

Cross-border eServices for public administration driven by Once-Only Principle

Carmen-Elena CÎRNU, Carmen-Ionela ROTUNĂ

National Institute for Research and Development in Informatics – ICI Bucharest

carmen.cirnu@ici.ro; carmen.rotuna@ici.ro

Abstract: Nowadays implementing cross-border electronic public services is a top priority for public administrations across EU for accelerating economic development. Currently, there are still technical, administrative and legal barriers at European level that prevent businesses and citizens from accessing electronic services in and from other countries. The use of digital technologies is currently an integrated part of modernisation and innovation strategies in member states. The Once-Only Principle (OOP) is one of the key principles for developing electronic services while promoting cross-border cooperation between authorities. The Once-Only Principle Project (TOOP) supports EU efforts on granting every European a similar level of digital experiences and rights by developing a federated OOP architecture and real-life pilots.

Keywords: eServices, eGovernment, OOP, data reuse, cross-border public services, interoperability.

Servicii electronice transfrontaliere pentru administrația publică bazate pe principiul „Once-Only”

Rezumat: În acest moment, implementarea serviciilor publice electronice transfrontaliere reprezintă o prioritate a administrațiilor publice la nivel european pentru accelerarea dezvoltării economice. În prezent, există încă bariere tehnice, administrative și juridice care împiedică întreprinderile și cetățenii să acceseze servicii electronice în și din alte țări. Utilizarea tehnologiilor digitale este o parte integrantă a strategiilor de modernizare și inovare din statele membre. Principiul „o singură dată” (OOP) este unul dintre principiile cheie propuse pentru dezvoltarea serviciilor electronice, promovând în același timp cooperarea transfrontalieră între autorități. Proiectul The Once-Only Principle Project (TOOP), susține eforturile UE de a acorda fiecărui cetățean european niveluri similare de experiențe și drepturi digitale, prin dezvoltarea unei arhitecturi federalizate OOP și pilotare.

Cuvinte cheie: eServices, eGovernment, OOP, reutilizarea datelor, servicii publice transfrontaliere, interoperabilitate.

1. Introduction

As technology advances, it is necessary for public administrations to provide modern and efficient services for citizens and companies, while opening their services to other administrations. Increasing emphasis on the principles of good governance has been associated with a strengthened role for regions in economic development. For business development, this is particularly important since it is at the sub-national level that entrepreneurs are most likely to come into contact with the state.

The constant evolution of information systems and their diversity at European level creates challenges concerning cross-border interoperability aspects. As a result, citizens and businesses still face barriers when using online tools and services across EU. The Digital Single Market strategy supports the development of cross-border digital mobility by providing digital infrastructures and creating the appropriate regulatory conditions.

Currently at European level there are still administrative and legal barriers which prevent businesses and consumers to access electronic services in and from other countries. Citizens and businesses have the option to communicate with their governments fully digital in a small number of countries. This also makes it difficult for small and medium companies to start new activities or to expand at home or abroad. Still in many EU countries, they are required to carry out formalities and registration procedures which are time and resource consuming before they can cross the border to provide a service.

The Once-Only Principle (OOP) is one of the key principles for developing eServices and is included in the European Union's (EU) actions to further develop the Digital Single Market (DSM) by reducing bureaucracy for citizens and businesses (eGovernment Action plan 2016–2020, 2016). The Once-Only principle states that, when applying for a cross-border service, citizens and businesses will not have to provide standard information which can be retrieved from other public administrations. By developing a European service infrastructure which connects authorities from all member states, in accordance with data protection regulations, the public administrations will be able to exchange information with each other and reuse it.

2. State of the art

European Commission (EC) estimated that the digitization of goods and services will bring annual revenues of EUR 110 billion to European industry in three years (2017–2020). Digitisation is also expected to foster a substantial growth in European productivity (Transforming European industry and services, 2017; Dumitrache et al., 2017). The current focus on the reduction of the administrative burden however opens up new perspectives in the development of eGovernment. (Arendsen et al., 2004; Anghel et al., 2013; Akkaya et al., 2018).

