Analysis of cloud best practices and pilots for the public sector

FINAL REPORT

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Executive Summary

The objective of this study was to analyse the current **national initiatives** for the deployment of clouds in the public sector in ten Member States, to identify and describe best practice use cases and to propose pilots for those application areas where current cloud take-up is absent or however limited.

So far, in the 10 Member States covered by the study (Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Portugal, Spain, the United Kingdom), the deployment of cloud in the public sector (*at the national level*) is at a very early stage.

The Member States have taken very different approaches regarding cloud in terms of applications covered (citizen-type, employee-type, vertical, critical, sensitive), type of infrastructure (public cloud versus private cloud), relationships with e-government applications (development from scratch or just migration of existing applications), or global policy.

These approaches can be clustered into 3 main emerging models (with their own best practices) that are presented below. They differentiate mainly in the nature of the infrastructure and the level of centralisation, implying the search for a trade-off between level of control (to ensure better technical performances or security, especially when sharing data) and short-term savings.

First model: Procurement and Marketplace

The first major emerging model for cloud has a focus on the procurement of cloud solutions. Generally it consists in a procurement framework to allow easier purchase of cloud solutions and a marketplace (like Apple App Store). This model is already operational in the UK (with G-Cloud and the CloudStore), clearly considered a flagship initiative by other Member States. It is under development in Portugal and partly also in the Netherlands (in this case covering only the marketplace, not the procurement component), in both countries planned to be launched in 2014, and also some other Member States have considered this approach.

The model takes a very broad approach, covering all types of cloud applications. However, the procurement framework generally includes some restrictions (especially regarding security levels), thus limiting the possibility to develop sensitive or critical applications. Most of the applications that are purchased through such a framework are, indeed, limited in terms of features (generally horizontal applications which could be adopted by the private sector), because it is harder to have tailor-made solutions. Technical requirements associated with applications in this model are therefore more limited than in other models.

The underlying strategic concept is to focus on cost savings and improvement of the local economy through a better involvement of local cloud suppliers. The general philosophy is to turn to the market in order to achieve more cost savings, by means of external providers' applications and even infrastructure (public cloud is indeed the main model). Efficiency is achieved through standardised processes and procedures with cross administration accreditations; it is also easier to monitor in terms of actual adoption and savings targets.

Lessons from the app store model in the mass market can be expanded to the cloudstore approach. The "procurement and marketplace" model can, indeed, increase innovation though its network effects. The platform attracts more users and therefore more application developers offering more diverse applications, which in turn bring in more users. In order to ensure a sufficient number of users and developers and to generate this virtuous circle, several initiatives have been launched to attract

developers (through camps) and governmental users. The UK even developed a specific federated management structure to support the development of standards across key 'clusters of service' in order to facilitate adoption by other administrations.

The main issue associated with that model (which stopped some Member States to adopt it) is that the establishment of a procurement framework is a long process. It also needs to be repeated at regular intervals in order to comply with the general public procurement framework, which is not flexible enough to accommodate with cloud in general and the business practices of many cloud providers in particular. First, the procurement framework cannot be kept open continuously due to EU procurement rules, which implies that for example G-Cloud (and its tendering process) has to be updated every three to six months. This is obviously not well adapted to usual cloud business practices. Second, a supplier's offer must remain fixed at the time of the tender, so cloud providers have to wait for the update of the framework to be able to change their services (in order for instance to remain competitive). Finally, the traditional "pay-per-use" business model of cloud is difficult to implement in the public sector procurement framework (there needs to be a clear budget in advance, not along the way).

Another issue is that this model does not encourage sufficiently administrations to cooperate and to break the traditional silo effect. The idea is more to generate cost savings thanks to new cloud technologies (also promoted in the UK by a "cloud first" approach) rather than cultural changes. In other words, the main idea is not to reach cost savings through a better and easier cooperation between siloed administrations, which may be operating redundant operations, but to generate savings directly within each administration.

Second model: Resource Pooling

The second major emerging model involves resource pooling across administrations through a common central infrastructure and/or platform in order to deploy cloud computing. This model is already operational in Spain with numerous applications around the Sara Network and is currently in deployment in France (DILA, pilot), Belgium (Fedict) and the Netherlands (also a partly adopter of the first model). Spain is clearly the most advanced country for this model, but its developments are not really known by other countries. Some other countries could also qualify for this model (Germany with the R&D project GoBerlin, Austria with its IaaS pilots), but their projects do not have really yet the same breadth in terms of scope and ambitions.

The main idea is to get the infrastructure right first around a private cloud, which potentially allows for more developments of critical or sensitive applications. However, in reality, initiatives focus so far on IaaS solutions rather than applications. And even Spain has rolled out mostly horizontal applications (i.e. solutions addressing citizens and/or employees that are not very specific with any administration like collaboration tools or information portals). While having obviously in mind potential cost savings, most Member States involved around this model are testing the cloud technologies through their infrastructure initiatives. This leads to advanced requirements compared to the first model for scalability (with even network performances issues), reliability (though SLAs) and security.

It should be noted that an alternative approach is taken by the research and education communities in several European countries, where institutes work together and look at cloud solutions in the public cloud first (the benefits of using readily available services). When the required services are not available, or when they cannot be used due to legal considerations, community cloud services (specifically tailored to the needs of higher education and research) are implemented.

The high level of centralisation has logically some strong benefits. The common infrastructure should allow easier cooperation between Ministries and better savings

in the long term with the amortisation of the infrastructure and scale economics. It is also a good approach to tackle the biggest issues, which in the end allows for development of advanced applications. Finally, many of the countries use the centralized approach as a way to limit the financial risks for Ministries. Indeed, Ministries still benefit from cloud business models (i.e. pay per use), allowing for limited upfront investments.

The drawbacks of this model are the natural consequences of the centralization approach. The overall process is rather slow. Indeed, many technical issues related to the integration have to be solved before launching anything. In addition, the funding remains an issue for the central organization in charge, handling all of the upfront costs without a clear return, which can also contribute to a slow start. Finally, there is a higher risk of lock-in with this model if the infrastructure is handled by a third party.

Third model: Standalone applications

The third and last emerging model involves isolated standalone applications developed by Ministries on their own. There is no real central coordination in this model (even when a central policy does exist). This model is operational in Denmark and Italy and to a lesser extent in Germany and Austria (small projects like email), but also in France (Chorus) or in the UK (around NHS), in which advanced projects have been launched outside of the framework of the two first models.

The focus is generally on applications only, decided upon by the Ministries. In most of the cases, the effort is concentrated on the cloudification of existing applications (especially for horizontal solutions). Those applications may be already quite advanced in terms of features, often implying advanced requirements and need for back-up systems. The cloud adoption for these applications is clearly driven by cost savings objectives. The investments required are generally quite limited, as there is no need to start from scratch. The projects are only launched when return on investment and potential of scalability have been identified.

This model is very pragmatic and allows for faster development, at least in the short term. This is indeed the model with the most running projects so far. The effort remains moderate, thanks to previous investments and previous technical studies to tackle the main non-cloud issues. This allows also concentrating most of the efforts on the cloud migration and its specific problems (security, legal issues).

The main issue with this approach is the lack of visibility of such initiatives (as there is no global approach), which could limit the level of usage. This model also does not encourage any cooperation between administrations.

Identification of the Pilot Areas

In addition to the barriers mentioned in the description of the 3 models above, there are many barriers to cloud computing development in the public sector that would apply to all models. Privacy and security concerns are the most important barriers mentioned by Member States. There are also many financial questions, as the expected benefits remain still very unclear compared to the actual costs (like with any IT project, actual costs are often higher than anticipated costs; therefore cost savings are often smaller than expected). Many Member States implied in different models have also highlighted the lack of maturity of the technology, explaining the limited development so far of cloud. The lack of interoperability or clear SLAs is preventing faster adoption. Also data regulation is a key barrier, as many countries do not allow some data to be stored externally or to be shared between administrations. Finally, many issues are more cultural than financial or technical. It is unclear if cloud will help to really break the silo effect.

Most of the barriers would apply to any type of application moving to the cloud, with more concerns on technical aspects for critical or sensitive applications and more

issues regarding cultural changes for employee-type applications. Upcoming pilots will therefore have to try addressing those various issues.

Due to the early nature of current and even planned developments in the 10 Member States, there are plenty of potential areas for pilots related to cloud in the public sector. Pilots should obviously not tackle the few applications that are already being transferred to the cloud. Citizen portal information, email, storage, productivity tools (like CRM) and collaboration tools (including file sharing) plus trade systems to a lesser extent are already well covered by the Member States. There are also a few other solutions worth to be mentioned around tax collection, e-signature and civil registries. In general, pilots should probably not address employee-type applications, which are mostly customized versions of applications created by third party vendors and adapted to the public sector (those solutions are generally also offered to other industries).

Developments related to citizen-type applications and vertical applications, instead, remain quite limited, even if there are numerous running or planned citizen-type or vertical applications coming from e-government initiatives which could be cloudified. Those existing solutions constitute top candidates for the pilots. Among those applications, we have selected five pilot areas. The selection takes into account suggestions and remarks from Member States, the capacity of the pilot to overcome the main identified barriers and the capacity to leverage typical cloud benefits (massive usage, sharing of data and management of elastic demand).

A first pilot area would be **business portals and commercial registers**. Those are applications with potential massive usage and significant cost savings. It would somehow replicate current initiatives already in place for citizens. The set of barriers to address is relatively modest. This could serve as a first step towards other business-centric applications for specific forms, as mentioned by Germany and the UK (but without a concrete schedule).

A second area for pilots would be around **transport information services**, with car mobility information (gas prices and stations, congestions, etc…) and as complement public transport information (especially multi-modal information). This was attempted in the past in Austria but failed. There is significant elastic demand for such an application due to the very regular updates of information, which will lead to significant technical challenges, Nonetheless, there are potentially less issues regarding privacy as the service could use a more limited number of personal data.

Those first two pilots share a large number of characteristics. The services are not too difficult to develop (limited barriers). The level of innovation, therefore, is quite modest. However, such pilots would promote open e-government and still bring potential savings by relying on commodity public cloud (as they do not involve any real sensitive or personal data). Developments within a given Member State should be transferable relatively easily.

A third pilot area is the **research and education sector**. This community is actively pursuing the benefits of cloud services, as these help them to collaborate and share data across organizations and national borders. The challenges already mentioned (on procurement, marketplaces, resource pooling, interoperability, security and privacy) all are visible in the research and education sector and are being tackled through several (potentially Pan-European) collaborative efforts. These trans-national activities within a large and open, vertical community, can showcase the EC cloud strategy and emphasize the need to work on clouds on a European level. A specific area for pilots would be around **electronic student records**, as suggested by Italy in its guidelines, which would be a complement to the numerous online education and e-learning initiatives developing in the Member States. Such a pilot would tackle the interoperability of systems across the different education institutions (some of them depending from different administrations). The barriers are more likely to be technical

and cultural (to ensure the interoperability) rather than financial. There are also some privacy concerns, as some third parties should not be allowed to access those data.

A fourth and final area for pilots would be in the **health sector**. The most sensitive applications should be avoided; therefore the pilot should focus on appointment bookings and electronic prescriptions. Like for the education pilot, the benefits will come from the standardization of the systems allowing better efficiency and potential future applications on top of it. The pilot has a potential very large scope. Privacy and security will be the biggest barriers to overcome, while financial and technical barriers will remain significant.

Those two pilots also share some characteristics. They are more innovative and are harder to develop, as they involve more personal and sensitive data. Both would involve a lot of collaboration of institutions of their respective industries and also accelerate the transition to paperless administrations. This would imply potential significant cost savings compared to the two previous pilots. Nonetheless, the capacity to transfer developments from one Member State to another is limited, as there are plenty of very different national approaches to education or health. There are still niche applications that can be investigated for cross-border approach.

Solutions addressing **cross-border** concerns are obviously of high interest for the European Commission. There are plenty of interesting areas for pilots, but privacy concerns may be too important for areas dealing directly with people and their personal data (immigration systems, transport, police systems). A fifth and final area for pilot with directly a cross-border approach could be around cloud-based solutions addressing **cargo and logistics**. This industry has by nature to handle international developments. Potential applications include e-customs and e-inspection. Security remains therefore a big issue and privacy has to be taken into account. With an inherent cross-border approach, this pilot would provide more efficiency than siloed national systems and significant cost savings.

1. Introduction

This document is the final deliverable for a study to analyse best practices in the deployment of clouds in the public sector and the identification of potential pilot areas. The study is commissioned by DG CONNECT in the context of the Framework Contract SMART 2009/0042 Lot 2 and is being carried out by IDATE and Technopolis Group.

1.1 Study objectives

The main objective of this study is to contribute to an increase in the adoption of cloud-based services and applications in the public sector by enhancing the awareness on their benefits and value. For this purpose the study, on the one hand, identifies and describes best practice use cases and, on the other hand, proposes pilots for those application areas where current cloud take-up is absent or however limited.

Scope of the study is the current **national initiatives** for the deployment of clouds in the public sector in ten Member States: France, Germany, Spain, Italy, Denmark, the Netherlands, Portugal, Belgium, Austria and the United Kingdom. In the ToR the Commission informed that this selection of Member States reflects the interim results of the study SMART 2011/0055 'Clouds for science and public authorities'.

The ToR specified the following detailed objectives of the study:

1. Analyse in detail the main public authorities initiatives in the Member States for the deployment of clouds in the public sector: what are the main characteristics of the cloud infrastructures that are being selected, of the type of applications / services that are being deployed, and the rationale behind these decisions; how they are defining user requirements and SLAs, which are the main functionalities that are provided;
2. Understand how these public authorities initiatives address key concerns in the take-up of clouds such as: assist the migration to cloud computing solutions, assure data portability, overcome uncertainties in meeting compliance and audit obligations, security and privacy, etc.;
3. Analyse the type of applications that are NOT being transferred to the cloud; analyse the level of deployment of critical applications and applications dealing with sensitive data; identify the actions needed to overcome barriers and foster further deployment of these types of applications;
4. Identify a set of existing cloud implementations that constitute emerging best practice today. This set shall provide a good coverage in terms of the type of public sector applications being deployed and of their requirements;
5. Identify a set of areas where pilots could be deployed addressing new types of applications not currently transferred to the cloud and that should be promoted in order to trigger further deployment.

During the study, the focus of the objectives 4 and 5 was further specified in order to reflect and responses to the findings of this study, i.e. that Member States are at a very early stage of deployment of cloud initiatives. It was agreed that

- The examples of best practice in current deployment practices would identify the key characteristics of emerging models of cloud provisioning in Member States, i.e. what constitutes emerging best practice, and
- The proposed pilots would be a series of potential fields of application of these models in relation to the risk profiles of different cloud application and modes of provisioning

This report presents the result of the analysis in particular in relation to the emerging models and their potential fields of application.

1.2 Methodological framework

1.2.1 Methodological instruments

This study predominantly built on qualitative methodological instruments, namely desk research and interviews.

