REALIZATION OF A RESEARCH AND DEVELOPMENT PROJECT (PRE-COMMERCIAL PROCUREMENT) ON "CLOUD FOR EUROPE"

TECHNICAL SPECIFICATION: FEDERATED CERTIFIED SERVICE BROKERAGE OF EU PUBLIC ADMINISTRATION CLOUD

ANNEX IV (B)
TO THE CONTRACT NOTICE

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CLOUD FOR EUROPE

FP7-610650

EXECUTIVE SUMMARY

Note: This is an informative summary of the document. The actual specification relevant for the bids is in the remainder of the document.

Several EC studies (i.e. [1], [2], [3]) show that EU countries' Government Clouds are heterogeneous at different stages of development and for the time being mostly confined within country borders. On the contrary, European Cloud Communication [4] calls for a single digital market and suggests Public Administrations to be front runners of the single Cloud market creation. Taking the current status into account, the assumed realistic architecture of European Union Public Administration (PA) Cloud is the federation of Government Clouds of EU Member States. In order to provide PA Cloud services from a given country cross-border for PA customer in other countries, a secure, interoperable, legislation-aware environment within Federated EU PA Cloud needs to be established.

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1 FEDERATED CERTIFIED SERVICE BROKERAGE OF EU PUBLIC ADMINISTRATION CLOUD

According to Table 1 of *Annex IV(A): Cloud for Europe: Challenges and General Requirements* this lot covers the challenges as listed in Table 1 below. An overview of all defined challenges and a short informative description is given in Annex IV(A). A detailed description and specification of the lot is given in the remainder of this document.

Table 1 - Federated Certified Service Brokerage of EU Public Administration Cloud lot challenges

Phase	No.	Challenge Summary	Lot	Award Criteria
Design, Procuremen	1	Interoperability for cross-border federated cloud service selection and competition	1: FCSB	Q1, I2, I3
	2	Matching customer requirements with cloud service specification	1: FCSB	I2, I3
Transition, Delivery	4	Defining means of assuring service compliance with legislation of EU countries	1: FCSB	I2, I3
Operation	9	Legislation awareness, dynamic management, and propagation	1: FCSB	S1, S2
	10	Cloud service SLA assessment and monitoring	1: FCSB	S4
	11	Seamless change of service provider	1,2,3 (all)	Q1, I2, I3

1.1 INTRODUCTION

Note: This is an informative introduction to the topic. The actual specification relevant for the bids is in the remainder of the document.

Even today, a number of useful cloud services have already been implemented for Public Administration (PA) within various EU countries. If they were made available more broadly and cross-border, they would allow PAs from different countries, to make use of them for the purpose of:

- solving their business needs
- or reducing costs

However, such use is currently associated with several challenges specified in Chapter 1:

- Interoperability for cross-border federated cloud service selection and competition
- Matching customer requirements with cloud service specification
- Defining means of securing service compliance with EU countries legislation
- Legislation awareness, dynamic management and propagation
- Cloud service SLA assessment and monitoring
- Seamless change of service provider

The objective of this service is to define an EU Cloud for Public Administration, by creating a Federated Certified Service Brokerage (FCSB) system established at the national level. FCSB shall have the authority to govern a central catalogue of certified cloud services and all the processes related to cloud service certification, acquisition and operation. This catalogue will, in addition to services built at national level, also include mediated certified services from other countries and will unify service categorization, certification and legislative compliance taxonomy.

The FCSB will be linked with the corresponding FCSB in other countries, creating an interoperable system with autonomous service discovery. At national level FCSB will be a single point of contact for interoperability within a heterogeneous federated EU Cloud for PA. This ecosystem of interoperable brokers will substantially simplify the cloud service discovery and consumption and will help to lower the overall operational costs for public sector customer, and barriers-to-entry of European SME service providers along with providing the highest possible level of security, private data protection legislation awareness and guarantee

of using only certified and continuously monitored services provided by any Cloud Service Provider within Federated EU Cloud for PA users.