The eGovernment Action plan 2016–2020, aiming to accelerate the digitalisation process across EU, defines seven key principles for public administrations concerning service provision: digital by default, once only principle, inclusiveness and accessibility, openness and transparency, interoperability by default and trustworthiness and security. These key principles address issues such as: public services will be delivered online through a single contact point, public administrations will internally share and re-use data so that citizens and businesses will no longer have to provide the same data more than once, services will be designed inclusive by default and accessible for all citizens (elderly, people with disabilities etc.), public administrations will enable citizens and businesses to access and update their own data, digital public services will be available cross-border, services will be designed taking into consideration interoperability aspects and in line with the legal framework on personal data protection and privacy and IT security. (eGovernment Action plan 2016–2020, 2016).

Tallinn Ministerial Declaration on eGovernment, signed in 2017 by ministers from EU member states, promotes an user oriented approach for digital public services design and key principles to achieve this, such as: interoperability, digital by default, Once-Only Principle and trustworthiness and security (Tallinn Ministerial Declaration on eGovernment, 2017).

The declaration acknowledges the protection of personal data and privacy by introducing the General Data Protection Regulation (GDPR). Data sharing and re-use brings important questions about data protection. In some countries data exchange between public authorities is perceived with major resistance due to strong data protection regulations. (Cave et al., 2017).

The EU Single Digital Gateway Regulation (SDGR) supports cross-border electronic services by ensuring that the procedures which are available online for domestic users will be also accessible to users from other EU countries. Helping citizens and businesses comply with obligations across borders, the Regulation requires Member States and EEA countries to offer at least 21 key administrative procedures fully online. (Single Digital Gateway Regulation, 2018).

The SDGR Regulation is the main driver for OOP implementation at EU level as it provides the legal context for achieving the desired goals. Article 14 from the Regulation is the most relevant and states that the technical system for the cross-border automated exchange of evidence and application of the OOP should enable: the processing of requests for evidence at the explicit request of the user, the transmission of the evidence between competent authorities and the means by which the user can preview the evidence that will be used by the requesting public authority. Also, it states that the evidence provided to the requesting authority shall be limited to the information that has been requested and shall be used exclusively for the purpose of the procedure selected by the user.

There are several initiatives at European level that support and promote interoperability including Connecting Europe Facility (CEF), which provides Digital Service Infrastructures (DSI),

and Interoperability Solutions for Public Administrations Program (ISA2). The latter provides tools such as: EIF a European Interoperability Framework (European Interoperability Framework, 2017; European Interoperability Framework–Implementation Strategy, 2017), the European Interoperability Reference Architecture (EIRA) (European Interoperability Reference Architecture, 2019) and Core Vocabularies. EIRA is a tool developed for classifying and organizing the architectural blocks relevant for interoperability, used in the provision of digital public services. The aim is to facilitate interoperability and reuse of existing solutions in the development of public services.

Technical interoperability barriers to OOP implementation involve national solutions that might not meet OOP requirements, such as old systems, different local or national approaches to handling specific types of data and limited possibilities to develop common access tools for non-base repositories.

In the last eight years, the Commission has supported the development of seven major large-scale projects (Figure 1) that had as primary objective the development of cross-border electronic services for citizens and business environment:

- PEPPOL enables electronic services in the public procurement domain;
- STORK developed building blocks (BBs) supporting electronic identification across EU and electronic identity (eID) development;
- SPOCS developed electronic services for cross-border business mobility;
- eCodex enabled interoperability and cross-border operations in the field of justice;
- e-SENS used and further developed the building blocks from previous four LSPs;
- TOOP (The Once-Only Principle Project) project relies on e-SENS and CEF (Connecting Europe Facility) building blocks and demonstrates Once-Only Principle is feasible at EU level.

