Technical Study on Smart Borders

Final Report

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Executive Summary

The "Smart Borders Package" was proposed by the Commission in February 2013. It follows the European Commission (EC) Communication of February 2008 suggesting the establishment of an Entry/Exit System (EES) and a Registered Traveller Programme (RTP). The Smart Borders Package is constituted of three legislative proposals. It aims to improve the management of the external borders of the Schengen Member States (MS), fight against irregular immigration and provide information on overstayers, as well as facilitate border crossings for pre-vetted frequent third country national (TCN) travellers.

During the first examination of the Smart Borders Package, which was completed in February 2014, the Council and the European Parliament (EP) voiced technical, operational and cost concerns, mainly related to the **overall feasibility of the proposed new systems** and of some of their features. Concerns related especially to the impact on the actual border control process, the RTP token, the data retention period in the EES, the choice of biometric identifiers, the extent to which national Entry/Exit Systems could be integrated and/or reused, the need for enhanced synergies and/or interoperability with existing border control systems, and the possibility for law enforcement authorities to access the EES.

In order to further assess the technical, organisational and financial impacts of the various possible ways to address these issues, the Commission subsequently initiated – with the support of both co-legislators – a **proof of concept** exercise aimed at identifying options for implementing the Smart Borders package. This exercise consists of two stages:

1. A Commission-led **Technical Study** (this report) aimed at **identifying** and **assessing** the most suitable and promising **options and solutions**. Based on this Study, the options and solutions to be tested through a pilot project should be identified by the end of 2014.

2. A Pilot project to be entrusted to the Agency for the Operational Management of large-scale IT Systems in the area of Freedom, Security and Justice (eu-LISA), aimed at verifying the feasibility of the options identified in the Technical Study and validating the selected concepts for both automated and manual border controls.

This Study addressed a series of questions raised in 20 Thematic Files (TFs) that were jointly agreed between the EC's Directorate General for Home Affairs (DG HOME), the MS and EP representatives in February 2014. These questions focused on six domains:

1. Statistics
2. Biometrics
3. Border control processes
4. Data
5. Architecture
6. Costs[1].

The Study's methodological approach was primarily based on stakeholders' consultations through workshops, phone interviews and feedback from MS on the draft deliverables. The stakeholders consulted included MS, the EP, the European Data Protection Supervisor (EDPS), DG HOME, DG Justice (DG JUST), DG Taxation and Customs Union (DG TAXUD), eu-LISA, Frontex and representatives from industry.

The Study also built upon extensive desk research, literature review and various on-site visits. In addition, a specific data collection survey was carried out at the external borders of the Schengen Area by the MS at the end of May 2014. This survey allowed collecting up-to-date quantitative data concerning border crossings, including their number and type (air, land and sea), and the categories of travellers (i.e. EU/EEA/CH - abbreviated as EU-citizens, third country nationals either visa-exempt (TCN**VE**) or visa holders (TCN**VH**)).

The Study explored numerous options in relation to biometrics, border control processes, data, architecture and costs, to cover all aspects of the 20 TFs and **find the optimal design for the EES and RTP**. In order to present feasible combinations of the activities (e.g. enrolment for EES individual file, EES biometric verification, identification) and the choices to be made to effectively operate the EES and RTP, the concept of potential **Target Operating Model** (TOM) was

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[1] The cost analyses are presented in a separate report.

introduced. Each TOM is unique and corresponds to a possible hypothetical scenario (assembly of system components into a consistent set) for the implementation of the future systems.

An overview of each domain addressed in the TFs is provided below. A summary of the suggested TOMs and options for the Pilot are presented at the end of this Executive Summary.

Biometrics

The Study analysed in detail the use of biometric characteristics as a means to **enhance** and strengthen **identity checks** at external borders, and the overall **security of border controls**. The advantages, drawbacks and specificities derived from the use of biometric characteristics for the EES and RTP were looked at.

The Study evaluated the number of fingerprints (FPs) to be used, the different options to capture FPs and possible **synergies with other systems**. In addition, it explored the use of facial image (FI) recognition either as standalone biometric or in combination with FPs. The use of iris was also considered.

