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Study on cloud and service oriented architectures for e-government

Final report summary

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STUDY ON CLOUD AND SERVICE ORIENTED ARCHITECTURES FOR E-GOVERNMENT

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The study has been commissioned by the European Commission, Directorate General for Information Society and Media, unit ICT for Government and Public Services. All views expressed in this document, however, are those of the authors and do not necessarily reflect the views of the European Commission.

Executive Summary

Introduction

This is the summary of a study investigating eGovernment service delivery models based on the concept of providing 'Fundamental Services' in an open cloud of public services through which they can be reused and recomposed to create new services.

The key questions which the study addresses are: what is the correct level of granularity[1] to define 'Fundamental Services', which ones have the highest potential for reuse and what are the possibilities for and the impacts of delivering public services in an open cloud of public services?

The study reveals that the potential opportunities and benefits for public administrations, third parties and end-users of providing public services in line with the cloud of public services concept are significant. Migration towards this model of public service delivery is therefore highly recommended.

A cloud of public services

The notion of a 'cloud' is often associated with 'cloud computing' and the technical aspects of enabling a cloud environment. In this study, however, a 'cloud' refers to a collection of public services serving as 'building blocks', which can be offered in an open, and interoperable way and reused and combined by public administrations and third parties as part of other services, based on a concept that could be called "Universal or Global Service Oriented Architecture (SOA)",[2]

The idea of the cloud of public services is illustrated in Figure 1 below. The figure shows that the provision of public services decomposed into individual public services (the small blocks in the cloud) is instrumental in developing a new method of service delivery which can benefit the different actors involved, namely public administrations, third parties as well as end-users. In short, it allows public administrations to provide services that can be reused across eGovernment applications by different public administrations as well as third parties. The more 'Fundamental Services' available in the cloud, the higher the opportunity for reuse and the combination of existing services to deliver the same type of service in a more efficient, more tailored way (e.g. an eGovernment application or an application developed by a third party), or to develop new services in combination with third parties.

[1] *The overall quantity of functionality encapsulated by a service determines the service granularity. A service's granularity is determined by its functional context [...] The larger the quantity of related functionality, the coarser the service granularity* (SOA Glossary: Definitions for service-oriented Computing Terms, SOA Systems Inc)

[2] *'Universal' or 'Global' SOA has been described as "outside-in" SOA, which means reusing services within an organisation* (e.g. a public administration) *as well as services not created by that organisation, by connecting internal SOA to the internet* (Outside - in SOA" ... Are you ready?, Linthicum, D., (21 November 2005))