FCSB services are created on top of the standard Cloud Service Broker (CSB) responsibilities. Following are those, which really stand out in the context of a non-commercial FCSB proposal and need attention on research level:

- **Interoperability and customer requirements matching with service specifications:** Definition of service metadata registry governance in the context of federated EU Cloud ecosystem.
- **Service certification and monitoring:** Continuous real-time verification of the cloud service non-functional properties fulfilment.
- **Legislation and regulation:** Standardization of legislation change semantics and propagation.

1.2 BUSINESS CONTEXT

As indicated in the EC study "Analysis of cloud best practices and pilots for the public sector" [2], there is currently considerable heterogeneity within the EU, when it comes to Cloud computing adoption. This condition is a manifestation of the variety of strategies followed for the implementation and use of cloud services, each EU country is pushing for and gets funding for. In principle, it can be stated that all the forms of deployment (public, private, community and hybrid) are being used in various combinations.
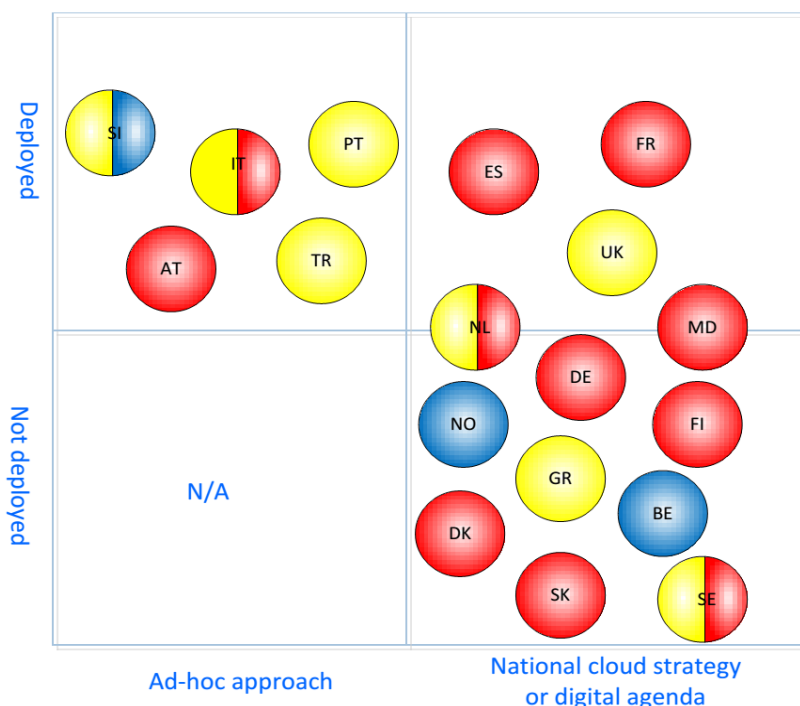
Figure 1 ENISA's „Good Practice Guide for securely deploying Governmental Clouds" [1]

The image above gives the categorization of the deployment models used in EU governmental Clouds: red circles refer to private cloud services, yellow circles to public cloud and blue to community Clouds.

In this situation, it is very difficult to define the role of cloud service brokerage, and the definition of such service brokerage, and its role in the interoperable network of nationally built cloud services. This is precisely the challenge that the Federated Cloud Service Brokerage is aiming to solve.