The short time frame foreseen for this study imposed a high level of efficiency in the implementation of the tasks. Desk research was therefore a critical tool and interviews were used to reach deeper insights on specific aspects, building upon and completing the information that was previously collected. Target stakeholders for the interviews were public and private players involved in public service cloud initiatives and people in charge of e-government initiatives in the respective countries. We provide a list of sources used and managers interviewed in Appendix A to this report.

Furthermore, during the interviews we took particular care to collect all information needed for the identification and description of the emerging best practices and potential pilot areas.

1.2.2 Analytical framework

A key element for this study was the categorisation of cloud-based applications and services in the public sector, grouping application and service types into three major categories:

- *Horizontal/Citizen engagement and service delivery* , i.e. applications that allow interaction between citizens and governments (information, communication, document exchange) and support the dematerialization processes
- *Horizontal/Productivity applications* , i.e. applications used by internal employees for overall management of the administrative processes, allowing exchanges with each other or with other administration departments. They may apply to any administration. Those are typically productivity applications to allow for modernization of the workplace, in line with developments in the private sector
- *Vertical applications* , i.e. applications addressing some specific needs around some vertical expertise. Those applications have often a large scope and can be accessed by internal employees, but also by third party stakeholders (suppliers, etc…) and sometimes by citizens, providing additional transparency

This taxonomy allowed us to map all applications and services into the broader categories, ranging from services to the citizen and business and services for democratic participation to back-office practices. It formed the base line for the collection of information and analysis of the initiatives and constituted the framework for the selection of the emerging best practice use cases and the identification of the pilot areas.

Table 1 Taxonomy of public sector apps fields

Horizontal/Citizen Engagement and Service Delivery	**Horizontal/Productivity applications**	**Vertical applications fields1**
Applications for citizen-government interaction	Applications for the internal management of administrative processes	Applications addressing specific needs
Accounts of different services ¶ Taxes ¶ Transactional (Payment) ¶ Online voting ¶ Web site hosting ¶ Social applications (wiki, billboards, blogs) ¶ Access to public sector information	¶ Email and communication tools ¶ Office automation ¶ Procurement ¶ HR management ¶ Virtual Desktop ¶ Records Management	¶ E-Health ¶ E-Education ¶ Energy Management/ Smart grid ¶ Smart Transport/ Intelligent Transportation systems… ¶ Urban planning ¶ Utility Management (waste, water, etc…) ¶ Smart Logistics / Intelligent Transportation systems…

1.2.3 Mapping of the cloud deployment practices and identification of models and pilot areas

The analysis leading to the identification of emerging best practices and potential pilot areas took place in two phases:

As a first step we analysed the information collected in the country case studies and mapped the current practices in the countries along the following criteria: the characteristics of the current and planned cloud computing initiatives, their objectives, the governance and organisation, the infrastructures supporting the services, and the applications and services. We provide the outcomes of this mapping exercise in Section 2, below..

In a second phase we developed a matrix for the analysis of the emerging models for deployment and pilot areas. We describe the analytical processes further in detail in the respectively Section 3 and Section 4.

1.3 Structure of the report

This draft deliverable report is set out in the following sections:

- **Section 2** – Mapping of the cloud deployment practices in the Member States
- **Section 3** – Emerging Models/best practices of cloud computing
- **Section 4** – Pilots for cloud in the public sector

[1] The focus will be later on apps like medical filing management rather than fields (like e-health)

2. Mapping of the cloud deployment practices in the Member States

In this section we describe the main initiatives in the ten Member States, including the overall cloud initiative, the cloudification of e-government activities and specific cloud applications.

- The current and planned cloud computing initiatives, including the nature of the initiatives, i.e. the approach taken in terms of central policies or strategies, the funding of the initiatives, and the current and future developments
- The objectives of the cloud initiatives
- The governance and organisation, including the articulation with e-government strategies
- The infrastructures supporting the services
- The applications and services, describing the segmentation, the main applications, and the technical operational details for the apps

2.1 Current and planned cloud computing initiatives

The approaches of cloud computing for the public sector at the central level are very different in the 10 Member States.

2.1.1 Nature of initiatives

First of all, in addition to standalone applications developed internally by some Ministries (which is the only real common practice so far), Member States have taken different roads for cloud computing.

Several Member States initiatives are more policy oriented than focused on implementation:

- The Netherlands has established a central strategy for cloud, which starts with cloud infrastructures (and datacenters consolidation) and explores potential next steps.
- In Germany, the main policy is to develop security for cloud. Therefore, Germany focus so far is on R&D projects related to the cloud rather than setting a real strategy, as cloud is not considered mature enough (for technology and security). The R&D projects do not focus anyway on the public sector.
- Italy and Austria rely so far on (non-binding) guidelines and recommendations. Italy is moving slowly to cloud due to layering of existing laws preventing the adoption of cloud, while Austria has less incentives to move to cloud due to its highly centralized nature (for which may offer minimum or no benefits).

In reality, many countries (France, Denmark, Italy, Germany and Austria to a lesser extent etc…) have no real central policies or strategies for cloud per se. The main developments are therefore coming from a few standalone applications, without a real initiative in place. They generally have nonetheless focused efforts on spreading the knowledge of the cloud in the public sector, especially regarding legal aspects. For instance, Denmark published several different guides on how to utilize cloud computing, particularly relevant is “Cloud computing and the legal framework” http://digitaliser.dk/resource/2368677.

Real implementations are concentrated around a few countries:

- The UK has gone with a global procurement framework and a store/marketplace[2]. Portugal and the Netherlands expect to launch similar solutions (for Netherlands only through a marketplace, no procurement approach). They will rely on the market as much as possible.
- Spain has developed a global strategy through a common network and infrastructure and has released already many applications.
- France and Austria are expected to launch an inter-ministry cloud. This is also the plan in the Netherlands and Belgium. The UK had a similar approach in the past, but changed radically to public cloud.
- Denmark is already quite advanced in the roll out of independent applications.

Figure 1: Mapping of cloud initiatives

Country	Nature of cloud initiative
United Kingdom (G-Cloud + CloudStore)	¶ Procurement framework + open marketplace for ICT + a few standalone apps ¶ Part of UK Government ICT Strategy
Italy	¶ Guidelines (not binding) + standalone applications
Germany (Trusted Cloud, of which GoBerlin)	¶ Research Projects (of which of marketplace) ¶ Not specific to public sector (only GoBerlin and CloudCyle)
Denmark (technical projects)	¶ A part of the e-gov initiative, but no policy per se ¶ Standalone applications (Technical projects) ¶ Part of Nordic initiative
France	¶ No central policy ¶ Standalone applications + upcoming inter-ministry cloud ¶ *Funding of Numergy and Cloudwatt by the State (but this is not at all specific to the public sector)*
The Netherlands (Cloud Strategy for the Central Government)	¶ Strategy with an emphasis on infrastructures (intra-government) and rules for implementation and additional steps (marketplace and, later, applications) ¶ Currently (2013) development of a marketplace ¶ Integrated with Digital Agenda ¶ (Also a strong collaborative 'cloud first' effort in the higher education domain)
Portugal	¶ Framework for procurement in development ¶ Investigation for Go-Cloud (Government Open Cloud), offering shared cloud services platform
Spain	¶ A central network evolving toward a cloud computing platform ¶ Integrated in a 2011-2015 cloud computing plan ¶ Multiple applications currently operational in the cloud platform ¶ As a part of the strong eGov policy
Belgium	¶ An e-gov strategy including a cloud computing strategy ¶ Development of a IaaS platform
Austria	¶ A white paper describing the strategy and an analysis of cloud potential in Austria ¶ IaaS inter-ministry cloud

[2] A marketplace or a store is a platform centralizing all applications that are provided by various stakeholders

2.1.2 Funding

All those initiatives remain relatively modest so far, as seen with the limited funding allocated to cloud developments.

Figure 2: Mapping of funding for cloud initiatives

Country	Funding
United Kingdom (G-Cloud + CloudStore)	¶ £15.5 million for the whole program
Italy	¶ No funding for cloud initiative ¶ Around 6 million EUR for M@E Cloud and 2 million for DT Cloud
Germany (Trusted Cloud, of which GoBerlin)	¶ 100 million EUR (of which half from BMWi), of which 5 million for GoBerlin (the other 95 million EUR are allocated to cloud projects but not specific to the public sector)
Denmark (technical projects)	¶ 44 million EUR for digitization initiatives (no details for cloud)
France	¶ No dedicated funding for apps ¶ Inter-ministry cloud will be charged pay per use to other ministries
The Netherlands (Cloud Strategy for the Central Government)	¶ Funding of implementation comes from the ICT budget of individual ministries (funding of strategy and coordination comes from the Ministry of the Interior and the Ministry of Economic Affairs)
Portugal	¶ N/A
Spain	¶ Funding from the Ministry of Finance for IaaS and SaaS development initiatives ¶ Pay-per-use model for the SaaS applications currently operational
Belgium	¶ No concrete funding for the moment
Austria	¶ 40 000 € each procurement cost, for the current IaaS project. Funding come from the Federal computing centre of Austria (BRZ)

2.1.3 Current and future developments

In most countries, cloud computing is far from being implemented. The real operational solutions come from the UK with the CloudStore, and several service deployments within education, the higher education community in the Netherlands with joint procurement efforts and a middleware infrastructure to interconnect cloud services, cloud service deployments within the education domain in the Nordic countries and a few standalone applications in France, Spain and Denmark, with a significant number of applications coming from the cloudification of existing e-government services.

Real pilots (with the exception of Spain) are still relatively rare while there are more projects under investigation or under developments.

Figure 3: Mapping of level of development of cloud initiatives and cloud applications

Under investigation	Under development (but still not available)	Pilots	Operational
¶ **AppStore (the Netherlands)** ¶ **Guidelines (Italy)** ¶ **Pilot projects (Italy)** ¶ **GOV.UK (UK)** ¶ **BundOnline (Germany)** ¶ **Civil Registry (Italy)** ¶ **Go-Cloud**	¶ M@E Cloud (Italy) ¶ GoBerlin and CloudCycle (Germany) ¶ Nordic initiative (Denmark) ¶ Central private cloud (the Netherlands) ¶ Inter-ministry cloud (France) ¶ A few DILA applications like	¶ *Univ Cloud* and other undisclosed DISIC projects (France) ¶ DT Cloud (Italy) ¶ Inventory, secretary affairs management (Spain) ¶ Automatic translator platform (Spain) ¶ Inter-administration communication platform (Spain)	¶ G-Cloud+CloudStore (UK) ¶ Chorus (France) ¶ NemHandel, Borger.dk, Digitaliser.dk and Miljoportal (Denmark) ¶ Service-Public.fr (France) ¶ A few DILA applications like

Under investigation	Under development (but still not available)	Pilots	Operational
(Portugal) ¶ **Fedict IaaS service (Belgium)** ¶ **eMail for the administration (Austria)** ¶ **Data cloud storage (Austria)** ¶ **eGov applications cloudification (Austria)**	Official Journal (France) ¶ Some UK applications (HMRC, Health) ¶ Framework for procurement (Portugal) ¶ Monitoring of ICT indicdents and office materials usage (Spain)	¶ IaaS inter-ministry cloud (Austria)	BOADCC (France) ¶ Generic platform for administrative procedures and registration applications (Spain) ¶ Document management system and e-signature platform (Spain) ¶ E-Invoicing platform (Spain) ¶ Many email solutions (several countries)

Spain stands out with many future application developments. Plans for cloud are becoming progressively more ambitious in a few other countries with inter-ministry clouds expected to be launched by DILA in France, the Belgian shared infrastructure or the framework procurement in Portugal. Developments in some countries like Denmark and the Netherlands are also being postponed due to budget cuts.

Figure 4: Planned developments for cloud initiatives

Country	Planned developments
United Kingdom (G-Cloud + CloudStore)	¶ Upcoming new version of G-Cloud, running until mid-2014 ¶ Slight modifications of Cloud Store
Italy	¶ Additional recommendations for datacenters in 2013 ¶ M@E Cloud running by late 2013
Germany (Trusted Cloud, of which GoBerlin)	¶ Pilots until early 2015
Denmark (technical projects)	¶ N/A
France	¶ POC from September 2013 ¶ Other developments depending on pilots results
The Netherlands	¶ A central private cloud (2013/2014) and an app store (2014/2015) ¶ A flexible timeframe for launching applications (partly depending on the app store)
Portugal	¶ Implementation of the framework for procurement in 2014 ¶ Go-Cloud (still in stand by)
Spain	¶ All common IT services and applications expected to be cloudified by 2015 ¶ 6 more applications will be cloudified by the end of 2013 ¶ On-demand storage capacities will be rolled out in 2013 ¶ On-demand calculation capacities will be rolled out by 2015
Belgium	¶ Currently choosing a cloud service provider ¶ Contract will be awarded in autumn 2013 ¶ Infrastructure available early 2014
Austria	¶ Update of the white paper defining the cloud strategy in autumn 2013 and will continue in 2014 ¶ eMail, data cloud storage and eGovernment applications cloudification are expected but without concrete schedule

2.2 Objectives of cloud initiatives

Almost all Member States have set the objective of *cost reduction* with cloud computing. For the UK, savings would come essentially from procurement and more competition between vendors. Savings are anyway expected by many Member States benefiting from virtualization of computing resources and renting business models usually available through cloud vendors.

Germany totally stands out here, as the current initiative has no target regarding savings. Cost reduction is not really the main focus also for some other countries like France or Austria (at least within its IaaS pilots for which cost reduction is not key, in contradiction with the whitepaper).

Indeed, for these three countries, the priority is more on the *technology developments* around cloud computing. In Germany, Austria and the Netherlands (or France to a lesser extent with virtualization), there is a stronger priority to have more mature cloud technologies, as they appear not secure enough and not reliable enough. France and the Netherlands want also more standardization, which would help to reduce the development costs and decrease dependency on individual suppliers of hardware, software and services.

While the *improvement of public sector services* (existing services or development of new services) is often seen as an objective, it is rarely a top priority. This is reflected by the fact that most cloud-based services are indeed cloudified versions of existing e-government services.

Indeed, a better collaboration between different administrations sharing data and resources is considered as important as services improvement. The pooling of resources could also come from central initiatives trying to consolidate the number of datacenters and servers, as in France, UK or the Netherlands.

Finally, for a few countries like UK, Portugal and Germany (and to lesser extent France), cloud is also used to develop its local industry (with mostly SMEs).

Detailed view per country is available in Appendix C.

2.3 Governance and organisation

2.3.1 Organization around cloud

The standard practice for cloud initiative tends to be a strong separation between the strategy and the implementation (Belgium, Italy and Denmark being more the exceptions and involving anyway at least relevant Ministries). The strategy is generally highly centralized through a dedicated organization created specifically for cloud (UK) or in organizations in charge of other IT strategies or Information systems.

The implementation is more decentralized, generally involving directly the appropriate Ministries. UK stands out here with the federated management structure approach. There is some form of centralization in several Member States, for very different reasons. In the Netherlands, the Ministry for the Interior aims for centralized coordination of cloud developments, in close collaboration with the Ministry of Economic Affairs, the Ministry of Justice and the ICT departments of all ministries.. In France, one entity is developing the inter-ministry cloud as a central (virtualized) infrastructure to be used by all Ministries.