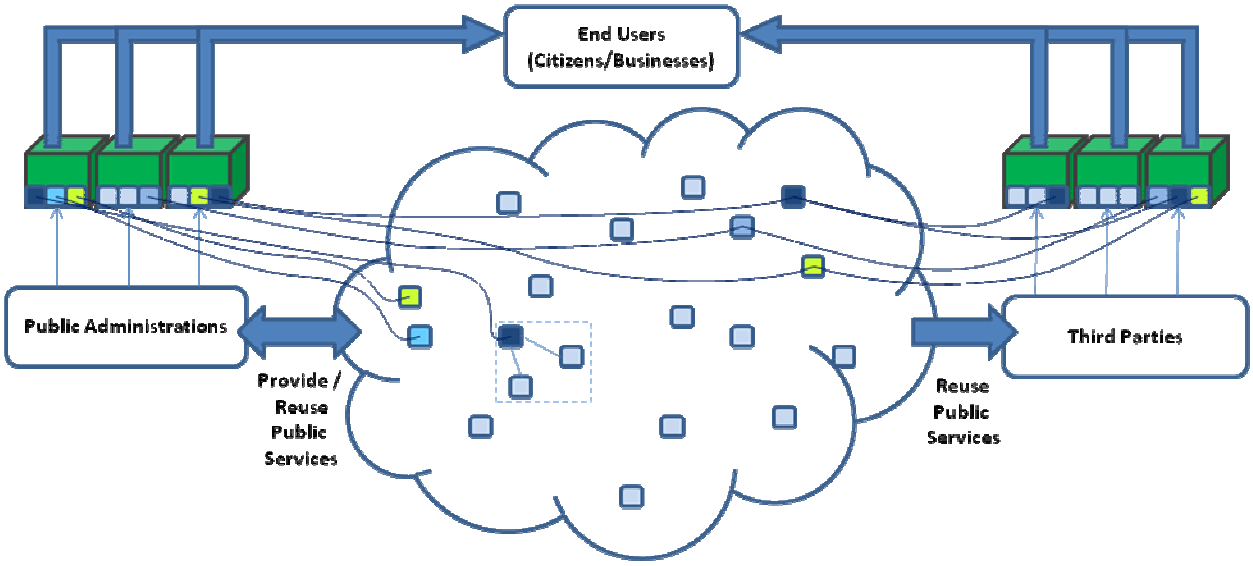

Figure 1 – The Concept of a Cloud of Public Services

In order to achieve service delivery in line with the concept of a cloud of public services, this study investigated: 1) How a public service can be categorised and what services are 'Fundamental services', 2) How can the different services be identified as part of the process of public service delivery and 3) What potential impacts can be derived from a cloud of public services

In view of recent policy and technological developments, the study developed a service taxonomy and methodology in order to identify the 'building blocks' of public services. The proposed taxonomy and methodology were then applied via case studies within the scope of the life-cycle of a business in Sweden, Italy and Belgium, the findings of which were used to develop the definition of a 'Fundamental Service'. Finally, based on real-life approaches to the provision of online public services for reuse by different actors, as well as suggested future scenarios, the study analysed the possibilities for the design of a cloud of public services and of the impact of offering public services in this way. The main conclusions are then presented and recommendations for future activities are made.

Service Taxonomy

Following a review of existing service definitions, the study proposed a service taxonomy based on the categorisation provided by Josuttis (2007)[3] in which services can be divided into three categories:

- Process Public Services which represent workflows or business processes, combining other services through orchestration.
- Composed Public Services are based on other services which are combined to form a new composed service.
- Basic Public Services implement basic business functionality;
  - Basic Data Services read or write data from or to a backend system.
  - Basic Logic Services represent fundamental business rules.

The taxonomy was selected as the categories provide an appropriate framework both for the establishment of a degree of granularity and for the investigation of the potential for reuse.

The study also adopted a 'life events' approach. A life event in the life of a citizen or life-cycle of a business generally requires interactions with different public administrations (e.g. on the birth of a child or at the start of a new business). In line with the service taxonomy, the entire process for the delivery of public services is supported by services that can be of the type Process Public Services, which are composed of Composed Public Services and/or Basic Public Services. A Basic Public Service can be

[3] SOA in Practice: The Art of Distributed System Design, Josuttis, N.M., (2007)

either a Basic Data Service or a Basic Logic Service. As the name implies, Composed Public Services are composed of Basic Public Services.

Service Methodology

Following a review of existing methodologies in SOA-related literature, the study proposes a top-down service decomposition methodology consisting of three steps:

- **Step 1:** Define the overall scope and life events

The focus in this study was placed on the life-cycle of a business. The European Commission has adopted a common life events approach to eGovernment services provided to businesses. 'Your Europe'[4] defines eight major groupings of life events. The involved actors were identified per life event.

- **Step 2:** Identify the laws, input and output

In the second phase, information concerning the service delivery process is analysed. A public service requires input and provides output. It also contains a certain 'logic' which is defined by rules originating in the relevant laws. The legislation defines the purpose, input and output of a service and is therefore key to defining the specific services that can be identified.

- **Step 3:** Identify services and create the service maze

The public services identified are grouped in different types, according to the service taxonomy and presented as a 'service maze'. Within this set, the services that form the 'building blocks' which support the delivery of public services related to a life event can be found at the level of Basic Public Services.

