SEVENTH FRAMEWORK PROGRAMME

THEME [ICT-2009.1.2]
[Internet of Services, Software and Virtualisation]

Grant agreement for: Collaborative project*

Annex I - "Description of Work"

Project acronym: Cloud4SOA

Project full title: " A CLOUD INTEROPERABILITY FRAMEWORK AND PLATFORM FOR USER-CENTRIC, SEMANTICALLY-ENHANCED SERVICE-ORIENTED APPLICATIONS DESIGN, DEPLOYMENT AND DISTRIBUTED EXECUTION "

Grant agreement no: 257953

Date of preparation of Annex I (latest version): 2010-09-16

Date of last change: 2010-09-02

Table of Contents

Part A

Workplan Tables

A1:
Project summary

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per project

General information

Project title [3]	A CLOUD INTEROPERABILITY FRAMEWORK AND PLATFORM FOR USER-CENTRIC, SEMANTICALLY-ENHANCED SERVICE-ORIENTED APPLICATIONS DESIGN, DEPLOYMENT AND DISTRIBUTED EXECUTION		
Starting date [4]	01/09/2010		
Duration in months [5]	36		
Call (part) identifier [6]	FP7-ICT-2009-5		
Activity code(s) most relevant to your topic [7]	ICT-2009.1.2: Internet of Services, Software and Virtualisation		
Free keywords [8]		Cloud Interoperability, Scalability, Security, User-Centricity, Semantic-Enhancement, Semantic Cloud	

Abstract [9]

Cloud4SOA focuses on resolving the interoperability and portability issues that exist in current Clouds infrastructures and on introducing a user-centric approach for applications which are built upon and deployed using Cloud resources. To this end, Cloud4SOA aims to combine three fundamental and complementary computing paradigms, namely Cloud computing, Service Oriented Architectures and lightweight semantics to propose a reference architecture and deploy fully operational prototypes.
The 36-month Cloud4SOA project will result in:
R1. The Cloud4SOA Cloud Semantic Interoperability Framework, which will provide a set of recommendations and good practices on how to achieve semantic interoperability between different Cloud platforms.
R2. The open, generic Cloud4SOA Reference Architecture, which will introduce a scalable, reusable and transferable approach for facilitating the design, deployment and execution of resource intensive SOA services on top of semantically interlinked Clouds.
R3. The Cloud4SOA lightweight models for resources and services which will offer the necessary semantics for annotating computing resources and SOA services.
R4. The Cloud4SOA platform as a reference implementation based on the Cloud Semantic Interoperability Framework and the Cloud4SOA Reference Architecture.
R5. Three showcases which will validate and prove the proposed Cloud4SOA architecture, models and tools.
R6. Wide-scale dissemination and exploitation of the project results to the European academic, scientific and business stakeholders and end-users organizations through the formulation and active day-to-day support of a broad Community of Practice or Interest Group on Cloud Semantic Interoperability. The goal of this group will be to raise Cloud Interoperability related issues to international standardization bodies (e.g. W3C, OASIS)
Led by ATOS, the Cloud4SOA consortium consists of nine (9) partners, from six (6) EU member states, i.e. Spain, Ireland, Greece, Germany, Portugal and Romania.

A2:
List of Beneficiaries

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

List of Beneficiaries

No	Name	Short name	Country	Project entry month[10]	Project exit month
1	ATOS ORIGIN SOCIEDAD ANONIMA ESPANOLA	ATOS	Spain	1	36
2	NATIONAL UNIVERSITY OF IRELAND, GALWAY	NUIG	Ireland	1	36
3	SINGULARLOGIC ANONYMOS ETAIRIA PLIROFORIAKON SYSTIMATON & EFARMOGON PLIROFORIKIS	SINGULARLOGIC	Greece	1	36
4	CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS	CERTH	Greece	1	36
5	CLOUDCONTROL UG (HAFTUNGSBESCHRÄNKT)	CLOUDCONTROL	Germany	1	36
8	CYNTELIX CORPORATION BV	CYNTELIX	Netherlands	1	36
9	PORTUGAL TELECOM INOVACAO SA	PTIN	Portugal	1	36
10	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	FIT	Germany	1	36
11	ROMTELECOM SA	ROMTELECOM	Romania	1	36

A3:
Budget Breakdown

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One Form per Project

Participant number in this project [11]	Participant short name	Fund. % [12]	Ind. costs [13]	Estimated eligible costs (whole duration of the project)					Requested EU contribution
				RTD / Innovation (A)	Demonstration (B)	Management (C)	Other (D)	Total A+B+C+D	
1	ATOS	50.0	A	580,947.00	0.00	134,681.00	0.00	715,628.00	425,154.00
2	NUIG	75.0	T	483,200.00	0.00	34,500.00	0.00	517,700.00	396,900.00
3	SINGULARLOGIC	50.0	S	729,600.00	0.00	60,100.00	0.00	789,700.00	424,900.00
4	CERTH	75.0	A	613,031.00	0.00	13,879.00	0.00	626,910.00	473,652.00
5	CLOUDCONTROL	75.0	T	345,955.00	0.00	12,422.00	0.00	358,377.00	271,888.00
8	CYNTELIX	75.0	F	319,200.00	0.00	12,000.00	0.00	331,200.00	251,400.00
9	PTIN	50.0	A	249,288.00	0.00	11,228.00	0.00	260,516.00	135,872.00
10	FIT	75.0	A	311,000.00	0.00	11,000.00	0.00	322,000.00	244,250.00
11	ROMTELECOM	50.0	A	201,000.00	0.00	12,750.00	0.00	213,750.00	113,250.00
Total				3,833,221.00	0.00	302,560.00	0.00	4,135,781.00	2,737,266.00

Note that the budget mentioned in this table is the total budget requested by the Beneficiary and associated Third Parties.

*** The following funding schemes are distinguished**

Collaborative Project (if a distinction is made in the call please state which type of Collaborative project is referred to: (i) Small of medium-scale focused research project, (ii) Large-scale integrating project, (iii) Project targeted to special groups such as SMEs and other smaller actors), Network of Excellence, Coordination Action, Support Action.

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project, and it cannot be changed. The project number **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

2. Project acronym

Use the project acronym as indicated in the submitted proposal. It cannot be changed, unless agreed during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry info force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a detailed justification on a separate note.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Activity code

Select the activity code from the drop-down menu.

8. Free keywords

Use the free keywords from your original proposal; changes and additions are possible.

9. Abstract

10. The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

11. The number allocated by the Consortium to the participant for this project.

12. Include the funding % for RTD/Innovation – either 50% or 75%

13. Indirect cost model

A: Actual Costs
S: Actual Costs Simplified Method
T: Transitional Flat rate
F :Flat Rate

Workplan Tables

Project number

257953

Project title

Cloud4SOA—A CLOUD INTEROPERABILITY FRAMEWORK AND PLATFORM FOR USER-CENTRIC, SEMANTICALLY-ENHANCED SERVICE-ORIENTED APPLICATIONS DESIGN, DEPLOYMENT AND DISTRIBUTED EXECUTION

Call (part) identifier

FP7-ICT-2009-5

Funding scheme

Collaborative project

WT1
List of work packages

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

LIST OF WORK PACKAGES (WP)

WP Number [53]	WP Title	Type of activity [54]	Lead beneficiary number [55]	Person-months [56]	Start month [57]	End month [58]
WP 1	Cloud4SOA Reference Framework	RTD	4	41.00	1	9
WP 2	Cloud4SOA Semantic Layer	RTD	2	38.00	7	21
WP 3	Cloud4SOA Intelligent Interfaces and Service Front-Ends Layer	RTD	8	31.50	7	21
WP 4	Cloud4SOA SOA Layer	RTD	2	42.50	7	21
WP 5	Cloud4SOA Governance Layer	RTD	1	38.50	7	21
WP 6	Cloud4SOA Virtualization and Execution Layer	RTD	3	42.00	7	21
WP 7	Cloud4SOA Platform Integration and Infrastructure Deployment	RTD	3	42.00	13	27
WP 8	Showcases Development and Overall Performance Evaluation	RTD	10	77.50	3	36
WP 9	Innovation Management, Dissemination and Exploitation	RTD	1	48.50	1	36
WP 10	Consortium and Project Management	MGT	1	28.00	1	36
			Total	429.50		

WT2:
List of Deliverables

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

List of Deliverables - to be submitted for review to EC

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D1.1	Requirements Analysis Report	1	4	9.00	R	PU	6
D1.2	Cloud4SOA Cloud Semantic Interoperability Framework	1	4	16.00	R	PU	9
D1.3	Cloud4SOA Reference Architecture	1	4	16.00	R	PU	9
D2.1.1	Cloud4SOA Semantic Layer Models - Preliminary Draft	2	2	6.00	R	CO	12
D2.1.2	Cloud4SOA Semantic Layer Models	2	2	8.00	R	RE	15
D2.2	Cloud4SOA Semantic Layer Components	2	2	24.00	P	RE	21
D3.1	User Interaction Model	3	8	5.50	R	RE	12
D3.2	Intelligent Interfaces Architecture and Cloud4SoA Widget Framework	3	8	9.00	R	RE	21
D3.3	Cloud4SOA Intelligent Interfaces	3	8	17.00	P	RE	21
D4.1.1	SOA layer software components v1 - Preliminary Draft	4	2	8.00	P	CO	12
D4.1.2	SOA layer software components v1	4	2	12.00	P	RE	15
D4.2	SOA layer software components v2	4	2	22.50	P	RE	21
D5.1.1	Cloud4SOA Service Lifecycle	5	1	5.00	R	CO	12

WT2:
List of Deliverables

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	Governance Framework - Preliminary Draft						
D5.1.2	Cloud4SOA Service Lifecycle Governance Framework	5	1	11.00	R	RE	15
D5.2	Cloud4SOA Service Lifecycle Governance Toolset	5	1	22.50	P	RE	21
D6.1.1	Cloud4SOA Network Infrastructure - Preliminary Draft	6	5	8.00	P	CO	12
D6.1.2	Cloud4SOA Network Infrastructure	6	5	12.00	P	RE	15
D6.2	Cloud4SOA Execution Environment	6	3	22.00	P	RE	21
D7.1	Cloud4SOA Platform Integrated Architecture and Integration Plan	7	3	10.00	R	RE	21
D7.2	Cloud4SOA Platform	7	3	32.00	P	RE	27
D8.1.1	Cloud4SOA Use Cases As-Is Analysis - Preliminary Document Draft	8	10	2.00	R	CO	12
D8.1.2	Cloud4SOA Use Cases As-Is Analysis - Preliminary Document	8	10	3.00	R	CO	15
D8.1.3	Cloud4SOA Use Cases As-Is Analysis	8	10	6.00	R	CO	24
D8.2	PTIN Business Intelligence Showcase	8	9	19.00	P	CO	32

WT2:
List of Deliverables

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D8.3	FIT Business Cooperation Showcase	8	10	19.00	P	CO	32
D8.4	RomTelecom Network Monitoring Showcase	8	11	19.00	P	CO	32
D8.5	Performance Evaluation and Lessons Learnt	8	10	9.50	R	CO	36
D9.1	Cloud4SOA Project Website	9	1	4.00	O	PU	4
D9.2.1	Communication and Dissemination Activities Report Y1	9	10	4.00	R	PU	12
D9.2.2	Communication and Dissemination Activities Report Y2	9	10	5.00	R	PU	24
D9.2.3	Communication and Dissemination Activities Report Y3	9	10	5.00	R	PU	36
D9.3.1	Market Analysis, IPR Model and Exploitation Plan v1	9	1	4.00	R	CO	6
D9.3.2	Market Analysis, IPR Model and Exploitation Plan v2	9	1	5.00	R	CO	12
D9.3.3	Market Analysis, IPR Model and Exploitation Plan v3	9	1	6.00	R	CO	24
D9.3.4	Market Analysis, IPR Model and Exploitation Plan v4	9	1	7.50	R	CO	36
D9.4.1	Collaboration Plan and Updates	9	1	2.00	R	RE	6

WT2:
List of Deliverables

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D9.4.2	Collaboration Plan and Updates	9	1	2.00	R	RE	12
D9.4.3	Collaboration Plan and Updates	9	1	2.00	R	RE	24
D9.4.4	Collaboration Plan and Updates	9	1	2.00	R	RE	36
			Total	401.50			

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP1	Type of activity [54]	RTD
Work package title	Cloud4SOA Reference Framework		
Start month	1		
End month	9		
Lead beneficiary number [55]	4		

Objectives

- To review the State-of-the-Art in the fields of Cloud Computing problems, i.e. semantic interoperability, semantic service and data models, and intelligent and adaptive service front-ends and create a prioritized list of the requirements that the Cloud4SOA project will address;
- To define and document the Cloud4SOA Cloud Semantic Interoperability Framework; and
- To design and document the Cloud4SOA Reference Architecture.

Description of work and role of partners

This workpackage aims at gathering the requirements that will be addressed by Cloud4SOA. As Cloud4SOA has a particular interest in achieving semantic interoperability among different platforms within the Cloud, this workpackage will elaborate on the Cloud semantic interoperability problems. WP1 will result in defining the Cloud4SOA Semantic Interoperability Framework and Reference Architecture. WP1 begins in month 1 and lasts until month 9.

Task 1.1 State-of-the-Art and Requirements Analysis (CERTH, Duration: M1 – M6)
The main objective of this task is to gather the requirements that will be addressed by Cloud4SOA. In order to achieve this, we will review and analyze the State-of-the-Art and identify gaps, deficiencies, needs and problems in the following research themes: (a) Intelligent and adaptive service front-ends for the development of service-oriented Cloud-based applications; (b) Semantic service and data models to support the semantic annotation of Cloud services and resources;
(c) Cloud computing problems, focusing mostly on semantic interoperability issues at the PaaS and IaaS levels. Moreover, the stakeholders, e.g. the Cloud4SOA user partners, will also participate in the requirements elicitation process. The analysis of the State-of-the-Art will result in a prioritized list of requirements that will be addressed by the Cloud4SOA project.

Task 1.2 Cloud4SOA Cloud Semantic Interoperability Framework (CERTH, Duration: M1 – M9)
The main objective of this task is to study and analyze the semantic interoperability problems that are raised in the Cloud. The semantic interoperability problems will then be categorized in different levels, e.g. data and schema. This will result in the Cloud4SOA Cloud Semantic Interoperability Framework. Additionally, the Cloud4SOA Cloud Semantic Interoperability Framework will also include a roadmap comprising of a set of guidelines and good practices for building interoperable Cloud platforms.

Task 1.3 Cloud4SOA Reference Architecture (CERTH, Duration: M1 – M9)
This task includes the development of the Cloud4SOA Reference Architecture as well as the specification (functionalities, interfaces) of the core architectural components and models, which will then be implemented in the context of WP2-WP7.
The Cloud4SOA Reference Architecture comprises of three horizontal layers, namely the Intelligent Interfaces and Service Front-Ends layer, the SOA-enabled Services layer, the Virtualization and Execution layer, and two vertical layers, namely the Semantic layer and the Governance layer, that span across all the horizontal ones.

Milestones and expected result:

Milestone 1: Availability of Requirements Analysis (Month 6)

The comparative analysis of the state-of-the-art technologies and platforms in research and technological domains related to the Cloud4SOA project, as well as, the identification and analysis of the semantic interoperability, scalability and security requirements of the emerging Cloud computing platforms will be documented in the deliverable D1.1 that will submitted to the EC by month M6. These be exploited in the definition of the Cloud4SOA Cloud Interoperability Framework (Task 1.2) and will constitute the obstacles and interoperability issues that the Cloud4SOA layers intend to address (WP2-WP7).

Milestone 2: Availability of the Cloud4SOA Cloud Semantic Interoperability Framework and Reference Architecture (Month 9)
By the end of project month M9, the Cloud4SOA is going to deliver the Cloud4SOA Cloud Semantic Interoperability Framework (documented in deliverable D1.2) that constitutes an open, innovative and generic approach for facilitating the implementation and deployment of semantically interoperable Cloud platforms, as well as the Cloud4SOA Reference Architecture (documented in deliverable D1.3). The Cloud4SOA Cloud Semantic Interoperability Framework and Reference Architecture will be further utilized in the design of the Cloud4SOA architectural layers (WP2-WP7).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ATOS	3.00
2	NUIG	3.00
3	SINGULARLOGIC	3.00
4	CERTH	15.00
5	CLOUDCONTROL	3.00
8	CYNTELIX	3.00
9	PTIN	4.00
10	FIT	4.00
11	ROMTELECOM	3.00
	Total	41.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D1.1	Requirements Analysis Report	4	9.00	R	PU	6
D1.2	Cloud4SOA Cloud Semantic Interoperability Framework	4	16.00	R	PU	9
D1.3	Cloud4SOA Reference Architecture	4	16.00	R	PU	9
		Total	41.00			

Description of deliverables

D1.1) Requirements Analysis Report: D1.1 is the outcome of Task 1.1. It documents the review of the State-of-the-Art and the prioritized list of requirements that will be addressed by Cloud4SOA. [month 6]

D1.2) Cloud4SOA Cloud Semantic Interoperability Framework: D1.2 is the outcome of Task 1.2. It documents a typology of semantic interoperability problems that are raised in the Cloud and a set of guidelines and good practices for building semantically interoperable Cloud platforms. [month 9]

D1.3) Cloud4SOA Reference Architecture: D1.3 is the outcome of Task 1.3. It documents the Cloud4SOA Reference Architecture as well as the specification (functionalities, interfaces) of the core architectural components and models. [month 9]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	Availability of Requirements Analysis	4	6	
MS2	Availability of the Cloud4SOA Cloud Semantic Interoperability Framework and Reference Architecture	4	9	

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP2	Type of activity [54]	RTD
Work package title	Cloud4SOA Semantic Layer		
Start month	7		
End month	21		
Lead beneficiary number [55]	2		

Objectives

- To build and document the Cloud4SOA cloud services and computational resources models, that will provide the placeholders for facilitating the addition of lightweight semantics in the SOA-enabled services interfaces and in the computational resources of the Cloud infrastructure; and
- To design and develop the software components and mechanisms that will facilitate the semi-automatic semantic annotation of services and computational resources complying the developed Cloud4SOA models.

Description of work and role of partners

This workpackage aims at defining and developing the service and computing resource models and the semantic annotation mechanisms that will rely on these models in order to semantically annotate the SOA services and the computing resources of the Cloud. WP3 begins in month 7 and lasts until month 21.

Task 2.1 Cloud4SOA Service Model (NUIG, Duration: M7 – M15)
This task will develop the Cloud4SOA service model, which will be used for describing the SOA services offered by the Cloud4SOA platform. The model will be developed in a bottom-up fashion, thus harnessing the collective intelligence that emerges directly from the users. This means that the service model will evolve throughout the duration of the project and beyond. However, we will not reinvent the wheel. Hence, concepts from existing efforts will be reused. The Cloud4SOA service model will be formally expressed using a standardized ontology language, either OWL or RDF.
Apart from the models themselves, this task also includes the development of a methodology which will describe the life-cycle of such lightweight vocabularies which emerge in a bottom-up fashion. Thus, the creation, the dissemination, the adoption, the uptake and the exploitation of such models will be studied and modeled. Consequently, the results of this task will be: a) the Cloud4SOA service model (both its conceptual view as well as its ontological representation); and b) the methodology that models the life-cycle of models that emerge in a bottom-up fashion. The results of this task will be documented in D2.1.

Task 2.2 Cloud4SOA Computing Resource Model (NUIG, Duration: M7 – M15)
This task will develop the Cloud4SOA computing resource model, which will be used for describing the computing resources offered by the different platforms in the Cloud. The main objective of the Cloud4SOA computing resource model is to achieve a minimum level of interoperability among the different platforms in the Cloud.
The Cloud4SOA computing resource model will be formally expressed using a standardized ontology language, either OWL or RDF. Consequently, the results of this task will be the Cloud4SOA computing resource model (both its conceptual view as well as its ontological representation). The results of this task will be documented in D2.1.

Task 2.3 Semantic Annotation Mechanism (NUIG, Duration: M10 – M21)
This task involves the in-detail functional and technical specification and implementation of two software components:
1. A component that will facilitate the semi-automatic semantic annotation of the SOA services. In order to do so, this component will harness metadata that are generated from the actual usage of the services. Hence, it will be able to infer relations between services. As the annotation of services will be semi-automatic, the component will allow users to directly annotate services using tags through a “widgetised” interface.

2. A component that will facilitate the semantic annotation of computing resources. In order to do so, this component will employ the Cloud4SOA computing resource model and will offer a “widgetised” interface that platform owners can use in order to annotate their computing resources. The semantic description of the computing resources will also be enriched by metadata that emerge from their usage.
The results of this task will be documented in D2.2.

Task 2.4 Semantic Interoperability Run-time Engine (NUIG, Duration: M10 – M21)
This task involves the development of a software component that will resolve semantic interoperability conflicts at design- and run-time. It will allow the Cloud vendors to create mappings in a formal language, e.g. RDF, between their platforms data models and the Cloud4SOA models.
Afterwards, these mappings can be used as the basis for resolving semantic interoperability problems at run-time, e.g. conflicts that might be raised when data are being exchanged between two different platforms. The results of this task will be documented in D2.2.

Milestones and expected result:

Milestone 3: Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing (Month 15)
By the end of project month M15, the Cloud4SOA consortium will have designed and document the semantic models for the conceptual representation and formal description of the SOA-enabled services offered by the Cloud4SOA platform and the computational resources provided by the different cloud infrastructures. These models will serve as the conceptual services backbones in all the service-related Cloud4SOA layers (WP4, WP5 & WP6). M15 also represent the preliminary integration testing of the initial components developed so far in each unfinished layer.

Milestone 4: Availability of the Cloud4SOA Layers and First Integration (Month 21)
Based on the semantic services and resources models developed within Tasks 2.1 and 2.2, the Cloud4SOA consortium will specify and implement the annotation mechanisms and the run-time components of the Cloud4SOA Semantic Layer (i.e. one of the main software subsystems of the Cloud4SOA platform), which will take place in the integration activities of WP7. Month 21 will also represent the first integration phase, continuing from the initial testing in Milestone 3.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
2	NUIG	17.00
3	SINGULARLOGIC	6.00
4	CERTH	15.00
	Total	38.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D2.1.1	Cloud4SOA Semantic Layer Models - Preliminary Draft	2	6.00	R	CO	12
D2.1.2	Cloud4SOA Semantic Layer Models	2	8.00	R	RE	15
D2.2	Cloud4SOA Semantic Layer Components	2	24.00	P	RE	21
		Total	38.00			

Description of deliverables

D2.1.1) Cloud4SOA Semantic Layer Models - Preliminary Draft: [month 12]

D2.1.2) Cloud4SOA Semantic Layer Models: The deliverable D2.1 documents the outcome of Task 2.1 and Task 2.2, providing the specification of the Cloud4SOA service and computing resource models and the description of the model development methodology. Preliminary work will be previewed in M12 (D2.1.1). [month 15]

D2.2) Cloud4SOA Semantic Layer Components: Prototype and detailed specification of the semantic annotation mechanisms (Task 2.3) that facilitate the semi-automatic annotation of the SOA-enabled services and the semantic uplifting of the computing resources, as well as the prototype and the respective specification of the run-time software component (Task 2.4) that enables the resolution of semantic interoperability issues. [month 21]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS3	Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing	2	15	
MS4	Availability of the Cloud4SOA Layers and First Integration	2	21	

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP3	Type of activity [54]	RTD
Work package title	Cloud4SOA Intelligent Interfaces and Service Front-Ends Layer		
Start month	7		
End month	21		
Lead beneficiary number [55]	8		

Objectives

- To define the Cloud4SoA Widget framework
- To define and document the interaction model of the intelligent interfaces layer
- To define, specify, develop and validate the Intelligent Interfaces Layer in the Cloud4SoA reference architecture that will enable users to create and manage their Cloud applications
- To define, specify, develop and validate the framework for Cloud Widgets
- To define the measures for analytical analysis of the intelligent interfaces layer to support the social recommendation of Cloud Widgets based on actual usage

Description of work and role of partners

Definition and development of the Cloud4SoA Intelligent Interfaces Layer, involving the user in the design process with rapid prototyping. The approach will be base on the use of a Personal Cloud Management for composing Cloud services using “mash-up” paradigm. The workpackage will also develop the Cloud Widget framework that enables the portability and viral distribution of Cloud applications. In addition to creation of Cloud applications based on composition, the user is able to manage their Cloud applications in a centralized manner, irrespective of how the Cloud Widgets are distributed across different environments (eg: mobiles, webpages, desktop, etc).

Task 3.1 User Interaction Model (Cyntelix, Duration: M7 – M12)
The aim of the task is to define the User Interaction Model which captures how a user interacts with the Intelligent Interface Layer. The approach will be driven by applied user stories that bridge the communication of functional design between potential users (possibly the user surrogates will be used) and the developers. Once the stories become more mature, the process will be supported by cardboard prototypes to embody stories thus refining further the interaction model.
The user interaction model will not only deal with the management of the personal Cloud applications, but also capture the interaction paradigm for manipulating and composing Cloud Widgets together. This involves finding existing Cloud Widgets, determining how the visual paradigm of composition and packaging the resulting composition as a new Cloud Widget.

Task 3.2 Definition of the Could4SOA Widget Framework (Cyntelix, Duration: M10 – M21)
This task will build upon the research of Cloud4SoA interoperability framework and reference architecture (Task 1.2 and Task 1.3) to design the CloudS4OA Widget Framework. It is necessary to understand how to encapsulate Cloud services and outline the constraints. The Cloud4SoA widget framework is to be integrated into the Beemway widget syndication platform. Moreover, in this task, the architecture of the detailed Intelligent Interfaces Layer will be developed and how it integrates the semantic services, namely the recommendation service to identify existing Cloud services. This task builds upon the work done in the Task 1.3 and the same architecture design methodology will be adopted.

Task 3.3 Implementation of the Cloud4SoA platform and Definition of Cloud4SOA Widget Measures (Cyntelix, Duration: M13 – M21)
The aim of the task is to implement the Intelligent Interfaces Layer of the Cloud4SoA platform, which consist of both the Personal Cloud Management and the CloudWidget Framework. The development will be carried out in iterative phases where prototypes are evaluated by user surrogates. In addition to the management of Cloud Widgets, the task will develop the visualization of the analytics. The task will also define the measures to

be captured with Cloud Widgets. The work entails focus groups with Cloud providers to determine the data that needs to be collated for distilment of information.

Milestones and expected result:

Milestone 3: Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing (Month 15)
Month 15 represents the preliminary integration testing of the initial components developed so far in each unfinished layer.

Milestone 4: Availability of the Cloud4SOA Layers and First Integration (Month 21)
At month 21, the Intelligent Interfaces Layer will have gone through a first integration phase with parallel layers, and completed work to be delivered for future final integration into the remainder Cloud4SoA platform.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ATOS	15.50
8	CYNTELIX	16.00
	Total	31.50

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D3.1	User Interaction Model	8	5.50	R	RE	12
D3.2	Intelligent Interfaces Architecture and Cloud4SoA Widget Framework	8	9.00	R	RE	21
D3.3	Cloud4SOA Intelligent Interfaces	8	17.00	P	RE	21
		Total	31.50			

Description of deliverables

D3.1) User Interaction Model: This deliverable corresponds to the output of task 3.1. The deliverable will also document the process of deriving the user interaction model, thus all the stories are documented. [month 12]

D3.2) Intelligent Interfaces Architecture and Cloud4SoA Widget Framework: This deliverable documents the design outputs of the workpackage, namely the Cloud4SoA Widget Framework and the architecture of the Intelligent Interfaces layer. [month 21]

D3.3) Cloud4SOA Intelligent Interfaces: Prototype and user documentation of the resulting implementation derived from Task 3.3. Outline of the measures for Cloud4SOA widgets. [month 21]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS3	Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing	2	15	
MS4	Availability of the Cloud4SOA Layers and First Integration	2	21	

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP4	Type of activity [54]	RTD
Work package title	Cloud4SOA SOA Layer		
Start month	7		
End month	21		
Lead beneficiary number [55]	2		

Objectives

- To design, specify and develop (following the iterative software engineering and development approach) the software components of the SOA layer of the Cloud4SOA Reference Architecture which will facilitate the service oriented application development.

Description of work and role of partners

This workpackage aims at developing the software components of the SOA layer of the Cloud4SOA Reference Architecture. These components will facilitate the service oriented design and development of applications that will be deployed and executed utilizing the Cloud resources. The software components depend heavily on the lightweight semantic service and computing resource models developed in WP2. WP4 begins in month 7 and lasts until month 21.

Task 4.1 SOA layer software components v.1.0 (NUIG, Duration: M7 – M15)
The software components of the SOA layer designed in Task 1.3 will be implemented during this task, and a first stand-alone testing of each software component will be conducted. The software components of the SOA layer are the following: the Service Discovery component, the Service Mashing component and the Service Recommendation component. These components will capitalize on components delivered from WP2 and WP6. The results of this task will be documented in D4.1.

Task 4.2 SOA layer software components v.2.0 (NUIG, Duration: M16 – M21)
This task will develop the final versions of the software components of the SOA Layer. In this final release of the prototypes, all the errors and problems reported during the testing that will be carried out in Task 4.1 will be corrected and the software components will be fully functional (according to their specifications developed in Task 1.3).
The results of this task will be documented in D4.2.