As cloud computing adoption proliferates, so does the need for consumption assistance and for service governance in general. Cloud services brokerage is a rapidly growing category of cloud computing, but as the Gartner's Hype Cycle (July 2013) [5] graph below shows – it is still in its initial research phase with estimated 5-10 years to reach the "plateau of productivity".
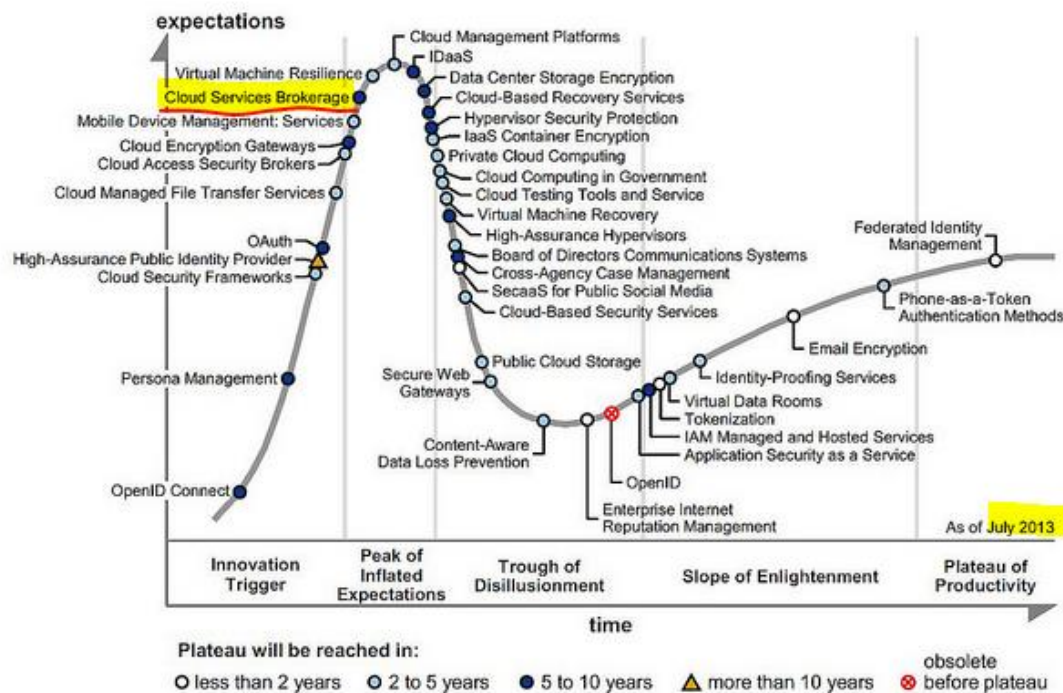
Figure 2 Gartner's Hype Cycle (July 2013) [5]

Gartner: „A cloud services brokerage (CSB) plays an intermediary role in cloud computing. CSBs make it easier for organizations to consume and maintain cloud services, particularly when they span multiple providers. "

The current market of CSB platform solutions is still very limited in size and with debatable clarity of individual value-added propositions. Nevertheless, the following is an arbitrary and not complete set of examples of currently existing CSBs. To our understanding none of those can provide a complete solution to the defined challenges in the context for the Cloud for Europe project:

- ***Gravitant cloudMatrix*** *is a cloud brokering software suite that addresses the entire IT value chain: assess, compare, design, procure, provision, operate, and control as well as the new area of broker operations. The consolidation of virtualized resources, public clouds, private clouds, and the integration of managed services through the entire lifecycle makes cloudMatrix the only software that supports an IT-as-a-Service model.[1]*
- ***Jamcracker*** *enables organizations to manage and deliver their own multi-cloud services as well as broker 3rd party providers'. IT organizations and service providers*

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[1] http://www.gravitant.com/cloudmatrix-overview/ 23.07.2014

can now unify private, public and hybrid cloud consumption for their employees, customers and through their channels.[2]

- *AppDirect offers the only cloud service delivery platform that exceeds the functionality provided by the most established distribution channels for on demand services, such as the Google Application Marketplace, Salesforce Appexchange, and the Apple App Store.[3]*

Other similar approaches include DeltaCloud, CloudSwitch and open source Aeolus. In any of these exemplary cases, however, we cannot perceive a solution that focuses on brokerage of cloud services in the EU context, or a solution, which upon deployment, solves all the corresponding PA Clouds challenges: metering, interoperability and legislation/regulation.