Towards identifying fundamental services

The service taxonomy and decomposition methodology were tested via case studies in three Member States within the scope of the life cycle of a business, including the life events 'Starting up,' 'Managing,' 'Expanding,' 'EU Market' 'Responsible Business' and 'Exit Strategy.' The findings of the case studies identified:

- A total of 239 services, 118 of which were Basic Data Services and 54 Basic Logic Services.

The high number of Basic Data Services highlights the fact that public administrations regularly deal with the registration of data to support the delivery of public services. Basic Logic Services, on the other hand, contain a degree of logic derived from the legislation. Many of these services are therefore 'verification' services, which verify compliance with a certain established law or rule.

Given that both data and rules (Basic Data and Basic Logic Services) are clearly essential to the delivery of public services and apparent in different public administrations across three Member States, it is at the Basic Public Service level that 'Fundamental Services' should be defined.

A 'Fundamental Service' is a Basic Public Service (both Basic Data and Basic Logic Services) that is autonomous and that is provided by a single responsible role, and receives as input only the output from Basic Data Services, documents or objects produced by citizens, businesses or administrations.

According to this formulation, the study identified a total of 172 'Fundamental Services' in the three Member States in a selected set of public services within the life-cycle of a business. Many of these services are similar in scope across the Member States investigated, i.e. they provide a similar functionality (e.g. to register a new business in the business registry), although details of each service may differ due to different legal environments and requirements for data input and output.

[4] Your Europe, European Commission (http://ec.europa.eu/youreurope/)

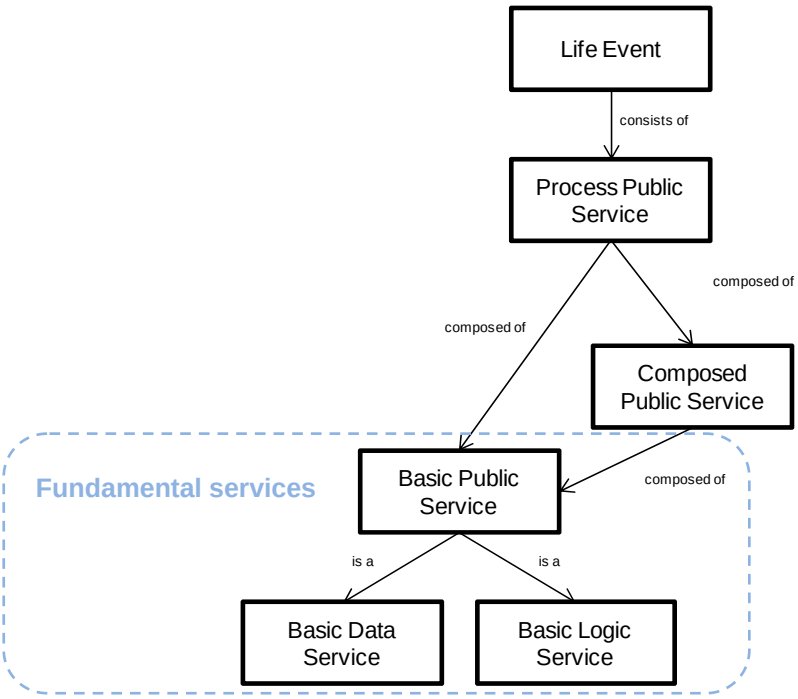

Figure 2 – Service Taxonomy

These service definitions are also in line with the recommendations put forward in the European Interoperability Framework (EIF) that calls upon "public administrations to develop a component-based service model, allowing the establishment of European public services by reusing, as much as possible, existing service components". According to the EIF, "aggregate public services are constructed by grouping a number of basic public services that can be accessed in a secure and controlled way [..] they can be provided by several administrations at any level, i.e. local, regional, national or even EU level""[5].

Reuse of public services can in principle be found at each level of services. However, the examples explored in the study demonstrate that there is a relationship between the domain specificity and the potential to reuse services. In addition, the higher the level of granularity, the more the service tends towards providing domain-specific functionality. As a general rule, there is therefore an inverse relationship between level of granularity and the scope for reuse - high level Process or Composed Public Services are less likely to be reused in comparison with Basic Public Services.