Milestones and expected result:

Milestone 3: Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing (Month 15)
Month 15 represents the preliminary integration testing of the initial components developed so far in each unfinished layer.

Milestone 4: Availability of the Cloud4SOA Layers and First Integration (Month 21)
By project month 21, the final running prototypes of all the software components of the SOA layer will be released. Initial prototype will have gone through a first integration phase with parallel layers.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ATOS	9.00
2	NUIG	11.00

WT3:
Work package description

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
3	SINGULARLOGIC	10.00
4	CERTH	12.50
	Total	42.50

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D4.1.1	SOA layer software components v1 - Preliminary Draft	2	8.00	P	CO	12
D4.1.2	SOA layer software components v1	2	12.00	P	RE	15
D4.2	SOA layer software components v2	2	22.50	P	RE	21
		Total	42.50			

Description of deliverables

D4.1.1) SOA layer software components v1 - Preliminary Draft: [month 12]

D4.1.2) SOA layer software components v1: D4.1 will document the interim prototypes of the SOA layer software components and the results of their testing. Preliminary work will be previewed in M12 (D4.1.1). [month 15]

D4.2) SOA layer software components v2: D4.2 will document the final prototypes of the SOA layer software components. [month 21]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS3	Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing	2	15	
MS4	Availability of the Cloud4SOA Layers and First Integration	2	21	

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP5	Type of activity [54]	RTD
Work package title	Cloud4SOA Governance Layer		
Start month	7		
End month	21		
Lead beneficiary number [55]	1		

Objectives

- To investigate the key research questions to be addressed concerning the management of cloud platforms.
- To evaluate alternative open standards and open source technological platforms for realizing an integrated cloud governance solution.
- To specify the key features and technical architecture of the Service Lifecycle Governance Framework.
- To implement the Service Lifecycle Governance Framework toolset.

Description of work and role of partners

Analysis of the key research questions and foreseen capabilities for service management, evaluation of state of the art approaches, methods, and tools for governance of service-based applications, derivation of architecture and design, and finally, realisation of the Service Lifecycle Governance Framework based on an integrated toolset.

Task 5.1 Service Lifecycle Governance Approach (ATOS, Duration: M7 – M12)
This task focuses on the investigation of the key research questions to be addressed concerning the management of cloud platforms, and the evaluation of alternative open standards and open source technological platforms for realising an integrated cloud services governance toolset. The state-of-the-art analysis that was carried within WP1 will serve as input concerning the requirements for managing cloud-enabled services. This task will result in the development and the documentation of a novel approach for cloud platforms and cloud enabled services lifecycle management, taking into account SLAs, security and scalability issues. Recent research and current collaboration with SLA-related standardisation working groups will be used to propel advancement and continue through T5.2 and T5.3, taking into consideration SLA languages and protocols evolution, and interoperability issues.

Task 5.2 Service Lifecycle Governance Framework (ATOS, Duration: M10 – M15)
This task focuses on the specification of the key features and technical architecture of the Cloud4SOA Service Lifecycle Governance Framework that realizes the approach developed within Task 5.1. The output of this task is the architectural design and the technical specification of the Service Lifecycle Governance Framework to be developed.

Task 5.3 Service Lifecycle Governance Toolset (ATOS, Duration: M13 – M21)
Task 5.3 focuses on the implementation and testing of the Service Lifecycle Governance Toolset, based on the architecture defined in Task 5.2. The implementation will be based on an integrated registry and repository platform and will aim for generality and effectiveness, with a view to leveraging contemporary approaches and technologies for service-oriented modelling, including semantic service description approaches. Furthermore, these will be used as building blocks to a powerful SLA layer, which will enforce the Quality of Service (QoS) constraints, gathering monitoring data at runtime and feeding it back into the service registry to adjust descriptions and make contract template derivation a more realistic process. The toolset will include functionalities for registering services information and keeping relevant services' metadata, concerning different phases and activities within the service's lifecycle.

Milestones and expected result:

Milestone 3: Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing (Month 15)
Month 15 represents preliminary integration testing of the initial components developed so far in each unfinished layer.

Milestone 4: Availability of the Cloud4SOA Layers and First Integration (Month 21)
In the frame of WP5, the Cloud4SOA consortium result in the design, development and documentation of the Services Lifecycle Governance Framework and Toolset, constituting the Cloud4SOA Governance Layer (that is one of the main Cloud4SOA Architectural Layers). The Cloud4SOA Governance Layer, which facilitates cloud services and platforms governance, will be further utilized in the integration work-package (WP7) in order that the integrated Cloud4SOA platform to be delivered.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ATOS	22.00
5	CLOUDCONTROL	16.50
	Total	38.50

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D5.1.1	Cloud4SOA Service Lifecycle Governance Framework - Preliminary Draft	1	5.00	R	CO	12
D5.1.2	Cloud4SOA Service Lifecycle Governance Framework	1	11.00	R	RE	15
D5.2	Cloud4SOA Service Lifecycle Governance Toolset	1	22.50	P	RE	21
		Total	38.50			

Description of deliverables

D5.1.1) Cloud4SOA Service Lifecycle Governance Framework - Preliminary Draft: [month 12]

D5.1.2) Cloud4SOA Service Lifecycle Governance Framework: In-detail documentation of the Services Lifecycle Governance Approach and Framework regarding the cloud platforms and cloud enabled services governance and lifecycle management, including security and scalability aspects. Preliminary work will be previewed in M12 (D5.1.1). [month 15]

D5.2) Cloud4SOA Service Lifecycle Governance Toolset: Prototype and detailed documentation of the Services Lifecycle Governance Toolset that will allow recording information about services, searching for reusable services, keeping track of service associations and dependencies, enforcing policies throughout the service lifecycle, supporting version control, enforcing QoS through SLAs, etc. [month 21]

WT3:
Work package description

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS3	Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing	2	15	
MS4	Availability of the Cloud4SOA Layers and First Integration	2	21	

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP6	Type of activity [54]	RTD
Work package title	Cloud4SOA Virtualization and Execution Layer		
Start month	7		
End month	21		
Lead beneficiary number [55]	3		

Objectives

- To realize a cloud infrastructure maintenance layer that will enable the self-organization of the computational infrastructure based on load measurement and scheduling algorithms;
- To specify and implement a virtual execution box for handling the distributed execution of various data- and computational- intensive services;
- To design and develop an Interoperable Clouds Overlay Network Infrastructure facilitated with Distributed Hash Tables, allowing distributed publication of cloud resources; and
- To implement the upper resources discovery modules that facilitates semantically-enhanced resource discovery and dynamic service biding.

Description of work and role of partners

Specification and development of a maintenance layer that allows the self-organization of the cloud infrastructure, as well as a virtual execution box enabling the distributed services execution and the handling and merging of distributed execution results. Implementation of a novel decentralized Cloud services and resources registry based on an overlay, distributed and DHT-facilitated network structure, as well as resources and services discovery modules.

Task 6.1 Cloud Infrastructure Maintenance Layer (cloudControl, Duration: M7 – M12)
This task is going to lead in the implementation of the Cloud Infrastructure Maintenance Layer that includes algorithms and software modules for controlling the distribution and sizing of the cloud infrastructure (allowing reactive control, forecast and planning operations), as well as for the fetching the current load from the different applications, and processing and storing the values, by sampling, aggregated storing of the data-stream, for load measurement purposes.

Task 6.2 Overlay Peer-to-Peer Network Structure (SingularLogic, Duration: M7 – M15)
In the frame of this task, we are going to realize a distributed overlay network structure that is going to be facilitated by the Distributed Hash Table techniques, in order to result in a scalable, flexible and robust mechanism for allowing distributed publication of services and resources. This overlay network will exploit a four-layered approach for building a dynamic routing and ring formulation protocol, including: the Neighbor-to-Neighbor reliable frame delivery layer, the Node-to-Node frame delivery layer, the Ring Maintenance layer, and the distributed hash table layer. This layered scheme will provide a well structured bootstrapping and frame encapsulation hierarchical sequence (based on a stabilized ring topology relying on the Chord protocol) that realized a decentralized registry for the efficient publication of cloud resources.

Task 6.3 Virtual Execution Box (cloudControl, Duration: M13 – M21)
The Cloud4SOA consortium will design and develop the Cloud Virtual Execution Box that defines what and how applications can be executed on the interoperable cloud platforms. At this point, security is a major concern here. It is crucial to keep different applications from interfering with each other. This includes data stored on persistent storage as well as data that are in memory at runtime.

Task 6.4 Resources and Services Discovery (SingularLogic, Duration: M13 – M21)
Task 6.4 will finally result in the specification and development of the upper resources and services discovery modules that will take advantage of the lightweight semantic annotations in order to enable dynamic discovery of the SOA-services and the cloud resources on the decentralized registry. More specifically, the Cloud4SOA

consortium intends to implement three (3) discovery modules: a) the direct discovery module that is based on the exact keyword match functionality, which is provided by the DHT protocol itself; b) the ontology-enhanced discovery module that provides semantic level service matching; and c) the composite discovery module that tries to compose several services, in case a single service can't fulfill the requested service functionality. Additionally to the service and resources discovery, grounding and biding parameters will be dynamically allocated to the discovered resources.

Milestones and expected result:

Milestone 3: Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing (Month 15)
Month 15 represents the first preliminary integration testing of the initial components developed so far in each unfinished layer.

Milestone 4: Availability of the Cloud4SOA Layers and First Integration (Month 21)
As WP6 will finally result in the design and development of the interoperable clouds overlay network infrastructure, and to the cloud infrastructure maintenance and execution environment, the two (2) subsystems of the Cloud4SOA Virtualization and Execution Layer (that is one of the main Cloud4SOA Architectural Layers) will be delivered. Month 21 represents a first integration phase with parallel layers. These final subsystems will then be further utilized in the integration work-package (WP7) in order the integrated Cloud4SOA platform to be delivered.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
3	SINGULARLOGIC	22.00
5	CLOUDCONTROL	20.00
	Total	42.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D6.1.1	Cloud4SOA Network Infrastructure - Preliminary Draft	5	8.00	P	CO	12
D6.1.2	Cloud4SOA Network Infrastructure	5	12.00	P	RE	15
D6.2	Cloud4SOA Execution Environment	3	22.00	P	RE	21
		Total	42.00			

Description of deliverables

D6.1.1) Cloud4SOA Network Infrastructure - Preliminary Draft: [month 12]

D6.1.2) Cloud4SOA Network Infrastructure: Prototype and detailed documentation of the algorithms, structures and software modules comprising the network infrastructure of the Cloud4SOA Virtualization and Execution Layer. Preliminary work will be previewed in M12 (D6.1.1). [month 15]

D6.2) Cloud4SOA Execution Environment: Prototype and detailed documentation of the integrated Cloud4SOA Virtualization and Execution Layer prototype comprising a) the Interoperable Clouds Overlay Network Infrastructure that includes an overlay peer-to-peer network structure and the upper resources discovery modules, facilitating efficient resources publication and discovery in highly-decentralized cloud environments, and b) the cloud execution environment comprising an infrastructure maintenance and load balance mechanism,

as well as a virtual execution box, allowing and handling the distributed execution of various data- and computational- intensive services and the handling and merging of distributed execution results. [month 21]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS3	Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing	2	15	
MS4	Availability of the Cloud4SOA Layers and First Integration	2	21	

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP7	Type of activity [54]	RTD
Work package title	Cloud4SOA Platform Integration and Infrastructure Deployment		
Start month	13		
End month	27		
Lead beneficiary number [55]	3		

Objectives

- To (pro-) actively handle software components integration issues through the design of a detailed, overall technical architecture, and the software integration and testing planning;
- To integrate the different software components that will be developed in the core technical work-packages WP2, WP3, WP4, WP5 & WP6 into a flexible, service-based cloud computing interoperability framework and platform;
- To technically evaluate the integrated system according to predefined testing criteria, ensuring the quality of the produced software system; and
- To deploy a cloud computing infrastructure facilitating the establishment and the operation of the integrated Cloud4SOA Cloud Interoperability Platform and Services.

Description of work and role of partners

Development of the integrated technical architecture and proactive planning of the integration of the different software components. Software integration, and technical and evaluation of the integrated Cloud4SOA Platform.

Task 7.1 Cloud4SOA Integrated Technical Architecture (SingularLogic, Duration: M13 – M21)
This WP starts off with an integrated analysis of all sources available and thereafter defines necessary interfaces to integrate components. Specifications of software components (layers) described in WP2-WP6 are inputs for the development of the Cloud4SOA Platform. Based upon the software components and the objectives of the Cloud4SOA project, the detailed technical architecture for the Cloud4SOA integrated system will be designed, focusing on the definition and documentation (at technical level) of the “integration contracts” among the several Cloud4SOA layers. An integration plan will be prepared to guide the integration of the discrete platform layers.

Task 7.2 Cloud4SOA Platform Integration, Testing and Refinement (SingularLogic, Duration: M19 – M27)
In the frame of Task 7.2, the Cloud4SOA consortium will integrate the developed software components (i.e. the Cloud4SOA layers) to form the final, integrated Cloud4SOA Platform. Moreover, additional, trivial software modules (such as role and users management and platform administration graphical interfaces). Software testing and evaluation will be based on a method such as STEP (Systematic Test and Evaluation Process), a well-established industry methodology for test and evaluation activities in software projects. It should be mentioned that within this task testing will be performed to verify the proper functioning and performance of the integrated Cloud4SOA Platform. If required, specific improvements will be made. Before this task, layer by layer preliminary testing will take place between WP2-6 (Milestone 3).

Task 7.3 Cloud Infrastructure Deployment (cloudControl, Duration: M22 – M27)
Within Task 7.3, the Cloud4SOA consortium will work towards the deployment of the cloud computational resources infrastructure, which comprises of a significant set of computational nodes and data storage machines, allowing the installation of the intelligent, innovative Cloud4SOA Cloud Interoperability Platform and the execution of the Cloud4SOA-enabled SOA services.

Task 7.4 Integrated Software Quality Assurance (SingularLogic, Duration: M13 – M27)
Software quality assurance involves the entire software development process - monitoring and improving the process, making sure that any agreed-upon standards and procedures are followed, and ensuring that problems are found and dealt with. It is oriented to 'prevention'. The total quality maintenance will ensure the continual software system improvement.

Milestones and expected result:

Milestone 4: Availability of the Cloud4SOA Layers and First Integration (Month 21)
Cloud4SOA will execute three steps of integration. The first, in Milestone 3, will be a very preliminary testing for the unfinished layers. Milestone 4, at month 21 will be a more extensive first integration phase of parallel layers (WP2-6), providing better feedback for the final integration phase.

Milestone 5: Availability of the Cloud4SOA Platform (Month 27)
By the end of Month 27, the Cloud4SOA technical partners will have successfully completed with the integration (and testing) of the several software components (i.e. Cloud4SOA layers implemented in WP2, WP3, WP4, WP5 and WP6), following the developed integration and technical testing plan, and resulting in the delivery of the integrated Cloud4SOA Platform, through the official deliverable D7.2. The Cloud4SOA Platform will be further utilized in the development and deployment of the industrial showcases in WP8.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ATOS	6.00
2	NUIG	3.00
3	SINGULARLOGIC	19.00
4	CERTH	4.00
5	CLOUDCONTROL	6.00
8	CYNTELIX	4.00
	Total	42.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D7.1	Cloud4SOA Platform Integrated Architecture and Integration Plan	3	10.00	R	RE	21
D7.2	Cloud4SOA Platform	3	32.00	P	RE	27
		Total	42.00			

Description of deliverables

D7.1) Cloud4SOA Platform Integrated Architecture and Integration Plan: In-detail documentation of the integrated technical architecture of the Cloud4SOA Platform, including the definition of the necessary interfaces to integrate the different software components. [month 21]

D7.2) Cloud4SOA Platform: Prototype of the integrated Cloud4SOA Platform (that constitutes the main result of the Cloud4SOA project) and detailed documentation of the deployed cloud infrastructure. Moreover, documentation regarding the development, integration and usage of the Cloud4SOA Platform (including an end-users manual and engineers' installation and customization guidelines cookbook) will be provided. Finally, documentation of a) the software testing plan, b) the evaluation of the technical testing of the integrated Coud4SOA platform, and c) the software quality assurance processes, tools and activities. [month 27]

WT3:
Work package description

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS3	Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing	2	15	
MS4	Availability of the Cloud4SOA Layers and First Integration	2	21	
MS5	Availability of the Cloud4SOA Platform	3	27	

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP8	Type of activity [54]	RTD
Work package title	Showcases Development and Overall Performance Evaluation		
Start month	3		
End month	36		
Lead beneficiary number [55]	10		

Objectives

- To define and organize the three Cloud4SOA showcases that focuses in the applicability of the Cloud4SOA project results (e.g. the integrated platform, the developed conceptual models and ontologies, and the designed interoperability framework) in pragmatic conditions;
- To develop, operate and support the three Cloud4SOA showcases prototypes that constitute the realization and cloud-enablement of the preselected scenarios and use-cases in the proposed intelligent and innovative Cloud4SOA cloud interoperability platform;
- To test and monitor the performance of the Cloud4SOA showcases prototypes in the given use cases;
- To define and validate the evaluation strategy of the performance of the Cloud4SOA showcases prototypes;
- To collect feedback from end-users and system engineers while experiencing the Cloud4SOA Platform in realistic use cases and scenarios, and assess the performance of the showcases prototypes through the analysis of the testing results; and
- To generate the lessons learnt (from the development, deployment and execution of the three showcases) and formulate them as a step-by-step cookbook and methodological adoption guidelines for innovative cloud computing platforms.

Description of work and role of partners

Definition and development of the Cloud4SOA showcases prototypes that will operate in the frame of preselected realistic use-cases and scenarios, leading to a stress-test of the implemented cloud computing infrastructure under real-life conditions. Definition, validation and refinement of the showcases prototypes' evaluation protocol. Monitor and evaluation of the performance of the showcases prototypes and generation of lessons learnt and methodological adoption guidelines for cloud computing.

Task 8.1 Use-Cases As-Is Analysis and Showcases Definition (FIT, Duration: M3 – M15)
This task will involve the in-depth as-is analysis of the three Cloud4SOA industrial use cases, which will lead to the identification of the drawbacks and bottlenecks of their current deployments, as well as to the definition of the business scope of the Cloud4SOA showcases and the exact technical scope of the Cloud4SOA showcases (in terms of the detailed cloud interoperability and portability aspects to be examined, tested and evaluated, as well as the specific Cloud4SOA concepts, tools and technologies to be demonstrated, validated and examined), and the organization of the realistic scenarios (for each one of the Cloud4SOA showcases) that are going to be piloted in order to prove the applicability, the usability and the effectiveness of the Cloud4SOA enabling technologies. Finally, the Task 8.1 is responsible for the showcases pre-analysis allowing quantification of expected benefits and their assessment measures and metrics, against the specific Cloud4SOA technologies that each showcase validates (the final assessment will take place in Task 8.5).

Task 8.2 Evaluation Strategy Definition and Validation (FIT, Duration: M10 – M18)
In this task, the evaluation protocol and methodology will be defined stating the various practices for obtaining feedback from end-users and system engineers (through workshops, focus groups, interviews, questionnaires, etc.). The evaluation processes and procedures will be specified and documented. The evaluation protocol will be studied extensively and defined in complete detail, as it will lead to valuable remarks and conclusions about the viability and sustainability of the Cloud4SOA Platform.

Task 8.3 Cloud4SOA Showcases Development (SingularLogic, Duration: M13 – M32)

In the frame of Task 8.3, the Cloud4SOA consortium will work towards the development of the three showcases prototypes. Each prototype will involve the development of the cloud-enabled and semantically-enhanced services required for the efficient realization and effective execution of each industrial use case, as well as the customization and extension (if required) of the respective intelligent end-users interfaces. Moreover, domain-specific extensions of the core Cloud4SOA Ontology may be required, so as to facilitate proper description (annotation), publication and discovery of the respective, domain specific services and resources.

Task 8.4 Showcases Operation, Maintenance and Governance (cloudControl, Duration: M31 – M36)
The Cloud4SOA consortium will proceed with the deployment, operation, maintenance and governance of the three showcases prototypes, in the frame of the real-life use cases and scenarios indentified and selected within Task 8.1. The performance the usability and the adaptability of the Cloud4SOA showcases will be monitored and captured, so as to provide the Cloud4SOA consortium with useful feedback regarding any optimizations and further customizations that have to be performed.

Task 8.5 Performance Evaluation and Lessons Learnt (FIT, Duration: M31 – M36)
The evaluation protocol will be set in operation once the operation of the showcases starts. Extensive data collection, regarding the end-users' and system engineers' feedback of their interaction with the Cloud4SOA Platform and Showcases, will be conducted. The data collection will meet the guidelines of the predefined evaluation protocol in order to ensure the high quality of the feedback gained and the consistence of the evaluation activities. Finally, effort will be allocated to the generation of the lessons learnt from the Cloud4SOA project (with regard to the development, deployment, operation, maintenance and governance of showcases in the frame of real-world industrial use-cases and scenarios) and formulate them as methodological adoption guidelines (including "dos and don'ts") enabling the deployment of cloud computing services and platforms in real-life conditions.

Milestones and expected result:

Milestone 6: Availability of the Cloud4SOA Prototypes (Month 32)
By the end of Month 32, the CloudSOA technical partners will have successfully completed the development and delivery of the three (3) showcases prototypes, in PTIN (PT), FIT (DE) and RomTelecom (RO). The Cloud4SOA Showcases will be deployed and executed, in the frame of preselected scenarios, while their performance will be monitored and evaluated in the last tasks of WP8.

Milestone 7: Availability of the Cloud4SOA Lessons Learnt (Month 36)
The performance of the operation three Cloud4SOA showcases will be monitored and evaluated (based on the showcases expected benefits quantified in Task 8.1. And the evaluation protocol defined in Task 8.2), leading to the documentation (by the end of Month 36) of the performance evaluation and the experience gained from the operation, maintenance, and governance of the showcases.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ATOS	3.00
2	NUIG	3.00
3	SINGULARLOGIC	9.00
4	CERTH	3.00
5	CLOUDCONTROL	6.00
8	CYNTELIX	6.00
9	PTIN	13.50
10	FIT	18.00
11	ROMTELECOM	16.00
	Total	77.50

WT3:
Work package description

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D8.1.1	Cloud4SOA Use Cases As-Is Analysis - Preliminary Document Draft	10	2.00	R	CO	12
D8.1.2	Cloud4SOA Use Cases As-Is Analysis - Preliminary Document	10	3.00	R	CO	15
D8.1.3	Cloud4SOA Use Cases As-Is Analysis	10	6.00	R	CO	24
D8.2	PTIN Business Intelligence Showcase	9	19.00	P	CO	32
D8.3	FIT Business Cooperation Showcase	10	19.00	P	CO	32
D8.4	RomTelecom Network Monitoring Showcase	11	19.00	P	CO	32
D8.5	Performance Evaluation and Lessons Learnt	10	9.50	R	CO	36
		Total	77.50			

Description of deliverables

D8.1.1) Cloud4SOA Use Cases As-Is Analysis - Preliminary Document Draft: [month 12]

D8.1.2) Cloud4SOA Use Cases As-Is Analysis - Preliminary Document: Documentation of the in-depth as-is analysis of the three Cloud4SOA industrial use cases, including the definition of the scope of the Cloud4SOA showcases (in terms of cloud infrastructures interoperability and data portability) and the organization of the realistic scenarios (for each one of the Cloud4SOA showcases) that are going to be piloted. Moreover, this showcases as-is analysis will include the quantification of expected benefits and their assessment measures and metrics, thoroughly identifying the specific Cloud4SOA technologies that each showcase will demonstrate, validate and/or exercise. D8.1.1 (draft) and D8.1.2 provides a preliminary document describing capabilities to be tested, with the full analysis document, D8.1.3, for Month 24. [month 15]

D8.1.3) Cloud4SOA Use Cases As-Is Analysis: Documentation of the in-depth as-is analysis of the three Cloud4SOA industrial use cases, including the definition of the scope of the Cloud4SOA showcases (in terms of cloud infrastructures interoperability and data portability) and the organization of the realistic scenarios (for each one of the Cloud4SOA showcases) that are going to be piloted. Moreover, this showcases as-is analysis will include the quantification of expected benefits and their assessment measures and metrics, thoroughly identifying the specific Cloud4SOA technologies that each showcase will demonstrate, validate and/or exercise. D8.1.1 (draft) and D8.1.2 provides a preliminary document describing capabilities to be tested, with the full analysis document, D8.1.3, for Month 24. [month 24]

D8.2) PTIN Business Intelligence Showcase: Prototype and detailed documentation of the PTIN Showcase, involving the deployment of cloud-enabled business intelligence services (with intelligent end-user interfaces) in the telecom industry’s information systems infrastructure. [month 32]

D8.3) FIT Business Cooperation Showcase: Prototype and detailed documentation of the FIT Showcase, involving the cloud enablement of the BSCW cooperation platform and its deployment in the Cloud4SOA infrastructure. [month 32]

D8.4) RomTelecom Network Monitoring Showcase: Prototype and detailed documentation of the RomTelecom Showcase, involving the development and deployment of distributed network monitoring and filtering services in the telecom operator’s network infrastructure. [month 32]

D8.5) Performance Evaluation and Lessons Learnt: Definition, in complete detail, of the protocol and procedures that should be followed during the evaluation of the performance of the showcases. Collection, categorization and statistical analysis of the feedback gained by the system engineers, through the evaluation protocol procedures, during the showcases execution and operation phase. In detail reporting of the experience during the operation of the various showcases. Step-by-step cookbook and methodological guidelines for the adoption of cloud computing platforms and services in real-life scenarios. [month 36]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS6	Availability of the Cloud4SOA Prototypes	10	32	
MS7	Availability of the Cloud4SOA Lessons Learnt	10	36	

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP9	Type of activity [54]	RTD
Work package title	Innovation Management, Dissemination and Exploitation		
Start month	1		
End month	36		
Lead beneficiary number [55]	1		

Objectives

- To handle the innovative results produced within the project and the relative IPRs, taking into account the individual contribution of each partner to the project resources;
- To ensure proper know-how exchange and collaboration among the Cloud4SOA consortium and other related European initiatives, through a set of clustering activities;
- To present the project progress, technologies and results outside the scope of the Cloud4SOA consortium and project reviewers, ensuring large awareness of the academic, ICT, social web, environmental and end-users organizations community through scientific and business publications (in journals and magazines) and participations to relative events (conferences, workshops, symposiums, exhibitions);
- To provide valuable feedback to relative standardization bodies and consortiums with regard to the integration of the respective technologies, their applicability, their completeness, their optimization and their future development;
- To analyze the market for the Cloud4SOA platform and solution, and define a viable exploitation and business model taking into account end-user needs and requirements in order to decide which projects' research results and exploitable assets can be further improved and have a strategy for commercialization;
- To establish, operate and maintain the Cloud Interoperability Special Interest Group (SIG), open to environmental information systems vendors (especially SMEs), environmental and end-users organizations, environmental public authorities and stakeholders, online communities, research institutes, universities, and individuals;
- To develop and maintain the official project's website throughout the project lifecycle; and
- To organize and deliver a set of promotional, dissemination events.

Description of work and role of partners

Wide dissemination of project's research results. Establishment, operation and management of the Cloud4SOA Special Interest Group (SIG), which constitutes the main large-scale dissemination activity of the consortium.

Task 9.1 IPR Handling and Innovation Management (ATOS, Duration: M1 – M36)
The development and the maintenance of a schedule of innovation produced during the Project are the main objectives of this task, so as the consortium (or a consortium member) to assess the opportunity for applying for patents or declaring copyrights. This activity will encompass the identification and definition of the innovative elements of the work conducted in the Technological R&D, as well as the efficient and effective handling of intellectual property rights issues. A preliminary look at these topics has been developed in section B3.2.5.

Task 9.2 Communication and Dissemination of Project Results (FIT, Duration: M1 – M36)
Initial communication actions will begin at project's start, with local press releases written by Project Coordinator (ATOS - Spain), Scientific Coordinator (NUIG - Ireland), and Quality/Risk Manager (SingularLogic - Greece). Also prepared will be the EC factsheet for Cloud4SOA.
The dissemination of the project results includes written and electronic publications, presentation of the project results in symposiums, meetings, congresses; technical magazines and transactions; and R&D Web Pages and EU dissemination channels. Dissemination will also be carried out through the presentation and demonstration of Cloud4SOA objectives, framework, concepts, platforms, tools and results at key sector technology related events addressed to the potential target organizations. Communication channels will be maintained with various press releases and media channels.

In addition, the official project's web site will be designed and developed, constituting one of the main dissemination channels of the Cloud4SOA Consortium and presenting information concerning the project and its progress, while a feedback channel will be available, so that interested end-user organizations, environmental stakeholders and citizen will be able to ask questions, comment and receive relevant answers from the consortium experts. The site will be maintained and updated regularly, and will be active for at least a year after the end of the project. The site will be accessible for special user groups and will be monitored daily by the staff of the project help desk. A visitor's feedback form and detailed visitors' statistics will be also implemented.
Finally, we are planning to organize three (3) annual Cloud4SOA workshops targeted to the scientific (including the ICT programme stakeholders and research initiatives), business and cloud communities, two for presenting intermediate results and one at the end of the project (i.e. at months M10, M22 and M34). In conjunction with the Cloud4SOA workshops, ICT concentration meetings will take place, making the results obtained available to the ICT sectors in Europe.