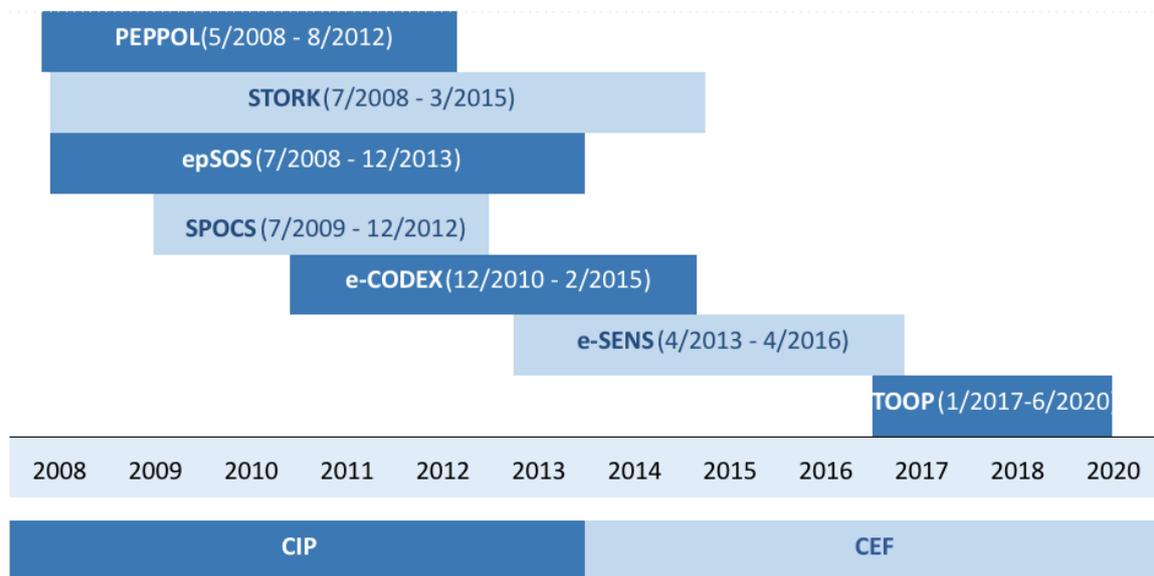


Figure 1. Large Scale Projects across EU (The Once-Only Principle Project, 2020)

TOOP project, together with SCOOP4C project were pioneers in addressing OOP at EU level. TOOP approached the business domain while SCOOP4C approached the services for citizens dimension of OOP.

Currently a small number of member states have a national OOP driven framework for public services. At national level OOP implementation is fragmented and limited to few services (for example, National Trade Register Office - National Agency for Fiscal Administration) and an OOP national layer is not available yet.

3. The TOOP Project as a cross-border OOP driver

The Once-Only Principle Project (TOOP), designed with the key objective to demonstrate that Once-Only Principle (OOP) implementation is feasible at EU level, was launched in January 2017 as a joint initiative of 51 EU organisations: universities, research institutes and public administration organisations from 21 Member States.

TOOP explores the Once-Only Principle by implementing three Once-Only sustainable pilots, using a generic and federated architecture while identifying barriers and drivers and providing a basis for future developments and wider use. (Krimmer et al., 2017).

The key drivers for TOOP project are reducing the administrative burden for companies, reducing the operational costs for business registers and competent authorities, developing electronic cross-border services and preventing and limiting frauds.

Through its Work Packages (WPs) the project consolidates, improves and expands technical solutions (building blocks) that will promote interoperable interaction in the public administrations within Member States. The project is structured in five work packages, with the aim of showing a distinction between management and communication work, technical work and the actual piloting.

The five work packages(WPs) under TOOP project are:

- WP1 Project Management – ensures administrative, financial, scientific and technical management of the project, communication within the consortium and effective liaison with the stakeholders, other projects, communities and other bodies as required;
- WP2 Technical Architecture, Legal and Governance – develops a generic, federated OOP architecture aligned with existing frameworks, develops profiles for the building blocks to be used by designers and implementers, identifies existing barriers and drivers concerning legislation and organisational aspects and assesses the impact of Once-Only Principle implementation in WP3 pilots;
- WP3 Piloting – designs and implements real pilot cross-border services for businesses that demonstrate the feasibility of an OOP infrastructure across Europe thus enabling companies to expand across Europe. It interconnects participating MS systems by developing virtual bridges between data consumer systems and data providers, as for example Business Registers;
- WP4 Dissemination – has the objective to conduct dissemination activities and support the sustainable exploitation of the results throughout the project. Other goals include the development of a dissemination plan raising awareness for the project among stakeholders;
- WP5 Ethics - sets out the 'ethics requirements' that the project must comply with.

4. TOOP architecture development

4.1. TOOP Reference Architecture

The architecture developed within TOOP (TOOP Reference Architecture) is generic, because it is designed by abstracting aspects specific to the field (business environment) and identifying the common elements associated with the field of interest Once-Only. The TOGAF methodology and the “Architecture Continuum” model are used in the description of the architecture, which allow the transition from a generic architecture to a specific domain and a particular implementation of a domain (Grandry et al., 2018).

TOOP Reference Architecture is described on three architecture layers (business, data and application, technology) and comprises the Business, Information Systems and Technology Architectures and has the main objective to support the OOP implementation in cross-border exchange of Evidences.