The UK Government G-Cloud initiative can be viewed, in some strategic alignment with this proposal, as of comparable capability. However, G-Cloud is closer to a simple incremental evolution of a commercial cloud service catalogue solution than a full-fledged PA CSB. The core responsibilities of FCSB go beyond being a mere service catalogue management – or cloud national "marketplace" governance; they are much broader in both the technical and business domains.

The service catalogue of FCSB would, in addition to services built at national level, include mediated services from other countries as well. In this way the FCSB would be interoperable with the corresponding FCSBs in other countries, creating a truly interconnected Europe-wide system. This ecosystem of interlinked CSBs and their catalogues will require standardized definition of SLA and Service Level Metrics (SLM) and will drive the general service standardization for enhanced interoperability.

1.3 LOT-SPECIFIC REQUIREMENTS

Note: Annex IV(a) contains a general requirement section which applies to all three lots. Bidders are expected to also respond to the common general requirements.

The main objective of FCSB is to ensure an easy and reliable brokerage of cloud services provided by national Cloud Service Providers (CSP) or CSPs within EU federated Cloud for PA

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[2] http://www.jamcracker.com/ 23.07.2014
[3] http://info.appdirect.com/products/marketplace-management-platform 23.07.2014

consumers at the national level (G2G, G2B, G2C). FCSB will also serve as a mediator for national and EC strategies harmonization.

The PA user of EU country *'A'* will be able to look through, not only cloud services at national level, but also through the list of all cloud services available within the federated EU PA Cloud. Once the cloud service of desired functionality is found and happens to be provided by cloud service provider in country *'B'*, part of the service usage initialization phase, the automated certification process of country *'A'* of legislation compliance will take place. In case of non-compliance either automated or human assisted correction process will – if possible – make Cloud service compliant with country *'A'* legislation. From this point on, the PA Cloud service is continuously monitored, legislation changes – of country *'A'* as well as of country *'B'* – are automatically propagated to PA Cloud service and service is automatically recertified. For legislation enforcement and/or legislation changes propagation, the appropriate legislation semantics means will be used (interrelation with Legislation Executing Cloud Services lot). This way, PA Cloud service cross-border legislation compliance will be certified, monitored and legislation changes propagated only for those countries where PA users are interested in using this Cloud service and limited overhead is ensured.

FCSB is established at the national level and shall have the authority to govern a central catalogue of certified cloud services and all the processes related to cloud service certification, acquisition and reliable operation. This catalogue will, in addition to services built at national level, also include mediated certified services from other countries and will unify service categorization and certification, and legislative compliance taxonomy. FCSB will be linked with the corresponding FCSB in other countries, creating an interoperable system with autonomous service discovery. At national level, the FCSB will be a single point of contact for interoperability within heterogeneous federated EU Cloud providing guarantees of using only certified services. This ecosystem of interoperable brokers will substantially simplify the cloud service discovery and consumption and will help to lower the overall operational costs for public sector customer, and help lowering current barriers-to-entry to European SME cloud service providers.

FCSBs established in all EU countries will create a distributed cooperating ecosystem which will secure interoperability within heterogeneous Federated EU PA Cloud and act as agents in a process of cross-border certification, monitoring and legislative changes propagation (apart of standard brokerage, i.e. contracting, monitoring, metering and billing).

Business aspects of the solution are the following

- Definition of the criteria the FCSB must comply with
- Definition of common certification criteria for PA service inclusion in the catalogue of services
- Definition of rules for usage of standardized SLA metrics and their applicability [7]
- Definition of the core business processes and roles
- Set of services definition, FCSB must provide at minimum

Technical aspects of the solution are the following

- FCSB reference architecture definition
- Technical reference implementations recommendations

Specifically, activities around FCSB need to address the following problem areas and come up with some innovative solutions for them.

The following sub sections specify general requirements for FCSB, which need to be addressed. The referenced actors are based on the definition of NIST[6], refer to the *Glossary* for the specification.