Detailed view per country is available in Appendix C.

2.3.2 Articulation with e -government strategies

There are strong links so far between e-government and cloud, at the organization level or at the deployment level.

The overall organization and split between different administrations often reflects the organization already in place for e-government developments, like in Germany. It is even the same organization that is in charge of both cloud and e-government in Denmark, the Netherlands and to a lesser extent in France and Italy.

Cloud is often a subset or sub-objective of the e-government strategies. UK stands out with "cloud first" approach that encourages administrations to consider cloud before other solutions when acquiring new IT/software solutions. Italy is claiming to have a similar approach.

Finally, many of the applications really deployed are cloudified versions of existing e-government services. Nonetheless, most of the countries have no plans for full cloudification of e-government applications .The plan is first to digitalize most of the application while considering cloud as a way to reach the objective.

Detailed view per country is available in Appendix C.

2.4 Infrastructure supporting the services

There is no standard approach for cloud infrastructure, even for potential similar projects. A few countries are clearly favouring private cloud to keep full control of developments, while other turned to public cloud to get more cost reductions. Indeed, public cloud consists in outsourcing the IT infrastructures to an external provider. It is therefore not necessary to invest in specific infrastructures. In addition, as the service is usually billed on a pay-per-use basis, the total cost of ownership is globally reduced.

Figure 5: Infrastructure associated with cloud initiatives

Country	Private cloud	Public cloud	Remarks
United Kingdom (G-Cloud + CloudStore)		X (Microsoft Azure hosting the CloudStore)	initial plan of private cloud given up in 2009
Italy (DigitPA)	X (M@E, DT Cloud)		Recommendation in guidelines to use private and community cloud
Germany (Trusted Cloud)	X	X (GoBerlin)	Will depend on project Avoid non local players like Google and Amazon
Denmark (technical projects)		X	
France	X (Hybrid for inter-ministry cloud)	X (Service-public.fr)	
The Netherlands	X (project, using current infrastructure)		
Portugal	X	X	Will depend on the application type
Spain	X		
Belgium			No specific configuration chosen for the moment
Austria	X		Public cloud could be good for cross border around commodity solutions

2.5 Applications and services

2.5.1 Segmentation of applications and services

There is no major trend in the type of applications covered in cloud initiatives, as opposed to e-gov initiative in which the applications are mostly citizen-oriented (such as application forms, civil registry, eHealth portal …) among other applications like business-oriented applications. The most common cloud applications relates to portal information (often already existing as part of e-government) and to transactional/tax/payment solutions, in addition to usual email applications.

There are also many initiatives involving the IT infrastructure in terms of mutualisation[3] and sharing that are being developed. In addition, the UK operational marketplace, which is seen as a best practice, has created strong interest in Germany, the Netherlands and Denmark.

Almost none of the cloud applications are critical applications (for a few type countries, there should not be any), while only a few of them handle sensitive data (mostly around health).

Figure 6: Mapping of current and planned cloud applications

Country	Citizen engagement and service delivery	Horizontal and productivity applications	Vertical applications	Other type
United Kingdom	*Web hosting, tax collection, social media management,*	*Emails, CRM, ERP, virtual desktop, procurement, collaboration in education, communication, customs and tax productivity*	*Patient data management, web hosting for health responsibility deal*	*Marketplace*
Italy	Civil Registries			Guidelines, *IT resources mutualisation, Infrastructure virtualisation*
Germany	*Portal information*			*Marketplace, Framework*
Denmark	*Environment portal information , Portal information*		*Transactional (Billing)*	
France	*Portal information for legal information and procedu re routines*		*Transactional (Billing)*	*IT resources mutualisation, Infrastructure sharing*
Netherlands				*Marketplace [2], Infrastructure centralisation [2]*
Portugal	*Portal*	*Email, File sharing, Storage, ID*		*Procurement framework*

[3] Mutualisation of infrastructures consists in gathering powerful infrastructures in the same place (datacenter) and reducing the number of small infrastructures in multiple places. The mutualisation allows reducing costs as the centralized infrastructures do not require multiple maintenance teams, and require smaller spaces.

Country	Citizen engagement and service delivery	Horizontal and productivity applications	Vertical applications	Other type
		management, HR, Financial Management, Patrimony Management		
Spain	*Application forms delivering and e-signature [1], URLs Shortener [1]*	*Inter - administration communication [2], inventory [2] and office materials usage management [2], implementation of citizen administrative procedures [1], eMail [1], eInvoic ing [1], translator [2], Administrative resources management [2]*		*ICT incident management*
Belgium	-	-	-	*Inter -ministry Cloud*
Austria	-	-	-	*IaaS inter - ministry cloud*

Legend: Applications as part of cloud initiative are in italics in the table below, those from e-government bold and those not integrated in any national initiative remain with normal style.
[1] application currently provided in the cloud
[2] applications that will be provided in the cloud in 2013 or 2014

Detailed view of applications per country is available in Appendix C.

2.5.2 Technical operational details for apps

The major requirements cover privacy and security, regarding to the data protection and also the necessity to have a back-up system to avoid data loss. A few applications require some specific performances regarding the network (bandwidth and/or latency).

SLAs are often being defined around the apps already deployed, even though there are not enough details to comment. Applications already deployed have in majority not waited for international standards for roll out.

Detailed view per country is available in Appendix C.

3. Emerging models /best practices of cloud provisioning

In this section, we present the three main models of cloud adoption in the public sector for the 10 Member States analysed in the studied. For each model, we provide a short description, analyse its key characteristics, present a few emerging best practices and develop the specific barriers.

We introduce this Section with a short description of the process underlying the identification of the models.

3.1 Introduction: methodological approach

The analysis conducted in the first phase of the study shows that Member States have taken sometimes very different approaches when addressing cloud and applications. It is then logically difficult to compare them, as the nature of the cloud current and planned developments are quite different.

AS objectives and barriers are very similar, the cloud initiatives are characterized in particular through four main elements:

- **The type of cloud services that are addressed**. Many Member States do not address yet applications per se (i.e. SaaS) and focus on IaaS or PaaS solutions, which are obviously less specific.
- **The nature of the cloud infrastructure**. There is a strong debate on which type of infrastructure should be used (private or public). Some Member States are reluctant to use public cloud solutions, at least for all data that is not in the public domain (indeed, despite promoting private cloud approach, France uses public cloud for its citizen information portal), due to the lack of control of the data (security issues, privacy issues, etc…). Other Member States are favouring a public cloud approach to optimize potential savings.
- **The type of applications that are covered by the cloud initiative**. While some initiatives have by nature a broad scope and therefore address almost all types of applications, other are focusing on the "easiest" applications with horizontal applications (targeting employees and citizens or businesses). Critical and/or sensitive data centric applications are rarely part of a global approach.
- **The link with initiatives and applications already in place** like e-government initiatives. Indeed, a cloudification of existing (e-government) applications can be faster and cheaper than developing from scratch.

We used the matrix shown in Table 2 to characterize each of the Member States (matrix for each Member State is provided in Appendix) along those criteria regarding their current and planned cloud developments.

Based on the analysis of the 10 Member States profiles, we have isolated **three main emerging models of cloud development for the public sector**. The models are described below in more details.

Member States initiatives may fall into one or two models as they may indeed combine different approaches for cloud in the public sector.

Table 2 Matrix for the identification of emerging models/best practices

		Applications			
		Citizen-type (Gov-Business; Gov-Citizen)	Employee-type (Gov-Gov)	Vertical/Specialized (All types)	Critical or sensitive
Level of cloudification	Individual applications (SaaS)				
	Platforms for developing, delivering and using applications (PaaS)				
	Computing power, Databases and basic storage (IaaS)				

Private Cloud
Public Cloud
Any type or not determined

Current	**Bold font**
Future	*Italic font + dots + lighter colour*
Cloudification of existing apps	Underlined

Arrow : links between the initiatives

3.2 First emerging model/best practice: Marketplace and Procurement

3.2.1 Model description

In this first model (see Table 3), **the approach is very centralized and top-down, but only for procurement aspects**. The main idea here is generally to simplify procurement for cloud services and then in a second step to provide a marketplace leveraging the procurement framework.

At the same time, **the model can be seen as involving bottom up approaches regarding application development and adoption**. Ministries are free to use or not the CloudStore and can acquire available applications rather than require specific applications to be developed.

3.2.2 Main countries concerned

Key countries that are concerned by this model are the **United Kingdom (G-Cloud and CloudStore) and Portugal, and partly the Netherlands**. Other Member States have mentioned following the flagship development of the UK with the CloudStore and may in the long term adopt a similar approach. Belgium also expressed an interest but gave up because of procurement rules (see below in barriers section for more explanations).

Table 3 Emerging model/best practice: Marketplace and Procurement

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="4">Applications</td></tr>
<tr><td>Citizen-type (Gov-Business; Gov-Citizen)</td><td>Employee-type (Gov-Gov)</td><td>Vertical/Specialized (Gov-Citizen)</td><td>Critical or sensitive</td></tr>
<tr><td rowspan="3">Level of cloudification</td><td>Individual applications (SaaS)</td><td colspan="3" rowspan="3">Marketplace and Procurement</td><td></td></tr>
<tr><td>Platforms for developing, delivering and using applications (PaaS)</td><td></td></tr>
<tr><td>Computing power, Databases and basic storage (IaaS)</td><td></td></tr>
</table>

3.2.3 Key characteristics

Within this model, the idea is generally is to address all types of cloud services, both in terms of target users and cloud level (the CloudStore even includes training type services, which represent the majority of the spending so far). Nonetheless, critical applications and sensitive data-centric applications are de facto excluded from such approach, through requirements generally expressed in the procurement framework.

This model relies mainly on **external providers** developing applications that can be adopted by various Ministries. Therefore, the model is more likely to be based on **public cloud solutions**, especially if a marketplace is implemented (private cloud remains an option if there is only procurement), and vertical solutions are in reality still marginal (as such solutions require generally more tailor-made solutions). The applications are likely to be more basic than in other models. Technical requirements

concentrate therefore more on data protection, privacy and security than on anything else.

Also, as a consequence of this model, **applications tend to be rather new applications than cloudification of existing applications**, which limits the efforts in terms of legacy migration.

Funding itself remains quite limited to implement it, but there are significant legal additional steps to prepare the framework.

Cost savings is by far the main objective of such an approach, even if there are no clear targets for savings. The idea is also to have some economic impact beyond the public sector by developing the local economy and allowing (local) SMEs to be involved more easily into IT purchase by the public sector.

3.2.4 Some emerging best practices associated with the model

Only the UK has already formally launched its Cloudstore, although very recently, while Portugal and the Netherlands are still in the designing process of their own marketplace and in the case of Portugal, also common procurement. Therefore, most of the lessons learnt for this model are inspired by the UK model.

The UK approach is interesting in that it is based on a **Digital by default policy** with a move of all public services online. It also includes a cloud first approach for the procurement of these services whenever cloud services are available and fit their needs. These principles give a strong basis for cloud deployment and uptake of cloud computing services.

The governance is key in this model, because of administrations pooling their resources together to adopt a common framework and marketplace. In the UK, the Cloudstore has a national scope and target all public administration users, including central and local public authorities, Police, National Health security (NHS), education and charities. **A Federated management structure with seven Foundation Delivery Partners** (FDP) recruited across UK public administrations is responsible for G-Cloud standards and approaches across key clusters of services, building on the existing competencies across public administration. **Additionally, the accreditation of services sold on the Cloudstore is pan-governmental.** However, if the governance is centralised, the approach is bottom-up, with a view to get buy-in and change mind set in the public sector. It is left to each public administration to decide on the uptake of cloud and to select which services they are going to buy or not from the CloudStore.

Furthermore, a marketplace approach also requires **standardisation in processes and procedures.** In the UK, the selected services are included on the G-Cloud Services Framework Agreement concluded between the Cabinet Office and each individual supplier. This allows standardisation in rules and processes to be followed by each CloudStore suppliers. Additionally, every time a public body buys out from the CloudStore, it concludes a call-off agreement with the cloud service providers. A standardised call-off agreement has been made available to public customers of cloud services, in appendix to the G-Cloud services Framework Agreement.

Case studies highlighted several good practices to change mind set and address the cultural barrier. In Portugal, a national consensus to the use of cloud computing has been created, to explore the possibilities and anticipate reluctance from users. In the UK, a propagation team within the G-Cloud team has been tasked with engagement and awareness raising activities. These include specific support whenever required and a system of specific training session – or Camps: ApplyCamps and AccreditCamps are offered to suppliers wishing to apply and get accreditations for their services in the CloudStore, while BuyCamps are for UK for public sector authorities who want to purchase services.

Another emerging best practice element of the Procurement/Market place model is that it not only allows for increasing efficiency (with a large number of public

organizations and application providers using one platform) but also **for increased innovation**. As the platform attracts more users and service/application providers, the platform becomes interesting for both types of actors (cf. network effects). This holds especially when the functionalities and standards of the platform strike the right balance between safeguarding interoperability, privacy, security, etc. and providing room for innovation. Note the parallel with Apple's iStore and Google's Android platform. The two main benefits could lie in an increased number of useful applications that are either cloudified or that are developed cloud-first, and applications being used by a variety of ministries, local governments, public agencies, etc.

Last but not least, the issue of the real cost of cloud computing for the public sector was questioned by many of the interviewees who inputted this study. A good practice in setting up a marketplace and framework pilot is to establish the **necessary tools to set and monitor realization and savings targets** (so far, the monitoring is still basic with aggregated numbers regarding overall spending on the CloudStore, but not on savings) , with a view to monitor development and communicate on results.

3.2.5 Main specific barriers of this model

It stands out from the case studies that **establishing the procurement framework is rather a long process** and requires regular updates to comply with general public procurement framework, which might impede the flexibility of the common framework used for cloud procurement. The procurement framework cannot be kept open continuously due to EU procurement rules. Therefore, G-Cloud (and its tendering process) has to be updated every three to six months[4]. This is obviously not well adapted to cloud usual business practices. Indeed, a supplier's offer must remain fixed at the time of the tender. Cloud providers have to wait for the update of the framework to be able to change their services (in order for instance to remain competitive). Also, the traditional "pay-per-use" business model of cloud is difficult to implement for the public sector procurement (there needs to be a clear budget in advance, not along the way).

Beyond data protection and security, **the ability to change the culture of government departments is one of the main challenges in a marketplace model**, since cloud deployment is driven centrally and not piloted by a specific administration. The existing silo processes in the way IT functions are developed and duplicated between different departments are as many barriers for the deployment of cloud in the UK public sector. Departments are used to buy their own bespoke services as individuals and they do not cooperate or share solutions with one another. The Cloudstore is therefore as much about the adoption of new technologies than about a change in behaviours in how ICT functions are delivered inside each department.

Suppliers' engagement is also one of the main risks in a marketplace approach. Establishing a marketplace requires to have not only sufficient demand but also sufficient offer of services. Some suppliers might also worry about specific requirements in terms of data protection, security and transparency that are of prime importance for public sector clients.