The OOP architecture research uses design science research methodology (DRSM) (Peffer et al., 2007), comprising: identification of a problem to be solved and motivation, setting goals and analysis of constraints, development of the architecture, demonstration, evaluation and dissemination of the findings. Throughout the project life-cycle, these steps were addressed in a close cooperation between WP2 and the other work packages.

The Business Architecture represents a coherent set of business concepts: capabilities, end-to-end value delivery, information, and organizational structure and the relationships among these business views and strategies, policies, initiatives, and stakeholders. (TOGAF, 2011). It is aligned with European Interoperability Reference Architecture (EIRA) which has the primary objective to facilitate interoperability of public services while reusing existing building blocks at EU level. The TOOP business architecture is concerned with the description of the business operations concerning Once Only Principle by the business actors. The architecture was build using an exploratory and agile approach, incorporating new requirements from TOOP pilots, the other WPs and EU regulations.

The architecture requirements comprise requirements from several areas: pilot requirements, General Data Protection Regulation (GDPR) (General Data Protection Regulation, 2016), European Interoperability Framework (EIF), legal requirements, as well as the SDGR and the Guidelines for the implementation of the SDGR (Guidelines for the implementation of the Single Digital Gateway Regulation 2019-2020 work programme, 2019).

The business architecture was designed considering the Architecture Significant Requirements and Architecture Principles which are qualitative statements of intent that should be met by the architecture, represented by a collection of guidelines, principles and assumptions that are used to guide the design of the OOP architecture.

In the first part of the project an assessment was carried out of already existing solutions and standards that could be useful for both architecture and solution development. Were identified CEF building blocks and e-SENS project results as key assets that we could use such as: eID, eDelivery, eSignature.

The TOOP business architecture describes the following core business assets:

- business roles relevant for TOOP;
- business data which is exchanged between TOOP participants;
- business services provided by each of the roles to meet the business goals of TOOP;
- business process describing the interactions amongst the business roles.

The TOOP Business Architecture focuses on describing two main business aspects: the Business Interactions which show the collaboration between the actors involved in cross-border Evidence exchange and the Capability Map which states the responsibilities of each actor participating in a cross-border Evidence exchange.

The operational processes (Figure 2) specify the necessary steps of executing OOP as part of the delivery of a public eService. The process of obtaining an evidence from another competent authority as shown in the diagram illustrates only a small part of the complete business process that is executed to meet the requirements of the public service that is being provided to the user.

The process starts when a user from a member state triggers an online procedure. The Data Consumer authenticates the User, identifies the required Evidence, asks for User confirmation for Evidence retrieval, finds Data Provider(s), checks feasibility of the request, retrieves Evidence from Data Provider, and processes Evidence. The Data Provider checks legitimacy of Evidence request, extracts data for User, and issues Evidence.

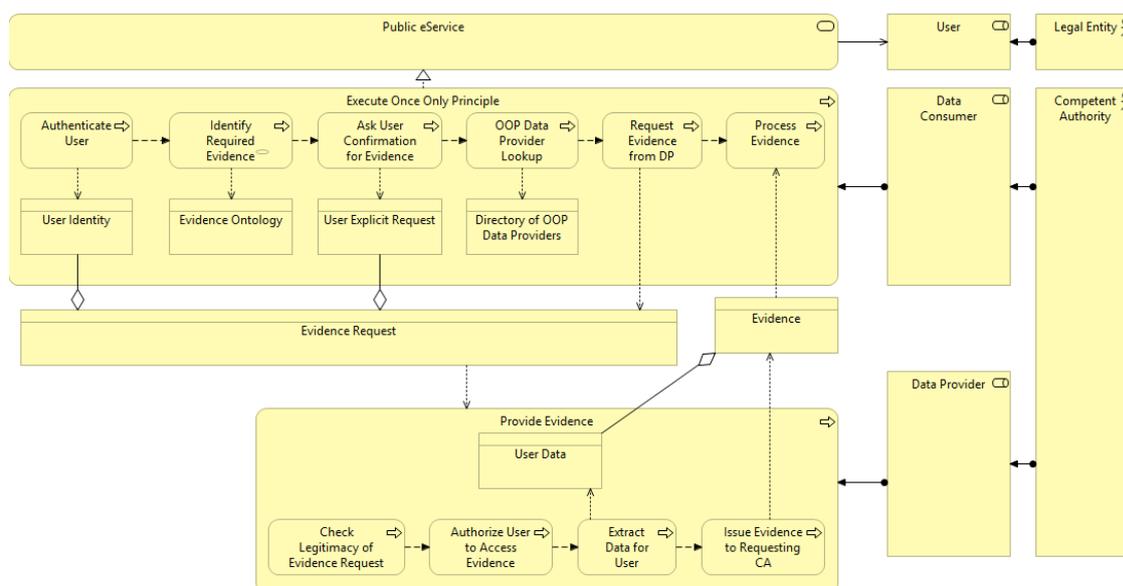


Figure 2. Business Architecture operational processes (TOOP Reference Architecture, 2019)