Task 9.3 Contribution and Feedback to Standardization (NUIG, Duration: M6 – M36)
In the frame of this task, the Cloud4SOA consortium will consist of presenting, summarizing and developing the adequate Cloud4SOA results in appropriate contributions to standardization efforts, recommendations, and bodies. Participation to standardization meetings, as well as technical coordination is foreseen for the presentation of these contributions as part of this project. In particular, participation, contribution (even extensions) and feedback to the "Semantic Annotations for WSDL (SAWSDL) Working Group" of the W3C standardization body, the ETSI autonomic network engineering for the self-managing Future Internet (ETSI ISG AFI) industry specification group (regarding the autonomous, distributes resources registries), and the GRAAP (SLAs) and OCCI (cloud interoperability) working groups of OGF, is foreseen.
Contribution to standards related to Cloud Semantic Interoperability, Resource and Service models (e.g. SAWSDL WG and OASIS Service Component Architecture TC) will be a focus. A detailed plan of the standardization activities will be delivered once preliminary results of the Cloud4SOA Reference Architecture and models have been produced.

Task 9.4 Market Analysis and Exploitation Planning (ATOS, Duration: M1 – M36)
Study the market possibilities for a solution like Cloud4SOA in order to identify its position in the market and to define the more adequate exploitation for the solution developed. The Cloud4SOA industrial partners (and especially SMEs) will perform some surveys and interviews with potential end-users, cloud experts and vendors in order to compile the conclusions of the different studies, and provide a complete market analysis that guide to a successful commercialization of the developed integrates platform prototypes and services.
Finally, the Cloud4SOA Consortium will prepare the exploitation plan, which includes intellectual property rights, business models, service's stakeholders, data privacy and security issues and will define a service framework and the contracts for the solution exploitation among consortium members. Note that the Cloud4SOA consortium intends to follow a "hybrid" exploitation approach: a) open-source exploitation of the separate exploitable assets (including the individual software services components, the framework and the conceptual modes, and the overall methodology – that are basically developed by research institutes and universities), and b) commercial exploitation of the integrated Cloud4SOA Platform accompanied with the delivery of professional service for installation, customization and technical support (for more details, please, see Section 3.2).

Task 9.5 Cloud Interoperability Special Interest Group (FIT, Duration: M1 – M36)
The Cloud4SOA consortium will establish, operate and maintain a Special Interest Group (SIG), called Cloud4SOA SIG, which will be open to cloud experts and vendors (especially SMEs), end-users organizations, research institutes, universities, and individuals interested in the Cloud4SOA research activities and project result. Cloud4SOA SIG members will monitor Cloud4SOA research and development activities, i.e. by receiving restricted results. Input of the Cloud4SOA SIG will be in particular used for validation of the Cloud4SOA concepts and tools.
A first core of Cloud4SOA SIG members will be directly contacted by the project partners during the first six months of the project. They will include cloud experts, services providers and end-users organizations, as well as, universities and research institutes working on related topics (to be proposed by the consortium partners), as well as know-how transfer bodies. However, all interested parties can apply for joining using the Cloud4SOA website. SIG members will receive early information/access on project outcomes and will be requested to evaluate the impact of Cloud4SOA.
We plan two workshops with the Cloud4SOA SIG members (to be held in conjunction with the two last annual Cloud4SOA workshops – Task 9.2), one for presenting intermediate results and one at the end of the project (at the project months M22 and M34).

Task 9.6 Collaboration with ICT IoS Projects (ATOS, Duration: M1 – M36)
The collaboration task covers the liaison and co-operation activities with other ICT projects under the WP2009/2010 Objective “Internet of Services, Software and Virtualisation”. The cooperation aims at exploiting synergies between the projects and increasing the impact of the ICT initiative.
The consortium members commit to provide contributions to the following activities:
• Exploitation of synergies / technical concertation: participation to workshops, contribution to some of the Collaboration Working Groups.
• Joint activities for exchange, dissemination and training
• Production of dissemination material that can be used for communication towards the general public.
• Co-ordination of standardisation efforts
• If open source software is delivered (more closely analyzed in ongoing T9.1), contributing it to open source to repositories
• Participation in a working group on best practices in the use of open source repositories/forges, which will initially identified in D9.4.1 Collaboration Plan
This Task only covers the specific activities for collaboration with other projects. The other project tasks in this workpackage cover the individual project activities in some of these areas (e.g., dissemination, standardisation).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ATOS	18.00
2	NUIG	1.00
3	SINGULARLOGIC	3.00
4	CERTH	5.00
5	CLOUDCONTROL	3.00
8	CYNTELIX	2.00
9	PTIN	5.00
10	FIT	6.50
11	ROMTELECOM	5.00
	Total	48.50

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D9.1	Cloud4SOA Project Website	1	4.00	O	PU	4
D9.2.1	Communication and Dissemination Activities Report Y1	10	4.00	R	PU	12
D9.2.2	Communication and Dissemination Activities Report Y2	10	5.00	R	PU	24
D9.2.3	Communication and Dissemination Activities Report Y3	10	5.00	R	PU	36
D9.3.1	Market Analysis, IPR Model and Exploitation Plan v1	1	4.00	R	CO	6

WT3:
Work package description

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D9.3.2	Market Analysis, IPR Model and Exploitation Plan v2	1	5.00	R	CO	12
D9.3.3	Market Analysis, IPR Model and Exploitation Plan v3	1	6.00	R	CO	24
D9.3.4	Market Analysis, IPR Model and Exploitation Plan v4	1	7.50	R	CO	36
D9.4.1	Collaboration Plan and Updates	1	2.00	R	RE	6
D9.4.2	Collaboration Plan and Updates	1	2.00	R	RE	12
D9.4.3	Collaboration Plan and Updates	1	2.00	R	RE	24
D9.4.4	Collaboration Plan and Updates	1	2.00	R	RE	36
		Total	48.50			

Description of deliverables

D9.1) Cloud4SOA Project Website: The official project web site. [month 4]

D9.2.1) Communication and Dissemination Activities Report Y1: This report should summarize all the dissemination and clustering activities done by the consortium partners and where possible, a certain measure of the success of the clustering and dissemination efforts. This report also describes the outcome of the three annual Cloud4SOA workshops, two for presenting intermediate results and one at the end of the project.
In conjunction with the Cloud4SOA workshops, ICT concentration meetings and Cloud Interoperability SIG Members meetings will take place. [month 12]

D9.2.2) Communication and Dissemination Activities Report Y2: [month 24]

D9.2.3) Communication and Dissemination Activities Report Y3: [month 36]

D9.3.1) Market Analysis, IPR Model and Exploitation Plan v1: This deliverable contains the respective market analysis and outlines the basic exploitation strategy for Cloud4SOA based on the market analysis conducted, which includes intellectual property rights, innovation management, copyrights and licence schemes issues. It is a constantly updated document, with the first version acting as a preliminary base. [month 6]

D9.3.2) Market Analysis, IPR Model and Exploitation Plan v2: [month 12]

D9.3.3) Market Analysis, IPR Model and Exploitation Plan v3: [month 24]

D9.3.4) Market Analysis, IPR Model and Exploitation Plan v4: [month 36]

D9.4.1) Collaboration Plan and Updates: The specific plan for collaboration, including the specific working group this project will participate to will be detailed in the first deliverable “Collaboration Plan” due at Month 6, which will be followed by deliverables at the end of each reporting period reporting on the activities done and updating the plans for the next period. [month 6]

D9.4.2) Collaboration Plan and Updates: [month 12]

D9.4.3) Collaboration Plan and Updates: [month 24]

D9.4.4) Collaboration Plan and Updates: [month 36]

WT3:
Work package description

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments

WT3:
Work package description

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

One form per Work Package

Work package number [53]	WP10	Type of activity [54]	MGT
Work package title	Consortium and Project Management		
Start month	1		
End month	36		
Lead beneficiary number [55]	1		

Objectives

- To ensure efficient communication within the Cloud4SOA Consortium and reassure effective liaison with the EC, other projects and other bodies as required;
- To ensure strategic and everyday management of the project, according to the project management structure detailed in Section 2.1, with three main levels of responsibility from the top to the bottom: project manager, work-package leaders, task leaders; and
- To ensure efficient scientific and technical coordination among the project's participants;
- To identify, assess and manage the technological development and project administration related risks; and
- To ensure the quality of the final results and deliverables (reports and prototypes).

Description of work and role of partners

Administrative and financial project management. Scientific and technical coordination at project, work-package and task level. Administrative and technical risk identification, analysis and management. Quality assurance of the project deliverables and results through project meeting and internal peer reviews.

Task 10.1 Administrative Consortium Management (ATOS, Duration: M1 – M36)
Control the project progress by ensuring administrative, financial and contractual relationships both within the consortium and with the European Commission, as well as verifying progress of work and production of deliverables according to the project time schedule. Coordinate production of the final project report. Assume responsibility for contacting the Project Officer, formulating propositions for possible modifications of the work plan, supervising contacts with all external organizations, delivering all types of reports and deliverables, monitoring project cash-flow, managing conflicts by application of the foreseen procedures and constantly co-operating with the project's scientific and technical implementation teams.
The project will be managed under the control of a project manager under the guidance of a project management committee. The project manager will coordinate the project from the global point of view considering all organisational, legal, and financial aspects of the project. He will ensure that the project meets its contractual commitments within the budget and the timing. He will formally liaise with the EC, other projects and other bodies as required.
In order to ensure clear and efficient project management, the following recurrent events will be organised: semi-monthly work-package conference calls, monthly project conference calls, project management meetings and plenary meetings.

Task 10.2 Scientific and Technical Coordination (NUIG, Duration: M1 – M36)
The technical co-ordination of the project will be performed by NUIG in collaboration with the Project Coordinator and the project's other technical providers. The Scientific and Technology Team will co-ordinate and assist work package leaders on scientific and technical issues and will undertake initiatives to propose technical solutions and fine-tune technical and scientific orientations whenever necessary. The Scientific and Technology Team will also control the technical work carried out in the related tasks and propose technical modifications and reallocation of resources as necessary for achieving the project objectives. Finally, the Scientific and Technology Team will report about technical and scientific deviations from the project work plan and constantly co-operate with the project's administrative and financial management.

Task 10.3 Risk Management (SingularLogic, Duration: M1 – M36)

Risks will be constantly assessed and evaluated within the whole project duration. The methodology to be followed for risk management consists of four steps: a) Risk identification. Here, areas of potential risk will be identified and classified, b) Risk quantification. Here, the probability of events will be determined and the consequences associated with their occurrence will be examined, c) Risk response. Here, methods will be produced to reduce or control the risk, and d) Risk control and report. Here, lessons learnt will be documented. Risk Management will be the responsibility of the Project Coordination Committee. Timely awareness of and reaction to potential problems will be crucial to effective risk management. In the event of technological changes, the Project Coordination Committee supported by the Scientific and Technology Team will task one or more work package leaders to investigate the development and to advise the Project Coordination Committee on appropriate actions.

Task 10.4 Quality Assurance (SingularLogic, Duration: M1 – M36)
Project meetings will be held at regular intervals and in particular at key milestones in the project, project reviews and audits in order to monitor the project's progress and compliance with quality standards. All project partners should thoroughly analyze the project goals and objectives at the start of each work-package in order to systematically identify critical requirements and the measures necessary to meet these. A number of internal quality audits will be carried out at regular intervals in order to ensure that all partners involved carry out all necessary tasks to abide by the project directives.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ATOS	18.00
2	NUIG	2.00
3	SINGULARLOGIC	5.00
4	CERTH	0.50
5	CLOUDCONTROL	0.50
8	CYNTELIX	0.50
9	PTIN	0.50
10	FIT	0.50
11	ROMTELECOM	0.50
	Total	28.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
		Total	0.00			

Description of deliverables

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments

WT4:
List of Milestones

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

List and Schedule of Milestones

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	Availability of Requirements Analysis	WP1	4	6	
MS2	Availability of the Cloud4SOA Cloud Semantic Interoperability Framework and Reference Architecture	WP1	4	9	
MS3	Availability of the Cloud4SOA Services and Resources Models; Preliminary Integration Testing	WP2, WP3, WP4, WP5, WP6, WP7	2	15	
MS4	Availability of the Cloud4SOA Layers and First Integration	WP2, WP3, WP4, WP5, WP6, WP7	2	21	
MS5	Availability of the Cloud4SOA Platform	WP7	3	27	
MS6	Availability of the Cloud4SOA Prototypes	WP8	10	32	
MS7	Availability of the Cloud4SOA Lessons Learnt	WP8	10	36	

WT5:
Tentative schedule of Project Reviews

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

Tentative schedule of Project Reviews

Review number [65]	Tentative timing	Planned venue of review	Comments, if any
RV 1	6	Brussels	Interim Review
RV 2	12	Brussels	Year 1 Review
RV 3	24	Brussels	Year 2 Review
RV 4	36	Brussels	Final Review

WT6:
Project Effort by Beneficiary and Work Package

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

Indicative efforts (man-months) per Beneficiary per Work Package

Beneficiary number and short-name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	WP 9	WP 10	Total per Beneficiary
1 - ATOS	3.00	0.00	15.50	9.00	22.00	0.00	6.00	3.00	18.00	18.00	94.50
2 - NUIG	3.00	17.00	0.00	11.00	0.00	0.00	3.00	3.00	1.00	2.00	40.00
3 - SINGULARLOGIC	3.00	6.00	0.00	10.00	0.00	22.00	19.00	9.00	3.00	5.00	77.00
4 - CERTH	15.00	15.00	0.00	12.50	0.00	0.00	4.00	3.00	5.00	0.50	55.00
5 - CLOUDCONTROL	3.00	0.00	0.00	0.00	16.50	20.00	6.00	6.00	3.00	0.50	55.00
8 - CYNTELIX	3.00	0.00	16.00	0.00	0.00	0.00	4.00	6.00	2.00	0.50	31.50
9 - PTIN	4.00	0.00	0.00	0.00	0.00	0.00	0.00	13.50	5.00	0.50	23.00
10 - FIT	4.00	0.00	0.00	0.00	0.00	0.00	0.00	18.00	6.50	0.50	29.00
11 - ROMTELECOM	3.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00	5.00	0.50	24.50
Total	41.00	38.00	31.50	42.50	38.50	42.00	42.00	77.50	48.50	28.00	429.50

WT7:
Project Effort by Activity type per Beneficiary

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

Indicative efforts per Activity Type per Beneficiary

Activity type	Part. 1 ATOS	Part. 2 NUIG	Part. 3 SINGULA	Part. 4 CERTH	Part. 5 CLOUDCO	Part. 8 CYNTELI	Part. 9 PTIN	Part. 10 FIT	Part. 11 ROMTELE	Total
1. RTD/Innovation activities										
WP 1	3.00	3.00	3.00	15.00	3.00	3.00	4.00	4.00	3.00	41.00
WP 2	0.00	17.00	6.00	15.00	0.00	0.00	0.00	0.00	0.00	38.00
WP 3	15.50	0.00	0.00	0.00	0.00	16.00	0.00	0.00	0.00	31.50
WP 4	9.00	11.00	10.00	12.50	0.00	0.00	0.00	0.00	0.00	42.50
WP 5	22.00	0.00	0.00	0.00	16.50	0.00	0.00	0.00	0.00	38.50
WP 6	0.00	0.00	22.00	0.00	20.00	0.00	0.00	0.00	0.00	42.00
WP 7	6.00	3.00	19.00	4.00	6.00	4.00	0.00	0.00	0.00	42.00
WP 8	3.00	3.00	9.00	3.00	6.00	6.00	13.50	18.00	16.00	77.50
WP 9	18.00	1.00	3.00	5.00	3.00	2.00	5.00	6.50	5.00	48.50
Total Research	76.50	38.00	72.00	54.50	54.50	31.00	22.50	28.50	24.00	401.50
2. Demonstration activities										
Total Demo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Consortium Management activities										
WP 10	18.00	2.00	5.00	0.50	0.50	0.50	0.50	0.50	0.50	28.00
Total Management	18.00	2.00	5.00	0.50	0.50	0.50	0.50	0.50	0.50	28.00
4. Other activities										
Total other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	94.50	40.00	77.00	55.00	55.00	31.50	23.00	29.00	24.50	429.50

WT8:
Project Effort and costs

Project Number [1]	257953	Project Acronym [2]	Cloud4SOA

Project efforts and costs

Benefi-ciary number	Beneficiary short name	Estimated eligible costs (whole duration of the project)						Requested EU contribution (€)
		Effort (PM)	Personnel costs (€)	Subcontracting (€)	Other Direct costs (€)	Indirect costs OR lump sum, flat-rate or scale-of-unit (€)	Total costs	
1	ATOS	94.50	511,245.00	2,500.00	46,000.00	155,883.00	715,628.00	425,154.00
2	NUIG	40.00	280,000.00	2,500.00	42,000.00	193,200.00	517,700.00	396,900.00
3	SINGULARLO	77.00	462,000.00	2,500.00	30,000.00	295,200.00	789,700.00	424,900.00
4	CERTH	55.00	302,500.00	2,500.00	32,750.00	289,160.00	626,910.00	473,652.00
5	CLOUDCONTR	55.00	193,986.00	0.00	30,000.00	134,391.00	358,377.00	271,888.00
8	CYNTELIX	31.50	252,000.00	0.00	24,000.00	55,200.00	331,200.00	251,400.00
9	PTIN	23.00	120,060.00	0.00	20,000.00	120,456.00	260,516.00	135,872.00
10	FIT	29.00	156,600.00	0.00	32,000.00	133,400.00	322,000.00	244,250.00
11	ROMTELECOM	24.50	122,500.00	0.00	20,000.00	71,250.00	213,750.00	113,250.00
Total		429.50	2,400,891.00	10,000.00	276,750.00	1,448,140.00	4,135,781.00	2,737,266.00

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It cannot be changed unless agreed so during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

53. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

54. Type of activity

For all FP7 projects each work package must relate to one (and only one) of the following possible types of activity (only if applicable for the chosen funding scheme – must correspond to the GPF Form Ax.v):

• **RTD/INNO =** Research and technological development including scientific coordination - applicable for Collaborative Projects and Networks of Excellence

• **DEM =** Demonstration - applicable for collaborative projects and Research for the Benefit of Specific Groups

• **MGT =** Management of the consortium - applicable for all funding schemes

• **OTHER =** Other specific activities, applicable for all funding schemes

• **COORD =** Coordination activities – applicable only for CAs

• **SUPP =** Support activities – applicable only for SAs

55. Lead beneficiary number

Number of the beneficiary leading the work in this work package.

56. Person-months per work package

The total number of person-months allocated to each work package.

57. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

58. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

59. Milestone number

Milestone number:MS1, MS2, …, MSn

60. Delivery date for Milestone

Month in which the milestone will be achieved. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

61. Deliverable number

Deliverable numbers in order of delivery dates: D1 – Dn

62. Nature

Please indicate the nature of the deliverable using one of the following codes

R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

63. Dissemination level

Please indicate the dissemination level using one of the following codes:

• **PU =** Public

• **PP =** Restricted to other programme participants (including the Commission Services)

• **RE =** Restricted to a group specified by the consortium (including the Commission Services)

• **CO =** Confidential, only for members of the consortium (including the Commission Services)

• **Restreint UE =** Classified with the classification level "Restreint UE" according to Commission Decision 2001/844 and amendments

• **Confidentiel UE =** Classified with the mention of the classification level "Confidentiel UE" according to Commission Decision 2001/844 and amendments

• **Secret UE =** Classified with the mention of the classification level "Secret UE" according to Commission Decision 2001/844 and amendments

64. Delivery date for Deliverable

Month in which the deliverables will be available. Month 1 marking the start date of the project, and all delivery dates being relative to this start date

65. Review number

Review number: RV1, RV2, ..., RVn

66. Tentative timing of reviews

Month after which the review will take place. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

67. Person-months per Deliverable

The total number of person-month allocated to each deliverable.

FP7-257953 Cloud4SOA

A CLOUD INTEROPERABILITY FRAMEWORK AND PLATFORM FOR
USER-CENTRIC, SEMANTICALLY-ENHANCED SERVICE-ORIENTED APPLICATIONS
DESIGN, DEPLOYMENT AND DISTRIBUTED EXECUTION

PART B – COLLABORATIVE PROJECT

PP	Partner Name	Short Name	Nationality
P1	Atos Origin Sociedad Anonima	ATOS	ES
P2	National University of Ireland, Galway (NUI, Galway) - Digital Enterprise Research Institute (DERI)	NUIG	IE
P3	SINGULARLOGIC ANONYMOS ETAIRIA PLIROFORIAKON SYSTIMATON & EFARMOGON PLIROFORIKIS	SingularLogic	GR
P4	Centre for Research and Technology Hellas	CERTH	GR
P5	cloudControl UG (haftungsbeschränkt)	cloudControl	DE
P6	Cyntelix Corporation	Cyntelix	IE
P7	Portugal Telecom Inovaçao SA	PTIN	PT
P8	Fraunhofer Gesellschaft - Institut für Angewandte Informationstechnik FIT	FIT	DE
P9	ROMTELECOM S.A.	RomTelecom	RO

Approved by EC on 07/09/2010

Table of Contents

B1. Concept & Objectives, Progress Beyond State-of-the-Art, S/T Methodology & Work Plan

B1.1. Concept and Project Objectives

B1.1.1. Introduction and Motivation

The paradigm of Service Oriented Architecture (SOA) has provided the means to develop highly flexible, modular, reusable and easily extendable applications by allowing the users to develop and to deploy discrete pieces of functionality as services. The derived loose coupling of services is perceived to be an important advancement towards more interoperable systems. Web Services became the prevailing SOA implementation paradigm during the last decade.

However problems still remain in SOA environments regarding service discovery, composition, execution and monitoring. In an attempt to address these problems semantics were applied in SOA for formally describing the Web Service and its capabilities. This led to the definition of various service ontologies and vocabularies, such as OWL-S, WSMO, WSDL-S, SAWSDL and SAREST. Although semantic SOAs and Semantic Web Services have become a common academic topic which attracted considerable effort, soon limitations became obvious for the actual uptake of such approaches in the industry.

Recently another paradigm interestingly seems to directly affect SOA related deployments in the near future: Cloud computing. The main idea behind Cloud computing is that computing will increasingly be delivered as a service, over the Internet, from vast warehouses of shared machines[1]. The concept of Cloud Computing entails computing resources and IT services being offered as a service (aaS) over the Internet. Cloud services generally fall in three categories: **Infrastructure-as-a-Service (IaaS)**, **Platform-as-a-Service (PaaS)**, and **Software-as-a-Service (SaaS).**

SOAs can be deployed in a Cloud following a pay-as-you-go approach. The Cloud provides the physical hosting environment for SOA services reducing the burden of owning, maintaining and upgrading the vast computational power that is needed for resource intensive applications. Cloud computing borrows and uses the idea of service orientation. In this sense the Cloud computing paradigm remains at its principles and foundations basically SOA compliant while at the same time it creates a new, promising landscape for a next generation of SOA deployment.

Although the fundamental idea behind Cloud is not new but rather dates back some decades, the means and infrastructure we currently have available for realizing such a vision are really unique, including the maturity of SOA and web related standards, as well as the drastically dropping prices and availability of hardware and network access. For these reasons, Cloud reserved the first place in the 2010 list of the top strategic technologies by Gartner[2].

However, there are still serious issues to be discussed and solved. Coincidentally, the days this proposal was written, Economist front article was titled “Battle of the Clouds” [3] where very interesting concerns with regards to the Cloud future can be found.

[1] Battle of the clouds, Economist, *15th October 2009* available at *http://www.economist.com/opinion/displaystory.cfm?story_id=14644393*

[2] http://www.gartner.com/it/page.jsp?id=1210613

[3] *http://www.economist.com/opinion/displaystory.cfm?story_id=14637206*

The competition between the three IT giant companies, namely Google, Microsoft and Apple, on who will take the lead in the Cloud is discussed and the article concludes with an alerting statement for the emerging Cloud market: "*the company or companies that dominate it will be American. European or Asian firms have yet to make much of an appearance in cloud computing*."

This dominance becomes even more problematic if combined with another finding discussed in the article: the familiar risk of technological lock-in, as the three major rival companies promote their own, mutually incompatible, Cloud standards and formats.

Taking into account the above findings, in such a dynamic, evolving but at the same time monopolised market, **Interoperability between Cloud providers becomes a major issue of discussion and concern, especially for the EU industry.**

Currently, there are **no standards for Cloud interoperability**. Some providers do not even allow software created by their customers to be moved off their platform. Initiatives are needed to ensure that the **IT industry does not remain dominated by monopolies of single companies** and to support competition in the cloud computing market. Companies developing applications should be able to choose between different Cloud platforms and should also be able to switch providers whenever needed.

B1.1.2. The Cloud4SOA Project Vision

With this problem formulation, the ultimate goal and scope of the Cloud4SOA project is presented below.

Cloud4SOA focuses **on resolving the semantic interoperability issues that exist in current Clouds infrastructures and on introducing a user-centric approach for applications which are built upon and deployed using Cloud resources.** To this end, Cloud4SOA aims **to combine three fundamental and complementary computing paradigms**, namely **Cloud computing, Service Oriented Architectures and lightweight semantics to propose a reference architecture and deploy fully operational prototypes**.

We briefly elaborate on this vision below.

From a business perspective, Cloud4SOA aims at lifting the barriers that cause the vendor lock-in problem, thus empowering Cloud users and allowing them to choose freely the Cloud provider that best fits their needs or easily combine services from different vendors. Cloud4SOA is also expected to empower the position of European SME Cloud vendors, such as CloudControl, in an emerging market which is currently dominated by the three American colossi, namely Google, Microsoft and Apple.

From a scientific and technical perspective, the proposed reference architecture coupled by a reference implementation are key concepts in Cloud4SOA. Relevant issues and discussions about a Unified Cloud Interface and standardised APIs for Cloud Computing are just emerging in the USA (more details in part 1.2). The Cloud4SOA consortium is aware that a reference architecture and implementation which nobody uses is literally worthless and this is why we intend to pay particular attention not only to good documentation and strong support of our proposed architecture but also to **community building activities in the domain of Cloud semantic interoperability**[4].

The envisioned reference architecture/implementation will exhibit the following characteristics.

The inherited Cloud features will allow the on-demand addition of new computing resources, while at the same time the SOA features will allow the development and deployment of rich applications in the form of

[4] http://cloud-standards.org includes a list documenting the activities of the various standardisation organisations working on Cloud standards.

services. Additionally, the Cloud will provide the underlying technical solution for the efficient and highly parallelized execution of resource intensive services. The main characteristic of these services is that they **need to process large amounts of data and consume resources**, which is usually a highly expensive operation that needs to be parallelized in order to ensure a time-effective execution. SOA will provide the means for users to design and directly deploy the applications of their choice in the form of Web services using intelligent and adaptable service front-ends. SOA will also help to integrate Cloud services backwards into legacy information systems.

Semantics will play a catalytic role in the whole process. Lightweight semantics will be used for annotating the Cloud resources and services. **Semantics can be applied at the interface level, the component level, and the data level by utilizing a generic semantic Cloud resource data model**. The semantic annotation of Cloud resources and services is expected to contribute towards addressing semantic interoperability, mainly in the areas of IaaS and PaaS.. Moreover, it will facilitate the matching between applications and resources that need to be assigned to it. Semantically annotating Cloud resources will also allow us to easily identify clusters of collaborating and/or complementary resources. Cloud4SOA will thus contribute to the development of a semantic Cloud, which will overcome the boundaries raised by different architectures and specific platform requirements and APIs, and will strive to gain develop and gain consensus on a set of semantic models for describing the main aspects of the Cloud, e.g. resource and service models.

Lightweight semantics will also be used in order to annotate the SOA services and the applications deployed by the users on top of the Cloud. The main challenges to be addressed there involve the specification of the appropriate properties such that the service (or service-based application) can be composed, deployed, parallelized and efficiently executed in the Cloud4SOA infrastructure. The rich existing experience and research on the field of service annotation will be exploited. Based on these additional service descriptions, compatibility with the SOA components will be checked, the required computing resources will be booked and an execution plan will be derived.

To provide a flexible Cloud environment where services can allocate resources on demand, existing methods for the adaptive execution and the monitoring of services have to be extended towards dynamic resource allocation mechanisms and service execution. The semantic Cloud abstraction will support this flexible dynamic environment as it will be able to interconnect Cloud platforms and API both between them and with existing protocols and standards.

The main challenges to be addressed within the Cloud4SOA project also include the enhancement of existing SLA description models as well as respective negotiation strategies and protocols to enable the semantic annotation of cloud resources, the development of monitoring and feedback mechanisms to observe the commitments met by an SLA, and the development of adaption strategies to mitigate the effects of possible SLA infringements. All three aspects will be analysed both on a design and implementation level. Cloud4SOA will as well participate with relevant standardisation bodies and working groups (e.g. OGF GRAAP, OGF OCCI or DMTF Open Cloud Standards Incubator) in the evolution of a standardised model of SLAs for Clouds, which will allow precise description of Quality of Service (QoS), an effective governance and audit processes, and lifecycle management of services in a distributed, multiple-provider, cloud environment..