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[4] G-Cloud : "By law a supplier's offer must remain fixed a at the time of the tender i.e. services cannot materially change. But, the cloud market moves on and suppliers need to change regularly their services to remain competitive and update to the last changes. There is no fixed frequency of framework realise but the UK government estimate that the pace of market change justified a new framework every three to 6 months. Suppliers can only apply to be on G-Cloud when each framework is released. "

See more on http://gcloud.civilservice.gov.uk/applying-to-g-cloud/

3.3 Second emerging model/best practice: Resource Pooling

3.3.1 Model description

In this second model, the approach is also relatively top-down. **Resources are pooled to provide a common platform and/or infrastructure that can be leveraged for IaaS (standard) services and for more specific applications by Ministries**. They are fully in charge of their own application development/purchase.

Table 4 Emerging model/best practice: Resource Pooling

		Applications			
		Citizen-type (Gov-Business; Gov-Citizen)	Employee-type (Gov-Gov)	Vertical/Specialized (Gov-Citizen)	Critical or sensitive
Level of cloudification	Individual applications (SaaS)				
	Platforms for developing, delivering and using applications (PaaS)				
	Computing power, Databases and basic storage (IaaS)	Shared infra			

3.3.2 Main countries concerned

Key countries that are concerned by this model are France (with its on-going development inter-ministry plan, even if France also falls into the third model for other initiatives), Spain (SaaS and IaaS developments around the Sara Network), Belgium (Fedict cloud) and the Netherlands. Except for Spain, none of those projects are already enabling real-life applications.

A few additional Member States could also be considered for this model even though their approach is not as large for now. Germany's GoBerlin could also fall into this category, despite being more limited in terms of scope (only citizen-type services around information exchange among various administrations in the case of a citizen relocation) and being more R&D rather than real life implementation. Austria is also considering that its IaaS pilots could serve later as common infrastructure for various application developments. But it looks more a like test for now rather than a full strategy.

There is no real flagship development used as a benchmark by other Member States, despite Spain being clearly more advanced than the other countries, with around 10 running applications on top of its infrastructure (ranging from forms and document management systems to e-signature and e-invoicing, and also translation tools or URL shorteners). It should be noted that the UK had initially similar plans but chose to focus on the marketplace. Portugal is also investigating such an approach, but most of the effort is so far on the procurement framework.

3.3.3 Key characteristics

In most of the cases, this model is based on a combination of IaaS services supporting SaaS applications. The idea is to use a common infrastructure (which also involves some datacenter consolidation) across different governmental entities through a private cloud. Ministries are supposed to develop their own applications thanks to the infrastructure. Reusing existing e-government applications is not generally mentioned, as **most of the Member States focus first on the infrastructure**.

Thanks to the **private cloud approach**, there is more potential for development of critical or sensitive data-centric applications. But such developments remain relatively rare so far. Indeed, the focus is generally more on horizontal applications (citizens, employees) which can be shared more easily across Ministries than vertical applications. Main applications are so far about administrative procedures, forms, messaging and invoicing.

Centralization is logically quite strong in terms of governance and funding. This model is likely to be the one requiring the biggest budgets.

Even if cost savings is still a key objective in most solutions of the model, **it is often not the prime objective**. **Technology development (virtualization in French projects, security in German projects including GoBerlin) and testing** regarding a wide range of characteristics is indeed as important. As a consequence, other traditional objectives with cloud have also limited importance (development of the local economy, improvement of services).

Requirements tend to be significant especially in terms of reliability (with SLAs) and security. This is logical for an approach that is more infrastructures oriented and relies on a common platform, and therefore with potentially bigger impacts of eventual security/privacy incidents.

3.3.4 Some emerging best practices associated with the model

It is hard to really isolate best practices for this model, as most of the solutions are not yet operational (nor even pilots); Spain being the exception so far, with a clear schedule for roll out of applications.

The funding in this model generally stands out. In many countries (France, Belgium, Spain to a lesser extent), a central entity is indeed making the infrastructure (the Sara Network in Spain) investments and get paid on pay per use basis by Ministries when they need resources. Ministries are seen as customers. This should allow all Ministries to get scale economics and strong security/privacy levels.

Another key positive element of this model is that there should be **easier cooperation between Ministries**, as they leverage the same infrastructure. Applications and even data could be made available from a Ministry to another. This could help to break the “silo effect”, which often impedes some developments. Nonetheless, there is no real advanced cooperation so far.

Another emerging best practice for the Resource polling model is **achievement of cost savings** because a range of public organizations can use the same, shared infrastructure. To achieve cost saving, central coordination is a prerequisite. For example, when one or two ministries or specialized ICT agencies coordinate the national cloud infrastructure (IaaS), other public organizations benefit from scale advantages, instead of reinventing the wheel or having limited bargaining power vis-à-vis ICT suppliers. Interviewees mentioned how national coordination is more contested in a Procurement/Market place model. For example, application development/procurement by local governments and specialized public agencies will be constrained by technical, regulatory, financial and other restrictions in the Procurement/Market place model.

Although there may be a risk-averse element to it, there is a best practice element in the step by step strategy of countries such as France, Belgium, the Netherlands and Spain. These countries try to **get the infrastructure right** (IaaS) and address a number of valid concerns that are relevant for a platform (PaaS) and for a range of applications. For example, privacy and security concerns are relevant for nearly all applications (taxation, registries, transport, health, education, etc.). Note that applications that fall under the responsibility of public organizations are different from entertainment applications where a trial and error approach is more appropriate. Moreover, financial budgets have become tighter across Europe, which provides a rational for starting with shared infrastructures that will most likely lead to cost savings.

3.3.5 Main specific barriers

The implementation of common resources and infrastructures raise multiple issues directly linked to the purchase, the choice and the integration of the common IT equipment or to the choice of a service provider.

The integration of such infrastructures in a generally complex IT system requires overcoming technical barriers. The technical interoperability of the services rolled out on this infrastructure with the existing internal IT services is usually necessary even if it may be impossible technically. In order to overcome this barrier, a careful study of the potential hardware and software solutions has to be done by the public entity. Moreover, in the case of the use of an external service provider (for the support or the maintenance for instance), some providers can create a lock-in effect avoiding the technical interoperability and favouring the provider's solutions. Making the infrastructure right first implies generally a slower roll out of applications. In addition, the cloud infrastructure may involve various cloud providers and therefore still raise some interoperability issues.

In addition, the definition of an appropriate Service Level Agreement (SLA) is necessary in order to establish a legal framework for the service between the customer and the provider. But such an SLA can be hard to define as the customer may have specific requirements that cannot be fitted by the provider (usually because of technical constraints).

In the end, **the roll out of large infrastructures can be very expensive**, especially in difficult global economic conditions for the countries. However, such initiatives may have an important return on investment, allowing reducing IT costs despite higher upfront costs.

3.4 Third emerging model/best practice: Standalone applications

3.4.1 Model description

This third model is about standalone applications deployed pragmatically by Ministries. This is generally not really coordinated, even when some form of central policy/strategy does exist.

This is a pure bottom-up model. In most of the cases, Ministries develop their own solution.

Table 5 Emerging model/best practice: Resource Pooling

		Applications			
		Citizen-type (Gov-Business; Gov-Citizen)	Employee-type (Gov-Gov)	Vertical/Specialized (All types)	Critical or sensitive
Level of cloudification	Individual applications (SaaS)	E-Gov Cloudified	E-Gov Cloudified		
	Platforms for developing, delivering and using applications (PaaS)				
	Computing power, Databases and basic storage (IaaS)				

3.4.2 Main countries concerned

Key countries that are concerned by this model are Denmark (several projects around statistics, information portal, environment portal), Italy and for part of its activities France (Chorus, a billing project, but also an information portal) or the United Kingdom (various projects, including one around health with NHS). To a lesser extent, Germany and Austria are also concerned, even though only around more basic applications (e-mail, cloud storage, information portal), that can leverage commodity cloud solutions.

Denmark is the most advanced country for this model among the ten Member States studied.

3.4.3 Key characteristics

In this model, **the focus is mostly on SaaS**, i.e. applications themselves. Often an external third party operates the infrastructure. **Most of the applications rely therefore on public cloud solutions.**

Many applications, at least for horizontal solutions, are **cloudification of existing e-applications**, which can also limit the investments. The applications tend to be more advanced than in the first model or even for now than in the second model. They have therefore more requirements in terms of performances, back-up systems, reliability and scalability, standards or SLAs in addition to the usual security and privacy requirements.

The lead is mainly coming from Ministries themselves; therefore **most of the funding is decentralized.** Most of the applications have a budget of a few million euros.

Compared to the other models, most of the applications are already running or at least at the pilot stage.

Like for the marketplace/procurement model**, cost savings is the main objective**. The impact on the whole economy is clearly less important, as the applications are clearly focused on very specific applications. The improvement of services is a more a secondary objective, due mostly to the cloudification nature of the existing applications**. The migration (rather than developments from scratch) also allows testing specific issues like security and legal aspects (as mentioned by Denmark in interviews)**.

Like for the previous model, there is also generally a willingness to develop some form of resource pooling, but generally mostly through datacenter consolidation.

3.4.4 Some emerging best practices associated with the model

The approach is obviously very pragmatic compared to the other models, allowing faster development. Except for Spain**, this is indeed the model with the biggest number of running projects**. Ministries that have identified projects offering strong return on investment and/or better scalability with cloud can move without waiting for a framework/infrastructure. Very significant cost savings have indeed been obtained with the existing deployments.

Also, this model has allowed developing more specialized applications (generally more vertical) and applications involving more security stakes due to the better control by the leading Ministry (environment in Denmark, finance in France, expatriates in Italy, health in the UK) . Thanks to this approach, countries have therefore often gone further to test security and legal issues more pragmatically.

Cloudifying existing applications rather than starting from scratch finally limits the financial investments and the necessary technical studies to the minimum. Indeed, many issues related to IT developments are often not technical but related to the right definition of user needs and requirements, which could have therefore been already defined earlier in the case of existing applications (like information portals or email solutions, but also like the various financial systems like Chorus in France or NemHandel in Denmark). The effort is therefore limited to the migration to the cloud.

3.4.5 Main specific barriers

Standalone applications development seems to raise non-technical barriers, in addition to privacy and security, mentioned in some countries' profiles.

The main barrier is the potential lack of visibility of such applications that may limit its usage**. Some countries have mentioned their concerns regarding the creation of a useless cloud service because of a lack of users**. It is indeed difficult to make a standalone application visible when it is not part of a global strategy or a global platform. It requires a lot of efforts to make it visible.

These applications may require the involvement of multiple departments of the administration, as it can be a "horizontal" application with exchange of data between departments. The cooperation can, however, be difficult as many of the administration departments are organized in "silos" and are not used to cooperate and to exchange data together. This model does not encourage any cooperation between Member States, implying that cultural barriers will remain high.

Moreover, a few countries have mentioned some regulatory issues as barrier for the roll out of standalone applications. One of the legal issues that were raised was the specific legislation for the personal data location (especially by interviewees from Italy or Austria). Some countries forced administrations that handle personal data or

specific kind of personal data to store it inside borders. Therefore, this barrier is applicable in the case of a deal with a service provider that may store data outside the country.

3.5 Synthesis: Model adoption by Member States

The table below recaps the different approaches by the Member States regarding cloud models. The majority of the Member States covered in the study are positioned on the second model (Resource Pooling). Nonetheless, there are not that many countries which have really adopted one single model.

Table 6 Model adoption by Member State

Country	Procurement and marketplace Model	Resource Pooling Model	Standalone applications Model
UK	**Yes**	Abandoned	Yes
Italy			**Yes**
Germany		Yes (but limited)	*Yes (marginal)*
Denmark			**Yes**
France		**Yes**	Yes
Netherlands	*Yes (future, only marketplace)*	**Yes**	
Portugal	**Yes**	*Yes (project)*	
Spain		**Yes**	
Belgium	Abandoned	**Yes**	
Austria		*Yes (long-term future)*	*Yes (future)*

Bold = dominant model

4. Pilots for cloud in the public sector

In this section, we suggest four pilot areas for cloud in the public sector. The selection is done by exclusion of areas already well covered in current developments or plans and by focusing on areas for which Member States have shown some interests and have strong potential for overcoming cloud barriers while leveraging cloud benefits.

4.1 Pilots as ways to address barriers

Pilots should logically be used to overcome barriers, which may be specific to one model or may apply to all models. We detail below the major barriers.

4.1.1Barriers

It does not come as a surprise that privacy and security concerns are the most important barrier for the deployment of cloud in the public sector across the ten countries that were included in the analysis, no matter if cloud privacy is the main driver for the initiative (e.g. in the German trusted cloud initiative) or if it is one of the barrier to the implementation of a specific applications (e.g. in France it was noted that distrust towards cloud remain because of the privacy issues, despite the implementation of the cloud initiative).

Other major barriers concern the implementation of cloud initiatives and applications, including:

- Financial issues - e.g. determining what are the actual costs compared to the expected benefits, when taking into account the total cost of potential back-up systems, etc. In particular the costs associated with functional adaptions of cloud services or their integration in procedures are unknown compared to those of conventional IT-services.
- Technical issues - e.g. interviewees in the Netherlands and in Italy mentioned problems associated with the lack of maturity of technologies. However, other countries such as Portugal highlighted that technicalities were not a major issue since cloud computing was a new tool and there are usually costs linked to the adoption of new techniques, x-whatever they are.
- Regulatory issues - e.g. in Italy, a main barrier to cloud uptake in the public sector is the law which impedes the sharing of services across different public administrations, as a consequence internal agreements had to be signed between in order to allow shared service on Cloud DT. In several countries (like Austria), it is also prohibited to save certain data abroad (e.g. in cases related to national security).
- SLAs and the lack of practice in drafting such agreements - e.g. Cloud service providers offer basic standard contracts for cloud development, which do not take into account needs and requests from clients with higher level of security requests
- Cloud Service Providers also often work with subcontractors, which makes the legal issues more complicated (indeed, the contract is between the administration and the CSP, but subcontractors need to follow the same rules regarding for instance security, SLAs or data exchange despite not being necessarily engaged by the contract).

We also found that many of the initiatives reviewed here were affected by barriers of a more cultural nature and the ability of internal organisations to manage changes. In most cases, the introduction of cloud requires new ICT management and procurement process (e.g. the g-cloud framework in the UK, which is being closely observed in Denmark and other countries), as well as various changes in ICT skills and job contents in the public sector (e.g. the impact on human resources was underlined in

France, where cloud automates some of the tasks that were previously carried out by staff). The Austrian case thus highlighted concerns in terms of organisational disintegration, as cloud computing could potentially lead to 'silo solutions' with restricted data exchange potentials. On the contrary, in the UK it is the independence that has been granted to public administrations when procuring and managing their ICT that was underlined as a main barrier. The existing silo processes in the way IT functions are developed and duplicated between different departments are as many barriers for the deployment of cloud in the UK public sector. Departments are used to buy their own bespoke services as individuals and they do not cooperate or share solutions with one another. G-Cloud is therefore as much about the adoption of new technologies than about a change in behaviours in how ICT functions are delivered inside each department. Likewise in Belgium, the loss of internal control over the ICT infrastructure was a major issue to shift to cloud. On a different note, a major barrier to the implementation of a Cloudstore in Denmark is the uncertainty about the extent to which the government institutions would actually use it. It appears that in Austria public administrations do not want to pay the price for early adoption as early adoption often ensues additional costs due to lack of experience.