Concerning the number of FPs to be used **for verification and identification**, the Study observed that 1 FP alone can be used for verification. A higher number of FPs enrolled leads to a better performance in terms of accuracy (for both identification and verification) and processing time. Yet, it may lead to problems at certain borders. In particular, taking into account the difficulty of capturing more than 4 FPs at land borders where limitations in enrolment quality and time may rise regarding the travellers in vehicle and use of hand-held equipment[2]. The Study considers the use of 4 FPs for EES and RTP as an approach that will facilitate synergies with the Visa Information System (VIS). The Study also suggests adding the enrolment of 4 and 8 fingerprints to the Pilot as one of the test cases involving ABC gates, hand-held equipment and self-service kiosks.

The Study also highlighted that if FI would be used in **combination with FPs**, then it has a **beneficial impact** on both **verification** and **identification** in terms of **speed** and **security** leading to **lower false rejection rate and reduction** in number **of FPs** enrolled.

Concerning the introduction of **FI** as a biometric characteristic, the Study concludes that the use of FI alone is an option to be considered for EES and RTP.

The inclusion of FI as a biometric identifier should also be seen in the light of the current ABC gates that mostly handle FI recognition.

While the FI can be taken from the electronic machine readable travel document (e-MRTD[3]) relatively easily, the FPs are impossible to access as long as there is no efficient and constraining mechanism for distributing the secret cryptographic keys used (so-called Extended Access Control for Terminal Access) at an international level (To this end, a shared certificate masterlist at European or Schengen level for exchange of certificates for cryptographic processing is recommended). For this reason and also because the inclusion of only two FPs in the electronic passport is optional, the Study suggests not relying solely on FPs taken from the e-MRTD.

For the RTP, the Study assessed the possible use of FI only to facilitate border crossings for frequent travellers. Three possible options were investigated:

1. use of **FI only**;
2. use of **FI** combined with a reduced number of **FPs** (the same or a subset of EES and/or VIS);
3. use of **no biometric data** at all.

Finally, the Study explored different options for introducing a **transitional period** for the use of biometrics in the EES as foreseen in the 2013 legislative proposal. Two main options were assessed:

- No use of biometric data in the EES during the transitional period. The system would rely instead on the alphanumerical data of the travel documents, and the use of biometric characteristics would only be introduced after the transition period. A variant would consist in using the photo in the e-MRTD during the transition period.

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[2] In any case, all FP-capturing devices should satisfy international security standards (FBI, LivDet and ISO 15408) for anti-spoofing purposes.
[3], i.e. 'chip passport' or 'electronic passport'

- Inclusion of biometric characteristics in the EES from the start by MS that are ready, with the other MS joining progressively so as to reach full implementation by a target date. This phased approach was used for the VIS.

The choice of one or the other option depends on whether the equipment installed at the border crossing points to perform FP verifications of visas (which become mandatory from 10 October 2014) will also be capable of enrolling 4 FPs. If the answer is positive, then the EES and RTP could be implemented without changes of FP scanners at the borders. In the opposite case, this implementation would become more time-consuming and costly. To clarify the situation, the pilot project should include actions aimed at assessing various possibilities for enrolling or verifying FPs.

For instance, an option is the mandatory enrolment of fingerprints following a given period. An alternative would be to make the most of using the photo in the e-MRTD and/or managing verification of the identity without biometrics for a certain period.

Border Control Processes – impact, alternatives and accelerators

The Study identified and assessed potential future border crossing processes for the EES and RTP, including a number of feasible options. The analysis focused on:

1. Estimating the **duration impact** of the new or modified activities of entries and exits for the various categories of travellers due to the implementation of EES and RTP mainly by:

    - minimising the data needed for EES first entry registration;

    - maximising the use of VIS data and biometrics (for TCNVHs) for both the EES and the RTP;

    - facilitating border control operations by maximising the use of e-MRTDs (as they are a reliable source of information;

    - analysing whether to include local border traffic permit holders and residence permit holders into the EES and RTP.

2. Proposing an **alternative application process** for the RTP that could limit the additional resources needed at MS level for dealing with RTP applications;

3. Highlighting **process accelerators** to speed up border crossing times.

Duration impact on border control processes

The Study outlined in detail the future processes for the border crossing of TCNs at entry (first and subsequent) and at exit by TCN**VH**, TCN**VE** and registered traveller.