Special emphasis will be given on the definition and development of the Cloud4SoA adaptable service front-end layer, involving the user in the design process. The approach will be based on the use of widgets thus enabling the user to manage their Cloud applications in a centralized manner, irrespective of how the Cloud Widgets are distributed across different environments (e.g. mobiles, webpages, desktop, etc).

Concluding, Cloud4SOA will contribute to the **reduction of the switching costs** between different Cloud vendors and to the **elimination of the vendor lock problem**. The latter is expected to **encourage the entrance of smaller companies**, apart from the big Cloud vendors, **in the Cloud industry**. Finally,

Cloud4SOA, through its user-centric focus, will **facilitate the direct access of the users to their data and their services through user-friendly and intuitive UIs**.

B1.1.3. Scientific and Technological Objectives

In order for the consortium to realize the above presented vision, **the Cloud4SOA project has a four-fold focus** that will be achieved through the following research and innovation related activities:

- *Objective I*: To **identify and analyze the semantic interoperability problems within the Cloud** by carrying out a comprehensive analysis which includes studying the State of the Art and reviewing the stakeholders' opinions *(Milestone M1)*. The Cloud Semantic Interoperability Framework will be the result of this exercise *(Milestone M2)*.
- *Objective II*: To **resolve the most important semantic interoperability problems through the Cloud4SOA Reference Architecture** *(Milestone M2)*, which introduces an open, generic architecture for a semantically interoperable Cloud that capitalizes on:
  - **Service Oriented Architecture** so that it offers a unified Cloud API which is also in line with the inherent service orientation of the Cloud, as resources are offered as a Service (aaS);
  - **Lightweight semantics** which will be used for developing simple, extendable and reusable resource and service models *(Milestone M3)*, e.g. semantic Cloud data model, semantic Cloud resource model and semantic Cloud service model. The use of lightweight semantics will enhance the SOA functionalities and will improve service discover, composition, execution and monitoring; and
  - **User-centric** design and development principles which will allow users to design and develop service-based applications by means of adaptable, intelligent service front-ends.

  The Cloud4SOA Reference Architecture comprises of three horizontal layers, namely the *Intelligent Interfaces and Service Front-Ends* layer, the *SOA* layer, and the *Virtualization and Execution* layer, and two vertical layers, namely the *Semantic* layer and the *Cloud Governance* layer, that span across all the horizontal ones *(Milestone M4)*
- *Objective III:* **Implement, deploy** and **evaluate the usability, applicability and adaptability of** the **Cloud4SOA Reference Architecture by developing a proof-of-concept platform (including a set of models and tools) which will be applied in different scenarios and setups across the enlarged Europe**. In particular, the Cloud4SOA research results will facilitate three industrial and business showcases *(Milestone M6)* regarding:
  - the service-oriented development and deployment of **reliable, scalable & highly available multimedia services to the mobile subscribers of PTIN in Portugal**;
  - the **faster reaction on dynamic use and interaction patterns of BSCW** (Basic Support for Cooperative Work) **groupware platform** of **FIT in Germany**;
  - the **constant monitoring of the quality of the voice and data services** provided by the fixed telephony and internet services **network infrastructure of RomTelecom in Romania**;
- *Objective IV:* Establish a **Special Interest Group on Cloud Semantic Interoperability** to generally act as a reference point and community building process for the Cloud interoperability discussion in Europe and beyond and to promote amongst others **the awareness, the use** and **the adoption** of the Cloud4SOA Reference Architecture and models in this community. The goal is to use this group as a vehicle towards a **technical committee or common specification proposal to a standardization body**.

B1.1.4. Expected Results and Indicators of Success

The 36-month Cloud4SOA project will result, through its deliverables (both reports and prototypes), in:

R1. The **Cloud4SOA Cloud Semantic Interoperability Framework**, which will provide a) a typology of semantic interoperability conflicts in the Cloud, and b) a set of recommendations and good practices on how to achieve semantic interoperability and transparent data and application portability between different Cloud platforms.

R2. The **open, generic Cloud4SOA Reference Architecture**, which will introduce a scalable, reusable and transferable approach for facilitating the design, deployment and execution of resource intensive SOA services on top of a semantically enhanced Cloud. The Cloud4SOA Reference Architecture will rely on open standards and open-source solutions.

R3. The **Cloud4SOA lightweight models for resources and service**, which will offer the necessary semantics for annotating Cloud computing resources and services. These models will rely on standards and will reuse existing service and data vocabularies.

R4. The **Cloud4SOA platform**, which implements the Cloud4SOA Reference Architecture and comprises of a set of interlinked collaborating software components and models.

R5. **Three (3) Cloud4SOA showcases** that will validate and prove the models and components of the proposed Cloud4SOA platform.

R6. **Wide-scale dissemination and exploitation of the project results** to the European academic, scientific and business stakeholders and end-users organizations through the formulation of a multinational consortium with direct and indirect presence in the enlarged Europe. Within this context, we envision a critical role for the proposed **Cloud Semantic Interoperability Special Interest Group** which will host the discussion and form a community of practice and at the same time raise the awareness, use and adoption of the Cloud4SOA Reference Architecture and models in the Cloud research and business communities within Europe and beyond.

Please, note that the technical achievement and other project benefits, including tentative key performance indicators, are summarised in the table of ANNEX I of this PART B.

B1.1.5. Relevance to the Topics addressed by the Call

Cloud4SOA is a Small or medium-scale focused research project (STREP) project that addresses Target Outcome **1.2.a "Service Architectures and Platforms for the Future Internet"**, which is part of the Strategic Objective **ICT-2009.1.2 "Internet of Services, Software and Virtualisation"** of the FP7 ICT Work Programme.

Relevance to the Strategic Objective ICT-2009.1.2: Internet of Services, Software and Virtualisation (Target outcome a: Service Architectures and Platforms for the Future Internet)

Point #1 *"Service front ends enabling communities of* ***networked users easily to compose, configure, share and use services*** *and providing* ***device and context aware service adaptations****. They facilitate the* ***development of, search for and interaction with services, cover the service life cycle*** *and take account of social network users having* ***different levels of expertise****."*

Cloud4SOA will adopt **user-centric design and development principles** which will **empower** professionals and engineers to **design, develop and deploy composite applications** leveraging the **paradigm of mash-ups** and following a **service oriented approach** by means of **adaptable, intelligent service front-ends**, utilizing **widget technology** for the encapsulation of functionality that can be **deployed and adapted to a wide range of destination environments and devices**. In particular, widget technology will be combined to permit the **packaging of services** to benefit the **viral distribution effect** thus **facilitating users**, with

different levels of cloud and technical expertise, to **design, publish, discover, compose and interact** with cloud-enabled services, **throughout the service lifecycle** on the cloud infrastructure.

***Point #2** "**Open, scalable, dependable service platforms, architectures, and specific platform components**, enabling **automatic service description, discovery, composition, and negotiation** with a **multiplicity of reusable services**, which may be mobile, multi-device, multi-modal, multi-context or nomadic."*

Cloud4SOA will deliver **a generic Cloud Semantic Interoperability Framework, a modular and extendable Reference Architecture** and an **open service platform of interconnected software components**, which will support **(semi-)automatic semantic description and publication of resource-intensive services**, as well as **enhanced service discovery and composition over a set of reusable SOA services**. These will contribute to a strengthened industry in Europe for software services, offering a greater number of more **reliable and affordable services**, enabled by **flexible and resilient service design, development, deployment and management platforms**.

***Point #3** "Evolution and **interoperability of service platforms** are also needed, and scale and complexity in dynamic, distributed heterogeneous environments, including open service networks, should be addressed."*

Cloud4SOA will develop **a generic, open and reusable Cloud Semantic Interoperability Framework** which employs **lightweight semantics** so as to **address semantic interoperability issues both at the SOA-level** as well as **within the Cloud**, contributing to **semantically interoperable service and Cloud platforms in the Future Internet**.

***Point #4** "System **management functionalities** such as **Service Level Agreement** (SLA) management, **Quality of Service** (QoS), **access rights** and customer charging have to be supported."*

Cloud4SOA will implement a novel approach and toolset for Cloud **platforms and Cloud enabled services lifecycle governance**, taking into account semantic **interoperability**, **security** and **scalability** issues, referring to the **capability to control and track changes to services** and to **place controls over who can access and change a service**, and **establishing Service Level Agreements** with end-users in the form of **service contracts** and ensuring that these contracts are **properly enforced maintaining a high Quality of Service**.

***Point #5** "**Virtualised infrastructures** extending the capabilities of distributed computing, storage and communication infrastructures to manage a **multiplicity of underlying hardware and software resources** and seamlessly integrate them within the composite service orientation paradigm enabling **operations across heterogeneous technological and business domains**. These virtualised infrastructures allow the **flexible, dynamic, dependable and scalable provision of advanced services** to support the various resource requests/needs of service platforms, including software as a service, resource as a service and other approaches."*

Cloud4SOA will realize a DHT-facilitated **distributed overlay network structure**, in order to result in a scalable, flexible and robust mechanism for allowing **distributed publication of resource-intensive services from diverse business domains** and **computational resources from heterogeneous low-level cloud implementations**. Cloud4SOA will allow the **virtualization and self-organization of computational infrastructures** based on load measurement and scheduling algorithms, as well as the **distributed services execution** and the handling and merging of distributed execution results, facilitating the **reliable, scalable and highly available composite software-as-a-service** provision.

Relevance to the Other Work Programme Topics

***Point #1** "**Competitiveness of SMEs**"*

Cloud4SOA will result in an open, generic and reusable cloud interoperability and portability framework and an enabling technologies toolset, **facilitating European SME to compete with the big US corporations** currently dominating the cloud computing market.

Point #2 "International cooperation"

Cloud4SOA will come up with a Cloud semantic interoperability space interest group so as to raise awareness in cloud interoperability and portability issues and promoting the developed interoperability framework and reference architecture, **enhancing the participation of European enterprises – especially SMEs – in EU-wide or world-wide research and business networks**.

B1.2. Innovation Character in Relation to the State-of-the-Art

The proposed Cloud4SOA project addresses research challenges in the fields of a) **cloud (semantic) interoperability**, b) **semantic service models**, c) **decentralized service registries**, and d) **service composition and mash-ups**. The next paragraphs present the current state-of-the-art technologies and proposed advancements in each one of the above mentioned knowledge domains.

B1.2.1. Knowledge Advancements regarding Cloud Interoperability

Cloud Computing presents a scalable and affordable approach for users to utilize resources on demand. Cloud services are usually paid per use and the client can have as much of a service as they need at a certain point of time. Moreover, in Cloud computing all the burden of service management and governance falls on the Cloud provider.

Cloud services are usually grouped in three categories: **Infrastructure-as-a-Service (IaaS)**, **Platform-as-a-Service (PaaS)**, and **Software-as-a-Service (SaaS).**

Applications evolve from being installed on a local computer to running on servers and being used from inside a browser over the internet. Therefore for cloud computing these servers and the software stack executing the actual application and answering the browser requests are the new type of platforms that applications are developed for. Until now the platforms applications usually are developed for the different operating systems. Here a major monopoly probably did seriously decrease industry innovation for a long time.

With this background it is natural that one of the concerns regarding Cloud Computing is related to portability and interoperability between different Clouds. Currently, there are no standards for interoperability or data portability in the Cloud. To complicate things even more, some providers do not allow software created by their customers to be moved off their platform. Musser (2009) explains that if one builds an application on Amazon's EC2 or Google's AppEngine, or store their data on Box.net or Amazon's S3, it can turn out to be difficult to port the application or move the data to another Cloud provider. Even more obstacles can be raised when the customer has multiple applications running in platforms of different cloud providers as they will probably follow different data models and different technological solutions. In this case, communicating and sharing the data housed within different applications can be quite a challenge.

The vision of standardised APIs for Cloud Computing was born, e.g. (Zaino, 2009). The Cloud Computing Interoperability Forum (CCIF; www.cloudforum.org) has been formed to address this issue. Its aim is to enable a global cloud computing ecosystem whereby organizations are able to seamlessly work together for the purposes for wider industry adoption of cloud computing technology and related services. The CCIF have proposed a Unified Cloud Interface (UCI) (CCIF, 2009), which is a single interface that can be used to retrieve a unified representation of all multi-cloud resources and to control these resources as needed. To achieve such an interface and bridge the interoperability issues between heterogeneous service-providers, a semantic model of the components of Cloud Computing is required. In the UCI proposal, the resource description framework (RDF) is used to describe a semantic cloud data model (taxonomy & ontology). In his blog, Reuven Cohen, the instigator of CCIF and founder of *Enomaly* (www.enomaly.com), discusses Semantic Cloud Abstraction and how it may be used with the Unified Cloud Interface (Cohen, 2009). However, since its proposal, there has been little development on the UCI project and its semantic model. Additionally the proposal has met with some opposition from bloggers in the Cloud Computing community, e.g. (Vambenepe, 2009).

(Youseff, Butrico, & Da Silva, 2008) adopt an alternative approach to solving Cloud Computing problems such as availability and application migration. They present a unified ontology of Cloud Computing, with a classification of its components, and their relationships as well as their dependency on prior concepts from other fields in computing. However the ontology that they proposed in this paper does not take advantage of semantic technologies and languages, such as RDF or OWL.

In order to address Cloud interoperability, Cloud4SOA will

- **define a Cloud Semantic Interoperability Framework,** thus offering a roadmap for building semantically interoperable Cloud applications
- **draft a reference architecture with a semantic layer to provide a lightweight resources model** for semantically annotating Cloud computing resources, e.g. similar to, building upon or extending the semantic Cloud data model discussed earlier; and
- **create Communities of Interest around Cloud semantic interoperability issues** in order to discuss and share knowledge and experience with similar research and business initiatives

B1.2.2. Knowledge Advancements regarding Semantic Service Model

As already presented in the introduction SOA is an architectural approach that allows modularity and service decoupling. These results in cost reduction in new applications development since architects and programmers can leverage, combine and build on top of the functionalities of existing building blocks (services). Moreover, the standardized interfaces and protocols, together with the ever evolving web, unlock and opens-up development and enable a shift of creativity towards broader developers' communities. Currently SOAs enjoy a wide commercial acceptance and major software vendors such as SAP, IBM, Microsoft and ATOS can be found among the key players.

Web Services, either using SOAP or REST, have become the main technology used for implementing service oriented systems. They contribute significantly to the flexibility, modularity and extensibility of SOAs. However, certain limitations were identified and there was a systematic effort to address many of these through semantically annotating web services. Summarizing, the following efforts for semantically annotating Web Services have been proposed:

- The Web Ontology Language for Services (OWL-S) (Martin et al., 2004) ;
- The Web Service Modeling Ontology (WSMO) (Roman et al., 2005), WSMO-Lite (Vitvar, Kopecky, & Fensel, 2008) and MicroWSMO (Kopecky, Vitvar, & Gomadam, 2008) ;
- Web Service Semantics (WSDL-S) and its successor Semantic Annotations for WSDL and XML Schema (SAWSDL) (Farrell & Lausen, 2007); and
- Semantic Annotations in REST services (SA-REST) (Verma & Sheth, 2007).

Most of aforementioned approaches are characterized by a high degree of complexity which hinders their wide adoption (Xuan, 2007). Moreover, in all of them, the service related metadata come solely from the service providers, while, the metadata that emerge from the actual usage of the service are completely left out of the picture, e.g. (Loutas, Peristeras, & Tarabanis, 2009), (Meyer & Weske, 2006).

Cloud4SOA will **develop a lightweight service model within the Semantic Layer of the reference architecture**, through the reusability of existing efforts, which will allow the **semantic annotation of SOA services** and will also **include metadata which emerge bottom-up from the actual usage of the service**.

B1.2.3. Knowledge Advancements regarding Decentralized Service Registries

Web services discovery based on the Universal Description Discovery and Integration (UDDI) specification is in fact the traditional client/server model. With rapid development of electronic commerce applications, different organizations have specialized UDDI registries, called private registry. Also in e-marketplace applications, semi-private registry is used for theirs members to publish and discover Web services. With such increasing number of private or semiprivate registries, typical centralized indexing scheme based on UDDI technology can't scale well. Physical distribution of the registries can quickly overwhelm this centralized configuration and can lead to serious performance bottlenecks. Emerging P2P solutions particularly suit for the increasingly decentralized application. Recently a number of groups have proposed a new generation of P2P system like CAN [Ratnasamy et al., 2001], Pastry [Rowstron & Druschel, 2001], Chord [Stoica et al., 2003] and many others [Lua et al., 2005], avoiding shortcomings of early P2P systems like Gnutella (gnutella.wego.com) and Napster (www.napster.com). While different implementation exists, these systems all support a Distributed Hash Table (DHT) interface of put (key, value) and get (key). In contrast to UDDI, P2P networks content is normally described and indexed locally to each peer and search queries are propagated across the network.

DHTs largely solve the problem of centralized UDDI registries. However, DHTs support only exact match, which is the same to UDDI based keywords search. Thus semantic Web services annotation is prerequisite for enhanced search capabilities. Semantically described services will enable better service discovery and easier interoperation among services. Semantic information facilitates developers to find services that best match their needs and to enable automatic service discovery [Paolucci et al., 2003], utilizing one of the several approaches suggested for adding semantics to Web services [Farrell & Lausen, 2007; DAML-S Coalition, 2002; Akkiraju et al., 2003].

In **Cloud4SOA**, the consortium is going to

- **exploit the benefits of distributed P2P network architectures** in the development of **decentralized structures for efficient publication and effective discovery of resources** (including cloud-enabled services, data and computational nodes);
- **utilize the Distributed Hash Tables (DHTs) for establishing the overlay distributed network structure** (including the routing and ring formulation mechanisms) **on top of the stabilized Chord ring topology** that realizes (at the physical level) the decentralized resources registry; and
- **make use of the lightweight semantic annotations** so as to **facilitate efficient resources publication** on the decentralized registry structure and **dynamic service discovery**, providing both **semantic level service matching** and **services composite discovery**.

B1.2.4. Knowledge Advancements regarding Service Composition and Mashups

In order to compose Web services the Semantic Web community adopts Artificial Intelligence planning where service's preconditions and effects are semantically defined and validated. Hence, defining a service's interface allows synthesizing the services' flow (Srivastana and Koehler, 2003). More specifically, having the web services' descriptions expressed using a semantic service model, e.g. OWL-S, WMSO or SAWSDL, the service's flow is validated using the semantically defined preconditions and effects and a composite service is developed (e.g. see (Burstein et al., 2005), (Sycara et al., 2003), (Wu et al., 2007), (Charif & Sabouret, 2005)). Semantic annotations guide a composition tool to select the right service, but automatic composition is the one that really utilizes the power of the Semantic Web. For, example, Liu et al. (2005) propose an automatic composition approach that can generate all the composition plans for a composite service and selects one with the minimal execution price.

Recently, as part of Web 2.0, the term "Mashup" was introduced to indicate a new way to create Web applications by composing existing Web resources and by utilizing data and Web APIs (Benslimane, Dustdar & Sheth, 2008). Mashup editors have been developed in order to support end-users access and compose various data that Web applications can provide. The most popular mashup editors are *Yahoo Pipes*[5] , *IBM Mashup Ceter*[6], *Intel MashMaker*[7], Serena Mashup Composer[8], Dapper[9] , Openkapow[10], Orchestr8[11], Presto[12], and DERI pipes[13] .

These editors provide easy to use GUIs for the aggregation, manipulation and mashing up of the content available online. However, most of these editors do not take into account semantic information that potentially can be embedded into Web applications and, thus, do not exploit semantic means for services' interoperability and integration to their great extent.

In order to address these deficiencies, **Cloud4SOA** will develop an **intelligent and adaptive service front-end**, which will be **based on widgets**, and which will **facilitate the service oriented design of applications**. This service front-end will be **supported by rich user interfaces**, **contextual help** and **recommendation mechanisms**.

Please, note that a description of the performance and research indicators regarding the advancement beyond the state-of-the-art, is already included in the table of ANNEX I of this PART B.

[5] http://pipes.yahoo.com/pipes/

[6] http://www-01.ibm.com/software/info/mashup-center/

[7] http://mashmaker.intel.com/web

[8] http://www.serena.com/products/mashup-composer/index.html

[9] http://www.dapper.net/open/

[10] http://openkapow.com/

[11] http://www.orch8.net

[12] http://www.jackbe.com/

[13] http://pipes.deri.org/

B1.3. S/T Methodology and Associated Work Plan

This section presents the technical and architectural approach that the Cloud4SOA consortium is going to follow so as to achieve the project's objectives, as well as the detailed work plan, broken down in work packages and tasks, which materialize the logical implementation phases of the project.

B1.3.1. Overall Strategy and General Description

B1.3.1.1 The Cloud4SOA Concepts at a Glance

Offering an infrastructure and standardized for building applications on top of the Cloud is a need that has recently emerged in the Cloud community, e.g. (Zaino, 2009). Cloud4SOA will work towards this direction in order to develop an **open, generic and reusable framework** which will facilitate the **service oriented development of applications which utilize the power offered by Cloud computing.** To do so, Cloud4SOA will start by delivering the **Cloud4SOA Cloud Semantic Interoperability Framework** and the **Cloud4SOA Reference Architecture** which will address the semantic interoperability problems discussed in section B1.1.B1.2.1.

In order to define both the Cloud4SOA Cloud Semantic Interoperability Framework and the Reference Architecture, the first step is to carry out an extended review of the State-of-the-Art in the following research fields covered by Cloud4SOA in order to identify gaps, deficiencies, needs and problems, and thus elicitate requirements:

- **Intelligent and adaptive service front-ends for the development of service-oriented Cloud-based applications**;
- **Semantic service and data models to support the semantic annotation of Cloud services and resources**;
- **Cloud computing problems**, **focusing mostly on semantic interoperability issues at the PaaS and IaaS levels.**

Moreover, the stakeholders, e.g. the Cloud4SOA user partners as well as cloudControl, will be involved in the requirements elicitation process. Standardized requirements elicitation techniques, e.g. structured questionnaires and interviews, will be employed in order to elicitate requirements from the stakeholders.

Once these two parallel steps are completed, a set of requirements that Cloud4SOA will have to address will be collected and prioritized. As said earlier, this prioritized list of requirements has a two-fold aim (**Figure 1**). On the one hand it will guide the development of the Cloud4SOA Cloud Semantic Interoperability Framework and on the other hand it will guide the design of the Cloud4SOA Reference Architecture.

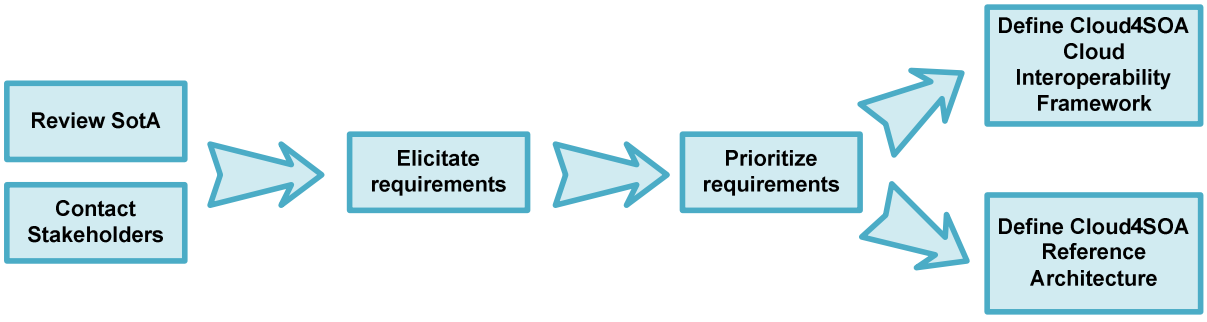


Figure 1 The Cloud4SOA Requirements Elicitation

In order to develop the Cloud4SOA Cloud Semantic Interoperability Framework the semantic interoperability problems that are raised in the Cloud when two platforms try to exchange data or when a user attempts to move his/her application/data from one platform to another one will be identified, documented, studied and analyzed. As such our research will mainly focus on IaaS and PaaS.

Semantic interoperability problems are a result of different data models used by different platform owners, and usually raised either at the data or at the schema level (Park & Ram, 2004). For example, different platform owners might use different terms in their models for referring to the same concept or a concept that exists in the model of a platform owner might not exist in the model of another one.

Currently, a number of well-know interoperability frameworks exist, such as the European Interoperability Framework[14]. In all these frameworks the semantic aspect is present. In the context of Cloud4SOA, these frameworks will be reviewed in order to reuse and transfer knowledge in the Cloud domain. This will allow us to define the Cloud4SOA Cloud Semantic Interoperability Framework. Thereafter, the semantic interoperability problems will be categorized in different categories. Thus, a typology of semantic interoperability problems in the Cloud will be developed, e.g. similar to the one of (Peristeras et al., 2008). Additionally, a roadmap comprising of a set of guidelines and good practices for building semantically interoperable Cloud platforms will be devised, e.g. similar to previous research (Tambouris et al., 2009; Tambouris et al., 2008).

Table 1 summarizes the levels of interoperability that will be studied in Cloud4SOA, i.e. semantic interoperability, and couples them with the Cloud categories on which we focus, i.e. IaaS and PaaS.

	IaaS	PaaS	SaaS
Technical Interoperability	☒	☒	☒
Semantic Interoperability	☑	☑	☒
Organizational Interoperability	☒	☒	☒

Table 1. Semantic Interoperability in Cloud4SOA

The Cloud4SOA Reference Architecture will introduce a scalable, reusable, modular, extendable and transferable approach for facilitating the design, deployment and execution of resource intensive SOA services on top of a semantically enhanced interoperable Cloud. The Cloud4SOA Reference Architecture will rely on open standards and open-source solutions. The Cloud4SOA Reference Architecture will address the requirements that will be included in the prioritized list discussed earlier.

The Cloud4SOA Reference Architecture (**Figure 2**) comprises of three horizontal layers, namely the *Intelligent Interfaces and Service Front-Ends* layer, the **SOA** layer, the **Virtualization and Execution** layer, and two vertical layers, namely the **Semantic** layer and the **Governance** layer, that span across all the horizontal ones.

- The Intelligent Interfaces and Service Front-Ends layer supports the user-centric focus of Cloud4SOA and the easy access of the users to the Cloud4SOA functionalities;
- The SOA layer implements the core functionalities offered by the Cloud4SOA platform, such as service discovery and mashing;

[14] http://ec.europa.eu/idabc/servlets/Doc?id=31597

- The Virtualization and Execution layer puts in place the technical infrastructure, e.g. distributed virtualized registries, on top of which the Cloud4SOA platform is built;
- The Semantic layer puts in place the semantic models and tools offered by Cloud4SOA; and
- The Governance Layer offers a toolkit for monitoring the service life-cycle of Cloud4SOA services.

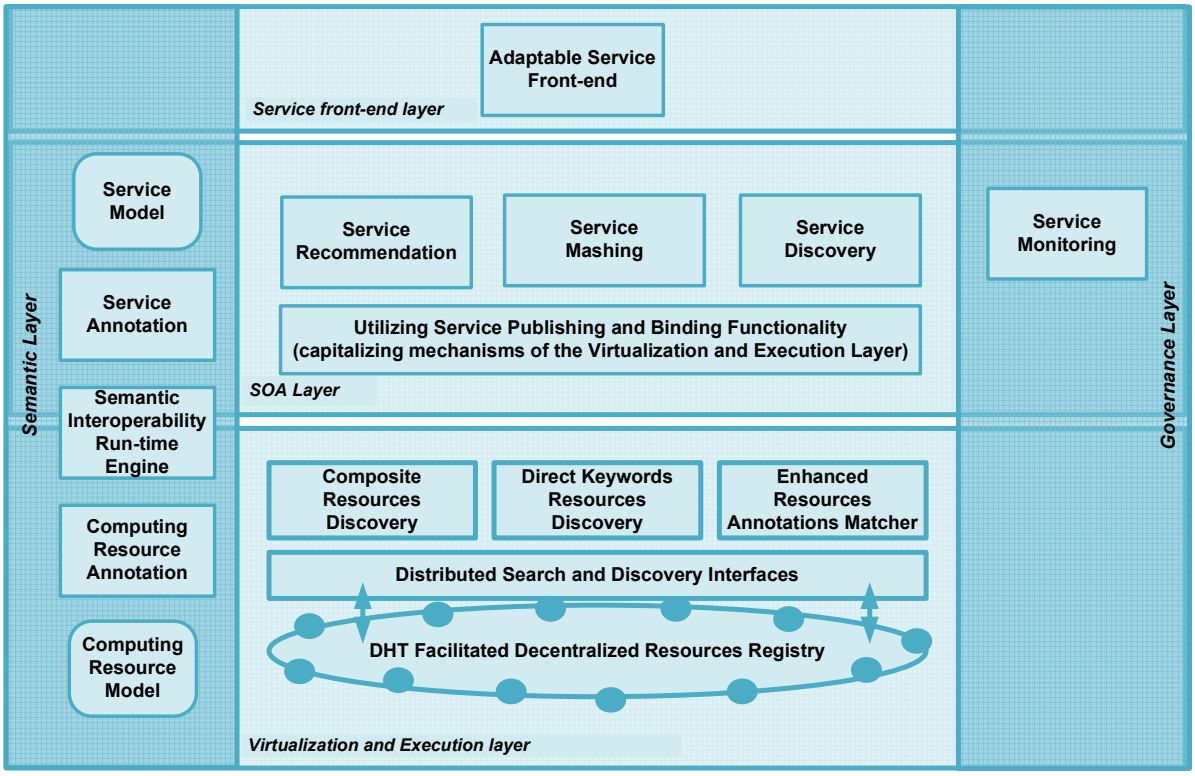


Figure 2 The Cloud4SOA Reference Architecture

B1.3.1.2 The Cloud4SOA Semantic Layer

In Cloud4SOA semantic models and technologies will be employed for two main reasons. On the one hand they will resolve semantic interoperability conflicts that are raised when different Cloud platforms exchange data. On the other hand semantics will be used at the SOA layer in order to provide the means for developing intelligent service discovery, mashing and recommendation mechanisms. These two parallel lines of work call for two different types of semantic models and tools to be developed, namely a service and a computing resource model and a set of mechanisms that will facilitate the semi-automatic semantic annotation of SOA services and computing resources respectively.