Model of a cloud of public services

Following implementation of the service taxonomy and methodology in Sweden, Italy and Belgium, a conceptual model was developed to represent the key elements in a cloud of public services. These include:

- End-user (client or web) applications which allow end-users to use services and interact with the service provider
- The collection of public services as 'building blocks,' which can be offered in an open and interoperable way and reused
- The different categories of public services - Process, Composed, or Basic (Data and Logic) Services - as defined by the service taxonomy

The conceptual model of the cloud of public services reflects the public services (as also identified in 'service mazes' in the case studies) by structuring these in layers as illustrated by Figure 3.

[5] European Commission: Towards interoperability for European public services, COM (2010) 744

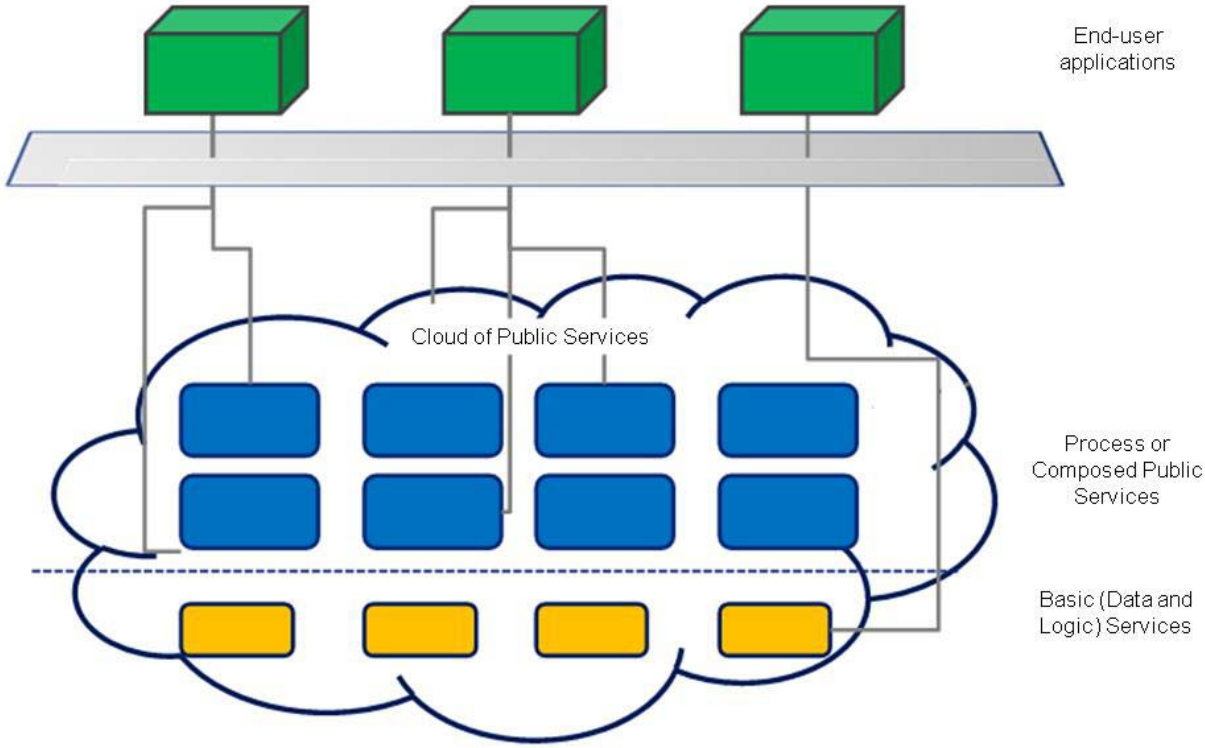

Figure 3 – Conceptual model for the design of a cloud of public services

The green boxes represent end-user applications which deliver public services to citizens and businesses. They are typically built from Composed and/or Process Services, the blue rectangles, and Basic (Data and Logic) Services or 'Fundamental Services', the orange rectangles. These are the 'building blocks' of public services, which contribute towards the fulfilment of public services for end-users.