The main variables impacting the border crossing time are the **data and biometrics** used in each step of the border control process, so, the data used throughout the processes are studied.

The **photo** stored in **e-MRTDs** is of high quality and the Study suggests using it as much as possible. The Machine Readable Zone (MRZ) and the visa number were found to be a sufficient set of alphanumeric data for the purpose of the **EES individual file,** and do not make the border control process longer. The unique key composed by the issuing country together with the document number is sufficient to retrieve the EES individual file.

For the entry/exit records, additional optional data could be useful for immigration control and law enforcement purposes, however, this would add to the duration of the border crossing as these data would have to be collected manually.

For reasons of travellers' convenience and to ensure synergies with the VIS, the Study recommends that biometric characteristics be **captured only once**. Hence, for TCNVHs it is recommended to rely on the VIS biometrics as regards the EES and RTP. For TCNVEs, biometric characteristics used for the RTP should mirror the ones stored in the EES. This synergy is important as the first time enrolment of FPs would be limited to TCNVEs since TCNVHs would not need to enrol FPs a second time after having done so to obtain their visa.

Use of a the e-MRTD as a token for the RTP

In order to speed up border crossing times, **travellers with RTP status** could use ABC gates, where possible, and be verified using a live photo checked against the e-MRTD or fingerprints/photo checked against the central system.

To this end, the Study analysed the pros and cons of using a separate token to prove RT status or, as an alternative, **the use of the e-MRTD as a token**. The Study concluded that a separate token would provide no added value and would add operational complexity, whereas using the e-MRTD would be less costly and less complex to implement and maintain, while providing the necessary security level and not impacting the border crossing time.

The use of MRTDs as tokens by registered travellers was also examined, and the Study came to the conclusion that the MRTD would not work well in any existing or planned ABC gates since these normally require an e-MRTD for security reason. RTs with an MRTD would therefore only be able to use manual gates. However, using MRTDs at manual gates would not make it possible to reach the same security level in document check and bearer authentication as with e-MRTDs. Moreover, the use of EU/EEA/CH lanes by RTs with MRTDs could possibly adversely impact the duration for EU citizens by slowing down the crossings at this lane, because of the manual (ocular) inspection needed.

Variations between air, land and sea borders

General conditions are not the same today at air, sea and land borders and they also differ at each specific Schengen border crossing point. For instance, RTP travellers would be able to use ABC gates mainly at air borders, and the facial image can only be taken from an **e-MRTD** to verify or enrol the traveller where e-MRTD readers are in use.

The assessment of the duration impact was supported by the simulation of **real data** from border crossing points processing tools developed by Frontex. The simulations of an average and a large air border allowed demonstrating that an added duration below 60 seconds at first entry would have very limited impact on service level and average dwelling time, and that an added duration below 30 seconds would have practically no impact. With an additional 60 seconds, the service level would still not be impacted but there would progressively be a slow increase of dwelling time and workload.

The simulation of a land border demonstrated the impact to be more important. To limit adverse effects on service level and dwelling time, the added duration should preferably remain below 60 seconds per vehicle. To have minimal adverse effects the limit to the added duration should be set at 30 seconds per vehicle.

The Study also looked into the practical terms and constraints of enrolling biometrics at various borders. While enrolling 8 or 10 fingerprints seems challenging at all types of border crossings and in various types of conditions, state-of-the-art mobile technology is already available today, which enables the enrolment of a minimum of 4 fingerprints using handheld equipment.

Local border traffic permit holders and residence permit holders

In addition, the Study looked at the opportunity of including in the scope of EES or RTP local border traffic (LBT) permit holders (who currently account for up to 10 million border crossings per year at land borders, i.e. +/- 3% of the total) and residence permit holders (currently around 6 million EU and national long-term residence permit holders cross the border every year in total, i.e. +/- 2% of the total). Three options were assessed:

- unchanged procedure for LBT and residence permit holders;

- registration of LBT and residence permit holders in the EES;

- registration of LBT and residence permit holders in the RTP.

The Study concluded that the added value of including LBT and residence permit holders within the EES would not outweigh the disadvantages, such as longer duration of border crossing or mandatory registration of EU family members in the EES. Therefore, it recommends **not to register** LBT and residence permit holders in the EES.