The IS Architecture describes of the realization of the Business Architecture by using IT components, taking into account the ASRs, reuse of Digital Service Infrastructure (DSI) BBs, and the TOOP Solution Architecture implemented for the TOOP pilots. All Business Architecture level capabilities are represented on the IS Architecture level. The IS Architecture comprises two main components: the TOOP Connector and the eID Component.

The Technology Architecture provides logical components and services that support the deployment of business capabilities and application components described in the Information System Architecture. It comprises both the European infrastructure components and the components within the MS responsibility. The components within the MS responsibility include the components maintained by the Member State and by its Competent Authorities.

4.2. Solution architecture TOOPSA

TOOP Solution Architecture was developed with the primary goal to enable the execution of the main business process of evidence exchange between the two main actors of the architecture: a data consumer and a data provider. The Solution Architecture achieves this through combining reusable CEF building blocks (BBs) with semantic and technical standards, thus promoting interoperability and reusability principles on all the levels defined in the European Interoperability Framework (EIF).

The solution was developed in line with currently used and recommended standards at EU level, with CEF OOP recommendations and with piloting use cases. Within the development process several standards and specifications were analysed and assessed both on the semantic and information level but also on the technical level.

4.3. TOOP project piloting and results at national level

TOOP project implements, operates and delivers real-life pilots that prove OOP is feasible by interconnecting systems from partner member states. Also, the pilots promote cross-border collaboration between public administration by interconnecting existing electronic services with data provision sources from other countries, while ensuring transparency and security concerning business operations.

The main objectives for piloting are:

- interconnecting member states national systems through virtual bridges either as data consumers or data providers, without altering national infrastructures and existing services;

- validating the feasibility of TOOP generic architecture, re-use building blocks and solutions that have been proven sustainable and re-use available infrastructure;
- assess the legal feasibility of OOP in cross-border scenarios between the piloting MS and identify national constraints that should be overcome.

The main drivers that enable or support the implementation of TOOP pilots, both at national and EU level are: reducing the administrative burden for companies, reducing the operational costs for business registers and other competent authorities, developing electronic cross-border services and preventing and limiting fraud.

Piloting allows experimentation with real usage scenarios focusing on crucial piloting use cases that facilitate business mobility such as:

- Cross-border e-Services for Business Mobility is composed of different usage scenarios that are of interest to the participating states: participation in public procurement procedures across borders, doing cross-border business and cross-border service provision;
- Updating Connected Company Data implies accessing business register data on demand by a change notification service (“pull” mode) or triggered by company “life event” changes (“push” mode);
- Online Ship and Crew Certificates pilot connects the databases of national Maritime Authorities and makes information available to authorized parties thus enabling online certificates to substitute paper-based or electronically-signed certificates that have to be carried on board.

Romania is one of the active piloting countries using the TOOP infrastructure, providing company data to other consumer member states. The Romanian National Trade Register Office (NTRO) is the public organisation at national level which fulfils the role of data provider.

NTRO registers all natural and legal persons running commercial activity with headquarter in Romania, as well as foreign legal entities with the establishment of branches or subsidiaries in Romania. The TOOP pilot use cases related to business mobility are based on cross-border data exchange needs identified at national level. Piloting contributes to the development of business environment for Romanian enterprises running cross-border businesses and increases quality of public services.

The use case piloted by NTRO involves several actors: NTRO as data provider, a legal entity registered by NTRO, an authorized representative of the legal entity and a foreign Public Authority offering a cross-border eGovernment service. The basic steps of the process are:

- A legal entity registered in NTRO wishes to use a cross-border service offered by a foreign Public Authority;
- The authorised representative of the legal entity uses the foreign eGovernment Service and sends a request;
- The foreign eGovernment Service forwards the request through the TOOP infrastructure to the Romanian Business Registry (NTRO) in order to retrieve relevant information;
- The NTRO receives the request, verifies the request and starts processing it in order to send to the requesting service the relevant information;
- NTRO sends the relevant information to the foreign Public Authority in the destination country via the TOOP infrastructure.