Last but not least, privacy and security concerns shape the perceptions that users and public sector staff have from cloud computing, thus impeding the uptake of initiatives at the national level. Cultural barriers span across most countries that were analysed in these countries, no matter what is their level of cloud deployment.

Below summarises the results of our mapping and the main barriers by country.

Table 7 Main barriers from cloud initiatives and applications

Country	Privacy and security concerns	Regulatory issues	Financial issues	Technical issues (e.g. interoperability, technology maturity, reliability)	Issues in SLAs (due to the immaturity in practice and market)	Changes in job content, skills and processes	Cooperation between administrations	Cultural barriers and perceptions by users and public sector
UK	√	√		√		√	√	√
Italy	√	√		√	√	√	√	√
Netherlands	√	√	√	√	√			
France	√			√		√		√
Denmark	√	√	√	√		√	√	√
Germany	√	√					√	
Spain				√	√			√
Portugal	√				√		√	√
Belgium	√	√		√	√			
Austria	√	√	√	√	√	√		√

4.1.2 Evolutions needed to overcome these barriers

Some of the barriers mentioned above have been addressed along with the implementation of the various cloud initiatives, while others still needs more development for successful cloud deployment in the public sector.

Among the solutions that have been implemented in the ten countries, we have found: technical guidelines, awareness raising activities, training on cloud computing for public sector staff, organisation of forum for exchange of good practices and specific security and data protection requirements when drafting cloud procurement documents. Another key enabler of cloud deployment is the participative level of the initiative, involving a wide range of stakeholders in the governance process and in the consultations surrounding the design of national initiatives. In this respect, the UK G-Cloud is based on a federated management structure with participation of a cross-governmental team. In France the implementation of cloud at DILA requires external support to manage HR and technical changes.

With regards to what still needs to be done, our analysis shows that most countries are lacking common standards, common rules and common agreements that would enable a more standardised and harmonised approach to cloud computing at the national level. This is the direct result of a lack of coordinated overall initiative for cloud computing at the national level (apart from the UK). One of the questions arising is that of the subsidiarity level, with interrogations on what level between the EU and countries is most appropriate to take up regulatory and privacy issues.

Detailed view per country is available in Appendix C.

It should be noted that most evolutions mentioned above are not application-specific. Upcoming pilots should therefore try to address those issues (procurement, agreements, technology, etc…). Depending on the type of application, the main barriers to address will be of different nature as seen in the figure below.

Table 8: Pilots: addressing clusters of barriers for specific types of applications

	Citizen-type (Gov-Business; Gov-Citizen)	Employee-type (Gov-Gov)	Vertical/ Specialized (All types)	Critical or sensitive
Privacy and security concerns	√	√	√	√
Regulatory issues	√		√	√
Financial issues	√	√	√	√
Technical issues (e.g. interoperability, technology maturity, reliability)	√		√	√
Issues in SLAs (due to the immaturity in practice and market)	√	√	√	√
Changes in job content, skills and processes		√	√	
Cooperation between administrations		√		
Cultural barriers and perceptions by users and public sector	√	√	√	√

4.2 Methodology for the selection of the pilot areas

The selection of the pilots should be done with the following principles:

- De facto exclusion of areas in which there are already one running application by a Member state.
- Exclusion of areas in which there are pilots or clear plans for development by at least two Member States
- Focus on applications addressing a minimal set of barriers and with potential benefits by moving to the cloud.
- Focus on applications for which there has already been some expression of interest from Member States

4.2.1 Gap analysis with current or planned developments for cloud

In this first part, we review the applications already available or that will be available soon. There is no need to propose pilots that would address applications already covered in that section.

Citizen-type solutions

There are not that many current cloud-based applications to allow citizen engagement and service delivery. Member States are mostly offering portal information, with generic information. This can be explained by the fact that this is less likely to involve personal data.

Efforts could therefore be more significant in this category, especially for the procurement and marketplace model. Indeed, solutions addressing citizens/businesses are likely to be too much specific to attract developers.

Table 9: Mapping of current and planned cloud applications for citizen-type applications

Country	Portal information	Tax collection	E-Signature	Civil Registery	Other
United Kingdom		Yes			Social Media Management, Web hosting Forms
Italy				Yes	
Germany	Yes				Address change (R&D)
Denmark	Yes				
France	Yes				
Netherlands					
Portugal	Yes				
Spain			Yes		URLs Shortener Application forms
Belgium	-	-	-		
Austria	-	-	-		

Employee-type applications

There are more cloud-based applications targeting the employees rather than citizens or businesses that are already available (operationally or in plan). There are indeed more likely to be customized versions of traditional applications created by third party vendors and adapted to the public sector.

While some areas of productivity are not yet covered, there is less need for efforts in this category, well addressed already with the three different models (especially marketplace and cloudification of standalone applications). We suggest therefore not to focus on this category of applications for the selection of pilots.

Table 10: Mapping of current and planned cloud applications for employee-type applications

Country	**Email**	**Storage**	**Productivity (CRM, ERP, HR, Financial)**	**Collaboration (file sharing, communication tools)**	**Other**
United Kingdom	Yes		Yes	*Yes*	Procurement Virtual desktop Customs and tax productivity
Italy					
Germany	Yes				
Denmark	Yes				
France					Procurement
Netherlands					
Portugal	Yes	*Yes*	Yes	*Yes*	ID Management
Spain	*Yes*		Yes	*Yes*	Translator Office Materials Management
Belgium	-	-	-		
Austria	Yes	Yes	-		

Vertical-type applications

The only area that can be ruled out when looking at initiatives already deployed is around financial applications, already well covered in Denmark and France. Health is only partly addressed so far.

Major efforts could therefore be realized for this category, even though it is more difficult to really implement solutions here.

4.2.2 Gap analysis with existing major public sector applications

There are already plenty of applications already existing that have not been at all transferred to the cloud by any Member States. Many of them could therefore be cloudified. Below we provide a list of top applications listed by several Member States in their e-government strategies (see profiles in Appendix) but that are not cloudified or planned to be cloudified in any of the Member States. The list below is therefore the candidates for pilots.

Table 11 : Candidates for pilots

Citizen	Vertical
¶ Payment Platforms ¶ Digital identity/eID ¶ Messaging systems with administrations (to exchange documents) ¶ Business portals ¶ Commercial registers ¶ Legal information portal ¶ Tax filling ¶ Driving licence ¶ Police record	¶ Health : electronic prescriptions, appointment bookings, delivery of medical results, electronic medical records ¶ Education : electronic student record, e-learning tools, cloud storage for teachers, tools for interactions between parents, teachers and students ¶ Social : social security account (including reimbursements), family State aid account ¶ Jobs : classifieds, unemployment accounts ¶ Energy and Transport: energy costs information, public transportation information ¶ Messaging systems with administrations (to exchange documents related to permits, customs, cargo, etc.) ¶ Other information portals (health, environment, etc…)

It should be noted that DG CONNECT has also worked on e-government pilots (although not based on cloud computing) related to business portals activities with SPOCS (http://www.eu-spocs.eu) and related to electronic prescriptions with ePSOS (http://www.epsos.eu/). In both cases, the pilots have a cross-border approach.

4.2.3 Criteria for selection

Interviews revealed a **number of suggestions for pilots**. Most explicitly, interviewees mentioned the substantial challenges and the expected benefits of cloudification of e-government applications. This concerns online forms for citizens and business (Germany and UK), opportunities in health and education (Italy), tax filings (Denmark), legal information services and transport information services (Austria) and - more in general - applications for a large set of users, which maximizes the benefits of cloud computing in terms of scalability (Denmark and Spain).

Detailed view per country is available in Appendix C.

A second starting point for suggesting pilots is that pilots will generate substantial results when they address the main barriers for cloud computing in public sectors (Figure 19 in Section 5.1) in the context of e-government applications that are not yet cloudified (see the examples above and Table 11 in Section 5.2.). Pilots should be in areas with the most capacity to leverage cloud usual benefits which are the following:

- Massive usage, which implies to focus pilots on top applications rather than niche solutions.
- Using/Sharing multiple data sources/databases across multiple entities of a same administration (and even potentially across different administrations). Pilots should therefore address solutions requiring coordination between different databases.
- Elastic demand, meaning pilots should involve peaks of activity during the day and/or during the year

A third consideration for suggesting pilots is variety in terms of the barriers that are addressed and the type of applications that are cloudified (or that are developed as cloud-first applications). Variety in the type of applications refers to domains (such as health and education) but also to the continuum between applications that require research and development and applications that mainly build on technologies and standards that are mature enough for implementation.

Moreover, suggestions for pilots should take into account that countries are different in terms of the emphasis on the Market place/Procurement model, the Resource pooling model and the Standalone applications model. These models are different in terms of the objectives and benefits, progress made in terms of infrastructures, platforms and applications (IaaS, PaaS and Saas) and remaining barriers. The feasibility and relevance of the pilots increases when the priority applications and the level of ambition acknowledges the dominant model in a specific country.

4.2.4 Pilots description

Table 12 below presents the main barriers (adapted from Figure 19) and the main clusters of applications that could be addressed in pilots, based on Table 11 and suggestions by interviewees. The set of applications excludes employee-type applications, because cloudification of these applications is implemented or planned in nearly all countries. Consequently, the set of barriers excludes two barriers that are mainly relevant for employee-type applications (changes in job content, skills and processes; cooperation between administrations).

The relevance of specific barriers for specific clusters of applications is indicative and is based on the analysis - per country - of barriers and progress in addressing these barriers (Figure 20 in Section 5.1.2).

Table 12 : Main barriers and drivers and clusters of applications for selected pilots

	Business portals and commercial registers (Citizen-type)	Transport information services, for mobility by car and public transport (Citizen-type & Vertical)	Electronic student records (Vertical/ Specialized)	Health: appoint-ment booking and electronic prescriptions (Vertical/Specialised and Critical/Sensitive)	Cross-border cargo/logistics: solutions for mainports and e-customs (Vertical/ Specialised)
Privacy and security concerns	√	√	√	√√	√√
Regulatory issues	√	√	√	√	√
Financial issues		√		√	√
Technical issues (e.g. interoperability, technology maturity, reliability)	√	√√	√	√	√
Issues in SLAs (due to the immaturity in practice and market)	√	√		√	√
Cultural barriers and perceptions by users and public sector			√	√√	
Massive usage	√	√	√	√	
Sharing of data between entities	√	√	√√	√√	√√
Elastic Demand		√√	√	√	√

4.3 Pilot #1: Business portals and commercial registries

Cloudification of **business portals (equivalent to citizen information portals but targeting businesses) and commercial registers** can achieve *benefits* such as scalability (number of applications and users), increased availability/reliability of applications (compared to a situation with one or two servers) and reduced costs for governments as well as citizens and businesses.

Benefits will likely be limited beyond the massive usage effect, but the set of *barriers* to be addressed is modest, with few financial resources needed and a number of barriers in privacy and security (e.g. securing that information is authentic), regulation (e.g. liability and IPR), technology (e.g. updating information and ensuring connectivity from several user-devices) and SLA (related to hosting information on public, private or hybrid clouds). This pilot can be applied to any model and can be done very quickly within the Standalone applications model. In countries with an emphasis on the Market place/Procurement model or to a lesser extent the Pooled resources model (public cloud is more likely to be used as explained below), a pilot of business portals and commercial registers can precede a launch of applications.

This pilot cannot really be considered as innovative. It is indeed a business version of widespread citizen information portal that are often cloudified. There are also plenty

of business information portals without cloud computing features. The innovation aspects are quite low, but there is real potential for cost savings. Indeed, as the solution is quite basic and does not imply any sensitive data, Member States could easily use commodity public cloud solutions instead of internal solutions that are likely to be more expensive. Also, there would be additional transparency, and therefore a better promotion of open e-government. Finally, there is a high potential of transferability (despite different procedures) from a Member State to another, which could lead to cross-border deployments, as tested within SPOCS without cloud computing.

4.4 Pilot #2: Transport information services

Transport information services that could be addressed by this pilot would be around mobility by car (price information about gas stations, petrol prices, congestion, road pricing, etc.) and public transport (schedules, delays, connections, multi-modal transport, etc.).

Cloudification of transport information services can achieve *benefits* such as increased access to applications (mobile) and improving the applications (interactive, location based, real-time, customized, incorporating information provided by users, etc.). To some extent, there can be benefits in scalability and cost savings, especially due to the very regular needs for information update (gas prices, road congestions, etc…) that cloud may better handle.

Technical *barriers* will be substantial. In addition, there are privacy and security concerns (e.g. tracking users and cargo), financial barriers (mainly because technical challenges are substantial) and issues in SLA (e.g. access via mobile and wireless infrastructures). In countries with an emphasis on the Market place/Procurement model or the Standalone applications model, a pilot on transport information services can be an important step in cloudification of advanced applications.

This pilot is not highly innovative per se, as there are already e-government existing services and also plenty of private initiatives. This pilot could be seen as a competition for private solutions, but this is already the case for France or Austria current services. Due to the many private initiatives, it is hard to say that this would bring significant cost savings. Nonetheless, it would help to promote open e-government around useful services that do not imply any sensitive or personal data for most of its features. This additional information transparency could even help private initiatives that could benefit from additional information thanks to open data and/or open APIs. Private players would focus their efforts on differentiation through visualization tools or combination with other data. While a cross-border solution is of limited interest (most of the citizens travelling locally), there is a high level of transferability between Member States, as most characteristics are the same whatever the country (prices, timetables, etc…) and as some standards already exist regarding open data for transport information (like GTFS).

4.5 Pilot #3: Research and education sector, electronic student records

This community is actively pursuing the benefits of cloud services, as these help them to collaborate and share data across organizations and national borders. The challenges mentioned in this document (on procurement, marketplaces, resource pooling, interoperability, security and privacy) are all visible in the research and education sector and are being tackled through several Pan-European collaborative efforts. These trans-national activities within a largely open community can showcase the EC cloud strategy and emphasize the need to work on clouds on a European level

Cloudification of **electronic student records** can achieve benefits in scalability and, especially, in promoting that pupils, student, schools and other education institutions

can use one application, instead of a range of applications that are not interoperable or scalable. Such a system could also be used for colleges when selecting their future students, despite colleges and other education institutions often belonging to different administrations.

For pupils and students, the main benefit is that their information can travel with them from one course or school to the next. As such, this application is complementary to online education, massive open online courses and other e-learning applications (in which commercial and public initiatives are omnipresent). Cloud would be of great help to ensure the proper coordination of multiple databases generally spread over the countries (like schools).

