Challenge 1
SEC-2011.3.4-2	Small/Medium	SUNNY	Artificial sniffer using linear ion trap technology URL: <a href="http://www.sniffles.eu/project/index.jsp">http://www.sniffles.eu/project/index.jsp</a>	5 226 007 (3 493 625)	TWI LIMITED UK	Developing a state-of-the-art miniature and portable electronic gas sensor capable of detecting hidden persons and illegal substances - providing a cost effective and scalable technology to complement the work of sniffer dogs	Challenge 1
SEC-2012.3.5-1	Collaborative	SUPPORT	Smart UNmanned aerial vehicle sensor Network for detection of border crossing and illegal entry URL: <a href="http://www.vitrociset.it/download/433">http://www.vitrociset.it/download/433</a>	14 439 544 (9 569 977)	BMT Group Ltd BMT	Developing a platform to gather data and information from distributed sensors active 24/7 in any weather conditions in order to patrol frontiers and intercept intrusions	Challenge 2
SEC-2009-3.2-01	Collaborative	SURPRISE	Security Upgrade for PORTs URL: <a href="http://www.supportproject.info/">http://www.supportproject.info/</a>	14 622 990 (9920 607)	BMT Group Ltd	Addressing 'total' port security upgrade solutions encompassing legal, organisational, technological, training and human factors perspectives	Challenge 4
SEC-2011.6.5-2	Small/Medium	SURVEILLE	Surveillance, Privacy and Security URL: <a href="http://surprise-project.eu/">http://surprise-project.eu/</a>	4 396 297 (3 424 109)	OESTERREICHISCHE AKADEMIE DER WISSENSCHAFTEN	A large scale participatory assessment of criteria and factors determining acceptability and acceptance of security technologies in Europe	Challenge 6
SEC-2011.6.1-5	Small/Medium	TASS	Surveillance: Ethical Issues, Legal Limitations, Efficiency URL: <a href="http://www.surveille.eu/">http://www.surveille.eu/</a>	4 382 719 (3 382 354)	EUROPEAN UNIVERSITY INSTITUTE	Analyzing the ethical issues, legal limitations and efficiency of the use of surveillance technologies	Challenge 6
SEC-2009-2.2-02	Collaborative	TABULA RASA	Total Airport Security System URL: <a href="http://www.tass-project.eu/">http://www.tass-project.eu/</a>	14 966 376 (8 986 696)	VERINT SYSTEMS LTD	Research, develop and illustrate the capabilities of the Front-End (FE) collection tools (which are mainly based on sensing real time technologies), Data Fusion mediation system, portal and web based applications	Challenge 3
ICT-2009.1.4	Collaborative	TALOS	Trusted Biometrics under Spoofing Attacks URL: <a href="http://www.tabularas-a-euproject.org/">http://www.tabularas-a-euproject.org/</a>	5 692 474 (4 095 417)	IDIAP (FONDATION DE L'INSTITUT DALLE MOLLE D'INTELLIGENCE ARTIFICIELLE PERCEPTIVE) CH	Addressing some of the issues of direct (spoofing) attacks to trusted biometric systems	Challenge 1 Challenge 6

Border Security Challenges and Research Topics

SEC-2007-3.2-02	Collaborative	TERASCREEN	Transportable autonomous patrol for land border surveillance URL: <a href="http://www.ed4bg.eu/files/files/Andrejczak_TALOS.pdf">http://www.ed4bg.eu/files/files/Andrejczak_TALOS.pdf</a>	19 497 387 (12 898 332)	PRZEMYSŁOWY INSTYTUT AUTOMATYKI I POMIAROW	Demonstrating the prototype of the land border surveillance system based on unmanned vehicle	Challenge 2
SEC-2012.3.4-5	Small/Medium	TURBINE	Multi-frequency multi-mode Terahertz screening for border checks URL: <a href="http://fp7-terascree.com/">http://fp7-terascree.com/</a>	4 782 686 (3 489 932)	ALFA IMAGING SA	Innovative concept of multi-frequency multi-mode Terahertz (THz) detection with new automatic detection and classification functionalities	Challenge 1 Challenge 6
ICT-2007.1.4	Collaborative	VIRTUOSO	Trusted revocable biometric identities URL: <a href="http://www.turbine-project.eu/">http://www.turbine-project.eu/</a>	9 691 039 (6350 000)	SAGEM FR	Developing innovative digital identity solutions, combining: secure, automatic user identification thanks to electronic fingerprint authentication, reliable protection of the biometrics data through advanced cryptography technology	Challenge 1 Challenge 6
SEC-2009-3.2-03	Collaborative	WIMAAS	Versatile Information Toolkit for end-Users oriented Open Sources exploitation URL: <a href="http://www.virtuoso.eu/">http://www.virtuoso.eu/</a>	11 497 567 (7999 182)	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	Providing security authorities with an advanced integrated toolkit, developed around open source architecture, in order to exploit open source information	Challenge 5
SEC-2007-3.3-02	Collaborative	XP-DITE	Wide maritime area airborne surveillance URL: <a href="https://www.academia.edu/3088463/Wide_Maritime_Area_Airborne_Surveillance_SoS">https://www.academia.edu/3088463/Wide_Maritime_Area_Airborne_Surveillance_SoS</a>	4 001 123 (2 737 169)	THALES SYSTEMES AEROPORTES S.A.	Developing innovative technological solutions to increase airborne maritime surveillance efficiency while reducing costs	Challenge 2
SEC-2011.2.2-1	Large-scale IP		Accelerated Checkpoint Design Integration Test and Evaluation URL: <a href="http://www.xp-dite.eu/">http://www.xp-dite.eu/</a>	14 613 264 (9 992 634)	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK - TNO	Developing a comprehensive, passenger-centred, outcome-focused, system-level approach to the design and evaluation of airport security checkpoints	Challenge 1



## Frontex Informal Advisory Group on Border Security Research

<b>Crt no</b>	<b>Country</b>	<b>Institution</b>
1	<b>Austria</b>	Federal Ministry of the Interior, Police
2	<b>Belgium</b>	Federal Police
3	<b>Bulgaria</b>	Ministry of Interior, Chief Directorate Border Police
4	<b>Croatia</b>	Border Police Directorate
5	<b>Denmark</b>	Danish National Police
6	<b>Estonia</b>	Border Guard Department, Development Bureau of the Police and Border Guard Board
7	<b>Finland</b>	Finish Border and Coast Guard Academy
8	<b>France</b>	Central Directorate of the French Border Police
9	<b>Germany</b>	Federal Police (Bundespolizei)
10	<b>Latvia</b>	Central Board of the State Border Guard
11	<b>Malta</b>	Dir. NS-SIS and ICT Units Malta Police GHQ
12	<b>Netherlands</b>	Royal Netherlands Marechaussee
13	<b>Norway</b>	Norwegian Police National Police Directorate
14	<b>Poland</b>	Border Guards Headquarters
15	<b>Portugal</b>	SEF (Immigration and Borders Service)
16	<b>Romania</b>	General Inspectorate of Romanian Border Police
17	<b>Slovakia</b>	Ministry of Interior/Bureau of Border and Alien Police Presidium of Police Force
18	<b>Slovenia</b>	Border Police Division of the Uniformed Police Directorate
19	<b>Spain</b>	National Police Force
20	<b>Sweden</b>	Swedish National Police Board
21	<b>Switzerland</b>	Swiss Border Guard
22	<b>UK</b>	Home Office, Centre for Applied Science and Technology (CAST)