Their enrolment in the RTP, on the other hand, was deemed to be a viable option. Their registration would be made on the same basis as for any other TCN. A same person could then have both a LBT permit to facilitate travel in a border area and an RT status to facilitate checks at any other Schengen border crossing. The registration of residence permit holders in the RTP was considered as possible provided a specific enrolment process is defined and their entries and exits are not recorded in EES.

Alternative application process for the RTP

The Study presents an alternative proposal for the RTP process, where registration in the EES would be a prerequisite to apply for RTP status. The application for RTP member status could then be simplified and made online, which would reduce the workload at consular posts, common application centres and external crossing points. The system would thus not store its own set of biometric data, but would rely on EES and VIS biometrics. The Target Operating Model (TOM) N

represents this alternative process for the RTP, which should be further analysed if considered a feasible option.

Use of process accelerators to speed up border crossing times

Several innovative approaches were analysed and assessed with a view to accelerate the border control process. They include gathering information from transport companies before arrival (e.g. Advance Passenger Information- API), enabling traveller self pre-registration before the border check, extending the EES data retention period to decrease the number of registrations of the individual file in the EES, minimising the number of documents used (e.g. maximise the use of the e-MRTD), as well organisational measures (e.g. separate TCNVE and TCNVH lanes, use of ABC gates for TCNs at exit).

Pre-border registration/checks could have a very positive impact on border crossing times, mainly at international airports and large land border crossings (rail or road) or ferry/cruise ship terminals. It would also make it possible to release a share of the border guards from manual processing. If such pre-border registration/checks were to be implemented, however, actions such as supervision of the self-registration kiosks would be required, which could be implemented for all TCNs (and not only RTs).

Another potential accelerator would be to minimise the number of documents used, in particular by removing the need for a separate token for the RTP and relying only on the e-MRTD as the token (as described at the beginning of this section).

Data – 26 items as minimum dataset for EES and RTP

A direct consequence of the introduction of EES and RTP will be that the manual stamping of the TCN passports will disappear and will be replaced by the creation of Entry/Exit records in the systems. This new situation will impact amongst others:

- the work of the border guard who will not have any more the possibility to see the stamps corresponding to Schengen border crossings that occurred in the past,

- the TCN travellers as they will not have any more the possibility to calculate the maximum number of day for authorised stay in the Schengen area,

- the carriers that will not have any more the possibility to check on the passport if a visa was already used.

The Study identified the **minimum and sufficient dataset** required to satisfy EES and RTP processes requirements while complying with data protection legislation. With regard to the retention period, the Study assessed different options against the main purposes of the system. The chapter also investigated the technical consequences of giving law enforcement authorities access to EES. Finally, the chapter looked into the output information that EES and RTP should provide to travellers, border guards and carriers.

While the EES legislative proposal suggests storing a set of 36 data items, the Study identified that the EES **minimum dataset** considered necessary to fulfil the objective of the EES while maximising automation is composed of **26 data** items. The collection of additional data than the minimum dataset would go against the data minimisation and proportionality principles, would not add value for first line checks and would slow down border crossing times. With regard to the RTP dataset, the Study concluded that the dataset as per the legislative proposal is sufficient to meet RTP objectives.

The Study has not identified any disadvantages derived from the data retention period as set up by the current RTP legislative proposal, i.e. the maximum of five years starting from the expiry date of granted or extended access to the RTP. Therefore no alternative options have been investigated.

In contrast to RTP, the current data retention rules established by the EES legislative proposal present a series of disadvantages with regard to the border crossing process. Therefore the Study has investigated alternative options to overcome certain drawbacks such as the need to repeat biometrics enrolment procedure and loss of time for border guards among others. The Study suggests for the case of two separate systems the following options:

- to maintain the retention period as proposed in the EES proposal but for RTs align the EES data retention period of the individual file with the length of the RTP status;

- a uniform 5-year retention period;

- a maximum of 366 days after the last exit record, if there is no entry record within 365 days following that last exit record.

For the case of one single EES/RTP system, the data retention options would need to be further examined depending on the final technical choices made.