Opportunities of a cloud of public services

Based on the conceptual model, three future scenarios were elaborated to illustrate the opportunities for public and private actors arising from the cloud of public services. The scenarios depart from the 'as is' situation, by building on existing initiatives to illustrate the potential, which can be derived from providing services in an open and interoperable way. They are:

- **Public Value Services**: The services currently provided by the eHealth platform in Belgium could also be used to provide additional services such as a Flu Prediction service;
- **Competition**: A scenario could be foreseen in which third parties, such as banks, also deliver company registration services currently provided by 'one-stop-shops' in Belgium;
- **New business models**: In the future, it could be possible for a single service provider to be authorised to carry out all activities needed to acquire permits and licences;

It should be noted that the scenarios depend on the specific context in which a new service is provided, the actual functionality provided by the available services and the creativity of service providers in combining these services to serve a specific purpose in a new context.

Prerequisites and Challenges

In addition, three real-life examples of open and interoperable approaches to public services were evaluated in order to investigate the prerequisites and challenges for the realisation of a 'cloud of

public services'. These were the Belgian Federal Service Bus (FSB), the reference architecture for the Dutch government (NORA) and German Standards and Architectures for eGovernment Applications (SAGA). The prerequisites and challenges identified included the need for:

- Open, published standards and agreements, which clearly state the ground rules;
- A service catalogue describing the available services, their content, quality and SLAs;
- Consideration of data security requirements and the establishment of trust via transparency;
- Attention to the legal implications of process redesign, political buy-in and coordination.

Migration Strategies

In order to fulfil the prerequisites and address the challenges identified, the study suggested that migration to the cloud of public services could be facilitated by using layered architecture to create domain specific clouds of public services, which are gradually integrated at a higher level. This approach would allow the service provider to start small, in cooperation with a limited set of involved stakeholders, to reduce the complexity and increase the buy-in and ability to move towards new ways of delivering services. This approach is followed by most countries where real life examples were identified, which started in specific domains to provide more open and reusable services (e.g. in the field of citizen administration, social security and business register).

Alternatively, functionality captured in existing 'legacy' systems can be reused by adding a service layer and exposing this to a cloud of public services. This approach avoids reinventing the wheel and keeps the responsibility for and ownership of services and data with the public administrations which are already in charge of these. This is likely to provoke less cultural resistance to change and keep the necessary changes to existing infrastructures and responsibilities at a minimal level.

Any strategy for migration is likely to be most effective when adopting a gradual, phased or incremental approach. Establishing a proof of concept, as was demonstrated by several examples in the study, is likely to result in the incorporation of more services over time, which could also lead to the exploration of services that can be reused at EU level in cross-border scenarios. The domain specificity of services and country-specific requirements stemming from national legislation would however also need to be taken into account when investigating the potential for cross-border reuse.

Impact of a cloud of public services

Following a review of existing frameworks, the study developed a model to investigate the potential impact of a cloud of public services. Three main high-level types of benefits were identified:

- **Efficiency**: combining services in a cloud to increase the efficiency of an existing service (time, costs, resources and administrative burdens).
- **Effectiveness**: enabling an existing service to be offered by new service providers (integrated service delivery and 'one-stop-shops')
- **Innovation**: facilitating the creation of new services by reusing already existing services in the cloud as building blocks for innovation

A series of more detailed indicators were also suggested, which characterise the main impact categories. These include: cost, time, resource and red tape reductions (Efficiency); more integrated and user centric service delivery and increased competitive advantage (Effectiveness); and the development of added-value and new services, which are secure and reliable (Innovation).