The Cloud4SOA service model will constitute a simple, open and extendable vocabulary for describing SOA services. It will comprise of a set of terms and relations between these terms. Similarly the Cloud4SOA computing resource model will offer a simple, open and extendable approach for describing computing resources.

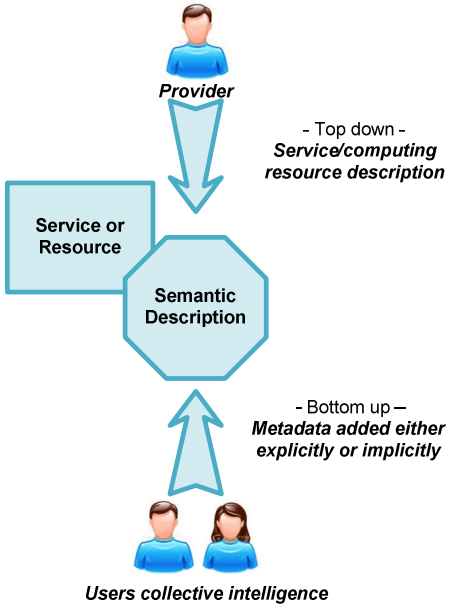


Figure 3 Semantic Annotation of services and computing resources in Cloud4SOA

The Cloud4SOA service and resource models will not be developed from scratch and the reusability of existing efforts will be considered. However, the Cloud4SOA service and resource models will extend existing efforts in order to include metadata that emerge bottom-up directly from the usage of the SOA services and the Cloud resources. Metadata can emerge bottom-up in two ways: either explicitly or implicitly (Loutas, Peristeras & Tarabanis, 2009).

- Explicitly, where metadata is added by users who wish to describe the SOA service as they perceive it. Users can annotate services, similarly to what they currently do for products, content and multimedia in platforms like Amazon or Flickr. Users would describe why they use a service, for what reason, on which occasion etc. They could also add annotations that are related with attributes of the service like inputs or outputs. In other cases, users may express their satisfaction or dissatisfaction with regards to quality, usability, user-friendliness etc. Tags and tagging mechanisms can provide the means for enabling service annotation. Tagging is easy and straightforward and users are already familiar with it.
- Implicitly, where information about the service can be inferred by monitoring the user's behaviour while using the service and then enrich the service description. For example, a statistically significant number of users execute service B after service A or users with similar profiles have an interest for some particular services. In both cases, this information can provide us with interesting usage patterns that can be further exploited e.g. for a system recommending services.

The Cloud4SOA service and resource semantic descriptions will evolve in a bottom-up fashion, thus harnessing the collective intelligence of the users. Of course, the service providers and cloud vendors will still contribute to these descriptions. This process is described in **Figure 3**. Apart from their conceptual design, the Cloud4SOA service and resource model will be formally expressed in ontologies using a standardized ontology language, either OWL or RDF.

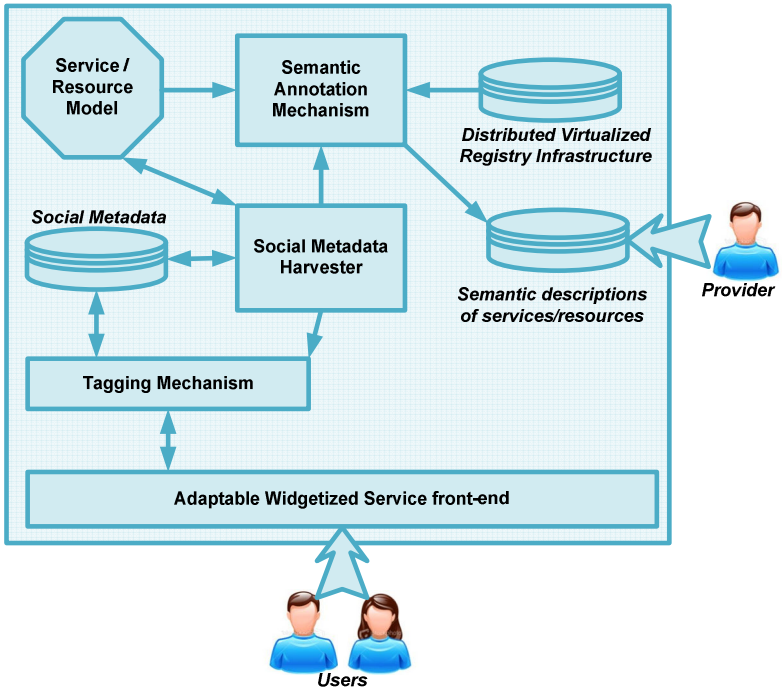


Figure 4 Semi-automatic semantic annotation of SOA services and Cloud resources

This innovative approach of developing models in a collaborative manner, urges us to rethink the model life-cycle. Hence, in Cloud4SOA the creation, the dissemination, the adoption, the uptake and the exploitation of lightweight vocabularies which emerge in a bottom-up fashion will be studied, analyzed and modelled. This will result in a methodology which will describe the life-cycle of such models.

Once the methodology and the models are in place, Cloud4SOA will develop the software components that will support the semantic annotation of SOA services and Cloud resources using the Cloud4SOA service and resource models respectively. These components will support both the implicit and explicit generation of service and resource related metadata. A generic architecture of both components is shown in **Figure 4**.

Service Annotation Mechanism

The service annotation mechanism will facilitate the semi-automatic semantic annotation of the SOA services. In order to do so, this mechanism will harness metadata *(social metadata harvester)* that are generated from the actual usage of the SOA services. Hence, it will be able to infer relations between services and compute the tagcloud of each service. As the annotation of services will be semi-automatic, the component will also allow users to directly annotate services using tags through a widgetised interface. These bottom-up semantic descriptions that emerge directly from the users of the SOA services will complement the semantic descriptions of the SOA services developed by the service providers.

Computing Resource Annotation Mechanism

Similarly to the previous component, the resource annotation mechanism will facilitate the semantic annotation of resources. In order to do so, this component will employ the Cloud4SOA resource model and will offer a widgetised interface that platform owners can use in order to annotate their resources. The semantic description of the resources will also be enriched by metadata that emerge from their usage.

Semantic Interoperability Run-time Engine

The development of multiple service and resource models and ontologies by different service providers and Cloud vendors can lead as discussed earlier to severe interoperability problems. Cloud4SOA focuses on

semantic interoperability problems and tries to address them by developing two reference models, one for services and one for resources respectively, which have been described earlier, and a component which will resolve interoperability problems at design- and run-time.

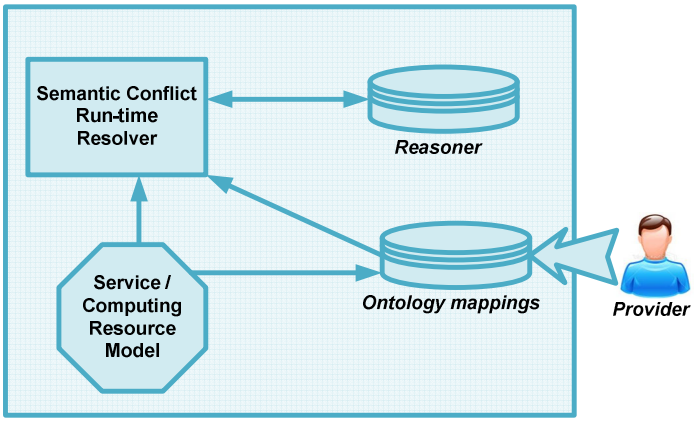


Figure 5 Cloud4SOA Semantic Interoperability Runtime Engine

The semantic interoperability run-time will allow the Cloud vendors to create mappings in a formal language, e.g. RDF, between their platforms data models and the Cloud4SOA models. Hence, a minimum level of semantic interoperability between different platforms will be achieved.

Afterwards, these mappings can be used as the basis for resolving semantic interoperability problems at run-time, e.g. conflicts that might be raised when data are being exchanged between two different platforms. At this point reasoning techniques will be employed, in order to do the semantic matching between equivalent concepts in different ontologies, e.g. (Euzenat & Shvaiko, 2007),(Gomadam et al., 2008), (Mocan et al., 2009).

B1.3.1.3 The Cloud4SOA Intelligent Interfaces Layer

In Cloud computing, the front-end services are very much neglected, with the business model being focused on the functionality facilitated by the Cloud that is supported by the underling network of computational and network resources. In this picture, the user is somewhat taken for granted, with solutions being pushed towards the market. It is important to stress that there are many successful Cloud computing applications, such as BitTorrent and Skype, but these are the exception rather than the rule. With 85% of product development resources wasted on products and services that never reach the market, of which that only 18% of those that actually reach the market actually prove to be successful (R. Bauer, 2005), the push model is not sustainable in the global market. An alternative improved strategy is to take a clear user centric approach and engage the users in what is necessary from an early stage of the development process.

The landscape of mashup and service composition technologies is maturing with several existing platforms that can be used as a baseline. Cloud4SoA will extend functionality of what is already anchored in particularities associated to the problem domain of cloud computing and of running application/services over a cloud infrastructure, with reuse and consolidation in mind.

The Cloud4SoA intelligent interface layer will exploit the “mash-up” paradigm for the composition and configuration of Cloud services. This will be combined with the use of widget technology to encapsulate Cloud applications, empowering them with:

- **Portability**. A widget encapsulates functionality that can be deployed to a wide range of destinations (eg: start page such iGoogle, mobiles, social networking sites, desktops, etc), thus abstracting the

developer of a widget from the particularities of a particular destination environment. Consequently, a Cloud widget would run the same from a mobile as from the desktop within a social networking website.

- **Viral Distribution**. When a widget is coupled with a viral distribution platform, a widget gains mobility provided it is installed in places on the web that are shared amongst members of a community. The installation of the widget allows others to select the widget and deploy it elsewhere, which in turn is deployed to yet other destinations, resulting in a network effect. Consequently, the Cloud widgets would benefit from a wider distribution.
- **Analytics**. With a widget distribution platform, one may monitor the use of a widget, collating data each time it is used, what events are generated, by whom it is used, etc. The analysis of this data conveys useful information on how communities of users interact with a particular widget. Consequently, it would be possible to assess the most successful Cloud widgets and identify patterns that promote reusability.

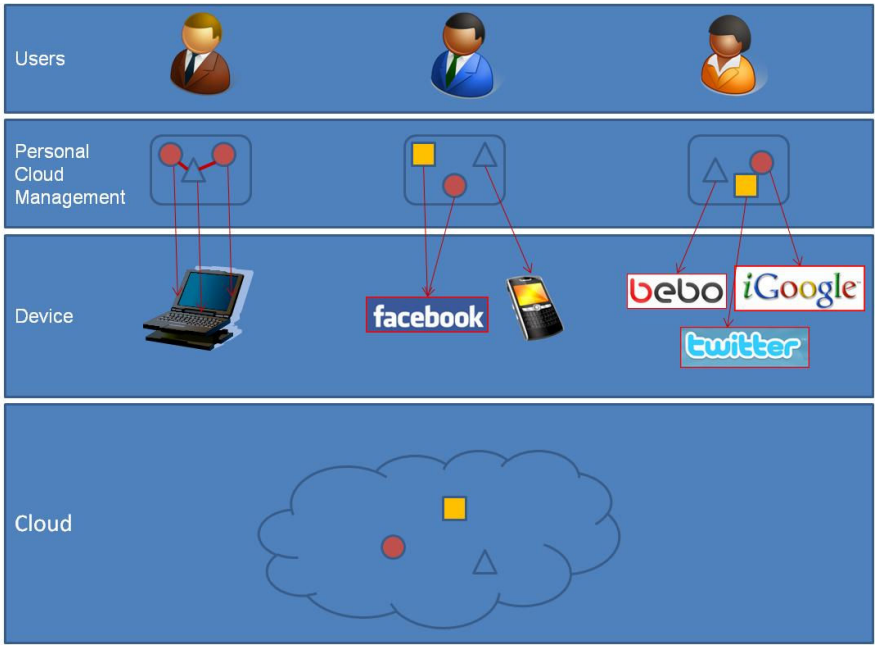


Figure 6 Cloud4SOA User-Centric Approach to Cloud Computing

Taking into account the "mash-up" paradigm and widgets, the Cloud4SoA will enable users to leverage the Cloud4SoA features in two manners:

- Personal Cloud Management. The user interacts with a visual integrated development environment (IDE) where cloud services are encapsulated as building blocks that can be visually manipulated, configured and composed into a cloud application. The IDE fully exploits the "mash-up" paradigm for supporting the composition. The semantic intelligence imbued in Cloud4SoA will empower the user with the ability of finding the appropriate services for their requirements, but also to receive recommendation based on the community intelligence of what works and what is the best composition for a particular cloud service. The output of the Personal Cloud Management is a cloud application, which can be stored and used for management. Some of the building blocks can have visual configuration interfaces, which the user may transform into widgets and distribute onto a device (eg: a mobile), thus making the cloud management pervasive.

- Cloud Widgets. In the case where the cloud application has associated to it a user interface, the final composition can be packaged as a Cloud widget, which enables the user of the application to benefit from both the viral distribution (a user shares with their friends, subsequently creating a net effect distribution) and application portability (a user can install the widget on a mobile, desktop, web, interactive TV).

The diagram in **Figure 7** reflects the optional paths for a user engaged with the Cloud Widgets. The user may acquire a Cloud Widget to deploy it to a particular destination; alternatively they might acquire it for creating a new Cloud Widget via composition, possibly integrating the result into any number of Clouds; finally, a user may just browse through the existing Cloud widgets before initiating one of the other two operational paths.

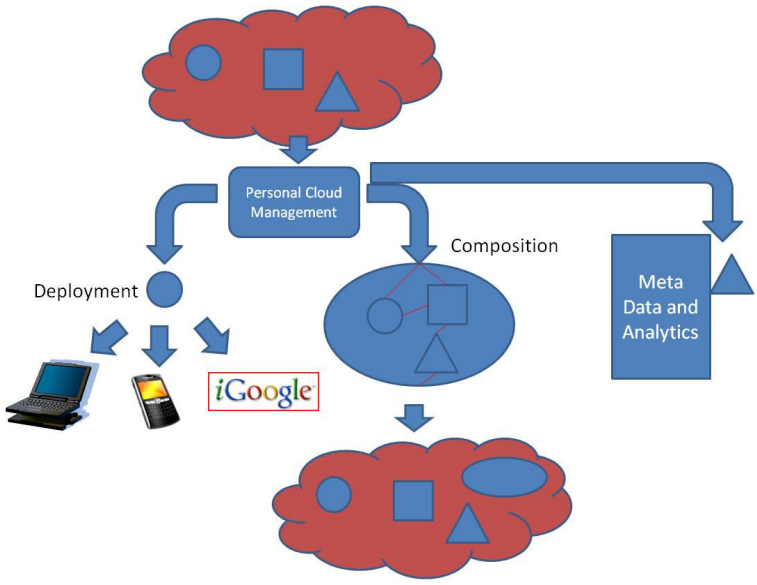


Figure 7 Cloud4SOA User-Centric Approach to Cloud Computing

Each user will have access to their own personal cloud manager, which provides persistency of their Cloud workspace (the collection of all Cloud Widgets) leveraging all the underlying semantic services associated to the SOA architectural layer (e.g. recommendation service).

B1.3.1.4 The Cloud4SOA SOA Layer

In order to facilitate the service oriented application design and development, Cloud4SOA has introduced in its Reference Architecture the SOA layer. Hence, the **SOA layer offers a toolbox that end-users can use through the Cloud4SOA adaptable service front-end in order to design, develop and deploy resource intensive services which utilize the Cloud resources**. The SOA layer comprises of the following software components:

- The **Service Discovery Component** which **capitalizes on the search mechanisms** offered by the Cloud4SOA Virtualization and Execution layer and **employs lightweight semantic models** and **techniques** in order to find available SOA services, taking care of the **binding of the SOA service** by **retrieving binding parameters** from the Decentralized Resources Registry of the Cloud4SOA Virtualization and Execution layer.

- The **Service Mashing Component** which **utilizes lightweight semantic models and techniques** implements a **simple and lightweight approach for mashing SOA services** and **capitalizes on the publishing mechanisms** offered by the Cloud4SOA Virtualization and Execution layer in order to **publish the composite services** in the underlying Decentralized Resources Registry.
- The **Service Recommendation Component** which **offers to the users suggestions of related service**. The degree of relation between two services is computed **based on the similarity of their semantic descriptions** as well as on latent relations that emerge from the usage of the services.

It is worth mentioning that the aforementioned software components depend heavily on the Cloud4SOA lightweight semantic service and resource models.

An **iterative approach comprising of two cycles** in total will be followed in order to reach to the final versions of the SOA layer software components. During the first implementation cycle prototypes of the software components will be developed based on the specifications delivered by Task 1.3. Once the prototypes are developed they will be tested in order to discover problems and to validate their correctness. The testing will result in a list of fixes. At this point the first implementation cycle will close. During the second evaluation cycle, the fixes identified earlier will be addressed. A final round of checking and validation will be performed and the final versions of the SOA layer software components will be released.

Service Discovery Component

The service discovery component **performs matchmaking using the lightweight semantic descriptions of the SOA services**. Matchmaking is performed between a set of criteria defined by the user profile and services by using concepts/instances defined in the Cloud4SOA service model. To do so, the service discovery component uses the search mechanisms offered by the Cloud4SOA Virtualization and Execution layer and employs lightweight semantic models and techniques. As such, this component will play the role of intermediate between the users and the Cloud4SOA Decentralized Resources Registry.

The service discovery component allows the users to submit a query for SOA services that best match their needs using different ways, such as **keyword search**, search using **tag clouds** or **browsing service catalogues** using elements of the Cloud4SOA service model, e.g. by service provider or service name. These queries are then forwarded to the appropriate component of the Cloud4SOA Virtualization and Execution layer, i.e. the Composite Resources Discovery, the Direct Keywords Resources Discovery and the Enhanced Resources Annotations Matcher, and will be handled by it. Afterwards, the list of matching services and their semantic descriptions are returned back to the service discovery component, which in turn processes them and forwards them to the user. The way of working of the service discovery component is summarized in **Figure 8**.

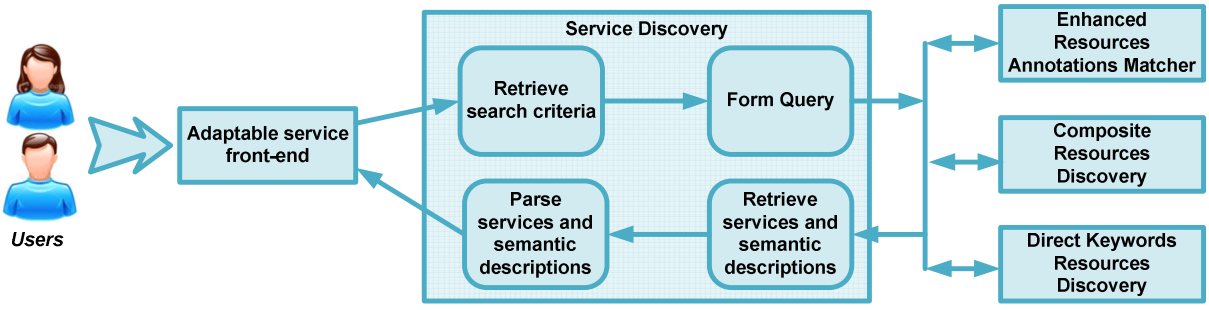


Figure 8 The Cloud4SOA Service Discovery Component

Service Mashing Component

The service mashing component implements a **flexible** and **lightweight mechanism for mashing SOA services**. It will be **supported by an intelligent service front-end tool** which will allow the easy composition of SOA services through a graphical user interface, similar to what current mashup editors do. Hence, the service mashing component will help the user design a composite service and deploy it in the Cloud4SOA platform. During the design of the composite service, the service mashing component will also propose to the user services that can be combined together. This functionality will be inherited from the service recommendation component described in the next section.

The service mashing component will **validate the correctness of the composite service** before allowing the user to publish it to the Cloud4SOA Decentralized Resources Registry. The validation will ensure that the SOA services mashed can do so (e.g. in terms of interfaces or input/output data types) and that the composite service will reach a final execution state. The service mashing component will also **propose to the user sequences of services** that can be composed together. Thus, **service mashing will be semi-automated**. The sequences of services will be produced by the service recommendation component. The way of working of the service mashing component is summarized in **Figure 9**.

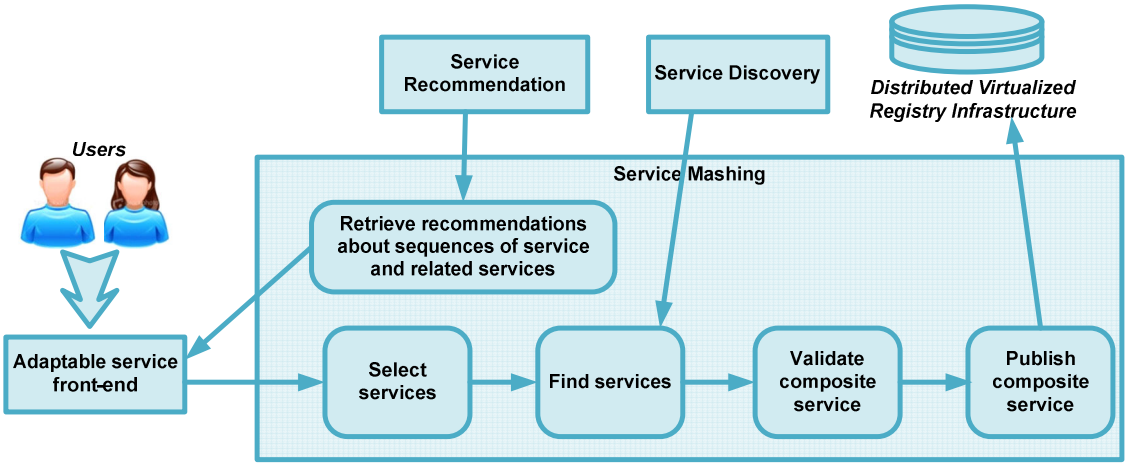


Figure 9 The Cloud4SOA Service Mashing Component

Service Recommendation Component

The service recommendation component implements **a set of mechanisms**, which offer to the users **suggestions of related services**. Service recommendations will be based on the degree of similarity between services. The degree of similarity between two services is computed based on the **similarity of their semantic descriptions** as well as on **latent relations between services that emerge from the usage of the services**.

The similarity of semantic descriptions is computed by examining semantic matching, e.g. equivalence or subsumption relationships between two ontological concepts. The ontological representation of the Cloud4SOA service model will play a key role here.

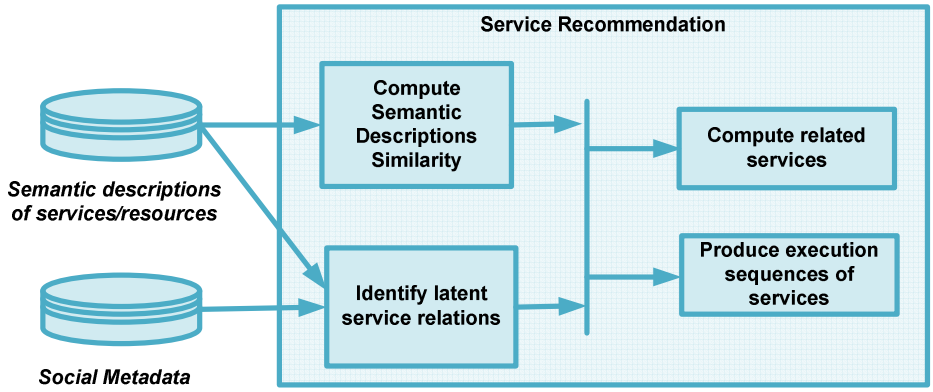


Figure 10 The Cloud4SOA Service Recommendations Component

The latent relations between services can be inferred by harnessing metadata that come from the actual usage of the services (social metadata) using semantic, statistical and data mining methods and tools.

Following the aforementioned techniques, the service recommendation component produces (**Figure 10**):

- Clusters of related services that can be used together or mashed together etc.; and
- Possible execution sequences of services.

B1.3.1.5 The Cloud4SOA Governance Layer

Cloud governance involves applying policies to the use of Cloud services. It can be useful to think of cloud governance by examining its opposite: the free-for-all chaos in which cloud services are used by an organization without any oversight in place. To avoid this chaos, put polices in place for cloud service use to control the leakage of private information to the cloud and to control the excessive use of cloud services. Cloud platforms, like the services in an SOA, are predominantly accessed using Web service APIs, and so they might be expected to come under the same heading as SOA governance. At the very least, you can reuse the principles behind SOA governance, and especially the lifecycle management of services, referring to the ability to control and track changes to services (i.e. individually-tailored customizations and extensions), and to place controls over who can change a service. Once this facility is in place, an organization can determine who created a service, who changed it, and when the changes were made.

The actors that will be responsible for performing changes to services will also be responsible for establishing Service Level Agreements (SLAs) with end-users in the form of service contracts and ensuring that these contracts are properly enforced. In addition, imperatives stemming from regulatory legislation, internal corporate policies, or bilateral agreements among business partners in the value chain will need to be enforced. In this setting, the availability of a comprehensive mechanism to support proper governance of cloud platforms throughout the lifecycle of its constituent components, and compliance enforcement at both design-time (i.e. before changes, customizations or extensions are rolled out) and run-time (i.e. while customization or extensions are operational) are considered vital for maintaining robustness, reliability, security, and performance.

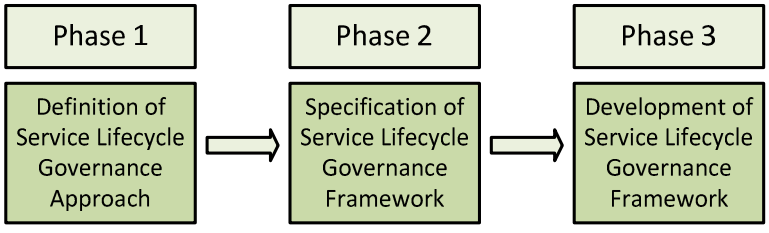


Figure 11 Cloud Governance Framework

Approved by EC on 07/09/2010

The introduction of Service Lifecycle Governance mechanisms in cloud platforms constitutes an important advancement beyond the state of the art in the domain of Cloud computing, addressing some of the main cloud management challenges (e.g. security and trust risks management, governance and audit processes maintenance, service lifecycles management and SLAs establishment and enforcement) and will be addressed within WP5 (entitled "Cloud4SOA Governance Layer"). The phases in which this will take place are as follows (Figure 11):

- Phase 1: Definition of the Service Lifecycle Governance Approach: Focus is on the investigation of the key research questions to be addressed concerning the management of cloud platforms, and the evaluation of alternative open standards and open source tools for this purpose. Research questions to be asked are: what needs to be checked at design-time and run-time, what attributes need to be described for checking to be possible, what is the best description approach, what is the best way to process the descriptions, etc.
- Phase 2: Technical Specification of the Service Lifecycle Governance Framework: Focus is on the specification of the key features and technical architecture of the Service Lifecycle Governance Framework. A technical specification will be developed covering both functional and non-functional characteristics of the Service Lifecycle Governance Framework, taking into consideration SLAs, security and scalability issues.
- Phase 3: Development of the Service Lifecycle Governance Framework: Focus is on the implementation and testing of the Service Lifecycle Governance Framework. The implementation will aim for generality, openness, making use of open standards and open source tools, and effectiveness, with a view to leveraging contemporary approaches and technologies for service-oriented modelling, including the usage of lightweight semantic service descriptions.

The envisaged technological basis for the Cloud4SOA Service Lifecycle Governance Framework will be a combination of registry and repository tools. According to insights from recent research efforts around the themes of Service Oriented Architecture Governance and Web Service Management (Kourtesis et al., 2009), and according to several reviews of the state of the software vendor market[15,16,17,18], it appears that integrated registry and repository platforms represent the most effective approach for introducing governance in a service-oriented infrastructure.