Summarising the assessment of the options, the longer the data retention period, the smaller the number of enrolment procedures per TCN. As a consequence, requiring TCNs to enrol fewer times – compared to what would result if the current legislative proposal were maintained – would shorten the overall border crossing time. At the same time, a longer data retention period coincides with the expectations of law enforcement authorities. However, personal data shall not be kept for longer than is necessary for the purpose for which they were collected. Thus, the decision on the data retention option should be based on the right balance between data protection considerations and the purposes of EES.

The Study also explores the additional requirements necessary in case it would be decided to provide **law enforcement access** (LEA) to the EES while taking into account data protection principles. Indeed, if the option to provide access to law enforcement authorities is positively considered, the Study recommends ensuring that data are handled only by the designated competent authorities to the extent necessary for the performance of their task, based on the "need to know" principle.

Regarding the **information to be provided to travellers** at the borders, the Study examines many options. However, the preferred option is a systematic display at ABC gates of at least the maximum number of days for authorised stay in the Schengen Area combined with at least one other option such as on demand print. Regarding information to be provided to travellers on demand within and outside borders, the Study recommends the use of the existing automatic calculator, which has been developed for the general public and for the Member States authorities.

Finally, analysis of the options regarding **information to be provided to the carriers** revealed that they could be relieved from their obligation to verify whether the single-entry visa or multiple entry visa has already been used by the travellers. This option would reduce the number of actors accessing the personal data of travellers. Alternatively, a restricted and secured access to the personal data of travellers could be provided to the carriers to enable them to fulfil their current obligations. One more option would be to extend their obligations to check entry requirements by including checks on the remaining authorised days of stay, taking into account the overall duration of the stay and the return date. The Study does not take any stand on one preferred option; however, it indicates that the latter alternative has the greatest legal implications both in terms of impact on the legislative proposal and on data protection compliance.

Architecture – integration options

The Study examined the main architectural options for the EES and RTP, and their potential impacts on related systems such as the VIS, Biometric Matching System (BMS), national entry and exit systems and existing border management systems. The Study also assessed the option of developing a National Uniform Interface (NUI) providing national end-user systems with the uniform services needed to easily integrate the use of the EES and RTP in their business processes.

The study assessed the pros and cons of two main possible architecture options – developing the EES and RTP as two separate systems (option A) or as a single system (option B). It appears that option A would reduce the complexity of the systems' development and implementation. However, it would generate a significant risk of functionality and data overlap. This could lead to a much bigger development effort and a duplication of hardware and software, negatively impacting investment and maintenance costs.

Option B is in line with the process and minimal dataset approach for both the EES and RTP. While infrastructure and development costs would be lower, there would be a risk of added complexity in the systems' development and implementation, which should be managed carefully. The Study considers this option as the most suitable one.

Concerning synergies between the new systems and the VIS, three options were analysed: (i) EES and RTP independent from the VIS, (ii) EES and RTP integrated with the VIS, (iii) EES and RTP independent from the VIS but reusing VIS artefacts. The first option would make the testing phase and entry into operation easier, but duplication of capabilities and data flows would be unavoidable.

The second option would be less cost-effective and would require the VIS legal basis to be amended. The evolution of a complex existing system, already operational across 30 countries, with high requirements of availability, would lead to a more complex testing phase and entry into

operation compared to the development of stand-alone new systems. Having in mind the lessons learned from the SIS II implementation, the impact of this second option on MS systems and organisation could be important and should be analysed extensively.

The third option would mitigate the complexity risk but would still have an impact at national level. It would probably lead to phased testing. Further synergies can be achieved in the long run.

The Study also assessed the option of creating a new RTP and EES – BMS and the option of further developing a common SOA-based BMS that would be accessed by the RTP, EES and VIS. A less complex architecture could be envisioned for developing a new RTP and EES – BMS, but there would be a negative impact on costs and a significant functionality overlap between the new BMS and the VIS-BMS. Reusing the technology and expertise gained from the VIS-BMS and further developing a common SOA-based BMS would help achieve significant cost savings.

With respect to ease of use and data sharing, a practical balance needs to be found. As a result, regardless of the option chosen, the Study recommends including additional safeguards and mitigating measures to reduce the impact on personal data protection such as differentiated access rights to read and query the data stored.