Because the application does not require high bandwidth or interactivity, financial *barriers* and SLA issues are small. More relevant are privacy and security concerns, e.g. ensuring that pupils/parents providing education institutions with possibilities to upload or view selected data only, and preventing that education institutions/ employers can browse for information. This is also where the technical challenges lie. In addition, there can be regulatory and interoperability issues (e.g. dealing with different grading systems) and cultural barriers (e.g. users with fear that their educational history will be disclosed).

Similar to cloudification of transport services, cloudification of electronic student record could take place in countries with an emphasis on the Market place/Procurement model or the Standalone applications model. This is because experience with cloud-based applications increases the feasibility of the pilot, whereas connectivity (that is central in the Pooled resources model) is a minor issue for cloudification of electronic student records.

This pilot would be really innovative compared to the existing initiatives in the education sector or compared to previous pilots mentioned above. The potential of cost saving is also very significant, thanks to better collaboration between the various education institutions and also thanks to a potential shift to paperless approach for student records. Transition to paperless approach has already brought significant cost savings in other types of applications in Spain for instance. Such a pilot would have little effect on the promotion of open e-government, as the information would mostly be exchanged within education institutions and whit parents. Finally, the level of transferability between Member States seems low, as the structure of education (including the grading system, the status of structures private vs public, the organisation of primary schools vs high schools) is often quite different. Nonetheless, there is already some form of harmonization at the higher education level, which could represent a first step. This could also be applied with a cross-border approach around Erasmus.

4.6 Pilot #4: Health sector, Appointment booking and electronic prescriptions

The benefits of cloudification (or cloud-first development) of **health applications** will differ greatly between individual applications. Based on the interviews, we suggest **appointment booking** (doctors, hospitals, etc.) and **electronic prescriptions** (involving users/patients, doctors and pharmacists). The main *benefits* are similar to those of electronic student record. All actors can move towards efficient, scalable, highly standardized and widely used applications, instead of being locked into the application of one doctor, hospital or pharmacist. As such, this cluster of applications is complementary to more specific and more advanced applications remote health monitoring (using sensors, mobile devices, etc.). Depending on the national context, applications for electronic prescription can be made interoperable with systems for electronic patient records.

The main *barrier* , obviously, is privacy and security. Moreover, there can be regulatory issues (e.g. increased transparency of prescriptions can lead to increased liability of doctors and pharmacists) and cultural barriers (such as users/patients

having to trust an online system for matters concerning their health). In addition, there is a combination of financial, technical and SLA issues. Applications should be highly detailed (e.g. timing of appointments, types of medicine). They should also allow for changes (e.g. new locations and new medicines) and 24/7 availability of the application is crucial.

Cloudification (or cloud-first development) of appointment booking and electronic prescriptions could take place in countries with an emphasis on the Standalone applications model, if there is substantial experience in providing secure applications via the cloud. Alternatively, the pilot could take place in countries with an emphasis on the Pooled Resource model, which can generally handle a high level of privacy and security.

Such a pilot would be significantly innovative; as such types of services are still very rare (this is indeed the most innovative pilot in our list if we do not take into account the cross-border aspects). The potential of cost savings is very high. Like for education, transition to paperless and better collaboration should bring automatic IT cost savings. But the impacts should be even more important by improving diagnostic and reducing medical errors. The level of transferability is likely to be low, due to very different health organization systems in the various Member States. Developing a cross-border is likely to be challenging, despite the potential leveraging of the ePSOS pilot.

4.7 Pilot #5: Cross-border cargo/logistics: solutions for mainports and e-customs

ICT is used intensively for monitoring cargo and coordinating the logistics across value chains. In the context of cloud computing in public sectors, most relevant are **e-government applications that support mainports such as large airports and sea ports. The main example is e-customs**. Another example is e-inspection, e.g. monitoring cargo, identifying risks related to security, food safety, pollution, etc., and increasing the efficiency and effectiveness of inspection by public authorities. The main opportunities lie in the cloudification or development of **cross-border** e-government services. In this case, the main *benefits* of cloudification are scalability (number of business users), increased possibilities for accessing data via mobile devices (especially for e-inspection) and reduced costs for governments and, especially for SMEs and large firms that are active internationally. As such, the European single market can be facilitated.

A cross-border cargo/logistics pilot can build on commercial services and innovation activities in the broader field of ICT and logistics. Private actors use Electronic Data Interchange (EDI), tracking and tracing, e-business software and other solutions that are provided by specialised service providers and by large firms that coordinate their own value chain (e.g. car manufacturers). Moreover, the pilot can build on cross-border pilots in the field of e-government. This includes Large Scale Pilots in the European Competitiveness and Innovation Programme (CIP). Examples are STORK (e-authentication), e-CODEX (e-justice) and SPOCS (providing business with a single point of contact by means of an online portal for e-government services).

The main *barriers* to be addressed in the pilot are security (e.g. human trafficking, transport of weapons and nuclear material) and political sensitivities and national differences in matters related to security in particular and international transport in general (e.g. customs). In addition, there will be technical barriers related to standardisation and interoperability, as public and private actors in different countries are using different commercial solutions. At the same time, this could be an area in which the pilot can provide substantial benefits. Sharing of data between entities could be a barrier for mainports in which a range of public, private and public-private actors are involved in inspection services. Financial issues will not be among the main

barriers because the pilot can build on commercial services (by means of procurement) as well as existing research and pilots on cross-border e-government applications. Issues in SLAs could be relevant as a number of applications are time-critical.

Because the cross-border element adds to the complexity of the pilot, the pilot could take place in a number of countries that are experienced in public services via the cloud (the Market place/Procurement model or the Standalone applications model). However, the pilot could also be an opportunity for countries that have focused on the underlying infrastructure (the Pooled resources model). These countries can collaborate with countries that are more experienced in using cloud computing to support e-government services such as e-customs and e-inspection.

The main innovation of this pilot would be the cross-border centric approach and its impacts in terms of standardization/interoperability. But even that aspect is already included in some other pilots. It would obviously bring pan-European value added around an industry which is by nature pan-European and even international. With a common system across Europe, there would be definitely significant cost savings, compared to a collection of national systems that still need to exchange between themselves.

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Belgium

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¶ Fedict, Moving government applications to the cloud, PowerPoint Presentation of 28/05/2012

¶ OECD (2008), e-Government studies, Belgium, assessment of proposals and actions

¶ Website of Fedict: http://www.fedict.belgium.be/en/

Austria

¶ White Paper on Cloud Computing 2011:

http://reference.e-government.gv.at/uploads/media/20120228_Cloud_Computing_Positionspapier_1.0.1.zip

¶ E-Government strategy of the Austrian Government:

http://www.digitales.oesterreich.gv.at/site/5237/default.aspx

¶ ABC guide of e-government in Austria:

http://www.digitales.oesterreich.gv.at/DocView.axd?CobId=19394

¶ Best Practice Catalogue 2008 of Austrian e-government services:

http://www.oesterreich.gv.at/DocView.axd?CobId=41869

- Web pages of the Federal Computing Centre of Austria (BRZ): https://www.brz.gv.at

A.2 Interviewees

UK

Name	Country	Organisation/ Company	Position
Sue Bateman	United Kingdom	Cabinet Office, Government Digital Service	Head of International ICT Alignment (Member of the e-government expert group)
Denise McDonagh	United Kingdom	Home Office	Director of IT Strategy and Delivery Programme Director for G-Cloud
Nicola Westmore	United Kingdom	Cabinet Office	Deputy Programme Director G-Cloud

Italy

Name	Country	Organisation/ Company	Position
Daniele Tatti	Italy	Agency for Digital Italy	Director for International Relations
Massimo Fedeli	Italy	Consip SA	Director of IT Infrastructure
Francesco Lazzàro	Italy	Ministry of Foreign Affairs	Director for administration, informatics and communication/ CIO
Marco Gentile	Italy	Ministry of Foreign Affairs	COO for the MAEcloud project
Venerando Pappalardo	Italy	Ministry of Foreign Affairs	Technical Officer/ leading engineering team

Germany

Name	Country	Organisation/ Company	Position
Matthias Kuom	Germany	DLR (German Aerospace Center)	Program Manager
Dr. Klaus-Peter Eckert	Germany	Fraunhofer-Institute for Open Communication Systems	System Architect

Denmark

Name	Country	Organisation/ Company	Position
Cecile Christensen	Denmark	Danish Agency for Digitisation	Head of Division Division for IT Standardisation and Security
Camilla Grynnerup Fisker	Denmark	Danish Agency for Digitisation	Project Manager
Jens Jakob Nørtved Bork (interview scheduled)	Denmark	Danmarks Miljøportalssekretariat	Enterprise Architect

France

Name	Country	Organisation/ Company	Position
Paul Braida	France	DISIC (Direction of Inter-ministry IT system)	Head of the IT transformation
Jean-François Imokrane	France	DILA (Direction of Administrative and Legal Information)	Head of the IT system organization
Emmanuel Spinat	France	AIFE (Agency of the Financial Information of the State)	Delegate of the director in charge of the support and the operational supervision

The Netherlands

Name	Country	Organisation/ Company	Position
Rob van Dorsten	NL	Ministry of Interior & Kingdom	Policy Advisor ICT/Cloud Computing
Martin bij de Leij	NL	Min. Of Economic Affairs	Policy Advisor DG Telecom
Nicole Goossens	NL	Min. Of Economic Affairs	Policy Advisor DG Regulatory Burden & Telecom
Frank van Dam	NL	Min. Of Economic Affairs	Strategic IT Advisor

Spain

Name	Country	Organisation/ Company	Position
Aleida Alcaide	Spain	Spanish Ministry of Finance and Public Administrations	Technical Advisor

Portugal

Name	Country	Organisation/ Company	Position
João Ricardo Vasconcelos	Portugal	AMA - Agency for the Public Services Reform	Innovation and International Relations
Paulo Gaudêncio	Portugal	AMA	Project Manager

Belgium

Name	Country	Organisation/ Company	Position
Mr. Frank Leyman	Belgium	FEDICT-Federal Public Service for Information and Communication Technology	Manager International Relations
Mr. Jan Colpaert	Belgium	FEDICT-Federal Public Service for Information and Communication Technology	Network architect

Austria

Name	Country	Organisation/ Company	Position
Mr. Herbert Leitold	Austria	Institute for Applied Information Processing and Communications, Technical University of Graz	Site manager of the Secure Information Technology Center – Austria (A-SIT) technology assessment group; Former head of the E-Government Innovation Center (EGIZ); Director of the non-profit foundation Stiftung Secure Information and Communication Technologies (SIC)
Mr. Peter Reichstädter	Austria	Platform Digital Austria; Federal Chancellery	Policy Officer for e-government, international relations
Mr. Wilfried Jäger	Austria	Federal Computing Centre of Austria	Head of the Department ‚Infrastructure'

Appendix B - The Context

B.1 Policy context

Current European Commission activities related to cloud computing are to be set into the context of the Europe 2020 Strategy and one of its seven flagship initiatives, the '**Digital Agenda for Europe'**. This initiative sets out to define the key enabling role of Information and Communication Technologies (ICT) for Europe to reach its ambitions for 2020[2]. The overall aim is to deliver sustainable economic and social benefits from a digital single market based on fast and ultra-fast Internet and interoperable applications. It makes proposals for actions that need to be taken urgently to get Europe on track for smart, sustainable and inclusive growth.[5]

The development of a **European Cloud Computing Strategy** is one of the actions of the Digital Agenda. The "Digital Agenda for Europe" states:

> *ñEurope should also build its innovative advantage reinforced eInfrastructure EU-wide strategy[é] should develop on 'cloud computing' notably for government and strategy should consider economic, legal and insti*
> *develop further eInfrastructures and establish an EU strategy for cloud computing notably for governme nt and science ò.*

The EU Cloud Computing Strategy[6] covers three broad areas:

- First, the *legal framework* . This concerns data protection and privacy, including the international dimension. It also concerns laws and other rules that have a bearing on the deployment of cloud computing in public and private organisations. And it concerns users' rights insofar as they are provided for by law.
- Second, *technical* and commercial fundamentals. Focusing on critical issues such as security and availability of cloud services. Here the Commission can play a key role in the technical standardisation of APIs and data formats, as well as in the development of template contracts and service level agreements.
- Third, the *market* . To support pilot projects aiming at cloud deployment. To harness the power of public procurement we want to engage with our public sector partners on Member State and regional levels to work on common approaches to cloud computing.

One of the Key Actions foreseen in the Cloud Computing Strategy is the **European Cloud Partnership** (ECP), bringing together cooperating public authorities working with industry consortia to implement a pre-commercial procurement action. The purpose is to overcome the fragmented public sector demand for cloud services in the EU. Its work will be organised in three phases:

- Phase 1: Harmonisation of requirements through agreeing common public sector cloud requirements. Develop specifications for use in procurement during Phase 2.
- Phase 2: Procure proof-of-concept solutions on phase 1 specifications. Develop specifications for use in procurement during phase 3.
- Phase 3: Procure reference implementations to demonstrate conformance and performance.

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[5] A Digital Agenda for Europe, COM (2010) 245 final/2

[6] 'Unleashing the Potential of Cloud Computing in Europe - What is it and what does it mean for me?', COM (2012) 529/2

Beyond this, the ECP may also assume a role for coordinating a number of cloud stimulation measures. These could include the coordination of research priorities, development of training material, and awareness raising actions. A role in future cloud-related standards development is also possible.

Data protection, interoperability and standards, security and resilience are at the core of the European Commission's attention. A key issue for European Union institutions is to what extent it is possible to implement a European public authority cloud as a supra national virtual space where a consistent and harmonized set of rules could be applied, both in terms of legislation and security policy, and where interoperability and standardization could be fostered. Initiatives and reports that are worth mentioning in this context are

- The *European Data Protection Authorities* , assembled in the Article 29 Working Party, adopted an opinion on cloud computing in which they analyse all relevant data protection issues for data controllers and cloud computing service providers operating in the European Economic Area (EEA) and their clients.[7]
- The Standards and Interoperability for e-Infrastructure Implementation Initiative (SIENA, www.sienainitiative.eu/) worked to break down the interoperability barriers that impede implementation of clouds by coordinating among various national and pan-European initiatives, policy bodies, and enterprises. The group also defined scenarios, identify trends, investigate innovation, and assessed the impacts of cloud and grid computing.
- In the context of the Emerging and Future Risk Framework project, the *European Network and information Security Agency* (ENISA) conducted a risks assessment on cloud computing business model and technologies, supported by a group of subject matter expert comprising representatives from Industries, Academia and Governmental Organizations. The result is an in-depth and independent analysis that outlines some of the information security benefits and key security risks of cloud computing and provides a set of practical recommendations.[8]
- In 2010 the *Expert group on Cloud Computing Research* , set up by DG Connect, issued the report "The Future of Cloud Computing – Opportunities for European Cloud Computing beyond 2010", providing a detailed analysis of Europe's position with respect to cloud provisioning and how this affected future research and development in this area, identifying the main opportunities for Europe to be active part in the global 'cloud movement'. The experts group 2012 report "Advances in Clouds – Research in Cloud Computing" mapped the advances in Cloud Computing in the more recent years and identified research topics that would provide Europe with the know-how to be world-leading in Cloud Computing.