The typical functions that an integrated registry & repository tool supports can be summarised in the following:

- Publishing service advertisements and storing service-related artefacts
- Discovering services that are suitable for re-use based on some search criteria
- Creating and managing electronic contracts (SLAs) among providers and consumers
- Creating and managing policies and associating them with services
- Validating services against policies during design-time
- Enforcing compliance of services with policies and SLAs at run-time
- Versioning services and artefacts stored in the registry or repository

[15] Oracle Corporation (2007). SOA Governance: Framework and Best Practices (White Paper).
[16] Hewlett-Packard (2008). Transforming Business: Optimizing the Business Outcomes of SOA (White Paper).
[17] Manes A.T. (2007). The Registry and SOA Governance Market (Burton Group Analyst Report).
[18] Sun Microsystems Inc (2005). Effective SOA Deployment Using an SOA Registry-Repository (White Paper)..

- Tracking dependencies among services and artefacts and monitoring change

Given the cross-cutting nature of Cloud management challenges, and the urgent need for cloud vendors to provide reliable, customized and QoS-guaranteed computing dynamic environments for end-users, algorithms with run-time adaptation features will be adapted to Cloud governance, SLAs management and policies enforcement. The negotiation of QoS to establish SLAs, mechanisms and algorithms for allocation of resources to meet SLAs, and management of risks associated with the violation of SLAs will be extended with the goal of supporting both end-users service requirements and provider's policies. Furthermore, interaction protocols will be evaluated, with the aim of supporting interoperability between different Cloud service providers. Monitoring data gathered at runtime can be used to increase the accuracy of service descriptions in the registry with up-to-date non-functional information and how based on these updates SLA templates can be adjusted semi-automatically.

B1.3.1.6 The Cloud4SOA Virtualization and Execution Layer

Given the context that the proposed Cloud4SOA platform constitutes a middleware for deploying and migrating service-oriented applications among several, heterogeneous cloud infrastructures, the main objective of the Cloud4SOA Virtualization and Execution Layer is to act as an intermediate among the Cloud4SOA SOA Layer (that is responsible – from the engineers perspective – for both the service deployment to the underlying cloud environments and the service mashing to support the delivery of complex applications at the end users front end) and the available cloud infrastructures, where the deployment services are actually executed.

Thus, the Cloud Infrastructure Maintenance and Execution Environment (constituting one of the two main components of the Cloud4SOA Virtualization and Execution Layer) handles a) the distribution of the work load and the service-oriented applications deployment among the several available ("Cloud4SOA enabled and compatible") cloud infrastructures, developing and utilizing biding algorithms for selecting the most suitable scheduling, as well as b) the merge of the results acquired from the autonomous execution of the deployed services, and c) the service-oriented application migration among different cloud infrastructures.

In addition, the Interoperable Clouds Overlay Network Infrastructure (i.e. the second component of the Cloud4SOA Virtualization and Execution Layer) serves as a dynamic, flexible peer-to-peer (P2P) overlay model of all bootstrapped underlying cloud infrastructures. The reason for selecting a P2P approach lies on the fact that the proposed Distributed Hash Tables (DHT) techniques handle the dynamicity factors in such autonomous and dynamically adaptive cloud computing environments, including (indicatively) the provided computational resources, the quality of service, the available hardware and network resources, the provided time and accounting models.

Cloud Infrastructure Maintenance and Execution Environment

On cloud infrastructures, it becomes possible to have more or less nodes running at any given point in time. To distribute applications and requests across these nodes efficiently it is important to measure each nodes load on a per application basis and develop algorithms to enable the cloud to decide how to distribute the applications, or when to add or remove nodes. Distribution of requests and applications are two completely different tasks. Applications have to be distributed across nodes, to enable them to answer requests in the first place. Then on a per request basis it has to be decided which node should answer which request. Two primary infrastructural components of the Cloud4SOA Virtualization and Execution Layer are involved here: a) the Cloud Infrastructure Maintenance Layer (CIM), and b) the Virtual Execution Box (VEB).

The **Cloud Infrastructure Maintenance Layer** includes the different nodes and all the software needed to execute applications on these nodes. Each node is an instance of a predefined virtual machine image consisting of: a) an operating system enabled to run on top of a virtualization layer, b) all software necessary to execute applications, and c) a reporting application with the purpose to report the status of the node and to wait for tasks to process. This application running on each node reporting the status to the controlling application is the first part of a series of applications needed to control the cloud. The second is the controlling application that receives each nodes status and is able to decide based on this status information how to distribute the applications and requests and also when to create new nodes or when to stop ones not needed anymore. This application should run on the cloud platform itself to benefit from the scalability and high availability the cloud platform offers. The Cloud Infrastructure Maintenance Layer is going to support two main functions:

- the **load measurement process** that consists of two phases: a) fetching the current load from the different applications, by sampling in an aquidistant time scale, and b) processing and storing the values, by sampling, aggregated storing of the data-stream. Reservoir[19] sampling may be a suitable algorithm for this task.
- the **cloud distribution and size control** that can be divided in three parts:
  1. the **reactive control** part. A cloud platform has to react instantaneously on different events and load situations. The distribution of the application to the nodes is based on the average and forecast of the application. Through unpredictable events the distribution may have to be adapted in an interactive manner. One of the common approaches for problems like this is the PID-Controllers[20]. PID-Controllers are working with three weighted factors to give an estimation about the load curve. The proportional term describes the current load of the application, the integral term describes the long time load and the derivative term describes the slope. A predefined threshold leads to the decision of adapting the distribution and cloud size.
  2. the **forecast** part. Distribution of applications and adding nodes to the cloud are time expensive actions. On high load slopes reactive controllers are too slow to adapt the environment to the load requirement. For these scenarios forecasting methods are necessary. The forecasts have to be calculated over a lot of applications with a lot of different values, so the forecast algorithm should use less state variables and should be online calculateable. Moving averages and especially exponential smoothing may fit to the requirements. To take noise and uncertain measurements in account (extended) Kalman[21] filter approaches can be applied.
  3. the **planning** part. Different applications have different load profiles and peaks. Efficient distribution of applications leads to a better resource usage and a minimization of resource bottlenecks. For the planning part it is necessary to generate load profiles of the different applications. The load profiles enable the comparison of different applications and allow giving estimations about the quality of different distribution algorithms. Time series analysis and pattern recognition are the usual tools for this and have to be applied. Additional interesting approaches

[19] The Reservoir Sampling Algorithm, available at http://blogs.msdn.com/spt/archive/2008/02/05/reservoir-sampling.aspx

[20] The proportional–integral–derivative controller, available at http://en.wikipedia.org/wiki/PID_controller

[21] The Kalman filter, available at http://en.wikipedia.org/wiki/Kalman_filter

are learning algorithms. Currently our research on distribution algorithms is based on reinforcement learning.

The **Virtual Execution Box** defines what and how applications can be executed on the cloud platform. Applications often have a multitude of dependencies starting with the operating system, executable formats, compilers and ending with middleware or libraries for specific functions. The cloud virtual execution box has to include some of these dependencies and or provide a way for developers to add more themselves.

Also different programming languages need to be supported to give application developers a choice. This forces the platform to handle the same problems in multiple ways therefore heightening the complexity by a multitude.

When defining the capabilities of the platform important decisions have to be made about the layout and functionality of the cloud Virtual Execution Box. Security is a major concern here. It is crucial to keep different applications from interfering with each other. This includes data stored on persistent storage as well as data that are in memory at runtime. Also due to the nature of the cloud some concepts used when developing for local systems, or traditional client-server systems are not an option for the cloud and even can be impossible to maintain.

Also not only is measurement of application load for scalability reasons important, it also is important for quality of service reasons. A single application in a shared cloud environment may not use all resources of a node for a long time. But on the other hand time limits introduce a new problem. It depends on the load of the actual node if an operation can be finished in a given timeframe. Unpredictable success is not acceptable. This is a problem currently not addressed by operating system schedulers. A possible solution for this problem might be to heighten the time limit according to node usage and at the same time make sure no new requests to any application are distributed to that particular node.

Interoperable Clouds Overlay Network Infrastructure

A critical factor to the overall and effective utilization of interoperable cloud computing infrastructures is an efficient discovery mechanism for data, services and computational resources. At present, resources are advertised in centralized registries implementation. As the physical distribution of the registries and resources can quickly overwhelm this centralized configuration and can lead to serious performance bottlenecks, we adopt **peer-to-peer (P2P) distributed network architectures** that allow participants to share their own resources and play roles as resource providers as well as resource requestors, in conjunction with **lightweight semantic annotations** enabling enhanced search and discovery capabilities.

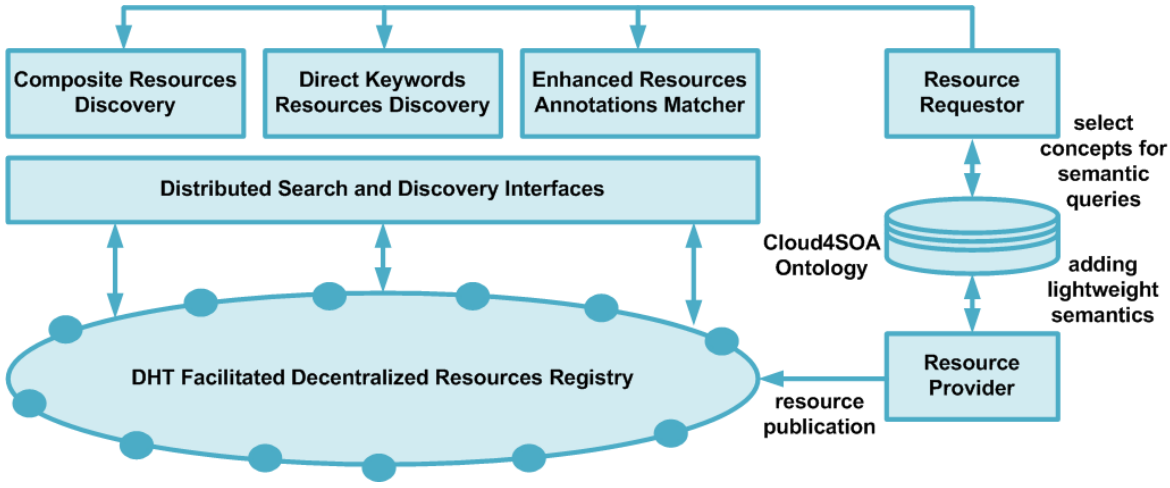


Figure 12 DHT-facilitated, Decentralized and Semantically-enhanced Resources Registry

Thus, we are proposing the implementation of the Interoperable Clouds Overlay Network Infrastructure that acts as **a novel decentralized and semantically-enhanced resource registry facilitated with DHTs (Distributed Hash Tables)**, constituting structures collaboratively built by all participating nodes of a P2P network and provides lookup services for resources that are published by these nodes. As shown in **Figure 12**, the implementation of the proposed Cloud4SOA Interoperable Clouds Overlay Network Infrastructure will rely on the combination of **an overlay peer-to-peer network structure** with the **upper resources discovery modules** that are based on semantic annotations aiming at facilitating identification of resources that best match given needs and enabling automatic resource discovery.

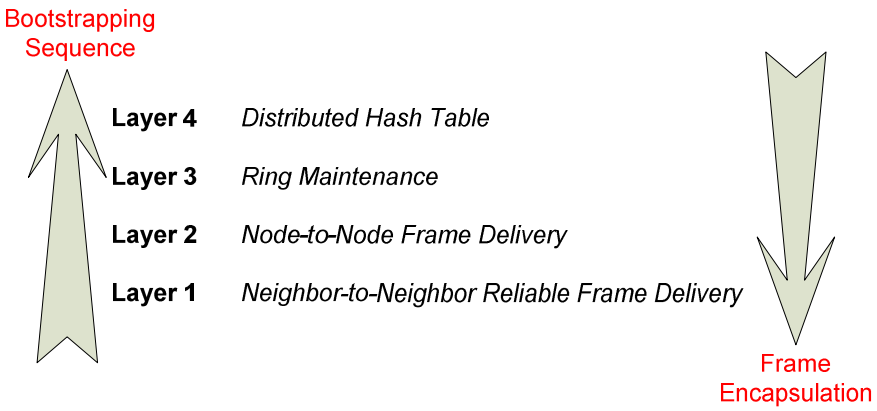


Figure 13 Overlay Network Bootstrapping and Frame Encapsulation Sequence

The establishment of the overlay distributed network structure will be based on a routing and ring formulation protocol that follows a four-layered scheme, as shown in Figure 13, consisting of: i) the **Neighbor-to-Neighbor reliable frame delivery layer**, which is responsible for delivering an upper-layer frame from a neighbor to another neighbour; ii) the **Node-to-Node frame delivery layer**, which is responsible for delivering an upper-layer frame from a node X to another node Y, relying on a re-active P2P routing protocol, called Data Source Routing (DSR), that allows the overlay network to be established without any existing network infrastructure or human intervention and is composed of the route discovery and route maintenance mechanisms; iii) the **Ring Maintenance layer**, which is responsible for formulating a virtual ring topology of the participating nodes; and iv) the **DHT layer**, which is responsible for maintaining a distributed hash table that is bootstrapped on top of the stabilized ring topology.

In Cloud4SOA, we are proposing Chord that is a simple but powerful protocol, which solves the problem of efficient resource location. The notion of 'frame' is hierarchical in the sense that a higher level frame encapsulates lower level frames. However each layer has a discrete role, implements different mechanisms and specifies its types of messages.

As already stated, the Cloud4SOA consortium is going to provide lightweight semantic annotations on the services interfaces and cloud resources (in general) so as to facilitate efficient resources publication on the decentralized registry structure and dynamic service discovery. There are three steps for a service/resource provider (N_n) to publish his services (Figure 14). First, N_n contacts any node N_c in the system. N_n gets a position in the Chord ring with hash algorithm. Chord finds N_n's successor N_s in the identifier ring. Second, the new node N_n, now part of the identifier ring, injects all its operations (K_{ni}, S_{ni}) into the system and the Chord protocol decides which nodes should receive the new catalogue information. Third, N_n becomes part of the decentralized infrastructure and should share load of the registry by hosting parts of key-value sets already in the network. Chord uses hashing to map both keys and nodes onto the Chord ring. Each key is assigned to its successor node, which is the nearest node travelling the ring clockwise. All the service

providers (node) and their service meta-description (key and value) are routed to the Chord ring according to DHT protocol.

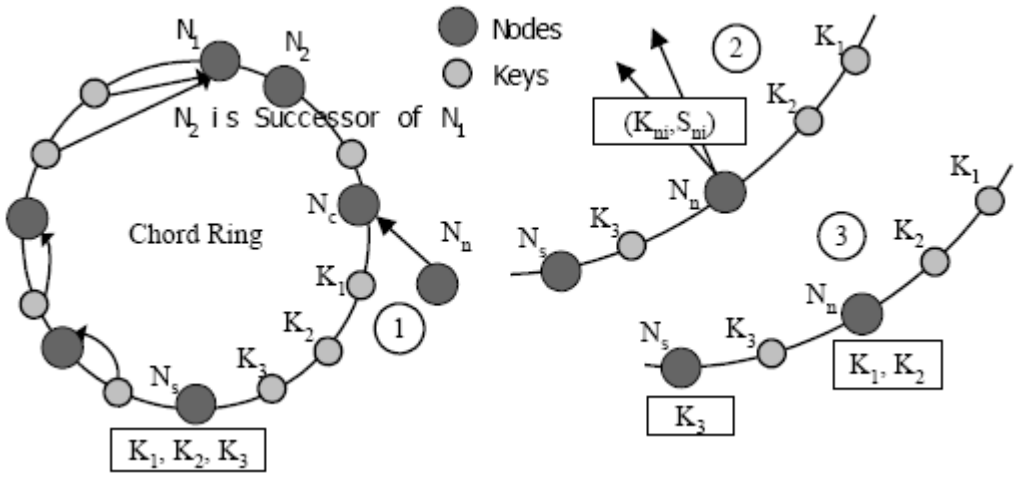


Figure 14 Services and Resources Publication in Decentralized Registries

Finally, services and resources discovery involves three components (**Figure 12**): a) the **direct resources discovery** module that is based on the exact keyword match functionality (providing limited search capabilities) and is provided by the DHT protocol itself; b) the **ontology-enhanced services and resources discovery** module that provides semantic level service matching; and c) the **composite discovery** module that tries to compose several services and resources, in case a single service can't fulfil the query requested.

B1.3.1.7 The Showcases Prototypes Development

Overview of the Cloud4SOA Showcases

By the time the three main R&D results of the Cloud4SOA project will be developed and delivered, meaning a) the open, generic Cloud4SOA Cloud Interoperability Framework, b) the innovative Cloud4SOA Reference Architecture, and c) the several software components and the enabling technologies and tools of the identified Cloud4SOA Platform, the definition, development, deployment and operation of the three Cloud4SOA showcases' services will be realized so as to prove the applicability and usability of the Cloud4SOA results in realistic setups and scenarios. The showcases cloud-enabled services and prototypes will aim at testing and assessing the concepts and tools resulting from the technological R&D in given systemic environments, addressing interoperability and scalability challenges in heterogeneous vertical markets and use cases.

Three Cloud4SOA showcases (**Table 2**) are scheduled to be developed in three end-user organizations, i.e. the mobile innovation of a Portuguese telecom (PTIN), a groupware platform provider (FIT), and a Romanian fixed telephony and internet service provider (RomTelecom), utilizing the Cloud4SOA Platform so as to deploy and operate scalable services for end-users. In order the performance of the showcases' prototypes to be tested and evaluated, a set of technical and business scenarios are going to be organized and executed in the frame of the Cloud4SOA project, piloting the Cloud4SOA use cases under pragmatic conditions.

Their precise scope will be jointly defined by the technological development team of each showcase. Overall, the objective is to address through these experiments all outstanding issues that need "hands-in" for ensuring a good understanding between the development team and system engineers. The activities, identified to facilitate the utilization of the Cloud4SOA Platform to every pilot showcase site, are grouped in the following objectives: a) **the as-is analysis and the definition of the scope and the use cases** of the Cloud4SOA showcases focusing in the applicability of the Cloud4SOA project results in pragmatic business scenarios; b) **the development and deployment of the showcases cloud-enabled services and pilot prototypes**; and c) **the operation, maintenance, governance and monitoring of the pilot showcases**, as well as **the evaluation of the performance of the prototypes** in given business scenarios, validating the overall Cloud4SOA solution.

Showcase Characteristics	PTIN	FIT	RomTelecom
Industry	Telecom Industry Mobile Operator	Business Software Groupware	Telecom Industry Mobile Operator
Use Case	Multimedia Service Delivery	Business Collaboration	Network Monitoring and Filtering
Scalability Issues	YES	YES	YES
Security Issues	YES	YES	NO
Service Front-Ends	YES (mobile interfaces)	YES	NO
Data Intensive Issues	NO	YES	YES
Data Storage Issues	NO	YES	NO
Computational Intensive	YES	NO	YES

Table 2 Overview of the Cloud4SOA Showcases

Current situation analysis and existing bottlenecks

Although recognizing the substantial business and technology benefits that it will bring, many service providers remain hesitant about when and how to begin the migration toward internet protocol multimedia services (IMS). Because of these challenges, many providers are failing to position themselves properly to take advantage of the horizontal layer of IMS, and are still developing standalone vertical services. Nevertheless, service providers should avoid this path and strategically invest in the proper use of IMS together with a Service Delivery Platform (SDP) for rapid creation of convergent services.

Thus, PTIN has been developing a SDP, which allows third-parties to develop and deliver new (multimedia) services quickly, respecting the widely accepted IMS standard according to which newly developed services will be purely IP-based and will be delivered following the SOA manner. These new services should be deployed in a way that ensures **high density, efficiency and extreme availability, providing 99.9% uptime**. However, the proprietary telecom hardware that was up to now supporting these services is considered today expensive since all "functionality" can be achieved with general purpose processors running specific algorithms. Therefore, **PTIN should decouple successfully its network infrastructure from the provision of high capacity value-added services** in an efficient and cost effective manner by utilizing cloud technologies.

Presentation of the Cloud-enabled analogy

In Cloud4SOA, PTIN intends to **combine the already adopted service-oriented multimedia services development** (by third parties) with their **deployment in a reliable, scalable and secure infrastructure** (like the one that will be provided by the Cloud4SOA consortium), increasing customers' satisfaction and mobile usage rates. In particular, PTIN showcase will probably include:

- the **development and porting to the cloud of a minimal set of services** that supports the cloud enablement of multimedia services, facilitating the successful decouple of the network infrastructure from the multimedia services exposed,
- the **service-oriented design and development of scalable value-added multimedia services**, based on the composition and dynamic discovery of cloud-enabled network services, and
- the **widget-based encapsulation of multimedia services** will provide intelligent and highly attractive **front-ends for the subscribers mobile devices**.
- In more technical terms, the PTIN showcase will most probably examine the case where third parties deploy and migrate on-demand their own multimedia services to different cloud infrastructures (based on the available resources as well as the pricing policies and deals that each third party has achieved with the respective cloud providers). These cloud-enabled services will be combined (interact, interoperate and exchange data) and mashed with services from several third party vendors (deployed in the same or different cloud infrastructure) as well as with profiling and location tracking services exposed from the PTIN's infrastructure, offering to the mobile end-users high capacity value-added services.

Expected benefits

The expected advantages and benefits of the cloud-enabled multimedia services would include:

- the service-oriented development and deployment of **reliable, scalable & highly available multimedia services to the mobile operator's customers**, and

- the design and development of **intelligent, widgetised interfaces for mobile devices** that will allow end-users to easily interact with the developed multimedia services.

The FIT Business Cooperation Use Case

Current situation analysis and existing bottlenecks

BSCW (Basic Support for Cooperative Work) is a groupware platform that supports a multitude of cooperation services to enable the distributed management and cooperation within a team. Typical application scenarios are the management of small or large projects, the document management within a department or whole company or the facilitation of knowledge management community. BSCW is very scalable, i.e. the more than 1000 installations worldwide host between 10 to more than 100.000 users. The platform is applied by many EU projects and it has been developed over the past 15 years within several EU and national funded projects. Licensing and Commercial support for BSCW is provided by OrbiTeam, a spinoff of Fraunhofer FIT.

The current architecture of BSCW consists of 3 main modules:

- the front-end handles all user request and is responsible to deliver the request for each user action. It is realized by cgi-scripts in Python.
- The back-end administers the data base of BSCW. It is accessed by a front-end process to which it returns the result of each data base operation
- The file-store represents the actual storage of all user data in a local file system.

Within this architecture, the front-end services require most of the computing resources to compose and deliver the web-front end for each user request, while the back-end requires less computing resources. This front-end represents the bottleneck of the current situation. To improve the performance of BSCW multi-processer hosts are employed such that the front-end processed can be distributed over different processors. Despite this unbalanced resource requirements BSCW is always hosted on a single host, while more advanced solutions offered by a Cloud service have not yet been investigated. More performance can be achieved only by the acquisition of faster server hardware.

Presentation of the Cloud-enabled analogy

A cloud enabled BSCW solution would be:

- The performance of the front-end services depends highly on the number of user access, i.e. for each user interaction a new front-end process is started. Ideally, the front-end could be distributed to a CPU-cloud, since this approach would enable BSCW to become more reactive to varying user interaction.
- The back-end requires less computing power and it can still remain on a single host. Because this component is responsible to guarantee the database integrity it will also be very challenging to distribute the front-end to different nodes.
- The file-storage represents an excellent candidate for being distributed in a storage cloud, as this would enable the dynamic extension of the data space.
- The interoperability of different BSCW servers would be enable on a back-end and file store level. This would reduce administration overhead and will provide users who work on different servers a seamless cooperation environment.

Expected benefits

The advantages of a cloud enabled BSCW solution would include:

- Better and faster reaction on dynamic use and interaction patterns of BSCW
- Dynamic adoption to data storage requirements.
- Almost unlimited scalability of BSCW
- Interoperability of different BSCW installations on a file store and back end layer
- Potential interoperability between BSCW and other cloud enabled applications on a data and service level, thus enabling the and-user creation of a seamless cooperation environment.

The RomTelecom Network QoS Monitoring Use Case

Current situation analysis and existing bottlenecks

Romtelecom offers professional integrated voice and data communications services for people at home, at work and on the move, requiring high quality of service (QoS), i.e. voice and data delivery. Telecom latency (host and/or network) can be mili-seconds away from being non suitable. Also voice applications tend to require strict SLAs – and the true cost of outages can be significant. Moreover, the ever-increasing complexity in network infrastructures is making critical the demand for network monitoring tools, in particular a modern IP-based network infrastructure. This is mostly due to the stateless nature of the IP service, which requires appropriate control loops to be implemented by observing and responding to network behavior.

Although several telecommunication QoS and network monitoring solution exists, relying on computational intensive algorithms and large-scale data analysis tools based on commodity hardware and operating systems, the increasing link speeds, the complexity of deployed network infrastructures and the vast amount of parameters that should be taken into account in the QoS estimation make network monitoring a data- and computational- intensive process, which may prohibit its utilization in high-speed networks.

Presentation of the Cloud-enabled analogy

In a cloud computing environment, the QoS analysis and network monitoring of the RomTelecom network infrastructure will mainly include:

- the **parallelization and cloud-enablement of the crucial, computational intensive network monitoring algorithms**, facilitating their distribution and execution be distributed to a CPU-based cloud;
- the **distributed execution of the QoS monitoring services**, which required large-scale packet filtering and data analysis, as well as **the handling and merging of distributed execution results**;
- In more technical terms, the RomTelecom network QoS monitoring showcase will most probably examine the effectiveness of the portability of the computational intensive network monitoring algorithms in the cloud, and the ad-hoc migration of parts of these algorithms to among different cloud infrastructures. As voice applications require strict SLAs and network monitoring should process filtered data and deliver real-time results, RomTelecom seeks to find a way for re-deploying and migrating parts of the monitoring services, taking advantage of the resources available each moment at the underlying cloud infrastructures.

Expected benefits

The advantages of a cloud enabled network monitoring and filtering solution would include:

- **mass utilization of distributed CPU power** for the effective execution of highly-complex and computational-intensive algorithms;
- **parallel deployment and execution of analytics services**, which process large datasets, minimizing the execution time and leveraging the network monitoring performance;
- better and **faster identification, analysis and reaction on non-suitable and non-acceptable QoS levels**.

B1.3.1.8 Risks Assessment and Contingency Plan

The Cloud4SOA project management will pay particular attention to risk management during the execution of the project. The ambitious objectives of the project together with the diverse range of RTD activities shared among a large number of partners motivate a continual monitoring of risks (of both internal and external origin) to ensure the greatest success in the project. Risk management in the Cloud4SOA Project will be enacted through an iterative cycle of: a) identifying risk, b) analyzing risk, c) managing risk, & d) monitoring risk. To successfully accomplish this process, the consortium has carefully defined WP structures and tasks to clearly indicate responsibilities and identify potential risks. Previous cooperation of project partners and their expertise gives us good opportunity to analyse and manage the risks. Milestones and deliverables were set up carefully to monitor, identify and analyse risks, including those which may arise during the project.

Additionally, risk management will be constant during the project duration; supported by a risk analysis document which will evolve as the project progresses and which will be regularly updated. Each work package leader is required to identify and describe initial risks which may affect the development within that WP and present these in the form of tables, as described below.

A	Risk event	Description of the event – brief statement of test (for occurrence)
B	Probability	Probability of the occurrence of the event
C	Impact	Description of impact due to the occurrence of the risk event; the loss that could result if the risk event occurred
D	Mitigation Strategy	Actions planned to avoid the risk event
E	Responsible person	Person responsible for the mitigation strategy, at the appropriate level

Upon receipt of contributions from all work package leaders, the Technical Board will issue a summary risk assessment document, evaluating the overall risks to the project and proposing appropriate mitigation strategies, if necessary. This document will then be reviewed each meeting of the Technical Board where corrective actions will be decided, if necessary. A preliminary risk analysis has been performed and risks detected are summarised in the following tables. Risks range from scientific/technical to organisational/communicational. The table includes a probability field (low, medium, high) and a contingency field, which summarises corrective actions.