Finally, the Study investigated the services that a National Uniform Interface (NUI) would offer to the MS and the way in which it would ease the integration of the new systems in their business processes. The NUI would be developed by eu-LISA and maintained centrally. It would include all message handling services that are common to all MS. As such, it would reduce the development effort of MS and the effort of integrating the national domain. It would also provide means for integrating existing MS systems performing similar functions as the EES, where they exist.

Target operating models (TOM) – key component combinations

The various analyses lead the Study to envisage the future target operating models (TOMs) of the EES and RTP. These TOMs consist in a unique set of components assembled to effectively operate a future system. In this perspective, five different TOM alternatives were identified, three for the EES and two for the RTP. The five TOMs were elaborated considering that the EES and RTP would be built up into one central system not integrated with the VIS. The biometric information would however be processed by the same AFIS as for the VIS if fingerprints are used.

The TOMs are articulated on the basis of the process steps and their sub-processes to combine different biometric and data components (e.g. number of fingerprints enrolled, optional vs. systematic identification).

In addition to the unique set of components, TOMs are comprised of generic features (e.g. for the EES: data retention, minimal dataset, LEA, LBT residence permits, transition period, use of self-service kiosks; and for the RTP: data retention, minimal dataset, e-MRTD as RTP token), a choice of system architecture (one or two systems, national uniform interface), and the use of process accelerators and additional cross-cutting items (e.g. management of LBT and residence permits, transition period, law enforcement access, use of self-service kiosks).

An overview of the EES TOMs is presented below:

Border check	TOM A Using only FI and no systematic 1:N identification	TOM B Using FI, 4 FPs and systematic 1:N identification at first entry	TOM C Using FI, 8 FPs and systematic 1:N identification at first entry
Document authenticity and validity	MRTD/e-MRTD: Physical/optical document safeguards e-MRTD: Passive and Active Authentication		
Bearer verification at each border crossing	VEs: MRTD: visual check of picture vs bearer e-MRTD manual lane: FI from e-MRTD vs bearer e-MRTD in ABC: FI from e-MRTD against live photo VHs: bearer verification considered to be part of the VIS framework		

Biometric enrolment at first entry[4]	VEs/VHs: FI from e-MRTD[5] stored in EES		
	VHs: no FP enrolment (10 FP's are stored in VIS)		
	VEs: No FPs are stored	VEs: 4 FPs are stored in EES	VEs: 8 FPs are stored in EES
Biometric verification at subsequent entries/exits (holder vs. travel document and holder vs. database)	VEs: verification of FI from e-MRTD against photo in EES VHs: live FP (1,2 or 4) against VIS	VEs: live FP (1,2, or 4) against EES VHs: live FP (1,2, or 4) against VIS Verification of FI in ABC-gates using FI	
Biometric identification at first entry[6]	VEs: Discretionary 1:few using FI and alphanumerical data VHs: Systematic identification was done at the moment of the visa application	VEs: Systematic 1:N identification using FPs VHs: Systematic identification was done at the moment of the visa application	
Entry/Exit record creation	Data recording of border crossing, e.g. day, time, BCP		

With regard to TOM M and TOM N of the RTP, they would not vary at entry and exit regarding process steps, yet the source of biometrics verification would be different. Namely, **TOM M** would rely on fingerprints and photo being part of the registration in the RTP application process (VE), while **TOM N** would rely on the existing biometrics of the EES (VE). No enrolment of biometrics would be made in the RTP application process. Identifications and verifications in the border control process would be made using the EES.

Options		TOM M	TOM N
• RTP enrolment procedure based on EES data.		No	Yes
• **EES individual file** created at the end of the application process		✔	EES file is a pre-requisite
• **1:N identification** using FPs against the RTP (in the RTP application process – to prevent RTP shopping)	• VEs:	✔	
	• VHs:	Not necessary – person already identified within the VIS	Not necessary – person already identified within the VIS
• **Number of FPs** enrolled for RTP application	• VEs:	Same as for the EES (i.e. for TOM B, 4)	0 FPs, relies on the EES for the biometric verification
	• VHs:	0 FPs, the VIS FP verification is trusted.	0 FPs, the VIS FP verification is trusted.
• Verification using **photo** (ABC)[7], **FPs** (ABC or manual)		✔	✔ (EES process used)

Each TOM alternative was assessed against the following main criteria: security (compliance with the Schengen Borders Code and related best practices), duration of the border crossing for travellers, and complexity of system implementation.