B.2 Cloud services in the Public Sector

B.2.1 Cloud infrastructures and functionalities

There are two main cloud computing configurations that have to be taken into account when addressing cloud computing (see Figure 7):

- **Public cloud**: in a public cloud the provided service is the same for each customer, will it be a private player or an administration. The word "public" point out the universality of the service. In order to provide a public cloud, the service provider has to build (or own) a large datacenter able to welcome new customers.

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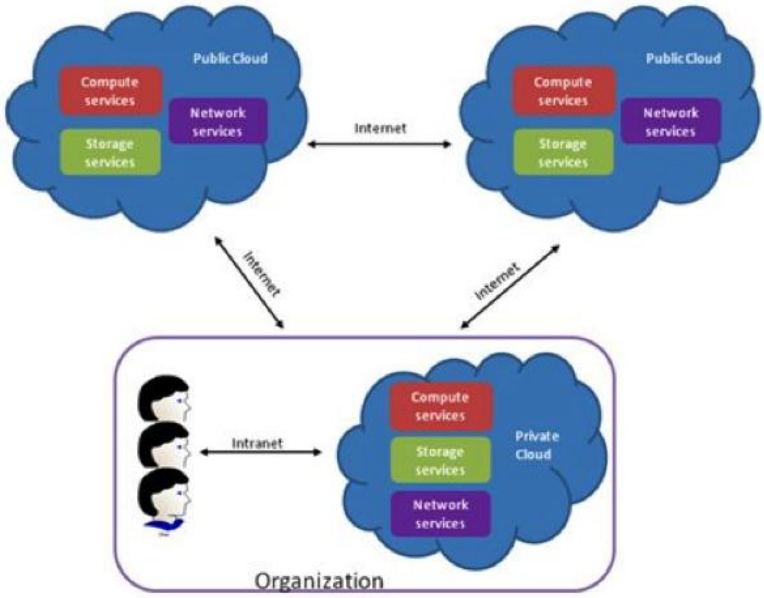
[7] Article 29 Data Protection Working Party – Opinion 05/2012 on Cloud Computing

[8] D. Catteddu, G. Hogben, Cloud Computing – Benefits, Risks and Recommendations for Information Security, ENISA, 2009

Services offered in a public cloud can be a “Software as a Service”, a “Platform as a Service” or an “Infrastructure as a Service”. In any case, the datacenter is placed outside customers’ building.

¶ **Private cloud**: a private cloud indicates a customized service. This service is different for each customer. The same type of services as in a public cloud can be provided in a private cloud. The service provider can host the service within its datacenter and its server, or hosts the customer’s server within the datacenter, or operate the customer’s server (using virtualization tools). This last case especially meets the expectations of large administrations, with numerous entities, and not localised in a unique area.

Figure 7 Public and private cloud architectures



Both configurations can be imagined for public sector applications. In any configuration, from the service provider point of view, large infrastructures are usually required to provide services to manifold users. Those infrastructures include servers, databases and network equipment. A high-speed broadband Internet connection is required to connect the datacenter to the web.

Another distinction can be made when considering cloud: the Expert Group Report “Advances in Cloud” distinguishes between cloud services of general purpose and of special purpose (specific use cases only). Clouds may also be made available to only a few users or community as in Community Clouds.

All those approaches may combine to form Hybrid Clouds or Meta Clouds (but then not as an aggregator of services but only as aggregator of meta-data).

There are three main **cloud services categories** or ‘cloud functionalities’ that consider the type of software functionalities: Infrastructure as a Service, Platform as a Service and Software as a Service.

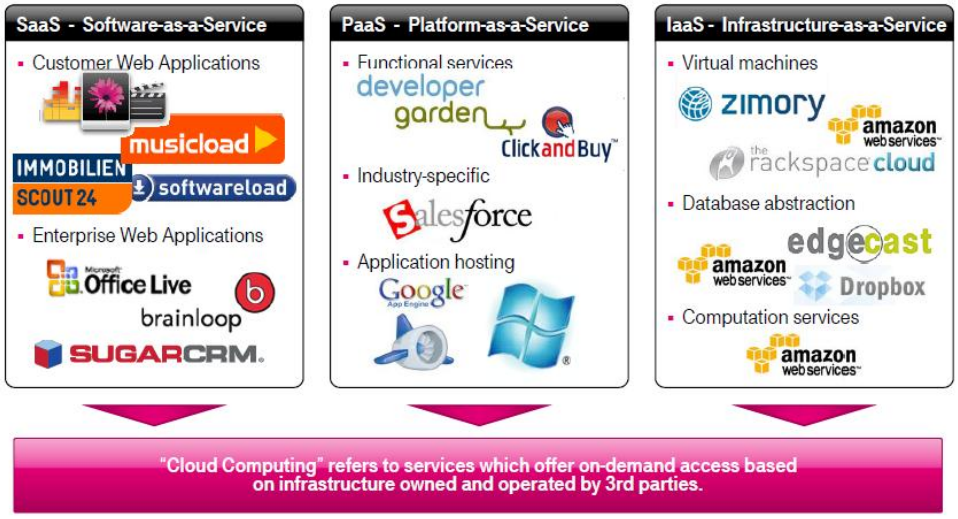
¶ **Infrastructure as a Service (IaaS)**: Here, a vendor makes physical infrastructure available to the customer: an administration or a company. This generally includes servers for storing data and hardware formatted for a specific operating system (Linux, Windows…). The customer specifies how much storage space or computing power it wants, and the cloud provider scales the service accordingly. The client enterprise can manage all or a portion of the software that it runs on the infrastructure supplied, or even uses it to offer other cloud solutions like PaaS or SaaS. Meanwhile, the provider of the cloud service concerns itself only

with the hardware side of things: virtualisation, memory, physical management of servers and its servers' Internet access.

¶ **Platform as a Service (PaaS)**: This type of service provides client companies with a platform that allows them to run applications that require a particular software environment. Customers choose PaaS to have a development or testing environment, or a service dedicated to producing/developing applications. The provider handles the maintenance of its servers (when it owns them), updating the software on the platform and ensuring its proper operation, while the customer generally manages only the applications its runs on the platform.

¶ **Software as a Service (SaaS)**: This last category includes services that provide customers with one or several applications that are available remotely using a computer connected to the Web, or an administration's network if the SaaS solution is installed locally. Users can access these apps using just a Web browser, or could require the installation of a thin client whose chief purpose is to display the information coming from the cloud server running the application. The purpose of these applications is to perform a very specific function, such as mail management, human resources or customer relations management, for instance. Customers do not need to have any application installed on their computers to access the service, which makes for much simpler software deployment and updates.

Figure 8 Types of cloud functionalities



B.2.2 Cloud computing services for the public sector

Cloud computing services can be used by **public administrations** as well as a company can do, as some of the processes are very similar. Processes addressed may be internal (for employees), or external (for customers[9] and/or for suppliers and partners). For a company, CRM (Customer Relationship Management), e-mail, content or file storage services can be used … Administrations may use cloud services to manage their operations like tax payment, wages, or state aid for instance.

Cloud computing can also be a central service that gathers various public services usually fragmented in different units. Some initiatives refer to "eGovernment" to describe public services provided to citizens, and cloud services and infrastructures dedicated to administrations. The aim of these initiatives is to allow some interoperability between public databases and to provide the ability to share data

[9] Citizens in the case of the public sector in most of the cases

between different units in order to avoid redundancy. Another argument to build such an initiative is to reduce operating costs of IT equipment, mutualizing them in a unique datacenter.

Overall, all software applications and services of the public sector may be migrated to the cloud, which may even help to create new ones. In Section 1.2.2we indicate the taxonomy of public sector cloud applications that is adopted in this study (see Table 1).

The scope of cloud-based applications is globally the same as for e-government (depending on the definition, it might include all types of services or only citizen engagement and productivity). Only a few applications do not rely necessarily on cloud architecture and strategy, as they are non-Internet based, like eID cards or digital kiosks in physical agencies.

Other initiatives are related to the (public) **scientific research sector**. Cloud computing can provide large calculation capacities during a short period, especially for specific research work in mathematics, physics or medicine for instance.

Cloud computing gives several **advantages** compared to traditional IT internal infrastructures, especially for public players:

- Flexibility: Because of providing "on demand" services, cloud computing allows flexible use: administrations can subscribe a cloud service for a variable period of subscription, with a price that is determined in function of this period, or in function of the real usage.
- Resource Pooling. The flexibility is also coming from the capacity to share resources across the administrations, reducing their costs.
- Elasticity: cloud customers can also choose and size the provided service. Because of technical capabilities handled by the provider, specific memory space or specific calculation power can be chosen, and usually billed in function of these specifications. The customer can also ask for a change of configuration with a short time of reaction of the provider.
- Turning CAPEX to OPEX: Moreover, from a user perspective, cloud computing is based on a subscription model (OPEX) rather than an investment model (CAPEX) that is used for traditional IT infrastructures. This aspect is especially interesting for small public organizations that do not have enough capital to invest in IT infrastructures that should provide the same services than cloud computing. For larger companies, this OPEX model aims to rationalize costs.
- No skills required: Furthermore, cloud computing services do not require specific skills to manage them. In a traditional IT architecture (no cloud), companies or administrations have to hire several qualified employees to manage the infrastructures, and to develop services.
- Improved time to market: cloud computing can improve the time to market of IT services. New services can be online faster because the distribution process is easier and automated.

There are a number of **regulatory issues** that affect private as well as public players and hinder the uptake of cloud services:

- Data security: users do not usually have guarantee that their data will be safe in the datacenter. Some cloud provider does not establish specific proceedings to avoid data destruction or theft. For instance, in case of fire, if data storage is not duplicated in another datacenter, data can be lost because of the database destruction. If a secure firewall is not set up, hackers may steal (i.e copy or erase) data in the database.
- Privacy: this aspect is the ability of a data to be read by another person than the authorized user. It can be a thief (cf. above) or a public authority that has the right to read the data thanks to specific laws. In the USA, the "Patriot Act" authorized

federal agencies to read data in case of terrorism suspicion, in American's companies (wherever is the datacenter in the world). This legal aspect in the US is a strong barrier for non-US administrations that do not want to store their data and applications in American companies' datacenter. Other governments have generally similar provisions. In this context, privacy and data protection issues are closely interlinked with the question of data locality.

- Quality of Service: as well as data security, cloud providers may not take care of the quality of service. The cloud service can be out of service in case of technical problems in the datacenter for instance. In this case, the cloud provider has to guarantee a percentage of availability that is not, sometimes, the case. In this context, cloud service providers have to write a "Service Level Agreement" (SLA) that specifies, at least, those aspects.
- Standardization and interoperability**:** cloud providers can try to keep their customers, applying behaviours called "vendors lock-in". These behaviours result in a verticalisation of the cloud services, forcing customers to use a specific data format for instance. This phenomenon is usually observable in mobile operating systems. To avoid this behaviour, public authorities try to make cloud services interoperable, establishing standards for every cloud providers.

Appendix C – Detailed results of the mapping

This section presents the main results with a comparison per country through tables. Detailed country profiles are available through a separate file.

Figure 9: Mapping of main objectives for cloud initiatives (Part 1)

Country	Cost savings	Improvement of services	Involving SMEs
United Kingdom (G-Cloud + CloudStore)	Primary objective (procurement mainly)		Secondary objective
Italy	Primary objective	Primary objective	
Germany (Trusted Cloud)			Primary objective
Denmark	Primary objective	Secondary objective	
France	Secondary objective (infrastructure mainly)	Secondary objective	(Indirectly through Andromède projects)
The Netherlands	Primary objective	Secondary objective	
Portugal	Primary objective	Primary objective	Secondary objective
Spain	Primary objective	Primary objective	Secondary objective
Belgium	Primary objective	Primary objective	
Austria	Primary objective	Secondary objective	

Figure 10: Mapping of main objectives for cloud initiatives (Part 2)

Country	Technology development (reliability, safety)	Datacenter consolidation	Resources Pooling (outside datacenters)	Other
United Kingdom (G-Cloud + CloudStore)		Primary objective	Secondary objective (FDP)	Flexibility of providers (no lock-in)
Italy			Secondary objective	Test security
Germany (Trusted Cloud)	Primary objective			Mobile services
Denmark			Secondary objective	Test legal aspects
France	Secondary objective	Primary objective	Secondary objective	
The Netherlands	Primary objective	Primary objective		
Portugal		Primary objective		
Spain		Secondary objective		
Belgium			Secondary objective	
Austria	Primary objective (pilots)		Secondary objective	

Figure 11: Mapping of Governance for cloud initiatives

Country	Strategy	Implementation	Key private partners for implementation
United Kingdom (G-Cloud + CloudStore)	G-Cloud Delivery Board	A central G-Gloud team part of the Cabinet Office's Digital Service A federated management structure with 6/7 Foundation Delivery partners to help around the development of a few key applications (but no decision role). Split by Cluster.	Solidsoft (SME), developed the CloudStore Microsoft
Italy (DigitPA Guidelines)	Agency for Digital Italy (in in collaboration with 45 public and private organizations for guidelines)	Initiatives remains not coordinated, even though Agency for Digital Italy is partly involved for implementation	BMC, CMDB, IBM, Clarity for DT Cloud
Germany (Trusted Cloud)	BMWi (Ministry of Economics and Technology) for strategy and integration across ministries and Landers	DLR (German Aerospace Center) for implementation of the program (also the case for e-government)	IDTZ, HP, VMWare, Oracle, Atos, etc… for GoBerlin Additional private partners for specific projects
Denmark (technical projects)	Danish Agency for Digitisation depending fr om Ministry of Finance	Danish Agency for Digitisation Other ministries are involved for implementation	Microsoft, Amazon, NNiT and several different Danish IT companies acting as brokers
France	DISIC (Direction of Inter-Ministry ICT Systems), except for Chorus (historical reasons)	DILA (Direction of Administrative and Legal information), part of Prime Minister Cabinet, for some implementation like inter-ministry cloud Ministries for some implementation like AIFE (Agency of the State Financial IT) for Chorus	Integrators like Atos, Accenture or Bull
The Netherlands (Cloud Strategy)	Ministry of Interior and Kingdom	Ministry of Interior and Kingdom in collaboration with all other ministries. This includes all ministries in their role as users of ICT, and some ministries with additional roles, e.g. the Ministry of Economic Affairs (Digital Agenda) and the Ministry of Justice (legal matters)	N/A
Portugal (Framework)	AMA (Agency for Modernization of public Administration)	ESAP (Public entity managing IT for the Portuguese government)	Cloud providers
Spain	The Ministry of Finance and the Highest council of eGovernment for eGov strategy including cloud computing	General directorate of administrative modernization, procedures and for the promotion of eGov – for eGov and cloud implementation	Infrastructures integrators and manufacturers
Belgium	The Fedict – Federal Public Service for Information and Communication Technology	The Fedict	N/A
Austria	The working group AG-Cloud, as part of the Digital Austria/IKT-BUND group (involving representatives of the federal government) and the Federal computing centre of Austria	Federal computing centre of Austria	N/A

Figure 12: Mapping of relationships between cloud and e-government

Country	Link with e-government
United Kingdom (G-Cloud + CloudStore)	¶ A subset of UK ICT strategy ¶ Directly linked with "Digital by Default" ¶ E-government commodity services can be cloudified within Cloudstore ¶ Cloud first approach
Italy	¶ Some links, but not fully synchronized (the Agency being quite new) ¶ Cloud first approach?
Germany (Trusted Cloud)	¶ Reuse services developed in e-gov BundOnline initiative (GoBerlin) ¶ Similar organization
Denmark (technical projects)	¶ Mostly cloudification of existing e-gov services ¶ Cloud is a sub-part of the e-gov strategy ¶ Same agency
France	¶ Cloudification of the major initiative (service-public.fr) and of a few other services of DILA, which has a key role in e-government
The Netherlands	¶ Cloud computing is an action line inside the Digital Implementation Agenda (that implements the Digital Agenda in the Netherlands, and that includes several e-gov action lines) ¶ Aim of cloud first
Portugal	¶ Cloud initiative is one of the 25 measures of the Portuguese global strategy plan to reduce IT costs
Spain	¶ 7 eGov applications currently provided "in the cloud" ¶ 6 more applications will be cloudified in 2013
Belgium	¶ Cloudification is one of the eGov strategy objectives ¶ Cloud will improve the efficiency of eGov services
Austria	¶ Cloud can be "one possible pillar" for the future eGov strategy

Figure 13: Mapping of plans for full cloudification

Country	Full cloudification
United Kingdom	Existing plan for full digitalization and cloud is a mean to reach the objective
Italy	No plans but obligation to consider cloud for software procurement
Germany	N/A
Denmark	Cloud should be considered at the same terms as other IT sourcing models
France	Objective to virtualize 80% of applications
The Netherlands	No detailed plans
Portugal	Not a priority
Spain	Plan for all "common" applications, involving few administrations. Not planned for the other applications
Belgium	No plans
Austria	No plans

The table below gives additional description of the main identified cloud applications (current and planned).