The study identified four existing examples of open and interoperable service delivery, which are comparable to the future implementation of the cloud of public services. These were the Belgian eDepot and the Crossroads Bank for Social Security (CBSS), the German Administration Services Directory (DVDV) and the Danish system for the Registration of Land and Property (eTL). Their

evaluation revealed significant positive impacts for public administrations, third parties and end-users in terms of Efficiency, Effectiveness and Innovation. Approximate

In terms of Efficiency, the eDepot for example reduces the time needed for a company to start up from 56 to 3 days, whilst the introduction of eTL resulted in annual cost savings of 70 million Euros. The CBSS and DVDV meanwhile demonstrate important Effectiveness indicators, acting as an integrated portal and one stop shop in the fields of social security and civil registration respectively. Indicators, which characterise Innovation in terms of new and added-value services, can also be observed across the two examples, with the CBSS and DVDV resulting in an improvement in both the quantity (availability) and quality (accuracy) of service delivery.

Importantly, the costs of providing public services in an open and interoperable way are relatively small in comparison to the benefits. The DVDV and eTL projects in particular display impressive returns on investment. Application of the proposed measurement framework to the three future scenarios suggested reveals a similar picture of a wide range of potential impacts.

This exercise shows that the potential benefits of delivering public services via a cloud of public services are significant and should be considered by public administrations when implementing eGovernment services. The approach allows not only for cost effective service delivery, but can also result in positive benefits for public administrations (which have the ability to reuse functionality provided by existing services for the development of new services), third parties (which, similarly can reuse existing services in order to deliver new services, thereby gaining a competitive advantage by providing better services to clients or tailoring services to a specific group of users), and end-users (who benefit from a wider choice of services which are potentially more user-centric, effective and efficient).

Conclusions

Based on application of the service taxonomy and decomposition methodology via case studies in three Member States, it is clear that this common approach can support public administrations to move towards more open and interoperable delivery of public services in a cloud of public services. A total of 239 services were identified in the case studies and interviewees from public administrations indicated that both the taxonomy and methodology provided a useful framework to investigate processes and define services that serve as building blocks supporting the process.

The move towards a cloud of public services has potentially large benefits for all actors involved, however, it also requires a certain amount of investment and poses challenges to overcome. Given the usually large amount of actors involved (e.g. different public administrations), coordination between these organisations may well represent a hurdle. The established legal framework governing the service delivery of these actors may also pose a barrier to moving towards new ways of delivering services. Therefore, changes in legislation may be needed for which political buy-in is essential. In addition, the actual take-up of services relies on the willingness of organisations and their employees to change their way of working. This human factor also needs to be taken into account.

Nevertheless, as existing examples have shown, success can be achieved by starting small and focusing on specific domains to establish a proof of concept and to subsequently expand to other domains thereby gradually providing more and more services in the cloud of public services. In addition, existing functionality captured in established (legacy) back-end systems can be made available for reuse through a service layer, thereby not reinventing the wheel and keeping established responsibilities intact. Managing the challenges successfully can result in impressive returns on investment as shown by the examples explored in the study. The Danish eTL for example reports potential savings of €70mln per year compared to a cost of €30-35 mln over 5 years, and the German DVDV reports total savings of €1mln per month compared to setup costs of €500.000. The eTL in particular illustrates that investment costs borne by the public sector can result in significant saving which are shared by the public administration (€10mln), companies (€50mln) and citizens €20mln).

Changes to the delivery of existing services can result in significant savings, but the potential for services to be reused also provides numerous possibilities for applications in a wide variety of domains (both public and private) to build on these building blocks and provide new services. Given

the possibility to make new services based on existing ones, theoretically the potential for developing new applications is virtually unlimited. The full potential depends on the level of reusability of services as well as on the creativity of service providers to build new services on top of existing ones. In this context, Web 2.0 technologies have an increasingly important role to play in the move towards 'Universal' or 'Global' SOA, which is linked to the cloud of public services concept. Indeed, Web 2.0 has been described as being about 'the entire Web being a reusable, shareable, public SOA.'[6] The future scenarios explored in this study show that the potential certainly exists and is likely to emerge more and more as more services are openly provided in a cloud of public services.

Recommendations

Given the potential impact of providing public services in line with the cloud of public services concept, notably the examples of financially beneficial investments for public administrations as well as potential benefits for third parties and end-users, it is clear that migration towards this model of service delivery is highly recommended.