The main cost items impacted by the choice of TOMs are (i) network, (ii) hardware and (iii) software. TOMs C and M were taken as the baselines for the calculation of costs, as they are the closest to the legal proposals, as well as the most expensive options. The main conclusion was that TOM A is always the cheapest alternative (approximately -5% to -10%) regardless of the EES

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[4] EES search is made using issuing country and document number but an individual file in EES is not found.
[5] If the e-MRTD is not available, then a live picture or the scan of the travel document could be used instead.
[6] At first entry or in case a new passport is used, to avoid duplicates and to increase security.
[7] Applicable only for VE, unless the VIS regulation is revised, as it currently mandate the verification through FPs.

scenario. As regards RTP, TOM N does not have a significant impact on the cost to be borne at central level but it could impact national budgets.

Options for the Pilot – live tests

The Pilot's objective is to test the potential options in operational and relevant environments in order to contribute to the preparation of the development and full implementation of EES and RTP in the Schengen Area. The Pilot would not cover a full end-to-end test of EES and RTP due to time and budget constraints. Hence, the objective would be to test significant parts or components.

Built on the conducted analysis, the options for the Pilot were selected based on the following criteria:

1. Additional evidence is needed to verify the expected impact;
2. Need to test possible process changes;
3. Requirements for specific technical solutions and need to test related constraints or possibilities;
4. Results from TOMs analysis indicating the options that add duration and/or complexity.

The different sets of options to be considered for the Pilot are as follows:

Border control processes and use of biometrics

- Biometrics: impact of the enrolment of FI or of different numbers of FP,
- Technology: feasibility and process impact of the usage of different types of devices for the biometric devices, use innovative or developing technology (e.g. enrolment of specific number of fingerprints using "touchless sensors" or enrolment/verification of fingerprints and facial image with handheld equipment at various types of borders or enrolment of iris); capturing a photo (FI) from the e-MRTD or taking a live photo and verifying it against another source;
- VIS: searching VIS based on travel document number, without using the visa-sticker number;

Process accelerators

- Self-service kiosks: the usefulness, usability and security in relation to using self-service kiosks for registering, checking and enrolling biometrics;
- Pre-border checks: the feasibility of introducing pre-border checks in the waiting areas of land borders.

For the Pilot execution phase, the necessary budget in terms of equipment and integration has been estimated to amount around €0.5 m. Others costs, estimated to amount approximately to €1.9 m, such as equipment leasing costs, meetings costs, travelling costs and contractor costs. The evaluation of the costs for the pilot concludes that the proposed set of Pilot options fit within the €3.0 m budget.

Statistics – 76 million TCN travellers with 302 border crossings in 2025

An effort was made to identify the number of people whose border crossings will be managed using EES and/or RTP.

The Study is based on a time-line that foresees the start of operations for the EES and RTP on 01/01/2020. In order to ensure that the systems' capacity is sufficient for the first years of operations, it builds on **sizing estimates for the period up to 2025**.

Volumes of border crossings were measured during a seven-day period from 18 until 26 May 2014 by all current Schengen MS and four EU MS that do not yet fully implement the Schengen acquis (Bulgaria, Croatia, Cyprus and Romania). The results obtained were extrapolated for one year, and towards 2020 and 2025 for the current Schengen MS. Based on consultation with various sources, an annual growth rate of 4.2% was used to estimate figures for 2020 until 2025.