1.3.1 *S1LR1 – INTEROPERABILITY*

Table 2 - Interoperability

ID	S1LR1 (Interoperability)
Actors	Cloud Consumer, Cloud Broker, Cloud Provider
Description	*Definition of service governance for enhanced interoperability.* One of the interoperability themes FCBS is aiming to solve is definition of service metadata registry governance, which would help to fully understand the state and scope of the service portfolio by communicating and managing the lifecycle of the services, and by identifying the dependencies between services and consumers. Another potentially high impact area of PA FCSB proposal in the domain

	of interoperability is a standardized information bus for data portability and integration through data services hosting and data stores integration. This would provide central place, as a part of federated EU Cloud, for secure and managed data access across federated data stores, data service transactions, and data transformation with the ability to create composite data views
Applicable award criteria	C1, C2, C3, C4, I1, I2, I3, I4, S2, S3, S5, P1, P2, Q1, Q2, Q3, Q4, Q6, Q7, General
Constraints	

Data portability and the seamless use of applications that can communicate and interoperate with each other are key considerations for cloud services consumers. The EU has put interoperability at the heart of its Digital Agenda, recognizing that the interoperability of services and data is central to promote user acceptance, increased value and choice.

MAIN CHALLENGES

- Cross-border broker interoperability (#1)
- Matching customer requirements (#2)
- Seamless change of service provider (#11)

MAIN OBJECTIVES

- Service metadata registry governance (declarative service configuration templates, API repository governance, …)
- Standardized information bus for data portability
- Standardized mechanisms for identity propagation

1.3.2 **S1LR2** – *SERVICE CERTIFICATION*

Table 3 - Service Certification

ID	S1LR2 (Service Certification)
Actors	Cloud Consumer, Cloud Broker, Cloud Provider
Description	*Continuous real-time verification of the cloud service non-functional properties fulfilment.* The cloud service assessment and monitoring process is to be able to verify whether a cloud service does fulfil a set of the properties while in execution. The properties to be verified are non-functional and are relevant when considering a cloud service being executed. Thus, this process must be supported by a continuously running service that assesses and monitors other cloud services. Such evaluation is for certification purposes and should not tamper with actual critical data. Given the results obtained, regarding each property, the certification service attributes a classification according to the degree of fulfilment.
Applicable Award Criteria	C1, C2, C3, C4, I1, I2, I3, I4, S2, S3, S5, P1, P2, Q1, Q2, Q3, Q4, Q6, Q7, General
Constraints	

There is a clear need for the certification of cloud services regarding relevant non-functional properties such as availability, performance, elasticity and consistency guarantees, etc. often while they are already being offered and in execution. Apart from cost and functional compliance, such non-functional properties are frequently determinant for the public entity mission but difficult to assess and to be used to compare service offerings.

The properties to be certified by the certification service are not a closed set. Initially, the ones considered more relevant are the following, and may be even tested in combination for increased levels of "real-world" certification:

- Performance
- Interoperability
- Availability and Resilience
- Consistency Guarantees
- Elasticity
- Geo-replication
- Vulnerability assessment

MAIN CHALLENGES

- Cloud service SLA assessment and monitoring (#10)

MAIN OBJECTIVES

- Architecture designed around a framework of components, one for each property to be assessed, that may be combined, extended and reused, all based on a core that generates and manages sets of requests, request streams, monitoring and timings.
- Certification with assurance of consistency and elasticity properties in the presence of geo-distributed or geo-replicated cloud provider resources and instances.