In order to facilitate further exploration of the potential move towards a cloud of public services, a set of suggestions for future discussion and next steps can be made. These emerge from the conclusions of the study and are intended to indicate the potential future direction and activities:

- The concept of a cloud of public services could be further developed by broadening the scope of the analysis to new Member States or policy domains beyond the life-cycle of a business. This would complement the conclusions of this study and enable the potential for and impact of a cloud of public services to be more broadly assessed. Extension of the scope of the study would also increase stakeholder engagement and enable best practices to be recorded. Employment of the taxonomy and method proposed here should be encouraged in order to ensure consistency.

- In order to stimulate the adoption of the concept of 'cloud of public services,' a high level roadmap should be developed taking into account and integrating existing initiaves. A link should also be maintained between the ongoing ISA ('Interoperability Solutions for European Public Administrations') initiatives[7] and any future activities in the scope of this study. These include the European Interoperability Strategy (EIS), European Interoperability Framework (EIF), European Interoperability Architecture Guidelines (EIAG) and the European Interoperable Infrastructure Services (EIIS), as well as studies on Base Registries, a Catalogue of Services and the National Interoperability Framework Observatory (NIFO)

- In practical terms, a gradual or incremental approach to the migration towards a 'cloud of public services' should be taken using the strategies proposed to mitigate the prerequisites and challenges identified. The migration strategies identified could also be applied to the provision of services at the EU level. The domain specificity of services would however need to be taken into consideration when investigating the potential for cross-border reuse. This phased approach would ensure that public administrations, third parties and end-users are able to take full advantage of the benefits derived from providing the building blocks of public services in an open an interoperable way via a cloud of public services.

Discussion

In line with the recommendations of this study, interesting opportunities can be identified in order to further the development and implementation of the concept of the cloud of public services. In the domain of public services concerning business the current policy developments and efforts of the Member States pose an important opportunity to advance eGovernment services both within Member States and across borders. In February 2011 the Commission adopted a proposal for a Directive with

[6] Is Web 2.0 the Global SOA? Ria News Desk (17 February 2006)
[7] Towards interoperability for European public services', European Commission COM(2010)744 final (16 December 2010)

the aim of interconnecting Business Registers within the EU[8] while at the same time Member States are developing their Points of Single Contact in accordance with the Services Directive. Using concepts of open, clouds of public services to interconnect business registers would not only accelerate and facilitate the process in itself but has also the potential of delivering important benefits for public administrations, consumers, businesses and the public as a whole.

One could envisage the multitude of applications that could be developed by both public administrations and third parties to serve the needs of the different stakeholders such as consumers (looking for information on businesses for example to gain trust when buying products online), businesses (looking for business partners in specific sectors), as well as public administrations (such as tax and justice administrations in need of accurate business information) and others. The development of such applications would be hugely supported once electronic public services are openly provided in a cloud of public services as building blocks for reuse by public administrations and third parties alike. Starting with providing public services related to the Business Registers and further expanding to services linked to the Points of Single Contact in the cloud of public services would demonstrate the important benefits this can bring to all stakeholders involved.

The impact assessment conducted for the proposed Directive on interconnecting Business Registers has shown that the demand for these services is very real (e.g. 185 million request for free business information in the UK alone). The annual savings as envisaged in this impact assessment amount to than 69 million euro[9]. The overall impact is likely to be much larger once this objective is achieved by making the services of Business Registers in the EU available in a cloud of public services. This is an important opportunity for the EU, not only to advance eGovernment to the next level of maturity but also to bring tangible benefits to all stakeholders involved.

[8] Proposal for a Directive amending Directives 89/666/EEC, 2005/56/EC and 2009/101/EC as regards the interconnection of central, commercial and companies registers, European Commission COM (2011) 27 Final (24 February 2011)

[9] Commission Staff Working Document, Impact Assessment accompanying the Proposal for a Directive as regards the interconnection of central, commercial and companies registers, European Commission SEC (2010)