TOOP technical solution implemented at national level enables seamless communication and data exchange. NTRO has successfully connected to the project architecture as a Data Provider via dedicated TOOP Connector. The request for information sent from the foreign eGovernment system

is exchanged with the eDelivery component supported by the Semantics module, which facilitates understanding of the message. The requested data is fetched from NTRO, safely transported and fed into the form in the foreign eGovernment application. The datasets that are provided include a number of standard data as well as more specific personal and business information.

Figure 3 illustrates national piloting scenario and the role of NTRO, acting as a data provider for any data consumer eService, in the TOOP ecosystem. TOOP Federation enables interaction between any eService as data consumer and data providers, either directly or through the National OOP Layer. The eServices NTRO Layer is a complement to other digital infrastructures such as BRIS, which can be connected to the TOOP infrastructure.

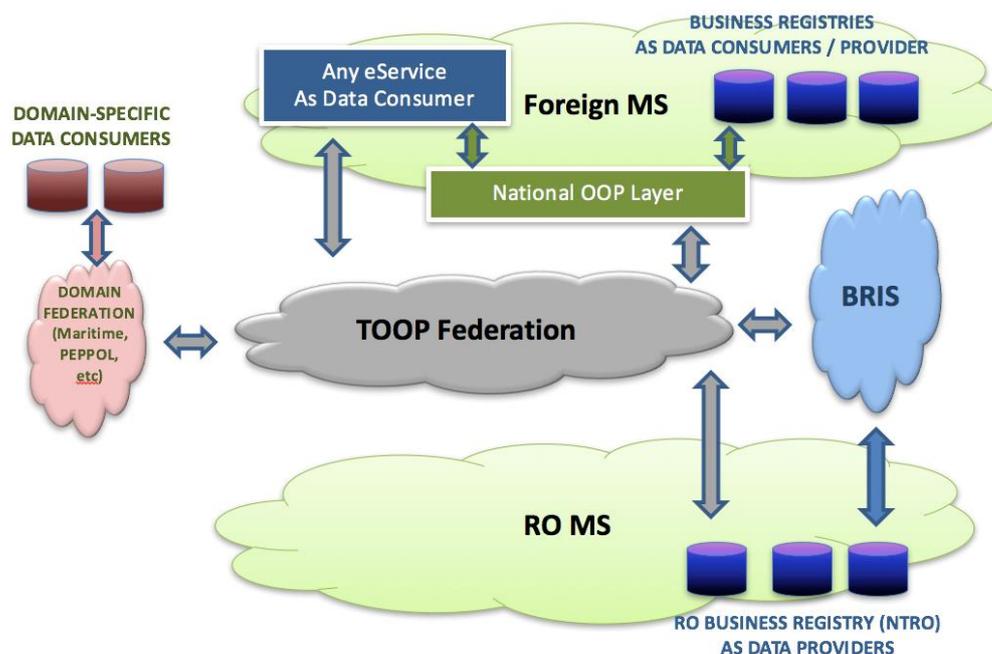


Figure 3. Romanian pilot overview

TOOP Piloting process comprises four stages for testing the readiness and maturity of the pilot implementations for member states. The national pilot solution, went through all testing steps: checking that all the conditions to start the testing process are met, testing TOOP transactions in a sandboxed environment, testing with a demo member state and joining “connectathon” testing sessions in which Data Consumers and Data Providers exchange information according to the piloting scenarios.

Within the TOOP pilot testing phase, Romania has successfully provided data to all other member states involved in the project through TOOP dedicated infrastructure. The TOOP pilot demonstrates that digital communication aligned with the Once-Only Principle is feasible. Also, it brings numerous benefits, both for Romanian administration and businesses. Furthermore, implementation of TOOP components supports the realization of the Romanian Digital Strategy and supports life events within the Romanian 2020 Digital Agenda based on standard and open building blocks. Additionally, the pilot paves the way towards the Single Digital Gateway regulation and reduces administrative burden for businesses at European level. TOOP pilot implementation at national level aims to create the conditions for information exchange in other areas and accelerate the implementation of the OOP layer.