Figure 14: Detailed view of cloud applications

Country / Name of the application	Nature of the application	Infrastructure	Target users	Part of cloud/e-gov initiative
United Kingdom				
CloudStore/ GCloud	Marketplace of more than 3200 services	Public cloud Iaas, Paas, SaaS	Administration users Potentially citizens, system managers	Cloud initiative
GOV.UK	Public information portal	-	Citizens	e-gov initiative
Janet Cloud brokerage	*Joint vendor management, procurement and cloud adoption in education and research*	*Public cloud Community cloud Iaas, Paas, SaaS*	*Education and research in the YK*	*Cloud initiative*
Italy				
DigitPA	Guidelines	-	Administration users	Cloud initiative
M@E Cloud	Interaction platform	Private cloud Mostly PaaS, few IaaS	Citizens and firms abroad and administrations	Not part of any national initiative
DT Cloud	Infrastructure virtualisation for the treasury department	Iaas and PaaS	Treasure department users	Not part of any national initiative
Germany				
GoBerlin	Marketplace to facilitate administration procedures	Private cloud Saas	Citizens, administration employee, private companies, application developers	Cloud initiative
CloudCycle	Framework	-	Administration employee, private companies	Cloud initiative
BundOnline	Public information portal	-	Citizens, administration employee, private companies	e-gov initiative
Denmark				
NemHandel	Trade system	Public Cloud IaaS	Citizen and business	Cloud initiative
Miljøportal	Environment information portal	Public Cloud	Citizen and business	Not part of any national initiative
Cloudstore	Marketplace	-	Administrations employees	Cloud initiative
Digitalisér.dk	*Communications and knowledge sharing platform*	-	Citizen and business	Cloud initiative
Statistics module of Borger.dk	Portal information	-	Citizen and business	Cloud initiative
France				
Chorus Facture	Electronic bills exchange	Public cloud SaaS	Any providers and employees	Not part of any national initiative
Chorus Déplacement Temporaire	Moving expenses bills	Public cloud SaaS	Employee of ministries	Not part of any national initiative

Country / Name of the application	Nature of the application	Infrastructure	Target users	Part of cloud/e-gov initiative
UnivCloud	- Mutualisation of IT resources of Paris universities	Private cloud	Administrations employees	Cloud initiative
Servicepublic.fr	Public information portal	Private cloud	Citizens, associations, SMEs	e-gov platform
Inter-ministry cloud	Infrastructure sharing	-	Ministerial employee	Cloud initiative
Netherlands				
Central private cloud	Centralisation of infrastructure	-	Employees of the administration	Cloud initiative
AppStore	Application hosts (in preparation)	-	Employees of the administration	Cloud initiative
SURFnet cloud brokerage and infrastructure	*Joint procurement and cloud adoption in education and research, including a middleware infrastructure to interconnect cloud services*	*Public cloud Community cloud Iaas, Paas, SaaS*	*Higher education and research*	*Cloud initiative*
Spain				
ACCEDA	Implementation of administrative procedures	Private cloud SaaS	Citizens and institutional websites	eGov and cloud initiative
ORVE/REC	Virtual registry office and common electronic registration window	Private cloud SaaS	Citizens and employees of the administration	eGov and cloud initiative
INSIDE	Electronic document management system	Private cloud SaaS	Citizens and employees of the administration	cloud initiative
RUN	Allows shortening URLs (for IM, email, social networks)	Private cloud SaaS	Citizens	eGov and cloud initiative
PORTAFIRMAS	e-signature platform	Private cloud SaaS	Citizens	cloud initiative
eMail	eMail platform	Private cloud SaaS	Citizens and employees of the administration	eGov and cloud initiative
eInvocing	Invoicing web platform	Private cloud SaaS	Businesses and administrations	eGov and cloud initiative
Belgium				
Expected cloud initiatives	No specific cloud applications are currently expected	IaaS in a private or public cloud	First : Fedict itself, then other Federal Public Services	Cloud initiative
Austria				
Expected cloud initiatives	No specific cloud applications are currently expected	Private cloud is recommended in the white paper	Administrations and ministries	Cloud initiative

Figure 15: User, performance, security and privacy requirements for selected apps

Country	User requirements	Performance	Security and privacy
UK			
CloudStore	Quality assurance required, high degree of duplication	-	Data protection compliance mandatory, personal data framework agreement between public body and customer, engagement of the service buyer regarding personal data processing Security Impact Levels (IL) below IL4
Italy			
M@E Cloud	High reliability, scalability, standardisation, management, re-usability in other public administrations, energy saving and low environment impact, security	Bandwidth able to host 400 virtual units	Defined in contract specifications
DT Cloud	-	12 Gbit/s between sites and latency < 1ms	Data recovery project Cloud security framework
Germany			
GoBerlin	Data protection Personal data use	no	Importance of privacy
Denmark			
NemHandel (Denmark)	-	Back up system	High requirements to avoid errors application
Miljøportal (Denmark)	Ability to work online and offline	-	Back up systems Personal data management
France			
Chorus Facture (France)	Back-up system Data protection requiring internal storage	Short latency and response time Ajusted bandwidth	Data protection Audit on security requirements
Chorus Déplacement Temporaire (France)	Back-up system Data protection requiring internal storage	Short latency and response time Ajusted bandwidth	Data protection Audit on security requirements
Spain			
ORVE / REC	Internal infrastructures implementation High security level “Open” user interface (compatibility) and easy to use	Low latency time High speed transfer rate	Data protection Standards for security and privacy interoperability

Figure 16: SLAs, standards and legacy migration requirements for selected apps

Country	SLAs	Standards and data portability	Legacy migration
CloudStore (UK)	Included in the Cloud Services Framework Agreement	-	no
M@E Cloud (Italy)	Defined in contract specifications	Standards considered	no
DT Cloud (Italy)	SLA defined including reliability requirements and timing for provision and assistance	Guidelines for standard operation environment	No
GoBerlin (Germany)	-	Security of data portability	no
NemHandel (Denmark)	Premium support SLA Gold	-	yes

Country	SLAs	Standards and data portability	Legacy migration
Miljøportal (Denmark)	Defined in contracts	-	yes
Chorus Facture (France)	SLA with penalties (without details)	No standards	no
Chorus Déplacement Temporaire (France)	SLA with penalties (without details)	No standards	no
REC/ORVE (Spain)	SLA for all services No penalties applied for the moment	SICRES standard for application forms	No

Table 13 Main solutions implemented to overcome barriers to cloud deployment and evolutions still needed

Country	What is done to overcome barriers to the deployment of cloud	What still needs to be done
UK	¶ Propagation programme to raise awareness and engagement with G-Cloud: including specific support whenever required and a system of training session – or Camps (ApplyCamps and AccreditCamps are offered to suppliers wishing to apply and get accreditations for their services in the CloudStore, while BuyCamps are for UK for public sector authorities who want to purchase service) ¶ Exchange of good practices: with the creation of a community group on the Knowledge Hub (*Local Government Association*) for exchanges between the users of the CloudStore ¶ Federated management structure with involvement of a cross-governmental team in the implementation of the G-Cloud programme	¶ Lack of flexibility in procurement processes: a revision to EU Procurement rules to allow for an open G-Cloud framework to which suppliers can apply at any time would be beneficial in order to make the process more efficient and less onerous.
IT	¶ Drafting of recommendations on cloud adoption in the public sector at the central governmental level (in consultations with main stakeholders) ¶ Training sessions to raise awareness of cloud around Italian public administration (DT Cloud) ¶ Drafting of technical guidelines with best practices for the development of cloud apps (DT Cloud)	¶ Establishment of a central governance mechanism for the deployment of cloud in the public sector ¶ Promote the diffusion of information on cloud and the exchange of good practice, through the establishment of a network of cloud experts or champions across public administration ¶ Streamlining of data centres and introduction of common standards ¶ Adopt common standards for cloud-based services and applications ¶ Redefinition of the ICT profession in the public sector, including integration of ne skills and competencies linked to the management of cloud services ¶ Draft national or European regulation for cloud service contracts and use of Privacy Level Agreement to clearly define the respective obligations and responsibility of cloud providers and public administration as part of cloud service agreement ¶ Elaboration of national or European guidelines on the obligations and

Country	What is done to overcome barriers to the deployment of cloud	What still needs to be done
		responsibility of both parties in terms of personal data protection ¶ Transfer good practices from abroad for the protection of data privacy and security ¶ Improvement in the transparency of security practices of cloud providers
NL	¶ Commissioning of a study to assess actions to be implemented on cloud computing (by Economic Affairs)	¶ To get the framework conditions right to ensure a safe and secure Cloud Computing framework
FR	¶ External technical support to DILA to manage HR and technical changes	¶ More detailed SLAs to increase users' trust ¶ Standardisation ¶ Maturity of technologies
DK	¶ Consultations with policy makers, cloud users and providers	¶ Drafting of special agreements with cloud service providers ¶ Changes in IT sourcing strategies
DE	¶ N/A	¶ Implement harmonised federal rules at Länders
ES	¶ N/A	¶ The economic crisis can lead to possible mutualisation of the infrastructures and egov services in order to reduce costs.
PT	¶ N/A	¶ Good regulation at national and European levels ¶ Sharing experience within Europe on successful implementations
BE	¶ Several specifications in the Request for Consultation to procure a Belgian Federal cloud address the risks that are usually associated with cloud computing, among others: ¶ Security: a second standby cloud provider is selected in order to ensure continuity in operations in the event of a failure of the first infrastructure (e.g. in case of natural disaster) ¶ Encryption of data so that they stay out of the reach of cloud service providers. ¶ Use of cloud broker services in order to simplify the migration to a different cloud provider if needed.	¶ Changes in national procurement law would be required in Belgian if a Cloudstore model is to be considered.
AT	¶ N/A	¶ Necessity to negotiate adequate Service Level Agreements (SLAs) and Operations Level Agreements (OLAs).

Pilots

Table 14 : suggestions for pilots and evolutions from Member States

	Projects not really concrete yet but mentioned that could serve as suggestions	**Projects that have been suggested or that should be avoided**
United Kingdom	By procuring a cloud-based service HMRC (HM Revenue and Custom) aims to make the iForms solution scalable in line with future demand for digital services."	
Italy	Providing "light" and "Internet-based" (i.e. web call centers) information Implementing telematics payment for the services provided	Evolution needed : Pilot projects in a few priority areas (i.e. education, health e-government)" What is lacking in Italy is the provision of horizontal services across administrations in the government.
Germany	Nothing specific (GoBerlin is just R&D project : marketplace of citizen-type services like address change)	It is not useful to put all applications in the cloud but there is no specific rule to go or not to go on cloud (except in health sector for which data must remain within hospitals).
Denmark	Nothing specific (beyond the CloudStore)	A lot applications could be in theory be cloudified; although the first application that can be migrated relatively easily in the cloud would be those without the use of personal data. "ig challenges for tax return applications as it requires a lot of capacity.
France	Other initiatives that are under consideration may be triggered such as : Platform as a service solutions in order to provide a standard execution environment for the design and deployment of e-services and applications Application store for "horizontal" applications such as communication tools, content management tools, archiving tools …"	The applications that handle critical and confidential data can be migrated in the cloud, in the case of a private cloud (as provided by the DILA).
Netherlands	Nothing specific	Focus on creating the framework conditions for safe and reliable Cloud Computing."
Spain	A full cloudification is not planned, as it would not be useful in terms of usage. Cloudification is useful for common applications are these applications are centralized at the national scale for all regional and local entities (in addition to national entities).	Some applications are currently not expected to be cloudified, but are eligible to such operation cause they may not be profitable, as cloud is for boosting economies of scale.
Portugal	Personal data is not addressed enough	
Belgium	Nothing specific beyond the cloudStore According to the interviewees, the Cloudstore model used in the UK was also an attractive model that has been considered. Such an initiative was not be possible in Belgium due to the Belgian legislation on procurement.	Fedict is only considering IaaS at the time, since most of its applications are critical and it is essential for the organisation to keep control of the operating system and applications.
Austria	Migration of the Austria's Legal Information System (RIS) into the cloud A good example for a potential cloud deployment would be the software to determine petrol costs in Austria (http://www.spritpreisrechner.at/). The data used is not personal, it is reproducible and restorable and therefore an optimal example for a potential cloud deployment. However, for various reasons, the calculator was not cloudified. When the service was introduced in 2009, it was accessed a great deal and the service frequently 'crashed', so that the service providers decided to upgrade the server. Nowadays, the servers are often idle. A cloud solution would have been better able to cope with these differences in use.	Any type of application is discussed by the initiative, even though some of them are favoured. The general rule is that less sensitive the data in terms of data protection, the more likely a cloud solution will be adopted. Cloud only saves costs in case of s*hort - term* spikes in demands which do not exist in the Austrian public administration. In case of higher consumer (citizen) involvement, which would imply that short-term peaks will be much more of an issue and a self-service portal is of obvious importance, there would also be a much higher need for cloud solutions.

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