1.3.3 *S1LR3 – LEGISLATION AND REGULATION*

Table 4 - Legislation and regulation

ID	S1LR3 (Legislation and regulation)
Actors	Cloud Consumer, Cloud Broker, Cloud Provider

Description	*Securing service legislation compliance and legislation changes propagation.*
	FCSB is the platform where the legislation and regulation issues could be managed in the most effective manner whether it would be through a simple information hub or via some intelligent automation logic. The most important advantage of solving these issues via FCSB is based on the premise that this would be the platform which would connect both sides of this story: those who consume the cloud services, which ought to comply with the given legislation and regulation requirements and CSPs who should secure compliance with legislation of EU countries.
Applicable Award Criteria	C1, C2, C3, C4, I1, I2, I3, I4, S2, S3, S5, P1, P2, Q1, Q2, Q3, Q4, Q6, Q7, General
Constraints	

It is broadly recognized that the lack of full EU harmonization of data protection rules is a recurring legal barrier. Nevertheless, even if legal harmonization would be the mainstream solution to break that barrier, the market will have to coexist with legal fragmentation for several years on. The services currently offered in the cloud market are not explicitly bound to legal requirements. That poses additional difficulties to public procurers, since they have to assess case by case, whether a given cloud service offering is in conformity with the applicable legal framework.

MAIN CHALLENGES

- Defining the means of securing service compliance with legislation of EU countries (#4)
- Legislation-awareness dynamic management (#9)

MAIN OBJECTIVES

- Standardized interface for legislative change propagation

- Legislation compliance assessment tools

1.4 FUNCTIONAL REQUIREMENTS

The referenced actors are based on the definition of NIST[6], refer to the *Glossary* for the specification.

Table 5 - Functional Requirements

ID	Actors	Importance	Applicable Award Criteria and questions	Description	Dependencies
S1FR1	Cloud Consumer, Cloud Broker, Cloud Provider	High	C1, C2, C3, C4, I1, I2, I3, I4, S2, S3, S5, P1, P2, Q1, Q2, Q3, Q4, Q6, Q7, General	Definition of service metadata registry governance, which would help to fully understand the status and scope of the service portfolio by communicating and managing the lifecycle of the services, and by identifying the dependencies between services and consumers.	
S1FR2	Cloud Consumer, Cloud Broker, Cloud Provider	Medium	The same Award Criteria as S1FR1	Definition and implementation of a model for functional and non-functional service level metrics and dynamic requirement matching algorithms with smart ranking in the distributed ecosystem of federated EU Cloud for Public Administration.	S1FR1

S1FR3	Cloud Consumer, Cloud Broker, Cloud Provider	High	The same Award Criteria as S1FR1	Definition of orchestration logic for service migration plan discovery and its fulfilment governance.	S1FR1 S1FR2
S1FR4	Cloud Consumer, Cloud Broker, Cloud Provider	High	The same Award Criteria as S1FR1	Certification with assurance of service level metrics compliance in the presence of geo-distributed cloud service providers and consumers.	S1FR3
S1FR5	Cloud Consumer, Cloud Broker, Cloud Provider	High	The same Award Criteria as S1FR1	Definition of models and methods to secure service compliance with legislation of EU countries.	
S1FR6	Cloud Consumer, Cloud Broker, Cloud Provider	Medium	The same Award Criteria as S1FR1	Definition of standardized API for cloud services and cloud service providers for legislative change propagation, adaptability and impact assessment and governance of services legislation compliance	S1FR1 S1FR5

1.4.1 *S1FR1 – CROSS-BORDER BROKER INTEROPERABILITY*

The key aspect of this functional requirement is related to the distributed manner of federated cloud service governance and smart allocation of responsibilities within such federated ecosystem to balance the local authority preservation with the inter-connectivity and interoperability requirement which is essential for better cost-effectiveness.

SCOPE

- Design concepts and implement methods for service metadata registry governance in such distributed ecosystem, supporting intelligent service discovery, context-aware service management and fluid service integration.
- Data portability assurance, which significance gets emphasized in this federated ecosystem of services. The service and information co-location is not guaranteed and

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this needs to be addressed via development of standardized information bus allowing secure and distributed information availability.

OUTPUT

- Declarative service configuration templates
- Distributed service contract management

1.4.2 *S1FR2 – MATCHING CUSTOMER REQUIREMENTS*

A Public Administration (PA) customer in any EU country should be provided with a guarantee of security, legislation awareness and other non-functional requirements when using any cross-border service within heterogeneous environment of FCSB. Therefore, the research challenge is to match customer functional and non-functional requirements in heterogeneous federated ecosystems.