5. Conclusions

OOP implementation on both national and EU level should be enabled in the following years as digital services are key enablers for the development of the economy. SDGR Regulation requires Member States to finalize the integration of 21 online procedures by the end of 2023. Establishing

cross-border electronic services is an important milestone in enhancing the functioning of the EU Single Market.

Both public administrations and enterprises will benefit from the results - architecture and solution - developed by TOOP project. Companies will make considerable savings in terms of costs and time to meet legal obligations by streamlining administrative steps. Public administrations will be able to provide companies with high quality full online digital services, developed taking into account their needs, allowing them to make savings in terms of processing time and money. At the same time, the data provided to public administrations by the companies involved will remain under their full control, in accordance with European data protection legislation.

TOOP methodology is based on an exploratory and agile pilot life-cycle approach to multiple sustainable cross-border pilots. Pilot implementation is supported by the development of a generic federated architecture and building blocks, the identification of barriers and legal aspects, and dissemination of the results throughout the project. The main technological innovation brought by TOOP project is represented by a generic federated architecture aligned to Once-Only Principle, demonstrated through piloting, that enables the interconnection, in an interoperable manner, of national Registers across EU. The pilot solutions provide a basis for the development of future implementations and the wider use of OOP by the member states.

The TOOP piloting at national level demonstrates that cross-border digital communication aligned with the Once-Only Principle is feasible. Moreover, it brings numerous benefits, for Romanian administration, businesses and citizens: reduced administrative burden, bureaucracy decrease, time and costs savings for companies, reliable online services for citizens.

Furthermore, TOOP piloting contributes to the realization of the Romanian digitalization strategies as it supports Romanian 2020 Digital Agenda and paves the way towards the Single Digital Gateway regulation implementation.

Acknowledgements

This work has been carried out as part of the TOOP („The Once-Only Principle Project”) project launched and co-financed by the European Commission.

REFERENCES

1. Akkaya, Cigdem & Krcmar, Helmut. (2018). *Towards the Implementation of the EU-Wide „Once-Only Principle”: Perceptions of Citizens in the DACH-Region*. The 17th IFIP WG 8.5 International Conference, EGOV 2018, Krems, Austria, September 3-5, 2018, Proceedings. 10.1007/978-3-319-98690-6_14.
2. Anghel, M. Cîrnu, C. Dumitrache, M. (2013). *e-Government and e-Services Portals*. Revista Română de Informatică și Automatică – RRIA (Romanian Journal of Information Technology and Automatic Control), vol. 23, nr. 1, 2013, București, pp. 31-36, ISSN: 1220-1758.
3. Arendsen, Rex & Engers, Tom (2004). *Reduction of the Administrative Burden: An e-Government Perspective*. 3183. 200-206. 10.1007/978-3-540-30078-6_33.
4. Cave, Jonathan & Botterman, Maarten & Cavallini, Simona & Volpe, Margherita. (2017). *Once-Only Principle for citizens and businesses Policy options and their impacts*. 10.2759/393169.
5. Dumitrache, M., Sandu, I. E., Barbu, D. C. (2017). *An integrated cloud computing solution for romanian public-sector entities: ICIPRO Project*. Studies in Informatics and Control, ISSN 1220-1766, vol. 26(4), pp. 481-487, WOS:000423249900013.