I. Administrative Risks and Contingency Plans

Risk	Probability	Contingency
R1: Insufficient consortium coordination	Low	The effective management of the consortium will be assured with the appropriate Project Management that is described in WP10. The roles and responsibilities of each partner are already identified and will be continuously reviewed in order to mitigate the risk of overlapping and implementation of the same activities from two or more partners.
R2: Insufficient consortium competence and effectiveness	Low	The project team is highly complementary and gathers together the requested skills and responsibility for the main streams of research and technology development. Moreover, all the technologies that are going to be used in the implementation of the project will be carefully selected so as to minimize potential risks based on

		these technologies.
R3: Conflicts over ownership	Low	Disagreements in the consortium over ownership may result in non-agreement on IPR. The Consortium Agreement and ongoing IPR inventory will ensure a proper protection of generated and prior IPR, taken strongly into account the collective interests of the participating software SMEs.
R4: Financial divergences	Low	It is not unlikely that excess of the estimated budget might occur. The consortium and mainly the coordinator must review the budget issues throughout the project duration very carefully and monitor costs closely. It is essential for the success of the project to allocate the budget with the appropriate way.
R5: Human Resources mix	Medium	Problems with personnel relate to lack of competencies and withdrawals. However, all the participating organizations have assured that they will choose their best personnel to implement the relevant activities. Further, the quality assurance procedures will be put in place early in the project period to ensure that the quality of work is high. Moreover, all the participating organizations have the ability to change a member of their team with another person with comparable competencies, in case of inability to continue. The project will have a strong focus on internal skill building and knowledge sharing to build redundancy in critical positions.
R6: Shortage of resources and/or change of personnel	Medium	Make binding agreements on the availability on resources. Keep close contact with all partners. Early communication of budget and personnel problems.
R7: Lack of communication among the partners	Medium	Keep close contact with all partners by regular teleconferences and virtual meetings. Organize regular plenary and technical meetings at different partners' sites. Consider reworking the exploitation plans. Detailed project plan that clearly states goals and responsibilities of the partners
R8: Partner withdrawal	Low	Withdrawal of SME partner: Immediate substitution by another SME, from an existing business partner or through the dissemination. Establishment of the outreach program and Special Interest Group will help expand options in such a case. Withdrawal of RTDP partner: Either share the workload among existing RTDP partners within the consortium or substitute by another RTD Performer with similar expertise.

Table 3 Administrative Risks and Contingency Plans

II: Technical/Scientific Risks and Contingency Plans

Risk	Probability	Contingency
R1: Tight Schedule for Interoperability Framework and Reference Architecture	Medium	WP1 is diverse: it covers State-of-the-Art as well as a rigorous start of developing the Cloud4SOA Interoperability Framework and Reference Architecture. By consolidating this in a single WP, it ensures top coordination and execution for tasks equally needed for the project to advance, as well as including support from the entire consortium. The workplan will need to start strong. Additional resources will be allocated if needed, representing the importance of this chapter.
R2: Inadequate Integration of Layers	Low	The project workplan includes tight cycles of development of the several layers (WP2-WP6). The successful integration of these components represents a critical chapter in the workplan, not just in importance but also depending on the continual involvement of the developers. An overlap is in place between implementation and integration, as well as the ensured continued participation of

		the same partners. Strong horizontal scientific coordination of WP2-WP6 will also be in place to prevent fragmentation.
R3: Project propositions too ambitious to work properly in project runtime	Low	The project will make careful steps towards the realization of its objectives. If needed, the consortium has the experience to adjust these objectives so that they can be achievable and still yield the anticipated results. The project will follow the motto "think big, act small" in order to produce results that could realistically become exploitable and useful after its completion.
R4: Project facing technology replacement issues	Medium	Information technologies continue to be developed at rocket speed, and it is difficult to foresee their evolution. For this reason, the project will be engaged in a continual technology watch effort which will last till the very end of the project. Moreover, the technical management of the project will always be in touch with the scientific community in order to ensure that possible future disruptive technologies relevant to the consortium activities.

Table 4 Technical/Scientific Risks and Contingency Plans

III: Exploitation and Outreach Risks and Contingency Plans		
Risk	**Probability**	**Contingency**
R1: Low interest of stakeholders in project's outcomes	Medium	The project depends highly on the involvement of the participating software development SMEs, which creates a reassuring effect for the project's results. The utilization of partners' contacts and the confident dissemination of the project will minimize this risk.
R2: Special Interest Group low participation	Medium	The Special Interest Group in particular requires hands-on participation. Benefits could be needed to ensure their continued participation, such as increased visibility in the project's dissemination work. The focus must be to propel them into increased interaction between industry and standards groups and forums, as well as provide expertise on the project's developing results.
R3: Insufficient Impact in Standards collaboration	Medium	Pro-active and worthwhile contribution and collaboration with Standards Development Organisation (SDOs) require a substantial amount of participation. Potential working groups have already been identified, and further examination on integrating in their collaborative development cycle will begin early on in the project. Additional collaboration will be allocated if needed.
R4: Dissemination and exploitation failures	Low	The consortium constituency has been set up to ensure visibility through both technology organizations and scientific institutions. The publication records and networking activities of the Consortium members show their outstanding ability to disseminate and exploit research results. This is backed by significant PM allocation for WP9 and by appropriate "Other costs" for preparing brochures, dissemination events, participation in exhibitions, etc. Furthermore, the dissemination efforts are spread so that different regions in Europe and different kinds of interested parties can be addressed by the appropriate partner and instrument. In the case that nevertheless dissemination and exploitation fails (publications rejected, press releases ignored, exhibition stands not visited, etc.), we will prioritize our dissemination / exploitation goals, focus on the most important or most critical part (scientific visibility, technological excellence, etc.), reallocate manpower and "other costs" to strengthen this focal point and use the increased resources for a concerted action in this area (e.g. SIG workshops, Showcases, etc.)

B1.3.2. Timing of Cloud4SOA Work-Packages and their Components

The following section describes the work planned to achieve the objectives of the proposed Cloud4SOA project. The reader will be presented with an overview of the analytical work plan for the duration of the Cloud4SOA project. More specifically, the project implementation plan is organized over **12 quarters** (**36 months**). To guarantee smooth and effective project running and progress the following **ten (10) work-packages** have been identified (**Figure 15**):

- eight (8) project implementation (RTD) work-packages related to the conceptual and the architectural design of the innovative Cloud4SOA Framework, the specification, development and integration of the Cloud4SOA software subsystems (layers), the definition, development, deployment and operation of the showcases prototypes, and the evaluation and the validation of the overall Cloud4SOA solution.

  More specifically, the eight (8) implementation work-packages include:

  - the conceptual and architectural design of the Cloud4SOA Framework and Architecture, which corresponds to the **WP1** entitled **"Cloud4SOA Reference Framework"** that involves a) the review and comparative analysis the project-related state-of-the-art technologies, b) the identification, analysis and homogenization of the cloud platforms requirements, c) the design of an open, generic Cloud4SOA cloud interoperability framework, and d) the development of the Cloud4SOA reference architecture;
  - the development of the SOA-enabled services and computing resources conceptual models and the semi-automatic semantic annotation mechanisms of the Cloud4SOA Semantic Layer, corresponding to the **WP2** entitled **"Cloud4SOA Semantic Layer"**;
  - the implementation of end-user (web) widget-based interfaces encapsulating service functionality from the SOA layer, corresponding to the **WP3** entitled **"Cloud4SOA Intelligent Interfaces Layer"**;
  - the specification and development of the software components of the SOA-enabled Services Layer including the services deployment, discovery and composition mechanisms, which corresponds to the **WP4** entitled **"Cloud4SOA SOA-enabled Services Layer"**;
  - the development of a methodology and a toolset for the lifecycle governance of cloud services and platforms, corresponding to the **WP5** entitled **"Cloud4SOA Governance Layer"**;
  - the specification and development of a) a maintenance layer allowing the cloud infrastructure self-organization, b) a virtual execution box enabling the distributed services execution, and c) a novel decentralized services and resources registry corresponding to the **WP6** entitled **"Cloud4SOA Virtualization and Execution Layer"**;
  - the overall system integration that corresponds to the **WP7** entitled "**Cloud4SOA Platform Integration and Infrastructure Deployment**", incorporating the integration, testing and quality assurance of the different software components (layers) that will be developed in technical work-packages WP2, WP3, WP4, WP5 and WP6 into a flexible, service-based software platform;
  - the definition, development and execution of realistic showcases, which constitute proof-of-concept of the applicability and the usability of the Cloud4SOA project results in pre-selected scenarios, as well as and the performance evaluation and the validation of the overall Cloud4SOA solution corresponds to the **WP8** entitled "**Showcases Development and Overall Performance Evaluation**";
  - Cloud4SOA will execute three steps of integration. The first, in Milestone 3, will be a very preliminary testing for the unfinished layers. Milestone 4, at month 21 will be a more extensive first integration phase of parallel layers (WP2-6), providing better feedback for the final integration phase.

- two (2) project horizontal work-packages related to dissemination and exploitation, as well as, to the project and consortium management. More specifically, the two (2) horizontal work-packages include:

- the innovation management and the intellectual property rights handling with regard to the results developed in the frame of the project, the proper dissemination and exploitation of the project results, corresponding to **WP9** that is entitled **"Clustering, Dissemination & Exploitation Planning"**; and
- the project management work-package, i.e. **WP10 "Consortium and Project Management"**, involves the administrative and financial project management, the technical coordination of the RTD activities, the risks management, and the quality assurance of the formal deliverables to be delivered to the EC.

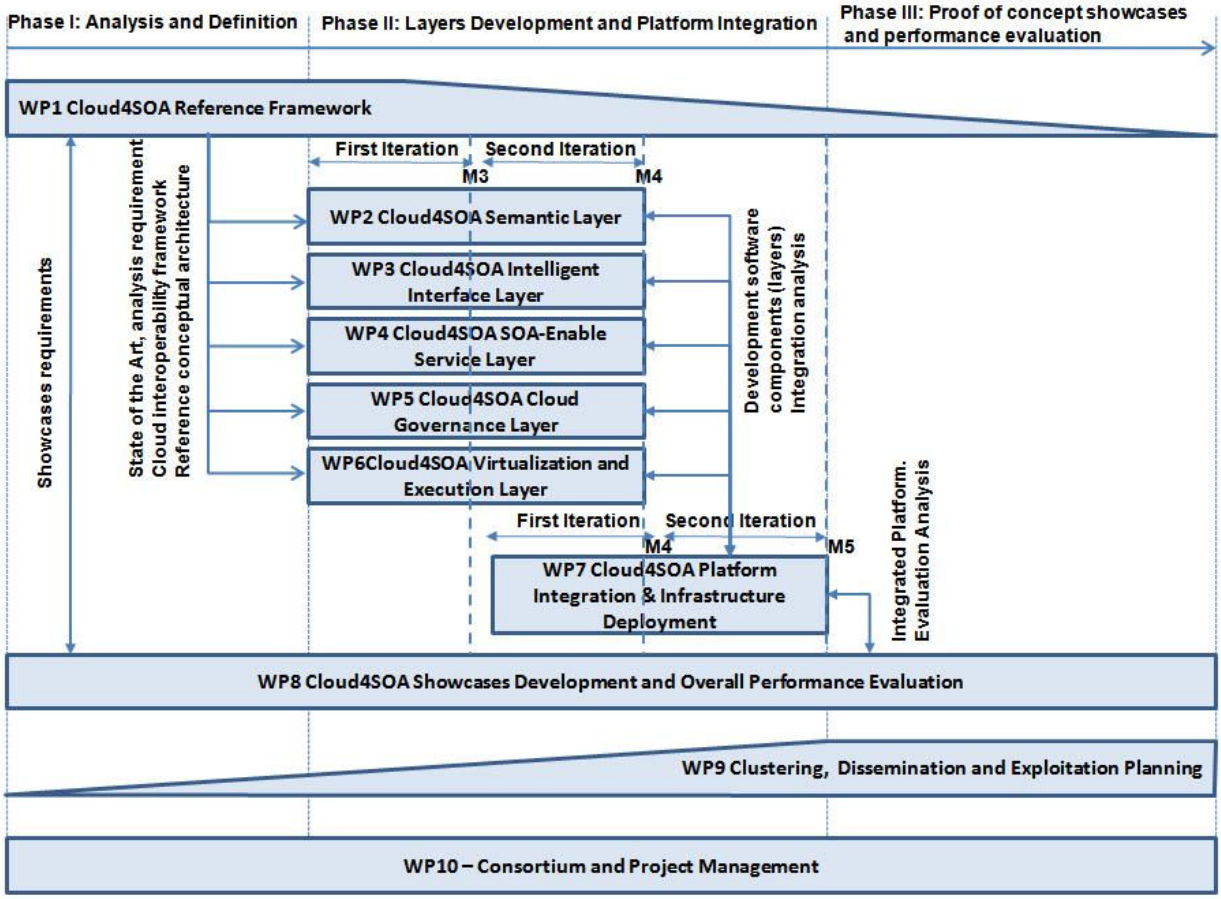


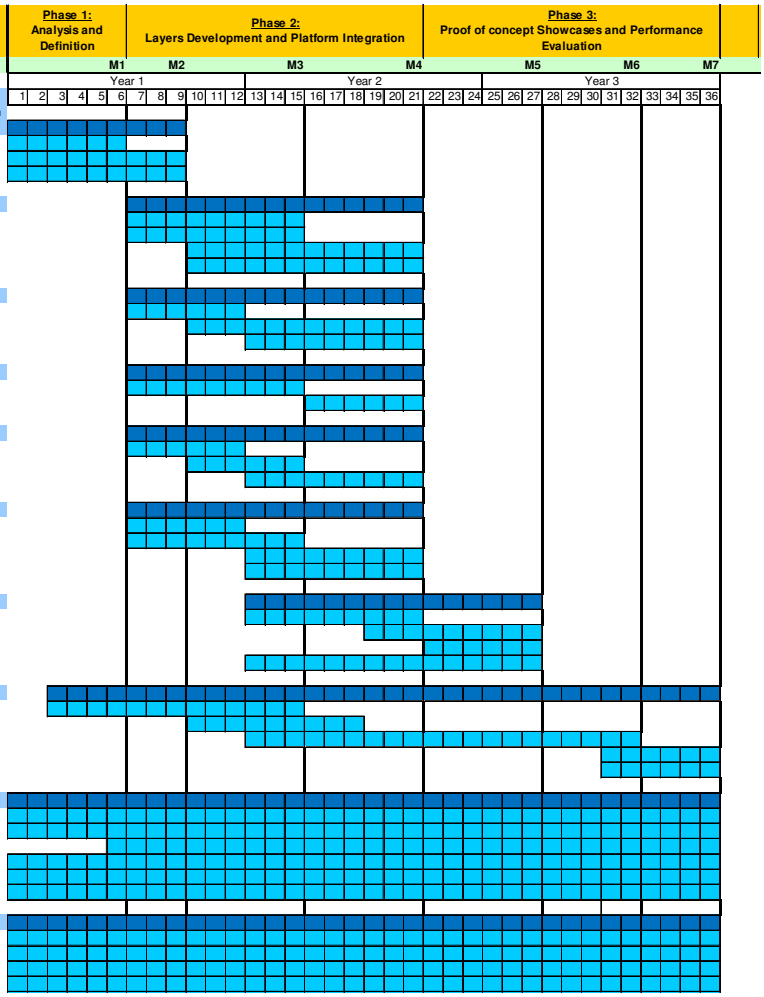
Figure 15 Cloud4SOA Pert Diagram (relations and interactions among WPs)

The proposed work-plan of the Cloud4SOA project ensures the meeting of all the scientific, technological and administrative objectives, as stated in Section 1.1.2, as depicted in the relationship matrix of Table 5.

Cloud4SOA Objectives	Cloud4SOA Workpackages									
	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10
Objective I: to resolve the interoperability and portability problems within the Cloud	☑								☑	☑
Objective II: to design and to implement the Cloud4SOA Reference Architecture and Integrated Platform	☑	☑	☑	☑	☑	☑	☑		☑	☑
Objective III: to evaluate and evaluate the research results in realistic scenarios							☑	☑	☑	☑
Objective IV: to establish the Cloud Interoperability Special Interest Group	☑							☑	☑	☑

Table 5 Relationship Matrix between Work-Packages and Project Objectives

The Cloud4SOA Gantt Chart



WP	Task	Name of the WP/Task	Start month	End month
WP1		**Cloud4SOA Reference Framework**	**1**	**9**
	T1.1	State of the Art and requirement Analysis	1	6
	T1.2	Cloud4SOA Cloud Semantic Interoperability Framework	1	9
	T1.3	Cloud4SOA Reference architecture	1	9
WP2		**Cloud4SOA Semantic Layer**	**7**	**21**
	T2.1	Cloud4SOA Service Model	7	15
	T2.2	Cloud4SOA Computing Resource Model	7	15
	T2.3	Semantic Annotation Mechanism	10	21
	T2.4	Semantic Interoperability run-time engine	10	21
WP3		**Cloud4SOA Intelligent User Interface Layer**	**7**	**21**
	T3.1	User Interaction Model	7	12
	T3.2	Definition of Cloud4SOA Widget Framework	10	21
	T3.3	Implementation and Definition of Cloud4SOA Widget Measures	13	21
WP4		**Cloud4SOA SOA Layer**	**7**	**21**
	T4.1	SOA layer software components v.1.0	7	15
	T4.2	SOA layer software components v.2.0	16	21
WP5		**Cloud4SOA Governance Layer**	**7**	**21**
	T5.1	Service Lifecycle Governance Approach	7	12
	T5.2	Service Lifecycle Governance Framework	10	15
	T5.3	Service Lifecycle Governance Toolset	13	21
WP6		**Cloud4SOA Virtualization and Execution Layer**	**7**	**21**
	T6.1	Cloud Infrastructure Maintenance Layer	7	12
	T6.2	Overlay Peer-to-Peer Network Structure	7	15
	T6.3	Virtual Execution Box	13	21
	T6.4	Resources and Services Discovery	13	21
WP7		**Cloud4SOA Platform Integration and Infrastructure Deployment**	**13**	**27**
	T7.1	Cloud4SOA Integrated Technical Architecture	13	21
	T7.2	Cloud4SOA Platform Integration, Testing and Refinement	19	27
	T7.3	Cloud Infrastructure Deployment	22	27
	T7.4	Integrated Software Quality Assurance	13	27
WP8		**Showcases Development and Overall Performance Evaluation**	**3**	**36**
	T8.1	Use-Cases As-Is Analysis and Showcases Definition	3	15
	T8.2	Evaluation Strategy Definition and Validation	10	18
	T8.3	Cloud4SOA Showcases Development	13	32
	T8.4	Showcases Operation, Maintenance and Governance	31	36
	T8.5	Performance Evaluation and Lessons Learnt	31	36
WP9		**Innovation Management, Dissemination and Exploitation**	**1**	**36**
	T9.1	IPR Handling and Innovation Management	1	36
	T9.2	Communication and Dissemination of Project Results	1	36
	T9.3	Contribution and Feedback to Standardization	6	36
	T9.4	Market Analysis and Exploitation Planning	1	36
	T9.5	Cloud Interoperability Special Interest Group	1	36
	T9.6	Collaboration with ICT IoS Projects	1	36
WP10		**Consortium and Project Management**	**1**	**36**
	T10.1	Administrative Consortium Management	1	36
	T10.2	Scientific and Technical Coordination	1	36
	T10.3	Risk Management	1	36
	T10.4	Quality Assurance	1	36

B2. Implementation

B2.1. Management Structure and Procedures

B2.1.1. The Cloud4SOA Project Management Principles

The general project management in Cloud4SOA will guarantee transparency and commitment to all engaged partners and thus, facilitate an unobstructed and successful project evolution. The objective will be to assure that the Cloud4SOA project will meet its entire objectives on time, on budget, and with high quality results. In addition, it will try to come up with a satisfactory plan for the management of knowledge, of intellectual property and of all other innovation-related activities. For this reason, the overall project management of Cloud4SOA will comply with the following two major principles:

1. Principle of creating an integrated project structure incorporating technical, scientific and partner coordination as well as issues of commonplace business operation. The applied project methodology will be based on the methodology of the Project Management Institute (PMI) and supported with state-of-the-art management instruments.
2. Principle of achieving agreement upon all partners and guaranteeing the arrangement of spot of decision making close to the responsible levels of execution as well as elevate them if necessary. This principle also conceals the reliable and trusted agreements in order to protect intellectual properties of all partners.

The main roles and instruments comprising the project management structure of Cloud4SOA include (**Figure 16**):

1. The **Project Coordination Committee (PCC)**: It will consist of representatives of each organization participating in the consortium. It will constitute the highest decision board and its main task will be project governance. It will have the overall responsibility of all technical, financial, legal, administrative, ethical, and dissemination issues of the project. It will monitor and assess the actual progress of the project and make amendments, where necessary. It will encompass the following main roles:
    a. The **Project Coordinator (PC)** who will chair the PCC and will be responsible for the overall management, communication, and coordination of the entire research project. A special emphasis within its responsibilities is to assure the overall integration of all work package activities.
    b. The **Participant Managers (PM)**, the role of whom will be the representation of each institution in the PCC and the participation in any voting procedures as regards administrative and/or technical issues of the project.
    c. The **Dissemination Manager (DM)**, who will be responsible to raise public awareness of the project service, to ensure wide dissemination of the Cloud4SOA results and share best practices.
    d. The **Risk Manager (RM)**, the role of whom will be the early identification, assessment, and – along with the support of the PC – the management of administrative and technical risks.
    e. The **Quality Manager (QM)**, who will be responsible for the development of the Quality Plan, the implementation of the quality procedures determined in it and the verification of the project results.
    f. The **Innovation & Exploitation Manager (IEM)**, who will be responsible for innovation management, IPR handling and the creation of the joint exploitation models and plan, and for supporting the partners

in setting up their individual business plans, in order to exploit the results of the project. The EM will also handle all IPR related issues, along with the guidance of the PC.

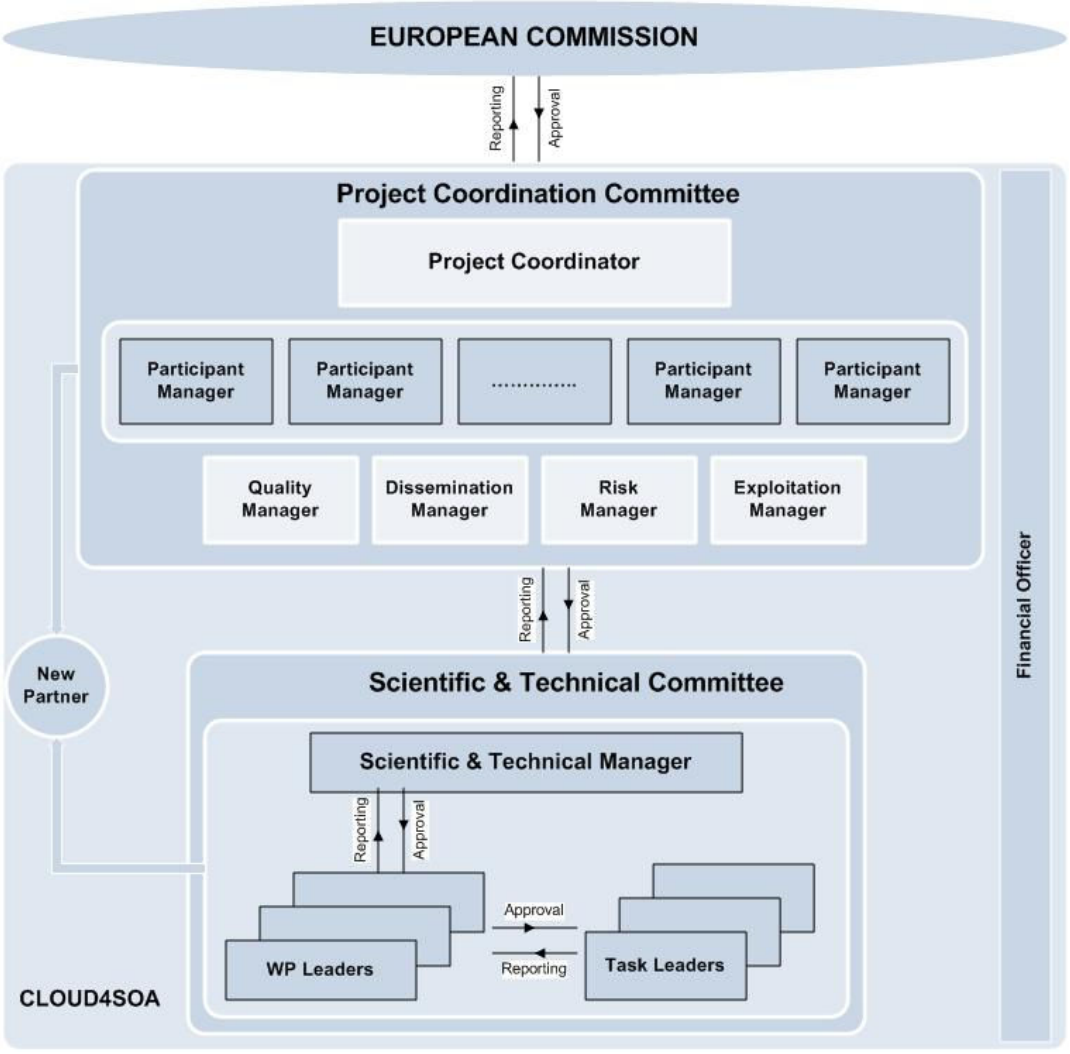


Figure 16 Cloud4SOA Project Management Structure and Communication

2. The **Scientific & Technical Committee (STC)**: Under the control of and in compliance with the decisions of the PCC the STC shall be responsible for the planning, execution and controlling of the project, as regards issues of both scientific & technical nature. It shall be in charge of monitoring project progress and will consult the PCC (the governing body) on all higher-level technical and administrative issues, such as: redirection of work in an WP, major transfer of resources across WPs or Partners (over 20%), technological choices, changes in time plans, inclusion of a new Partner, substitution or exclusion of an existing Partner, resolution of conflict between different WPs. It will also propose Calls of Tenders or central equipment provision or specifications, new Partners inclusion, etc. The STC will encompass the following roles:

   a. The **Scientific & Technical Manager (STM)**, who will ensure that the S&T objectives of the project are met with quality and in time. S/He is expected to lead the S&T activities undertaken within the project and will be responsible for resolving any issues of S&T nature that might occur.

b. The **Work Package Leaders (WPL)** of the project who will be responsible for managing their work package as a self contained entity. Their tasks include among others coordinating, monitoring, and assessing the progress of the WP to ensure that output performance, costs, and timelines are met.

The project management will also encompass an experienced **Financial Officer (FO)** who will be engaged for the financial and administrative project management and supervision.

The names of the personnel of the project's partners to assume the main roles of project management structure are as follows:

Cloud4SOA PROJECT ROLES	
PROJECT ROLE	**PARTNER**
Project Coordinator	ATOS
Scientific & Technical Manager	NUIG
Innovation & Exploitation Manager	ATOS
Dissemination Manager	FIT
Risk Manager	SingularLogic
Quality Manager	SingularLogic

B2.1.2. Communication amongst Cloud4SOA Consortium Partners

Efficient communication and collaboration structures are essential for the success of the project. Since all project partners are distributed across European member states, the centrepiece of the overall project communication will be a protected **online collaboration platform**, offering to each partner independent access to important documents, code, meeting agendas, supporting materials, individual to-do lists and other miscellaneous project information.

B2.1.3. Consortium Meetings

In order to ensure clear and efficient project management, regular work-package conference calls, project conference calls, project management meetings and plenary meetings will be organised.

- As regards PCC meetings, these will be held semi-annually, while conference calls may also be held in demand in between.
- As regards STC meetings, they will be held on a monthly or bi-monthly basis to monitor the project progress, while conference calls may also be held in demand in between according to the project needs.
- As regards meetings at work package level, they will be held on demand according to the work package progress and needs.

B2.1.4. Decision Making Process

Mandatory decision rules and agreements are necessary for the success of the project. As regards the decision making processes, they concern mainly two specific categories: a) decisions regarding issues of **technical**

and/or scientific nature; and b) decision regarding issues of managerial/administrative **nature including financial and IPR issues**.

A general guideline to reach agreement as close as possible to the level of execution will be followed, and only if agreement will not be reached on a given level, the decision will be escalated to the next appropriate level.

- **Decision Scope at the Task Level**: All partners being involved in a task are eligible to contribute to a decision regarding that certain task. In case a capable decision cannot be taken at this level, the issue has to be forwarded to the Work Package Leader.
- **Decision Scope at the Work Package Level**: All partners being involved in a work package activity (one for each innovation cycle) are eligible to contribute to a decision with regards to this work package in cooperation with and under guidance of the STM. In case a capable decision cannot be taken at this level, the issue has to be forwarded to the PCC.
- **Decision Scope of the Project Coordination Committee**: The supreme decision committee is the Project Coordination Committee. Each partner has to send a qualified representative to the PCC (i.e. the PM).

Decisions will normally be taken by the responsible team members, and organization bodies based on the description of work to be performed. In the course of the project the consortium will have to agree on and develop technical, scientific and commercial ideas and specifications. Usually, agreement will be reached first by informal contact, followed by official confirmation via electronic mail, letter or agreed written minutes. For important issues, the agreement may take the form of a short report that needs to be signed by those responsible for decision-making. Non-technical factors such as resource allocation and contractual terms will also need to be agreed on and documented in writing. Technical issues/conflicts within given contractual commitments that do not involve a change of contract, a change of budget and/ or a change of resources/ overall focus will be discussed/ solved on the WP level first.

B2.1.5. Conflict Resolution Procedure

As regards possible conflicts, if a decision being taken is unacceptable to a partner, the resolution of the conflict will be escalated according to the escalation procedure summarized in the following steps:

1. First, the implementation team will inform the WP leader for the conflict occurred.
2. The WP leader will organize the WP team meeting and the issue will be discussed. In case of agreement the team will inform the STC.
3. If no decision is taken the WP leader will inform the STC. The latter will contact the responsible persons and will try to resolve the conflict.
4. In case of agreement the STC will inform the PCC.
5. Otherwise the issue will be escalated to the PCC that have the authority for the final decision. The final decision must be accepted by all parties.