The total number of border crossings in 2025 is estimated at 887 million. The diagram below presents the projected number of entry and exit border crossings for Schengen countries in 2025 per type of passenger across the various types of borders.
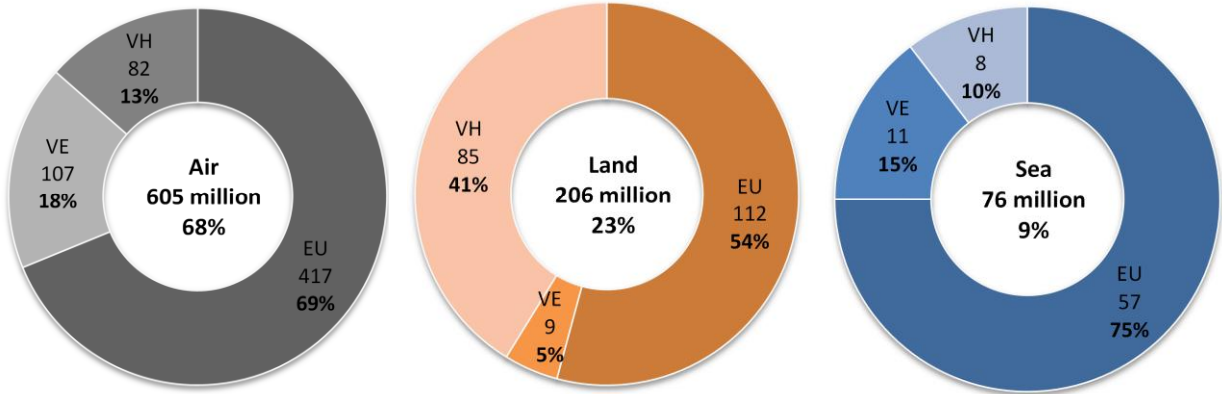

Figure *Breakdown of the projected number of entry and exit border crossings for Schengen countries in 2025 per type of passenger across the various types of borders (figures in millions)*

Key lessons from the analysis are as follows:

14

- As is already the case, **air borders** will account for the majority of border crossings by 2025, followed by land borders and then sea borders.

- For each border type, "EU" (EU/EEA/CH) citizens – who are not directly impacted by the Smart Borders package – will account for the largest share of border crossings.

- The total number of border crossings by TCN**VE** is estimated at 127 million in 2025, occurring predominantly at air borders (107 million).

- The total number of border crossings by TCN**VH** is estimated at 175 million[8] in 2025, occurring for an almost equal share at land borders (85 million) and at air borders (82 million).

These numbers have been estimated based on the fact that one traveller generates two border crossings per visit and on an estimate of the number of return visits for TCNVE and TCNVH, as presented in the following table.

Table 1 *Summary of estimations for the size of the individual file database (in millions)*

		2014	2020	2025
VE	Border crossings (entry + exit)	81	104	127
	Number of travellers	30	39	47
VH	Border crossings (entry + exit)	110	141	175
	Number of travellers	19	24	29
	Border crossings total	**191**	**245**	**302**
	Travellers total	49	63	76

The number of RTP users was estimated based on the assumption that the following TCNs will be most likely to enrol:

- TCNVEs who perform return visits and cross air borders, for whom the use of Automated Border Gates provides tangible benefits;

- TCNVHs having Multiple Entry Visas (MEVs);

- Holders of Residence permits and cards if a provision is made for this population to apply for RTP enrolment (to allow these travellers to use the ABC gates).

Based on those assumptions, the Study estimated that up to **9.2 million TCNs** (representing 12% of the number of travellers) may apply for **RTP membership by 2025**[9].

These estimates are instrumental in defining the type and magnitude of requirements for implementing the EES and RTP, in terms of processes, data and architecture.

Conclusions

The Study explored and analysed the various options, impacts, accelerators, constraints and related costs of the future EES and RTP systems from different angles: biometrics (identifiers), border processes (impacts, alternatives and accelerators), data (minimum number of data to enable the systems to operate) and architecture (leveraging on the current systems landscape, best practices and potential risks).

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[8] Based on 2014 situation of countries requiring a visa to enter the Schengen area.
[9] The number of individual files stored within the central database was estimated according to different data retention scenario, using the estimated number of travellers per year and the estimated number of returning travellers. These estimations are based on the data collected from the MS for border crossings, the likelihood that a traveller has to return to the country, and the number of visas issued, single and multi-entry, per year.

It brings a comprehensive overview of the various and tangible scenario to operate those systems in the most effective and efficient way (TOMs). The analysis provides also the impact on the legal basis and data protection concerns.

The chapter concerning the costs will be published in a separated document.

In combination with the Pilot phase to be run next to this technical study, it will provide the decision makers with evidenced based information allowing to support their decisions.