6. European Commission: Commission notice - Guidelines for the implementation of the Single Digital Gateway Regulation 2019-2020 work programme. C/2019/4881. <https://op.europa.eu/en/publication-detail/-/publication/877b88c4-b356-11e9-9d01-01aa75ed71a1/language-en/format-HTML/source-105856679>.
7. European Commission: European Interoperability Framework - Implementation Strategy. Communication from the Commission to the European Parliament. The Council, the European Economic and Social Committee and the Committee of the Regions, no. COM (2017) 134 final:9 (2017).
8. European Commission: eGovernment Action Plan 2016–2020 - Accelerating the digital transformation of government (2016). <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52016DC0179&from=EN>.
9. European Commission: Tallinn Ministerial Declaration on eGovernment (2017). http://ec.europa.eu/newsroom/document.cfm?doc_id=47559.
10. European Commission: Transforming European industry and services (2017). https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/dt_booklet.pdf.
11. European Interoperability Framework (EIF) (2017), https://ec.europa.eu/isa2/eif_en.
12. European Interoperability Reference Architecture (EIRA) (2019). <https://joinup.ec.europa.eu/collection/european-interoperability-reference-architecture-eira/about>.
13. European Union: Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation-GDPR). (2016).
14. European Union: Regulation (EU) 2018/1724 of the European Parliament and of the Council of 2 October 2018 establishing a single digital gateway to provide access to information, to procedures and to assistance and problem-solving services and amending Regulation (EU) No 1024/2012 (Single Digital Gateway Regulation). (2018).
15. Grandry, E., Fieten, S., Rotuna, C., Sellitto, G. P., Tepandi, J., Taks, E., Zeginis, D. (2018). *Generic Federated OOP Architecture (3rd version)*. Deliverable D2.3 of the TOOP project. European Commission.
16. ISA² - Interoperability solutions for public administrations, businesses and citizens Homepage (2020). https://ec.europa.eu/isa2/home_en.
17. Krimmer, R., Kalvet, T., Toots, M., Cepilovs, A. & Tambouris, E. (2017). *Exploring and Demonstrating the Once-Only Principle: A European Perspective*. In Proceedings of the 18th Annual International Conference on Digital Government Research, pp. 546-551.
18. Peffers, Ken & Tuunanen, Tuure & Rothenberger, Marcus & Chatterjee, S. (2007). *A design science research methodology for information systems research*. Journal of Management Information Systems, 24, pp. 45-77.
19. The Once-Only Principle Project (2020), www.toop.eu.
20. The Once-Only Principle Project Generic Federated OOP Architecture (3rd version).
21. TOGAF (2011), version 9.1, The Open Group.
22. TOOP Reference Architecture (2019). <http://wiki.ds.unipi.gr/display/TOOPRA>.



Carmen-Elena CÎRNU – cercetător științific gradul II, Vicepreședinte în Consiliul Științific al Institutului Național de Cercetare-Dezvoltare în Informatică – ICI București, Coordonator al Departamentului Securitate Cibernetică și Infrastructuri Critice – ICI București, inițiator și editor coordonator al revistei International Journal of Cyber Diplomacy. Este absolventă a Facultății de Filosofie, Universitatea din București, obținând titlul de doctor în 2011. Fellow al Institutului Aspen Japonia, cercetător invitat al Global Security Research Institute Japonia (2015, 2019), coordonator al activităților de cercetare în cadrul EuroDefense România, cu o bogată experiență atât în cadrul administrației publice centrale, cât și în domeniul academic.

Carmen-Elena CÎRNU - scientific researcher II, Vice President of the Scientific Council of the National Institute for Research and Development in Informatics – ICI Bucharest, Coordinator of the Cyber Security and Critical Infrastructures Department – ICI Bucharest, initiator and coordinating editor of the International Journal of Cyber Diplomacy. She is a graduate of the Faculty of Philosophy, University of Bucharest, obtaining a PhD degree in 2011. Fellow of the Aspen Japan Institute, guest researcher of the Global Security Research Institute Japan (2015, 2019), coordinator of research activities within EuroDefense Romania, with a rich experience both in the central public administration and in academia.



Carmen-Ionela ROTUNĂ a absolvit programul de master „Baze de date și tehnologii web” în cadrul Facultății de Matematică și Informatică, Universitatea din București. În prezent lucrează ca cercetător științific cu expertiză în ingineria software, eHealth, eServices, eGovernment, IoT și Big Data. A participat în mai multe proiecte de cercetare naționale și internaționale, trei dintre ele în domeniul serviciilor electronice: „Simple Procedures Online for Cross-border Services” (SPOCS), „Electronic Simple European Networked Services” (e-SENS) și „The Once Only Principle Project” (TOOP), unde în prezent are rolul de arhitect și coordonator al activităților de pilotare la nivel național. A publicat mai multe articole, a fost co-autor al livrabilelor de proiect și colaborează ca recenzor al unor publicații științifice.

Carmen-Ionela ROTUNĂ has graduated the Faculty of Mathematics and Computer Science, University of Bucharest, obtaining a Master's degree in „Database and web technologies”. Currently she works as a Scientific Researcher with expertise in Software engineering, eHealth, eServices, eGovernment, IoT, Big data. She was a team member in several international and Romanian research projects, three of them in the eServices domain: „Simple Procedures Online for Cross-border Services” (SPOCS), „Electronic Simple European Networked Services” (e-SENS) and „The Once-Only Principle Project” (TOOP), where she is currently architect and piloting coordinator. She published several articles, co-authored project deliverables and collaborates as a reviewer for scientific publications.