SCOPE

- Automated service discovery based on service metadata registry in all EU countries describing functional and non-functional attributes of all services certified for PA use.
- Automated assessment of possibility to meet customer requirements by services aggregation even in the cross-border context
- Automated assessment of customer requirements matching level of preselected services if none of them fully meets the requirements in order to provide data for human assisted decision/SLA negotiation.

OUTPUT

- Declarative model for service level metrics definitions
- Intelligent service discovery mechanism operating in federated ecosystem of services

1.4.3 *S1FR3 – SEAMLESS CHANGE OF SERVICE PROVIDER*

The service portability is an integral part of the general prerequisites and guarantees that all cloud services will provide the means for data portability. Moreover the S1FR2 will provide the methods for service discovery matching the given requirements, which will be preserved

via S1FR1 service metadata registry. The remaining complexity of service migration plan discovery and intelligent governance of its execution is the main aspect of this requirement.

SCOPE

- Utilizing S1FR1 and S1FR2, develop methods for determining the most suitable service migration plan and implementation of orchestration processes for administrating the plan execution in a secure and transactional manner

OUTPUT

- Orchestration logic for determining plan and overseeing service migration along with all necessary information and metadata.

1.4.4 *S1FR4 – CLOUD SERVICE SLA ASSESSMENT AND MONITORING*

The core proposition of presented challenges is the ability to not only oversee the manifold diverse properties of utilized services in real-time, but also to be able to provide all the critical information for the appropriate reaction when necessary.

SCOPE

- Define an architecture designed around a framework of components, one for each property to be assessed, that may be combined, extended and reused, all based on a core that generates and manages sets of requests, request streams, monitoring and timings.
- Develop methods for certification with assurance of consistency and elasticity properties in the presence of geo-distributed or geo-replicated cloud provider resources and instances.

OUTPUT

- Enhanced capabilities for describing allowable service level metrics compositions

- Service location-aware monitoring platform
- Distributed monitoring platform for last mile verification

1.4.5 *S1FR5 – DEFINING THE MEANS OF SECURING SERVICE COMPLIANCE WITH LEGISLATION OF EU COUNTRIES*

The legislation and regulation is the main communication protocol for conveying the critical information through the hierarchy of organizational units within public administration, and the research theme overarching the particular challenges here defined is to bring this solely human to human communication to a computer understandable form.

SCOPE

- Define standardized generic data model for legislative domain to be used for capturing complex legal and regulation concepts and constraints. These will be used for computer understandable linking to functional or nonfunctional service level metrics.

OUTPUT

- Complex and agile data model for legislative domain

1.4.6 *S1FR6 – LEGISLATION-AWARENESS DYNAMIC MANAGEMENT*

Once the legislative concepts are captured in the well-defined model, the applicable aspects of these legislative concepts need to be mapped to the appropriate functional and non-functional service level metrics. Methods and interfaces should be created for securing legislation compliance. The final key challenge is to provide the framework and the intelligence to determine, emulate and run the scenarios for legislative change propagation through the cross-bordered and aggregated services in a legislative heterogeneous environment.

SCOPE

- Develop the methods and interfaces for easy legislative change propagation through the potentially cross-bordered and composite services.
- Develop the methods and interfaces for securing services legislative compliance

- Implement assessment tools for legislative change emulation in order to get an estimate of the change impact within already procured service portfolio.

OUTPUT

- Easy-to-use methods and programming interface for securing service legislative compliance and legislative change propagation

2 REFERENCES

[1] ENISA, Good Practice Guide for securely deploying Governmental Clouds, TP-04-13-040-EN-N, 2013.

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[7] C-SIG-SLA, Cloud Service Level Agreement Standardisation Guidelines, Brussel, 2014