For all conflicts, standard voting procedures will be followed. In these, all members belonging to both the PCC and the STC have a single vote, with the exception of the PC who will have two votes

B2.1.6. Monitoring and Reporting

Internal reporting can be divided into two categories: reporting of administrative nature and reporting of technical & scientific nature.

- As regards reporting of administrative nature, the STC is responsible for reporting and keeping the PCC up-to-date.
- As regards reporting of scientific & technical nature, it follows the basic principles of decision making process. The task leaders are responsible for reporting to the work package leaders, who in turn are responsible for reporting to the STM. The STM is responsible for reporting to the STC, which in turn reports to the PCC.

B2.1.7. New Partner Inclusion

A new partner may join the consortium:

- Either because the consortium members deem the inclusion of a new partner purposeful and necessary for the fulfilment of the project goals. In this case the PCC will hold a meeting, evaluating the actual necessity of the inclusion of a new partner, evaluating the financial impact on the project and its partners, as well as defining the competencies that the new partner should have. A standard voting procedure will be followed to approve the inclusion of a new partner, and in the case of multiple candidates, another voting procedure will result in the decision of who that partner may be.
- Or because a consortium partner withdraws. In case of withdrawal of an industrial partner, an immediate substitution by another industrial partner with similar competencies, either from the business portfolio of the remaining partners or through the dissemination activities, will take place. In the case of multiple candidates, a standard voting procedure will be followed which will result in the decision of who that partner may be. In case of withdrawal of an academic partner, the consortium will substitute the partner with another member from the academic and scientific community with similar expertise.

B2.1.8. Coordinator's Management Capacity

Having significant experience in managing large projects (including IPs such as SOA4All, BEinGRID, TRUSTCOM, ELEGI, ORCHESTRA), ATOS will lead and coordinate the Cloud4SOA project.

The scientific coordination will be led by NUIG, but it is always convenient for a project that there is not a gap between administrative and technical coordination, and therefore, the two profiles will be complementary and with skills to understand each other's in the respective activities so that overall coordination and scientific leadership are aligned.

This will be possible in Cloud4SOA thanks to the technical expertise of ATOS in SOA architectures and the dynamic composition of Web services, including SWS. Besides that, ATOS has extensive customer base for exploitation purposes at the disposal of the project. ATOS will coordinate the project being responsible for the financial, administrative and day-to-day monitoring of the project as well as taking an active participation in RTD areas.

B2.2. Beneficiaries

B2.2.1. Atos Origin Sociedad Anonima

Partner Full Name	Atos Origin		
Short Name	ATOS	Country	Spain
Type	Industry	Website	www.atosorigin.com; www.atosresearch.eu
Official Logo			

Brief Partner Profile

Atos Origin is an international information technology services company. Its business is turning client vision into results through the application of consulting, systems integration and managed operations. The company's annual revenues are greater than EUR 5 billion and it employs over 46,000 people in 40 countries. Atos Origin is the Worldwide Information Technology Partner for the Olympic Games and has a client base of international blue-chip companies across sectors including CPG/Retail, Discrete Manufacturing, Financial Services, Process Industries, the Public Sector, Telecom, Utilities and Media. Further information is available at www.atosorigin.com.

Atos Origin SAE is the Spanish branch of Atos Origin. It is a founding member of the European Technology Platform NESSI (Networked European Software and Services Initiative). At a national level, Atos Origin SAE also participates in Spain in other technology platforms like INES for software and services, eMOV for mobility, eSEC for security, and PROMETEO for embedded systems.

Atos Research & Innovation, node of R&D of Atos Origin in Spain, is a point of world reference in innovation for the whole Atos Origin group. It is focused in the project accomplishment, which combine the most advanced Technological developments and the economic exploitation of results in R&D. Our aim is to lead our knowledge and experience acquired to concrete projects with clients.

Over these years, a strong partnership with several public and private institutions from all European Countries has been consolidated. In many of those projects the department has counted with the involvement of Eastern Europe countries as well as countries from the Mediterranean area, North Africa and Latin America. Additional information is available at http://www.atosresearch.eu

Relative Expertise / Experience

Atos Research & Innovation is structured around several research areas and units. The main unit involved in the work will be **SSSE: "Semantics, SW & Service Engineering" Unit**. The SSSE unit of Atos Origin has a solid background on service engineering projects (such as INFRAWEBS or SECSE from FP6 as well as SOA4All, NEXOF-RA and COIN, among other projects funded by FP7). The SW & service background has been complemented in the last years by an extensive work on Semantic technologies, through projects such as LUISA, TAO, NEON, IntelLEO and more than 15 projects successfully implemented at national level. ATOS has wide experience in Project coordination, as it has been shown in big Projects like BEINGRID, ORCHESTRA or SOA4All, to name a few. In this case, besides management, dissemination and exploitation, ATOS will provide a wide and solid background on the service layer and Semantics as required by the RTD work proposed by Cloud4SOA. In order to complement the Service Engineering/SOA aspect, ATOS will involve the research unit working on Cloud Computing whose expertise is briefly described here.

The Service Oriented Middleware & Infrastructure (SOMI) unit concentrates the research in this domain at technological and business level. SOMI expertise is in Cloud Computing, Service-Oriented Infrastructures including Grid and Utility Computing addressing also the associated business delivery models. Its research activities mainly focus on Service Level Agreement management at different layers, software licensing management in distributed computing environments. The role of this unit consists of aligning customer's needs with emerging cloud computing, grid and virtualisation technologies, by means of hiding technology complexity and simplifying the message when approaching customers. Relevant actives of the unit are R&D projects such as EU FP6 BEinGRID (www.beingrid.eu) and BREIN (www.eu-brein.com), EU FP7 SmartLM (www.smartlm.eu) and Spanish project Nuba (nuba.morfeo-project.org).

Key Personnel's CVs

Nuria DE LAMA: Telecommunications Engineer from the Polytechnic University of Madrid, with complementary

Telecommunications management courses and studies on different technical areas such as communication technologies and application development (in sectors such as e-learning, e-Inclusion, rural development, edutainment, entertainment and e-business, etc.). She joined Atos Origin SAE in 2005, where she is currently Head of the Semantics, Software and Service Engineering Unit in the research department. She has wide experience in EU programmes, having worked and managed many projects since FP5 (some examples are HEROE, ISTforCE, BROADWAN, MOSAIC, e-VALUES, SAMANTHA, RURAL-WINS, TUAMO, DAVINCI, AIM, CLOCK, C@R, CORELABS, INFRAWEBS, LUISA, TAO, SOA4All, NEXOF-RA...). She has been evaluator, reviewer and speaker in many conferences for the EC. She is currently chair of the Service Engineering WG at the INES platform and active contributor to NESSI and Future Internet initiatives.

Francesco D'andria: Francesco joined Atos Origin in 2005 and is a Project Manager of IT research initiatives. He obtained a high degree in Electronic Engineering from the "Università Degli Studi Di Salerno" Salerno, Italy (2001). His research activities concern the study of GRID technologies and SOA systems, pervasive technologies, and high performance middleware for distributed systems. He is interested in the employment of these technologies in the business world. He is investigating the use of Commodity Technologies in order to implement Grid Services and their integration with COTS components. His research activity on this topic started during his thesis period, which was funded by CRMPA (Research Centre in Pure and Applied Mathematics), with the thesis: "SIMULAZIONE IN (High Level Architecture) H.L.A. E POSSIBILE INTEGRAZIONE IN.NET". Some of the EU R&D projects in which he has participated in FP5 FP6 and FP7 related to GRID/SOA/Cloud technologies are: GRASP, AKOGRIMO, ELEGI, BeinGRID, SmartLM. Afterwards he has designed and implemented a .NET monolithic infrastructure (C#, ADO) for Eni ICT in Bologna (May to November 2005).

Yosu GORROÑOGOITIA CRUZ: Yosu Gorroñogoitia has a degree in Theoretical Physics from the Universidad Complutense de Madrid (UCM), also complementing his studies with a Master in Condensed Matter and Statistics Physics by UNED (Madrid). He has been working in diverse ICT companies as Software Analyst and Architect for 14 years. In Atos Research & Innovation (ARI) he is working as Software Architect and Technical Leader of the Service, Semantic and Software Engineering Unit (SSSE), in fields such as Service Oriented Computing (SOC), Model Driven Development (MDD) and Semantics. Yosu has been Technical Director of EC FP6 SeCSE project, member of the Architecture Board of EC FP7 NEXOF-RA project and leader of the Service Construction WP of EC FP7 IP SOA4ALL project.

James AHTES: Degree in Political Science and International Relations at Purdue University and a Post-Grad Degree for International Economy at the University of Barcelona. At ATOS, James currently works as a project manager in Grid & Cloud related research. He was part of the coordination team of the 98-partner FP6 IP project BEinGRID, as well as its spin-off website IT-Tude.com. In eInfrastructures, he has been the key ATOS personnel in OGF-Europe (FP7).

B2.2.2. National University of Ireland, Galway (NUI, Galway) - Digital Enterprise Research Institute (DERI)

Partner Full Name	National University of Ireland Galway		
Short Name	NUIG	Country	Ireland
Type	Public Non Profit	Website	http://www.deri.ie
Official Logo			

Brief Partner Profile

National University of Ireland, Galway (NUI, Galway) - Digital Enterprise Research Institute (DERI) is one of the main actors in research and development of semantic technologies in the world. DERI performs research in the semantic Web, social networks, sensor network platforms, and semantic web services and applies its research results to solve integration problems in various application-oriented projects in eLearning, eGovernment, eBusiness, and eHealth. DERI develops advanced Semantic Web infrastructures, and platforms for running large-scale, data-intensive experiments, which facilitate collaborative social working environments, scalable storage and reasoning engines, distributed computing, and ontology development. DERI actively participates in and leads research funded by the EU FP6 and FP7 programs while DERI members also actively participate in a number of standardization activities.

Relative Expertise / Experience

National University of Ireland, Galway (NUI, Galway) - Digital Enterprise Research Institute (DERI) is one of the main actors in research and development of semantic technologies in the world. DERI performs research in the semantic Web, social networks, sensor network platforms, and semantic web services and applies its research results to solve integration problems in various application-oriented projects in eLearning, eGovernment, eBusiness, and eHealth. DERI develops advanced Semantic Web infrastructures, such as Semantically Interlinked Online Communities (SIOC), distributed social semantic desktops (NEPOMUK), semantic search engines (SWSE, Sindice), and platforms for running large-scale, data-intensive experiments, which facilitate collaborative social working environments, scalable storage and reasoning engines, distributed computing, and ontology development. In Sensor Networks, DERI is co-developer (together with EPFL, Switzerland) of the Global Sensor Networks (GSN) platform which provides a flexible middleware layer that abstracts from the underlying, heterogeneous sensor network technologies and supports fast and simple deployment and integration of sensor networks on a large scale. In Semantic Web Services, NUI, Galway-DERI extensively contributes to the framework of SWS technology in the context of the Web Service Modelling Ontology (WSMO), the Web Service Modelling Language (WSML) and the corresponding architecture and Web Service Execution environment (WSMX). DERI actively participates in and leads research funded by the EU FP7 program (FAST, Romulus, Okkam, CONET, PECES, iMP), the EU FP6 program (DIP, SUPER, SemanticGov, NEPOMUK, TripCom, RIDE), Science Foundation Ireland (LION) and Enterprise Ireland (SAOR, eLITE). DERI members actively participate in a number of standardization activities such as the Wireless Sensors Enterprise Led Network (Ireland), the W3C Semantic Annotations for Web Services Description Language and XML Schema Working Group (W3C SAWSDL WG), OASIS Semantic Execution Environment Technical Committee (OASIS SEE TC), Semantic Web Services Challenge (SWS Challenge), Semantic Web Services Initiative (SWSI), and Ontology Management Working Group (OMWG). Semantically Interlinked Online Communities (SIOC) is currently a member submission to the W3C.
Within DERI, the Data Intensive Infrastructures group (http://di2.deri.ie) is developing Sindice (http://sindice.com); a search engine for the Semantic Web. The use of Cloud Computing is fundamental for Sindice to reach its scalability goals during the entire preprocessing phase and in particular to perform harvesting, storage, and data transformation. Another project which utilizes Cloud Computing in DERI is WebStar[22]. The goal of the WebStar project is to build a Web Science Laboratory, which will dramatically lower the barriers for performing large scale experiments involving Web Data alone or in conjunctions with other datasets as needed. The WebStar cluster will be used for large scale web data processing, using Cloud Computing paradigms. The specification of the WebStar cluster includes a total of 52 nodes, with 416 processor cores, 896GB memory and 198TB of raw storage (available storage will be a fraction of this due to RAID and replication).

Key Personnel's CVs

Prof. Stefan Decker is a full professor at the National University of Ireland and the director of the Digital Enterprise Research Institute (DERI) in Galway. Prof Decker obtained in 1995 a master degree in Computer Science at the University

[22] WebStar is an SFI funded project within the LION II CSET grant.

of Kaiserslautern (awarded with distinction). From 1995 to 1999 he worked towards a Ph.D. degree in Computer Science at the University of Karlsruhe (awarded 2002 with distinction). From 1999-2002 he worked as a Postdoc and Research Associate at the Computer Science Department of Stanford University and established one of the first Semantic Web research groups. From July 2002 to July 2005, he worked as a Computer Scientist and Research Assistant Professor at the Information Sciences Institute of the University of Southern California, USA. Since October 2003 Prof Decker moved to Ireland to help to set up a new Research Institute concerned with the Semantic Web. Since July 2006 Prof Decker is professor and director of the Digital Enterprise Research Institute. His current research interests include the Semantic Web, metadata, ontologies and semi-structured data, web services, and applications for Digital Libraries, Knowledge Management, Information Integration and Peer-to-Peer technology. He published around 80 papers as books and journal, book, conference, and workshop contributions. He co-organized around 35 scientific workshops and conferences and has edited several special issues of scientific journals. He was editor-in-chief of Elsevier's Journal of Web Semantics, editorial committee member of the Electronic Transactions on Artificial Intelligence (ETAI) (the Semantic Web), the Journal on Internet Research and the Journal on Web Intelligence and Agent Systems (WIAS) and is recognized as one of the most widely cited Semantic Web scientists. His dissertation work was quoted as one of the inspirations for the DARPA DAML program, which span the Semantic Web effort.

Dr. Vassilios Peristeras is the eGovernment Cluster Leader, Research Fellow, and Adjunct Lecturer in National University of Ireland, Galway – Digital Enterprise Research institute (NUIG/DERI) since 2006. He has studied Political Science and obtained master degrees in Public Administration and Information Systems. He also holds a PhD in Electronic Government. During the last 15 years, he has worked as scientific coordinator at the Greek National Center for Public Administration, Thessaloniki, as senior researcher at CERTH/ITI and the University of Macedonia, Greece, as eGovernment Consultant in the United Nations and as consultant in various public and private organizations. From 1998 until now he has initiated and participated in several R&D projects at the national and international level in the areas of eGovernment (e.g. EU-Publi.com, SemanticGov) and Collaborative Work Environments (e.g. ECOSPACE). He has published more than 90 papers in scientific journals and international conferences and has served as reviewer and program committee member in more than 40 conferences and workshops.

B2.2.3. SINGULARLOGIC ANONYMOS ETAIRIA PLIROFORIAKON SYSTIMATON & EFARMOGON PLIROFORIKIS

Partner Full Name	SINGKIOULAR LOTZIK ANONYMOS ETAIRIA PLIROFORIAKON SYSTIMATON & EFARMOGON S.A.		
Short Name	SingularLogic	Country	Greece
Type	IT/Software Industry	Website	www.singularlogic.eu
Official Logo			

Brief Partner Profile

SingularLogic is currently the leading Software and Integrated IT Solutions Group in Greece. With a full understanding of the entire range of market requirements, it offers advanced and integrated IT systems as well as full support services. Its products and services are currently used by thousands of companies and organisations belonging to the private or public sector throughout Greece. The company boasts the largest, most qualitative, and most dedicated nation-wide network of authorised partners, numbering more than 500 partners all over Greece. The Group is divided in three Business Division targeting different market segments and activities:

- **SingularLogic EnrerpriseDIS Division**: design and implementation of integrated IT solutions for large enterprises of the private sector, including distribution and support of well established international IT products for the following markets: General Business, Banking, Retail, Telecoms and Health Care.
- **SingularLogic Software Division**: development and distribution of business software applications covering any business need such as: Commercial and Financial Applications, EPR, CRM, Business Intelligence (BI) Systems and more.
- **SingularLogic Integrator Division**: design and implementation of Integrated IT Solutions for the public sector organizations especially in the areas of Defence, e-government, Transport, Health Care and Local Government.

In addition, SingularLogic operates in various countries in South East Europe through direct subsidiaries (Bulgaria, Rumania and recently Cyprus) or through partnerships.

Relative Expertise / Experience

SingularLogic has been recently involved in several ICT FP7, IST FP6 and Research for SMEs FP7 projects, such INTEROP, GENESIS, KWFGRID, COMMIUS, FUSION, EMPOWER and COLLECTIVE, related to software-as-a-service and cloud computing, grid computing, advanced service-oriented architectures, business and semantic interoperability, social networks and Web 2.0 intelligent interfaces. In the frame of these research initiatives, we have been working towards the development of integration methodologies and interoperability platforms that will support collaborative processes and transactions among heterogeneous systems.

Moreover, SingularLogic has significance experience in (Semantic) Web Services technologies and has developed a toolset for the ad-hoc extraction (as Web Services) of business functionality out of legacy systems and for the semi-automatic annotation of the operators and the input and output message elements of these Web Services' syntactic profiles, i.e. WSDL v1.1 and WSDL v2.0, with lightweight semantics, following the SAWSDL recommendation.

Finally, SingularLogic has utilized semantic technologies for experimental purposes in the fields of ontology assistive application design in service-oriented environments, decentralized services registries and distributed reasoning.

Key Personnel's CVs

Stelios Pantelopoulos is currently involved in the management of European and National R&D projects. He has over ten years of experience in participating in the implementation of IT projects and over six years of experience in managing multi-people teams. E-Business platforms, Interoperability frameworks, Business Software Applications Development, Multimedia Database Applications, Electronic Catalogues, Software Tools for Archaeologists, etc, is an indication of the IT projects that he was involved.

Thanassis Bouras holds a Diploma from the School of Electrical and Computer Engineering of the National Technical University of Athens (Greece) and is a research partner of the European Projects Department of SingularLogic since 2005. In the past, he has worked on several ATHOC (ATHENS 2004 Olympic Games) ICT projects. During the last 5 years, he has participated as research engineer in several EC and National co-funded projects in the areas of knowledge management and knowledge-based systems (INKASS, KWFGRID), business and semantic interoperability (FUSION, COMMIUS, EMPOWER), assisted and independent living (SOPRANO) and e-learning (ELEVATE).

B2.2.4. Centre for Research and Technology Hellas, Informatics and Telematics Institute

Partner Full Name	Centre for Research and Technology Hellas, Informatics and Telematics Institute		
Short Name	CERTH	Country	Greece
Type	Public Non Profit	Website	http://www.iti.gr

Official Logo

Brief Partner Profile

The Centre for Research and Technology Hellas (CERTH) (http://www.certh.gr/) is one of the largest research centres in Greece. CERTH was founded in March 2000 in Thessaloniki and is a legal, private law, non-profit organization, under the supervision of the General Secretariat for Research and Technology, of the Greek Ministry of Development. The mission of CERTH is to carry out basic and applied research with emphasis in developing new products and services with industrial, economic and social impact, with respect to the underlying principles of developing innovative technological applications, cooperating with universities in Greece and abroad, promoting the collaboration with enterprises and technology transfer and training new researchers. Informatics and Telematics Institute (CERTH/ITI) exhibits substantial research activity in the following areas: multimedia and internet technologies, virtual reality, multimedia and knowledge, computer vision, telemedicine applications, distributed systems and digital and interactive television. In addition, CERTH/ITI has significant experience in the area of Educational and Cultural Technologies and more specifically in e-learning enabling tools and platforms, flexible web-based distance education and training, open tools and platforms for personalized learning and educational multimedia content.

Relative Expertise / Experience

Participation in 40 FP6 projects, 26 FP5 Projects and 90 National Projects (42 of which have been successfully completed).
In addition to the above the key personnel involved in the Cloud4SOA project (please see below) have participated with leading roles in:

- Project Coordinator of ACCESSIBLE (Accessibility Assessment Simulation Environment for New Applications Design and Development - FP7), WeKnowIt (Emerging, Collective Intelligence for personal, organisational and social use- FP7), OASIS (Open architecture for Accessible Services Integration and Standardisation - FP7), AEGIS (Open Accessibility Everywhere: Groundwork, Infrastructure, Standards – FP7) etc.
- Project Coordinator of IST SemanticGov (Providing Integrated Public Services to Citizens at the National and Pan-European level with the use of Emerging Semantic Web Technologies - FP6), IST EU-Publi.com (Facilitating cooperation amongst European Public Administration employees through a Unitary European Network Architecture and the use of interoperable Middleware Components - FP5), SCHEMA (Network of Excellence in Content-Based Semantic Scene Analysis and Information Retrieval – FP5) etc.
- Project Partner in IST LD-Cast (Local Development Cooperation Actions Enabled by Semantic Technology - FP6), Infocitizen (Agent based negotiation for inter- and intra-enterprise coordination employing a European Information Architecture for Public Administration - FP5) and MODINIS (eEurope Initiative) “Study on Interoperability at Local and Regional level”.

Key Personnel’s CVs

Konstantinos Tarabanis is a professor at the Department of Business Administration of the University of Macedonia, Greece. He received an Engineering Diploma from the National Technical University of Athens (1983), an M.S. degree in Engineering and Computer Science (1984 and 1988 respectively) and a Ph.D. degree in Computer Science (1991) at Columbia University, New York. He was Research Staff Member at the IBM T.J. Watson Research Centre where he worked on e-manufacturing techniques. His current research interests include conceptual modelling of information systems, service models and architectures, as well as the domains of e-government, e-learning, e-participation and e-business. He has authored several research publications in the areas of software modelling and development for information systems in the domains of e-government, e-business, e-learning and e-manufacturing. He has received best paper awards from IEEE in the area of e-manufacturing, the European Conference on Information Systems and the International Academy of e-business.

Efthimios Tambouris is an associate professor at the Department of Technology Management of the University of Macedonia, Greece. He has also worked as a senior researcher at CERTH/ITI. Before that, he was founder and manager of

the eGovernment Unit at Archetypon SA. He holds a Diploma in Electrical Eng. from the National Technical University of Athens, Greece, and an MSc and PhD from Brunel University, UK. During the last ten years, he has managed several research and commercial projects. He has also participated in numerous research projects and standardisation activities. He has published more than 75 papers in journals and conferences.

B2.2.5. cloudControl UG (haftungsbeschränkt)

Partner Full Name	**cloudControl UG (haftungsbeschränkt)**		
Short Name	cloudControl	**Country**	Germany
Type	IT/ Software development	**Website**	http://cloudcontrol.de
Official Logo			
cloudControl			
Brief Partner Profile			
cloudControl is dynamic enterprise (SME) aiming at providing scalable and robust cloud-enabled services to end-users organization. As an novel cloud vendor, cloudControl has developed and maintains the its own web application platforms. The cloudControl web application platforms features enable developers to work faster and more efficiently by providing an integrated version control system and fine grained developer permissions. This enables different developers to work on multiple versions of the actual application simultaneously without interfering with other developers. Additionally all application versions are completely separated but still share the same platform. Differences between developments, staging and live systems potentially leading to bugs and security problems of the application are no longer a problem because of this. Additionally to these benefits for application development the platform also provides scaling, security and cost benefits for application hosting. On the platform each application is distributed across multiple cloud nodes based on actual load for scalability and high availability reasons.			
Relative Expertise / Experience			
As a team we developed a complete cloud hosting platform based on open standards. Our solution uses virtualisation and automation on multiple layers to abstract from underlying hardware and presents a common platform for web application development and hosting. We have already invested heavily into finding better ways to use computing resources more efficiently by distributing applications and adding and removing cloud nodes on-demand. Moreover, we are adopt and maintain cloud services lifecycle management methodologies for the monitoring of the effectiveness and the performance of the cloud infrastructures. Finally, our team have worked towards the resolution of interoperability, scalability and security issues of cloud platforms.			
Key Personnel's CVs			
Tobias Wilken: Tobias is the technical lead developer of the cloudControl platform. He is responsible for developing the efficient algorithms and overseas the overall platform development. He has gained comprehensive experience in system- and software development and research at the department of autonomous intelligent systems at University Bonn. Prior to his computer science studies he worked as a system administrator. Philipp Strube: Philipp has developed the idea and holds responsible for meeting the actual market requirements. He is a strong evangelist for cloud computing and cloud concepts in general and is actively involved in industry discussion. Additionally he is the author of a blog dedicated to cloud computing. Although coming from a background of studying law at University Bonn he has worked as a system administrator for several years himself and is actively developing software. Thomas Ruland: Thomas is responsible for statistical analysis and the creation of the platforms inherent logical decision making process. Further he assists Tobias with refining the efficiency of the platform's algorithms. Before working for cloudControl Thomas gained experience at UBS Investment Bank.			

B2.2.6. Cyntelix Corporation

Partner Full Name	Cyntelix Corporation		
Short Name	Cyntelix	Country	Ireland
Type	Industry (SME)	Website	www.cyntelix.com
Official Logo			

Brief Partner Profile

Cyntelix is a seasoned software company focused on the research and development of solutions in the areas of web2.0, semantic web, social networking, serious games, collaborative work environments and mobile services. The company operates in Europe with over 25 skilled people and its core team has more than 10 years experience in Semantic Web technology and Web 2.0 development and software implementation. We were one of the first in the US and European markets to propose a technology for dynamic automated creation of domain ontologies.

Recently, Cyntelix has also established itself as the leading European player in widget syndication technology. The Beemway operation develops, sells and supports standard syndication solutions to repackage existing content and services and syndicate them across multiple platforms. The solutions are based on cross-platform widget services and make it easy to package, distribute, and analyze digital content and services from across the Internet to weave personalized experiences. Industry analysts and strategic partners have identified widget technology as fundamental for the next generation of online content distribution. *The Beemway platform is incrementally augmented to deal with the huge amounts of data being generated, where widgets (eg: Coca-Cola, TomTom, KLM, etc) are supporting communities of a few million, thus generating several 100s of million entries of data*

Relative Expertise / Experience

TARGET - ongoing EU project aiming at research, analyze and develop a new genre of responsive Technology Enhanced Learning (TEL) environment that supports rapid competence development of individuals, namely; knowledge workers. TARGET achieves a step change in what can be done through TEL by integrating five significant developments brought together for the first time.

FAST - ongoing EU project aimed at the development of a user friendly visual development environment for widgets underlined by storytelling paradigm and supported by semantic ontology and reasoning

BEEMWAY – successful commercial product based on the syndication of widgets where users are able to deploy widgets onto start pages, mobiles, social networking sites, webpages, etc, leading to viral distribution.

Key Personnel's CVs

Hans Gijsbertsen is the Managing Founder of Cyntelix Corporation and has served as a Director of the Company since its inception in 2001. He holds degrees in Management and Business, and Enterprise Resource Planning. Mr. Gijsbertsen has over 15 years of experience in management, marketing, sales, software development and IT consulting. Mr. Gijsbertsen is a recognized authority on Internet behavior, Dynamic Enterprise Modeling and large-scale software architectures. At Cyntelix, Mr. Gijsbertsen has successfully build a global team to develop, sell and support standard "shrink wrap" software applications for search, summary and reporting.

Manuel Fradinho is the research coordinator of Cyntelix. He received his degree in Computer Science from the Instituto Superior Técnico of Lisbon (IST) and holds a PhD degree in Computer Science from the University College London. He has over 17 years experience in the industry and academic environment. His core research experience covers different domains, namely networking, semantic technology, distributed virtual reality, HCI, extended/virtual enterprises, web2.0, social networking, widget technologies and serious games. Previous experience from EU projects includes, among others, SMARTISAN (virtual agents and semantic technology) and WIT (virtual reality and semantic technology). Recently, he was research coordinator of the PRIME research project, which explored the potential use of a serious game for competence development in strategic global manufacturing. He is currently involved in ECOSPACE, FAST and TARGET EU co-funded projects. He is also responsible for the research of the technological roadmap of the Beemway platform to support the sustainable growth. He has written more than 70 publications.

B2.2.7. Portugal Telecom Inovaçao SA

Partner Full Name	Portugal Telecom Inovação SA		
Short Name	PTIN	Country	Portugal
Type	Telecom Industry	Website	www.ptinovacao.pt
Official Logo			

Brief Partner Profile

Portugal Telecom Inovação, SA develops innovative and competitive services and solutions for the telecommunications market. Our success has been built and sustained on the competences we can call on in applied research, technology integration, services and solutions development, telecommunications engineering and training services. Major products include systems and solutions for intelligent networks (IMS - next generation/convergence approach), Access Networks (both copper and optical), Multimedia and IP Solutions, Mobile Networks, Services and Platforms, Network Management, Business Intelligence, IT Systems and Software Engineering, as well as Telecommunications Business Processes, Support and Training. With operations spread over three continents and its headquarters in Aveiro, PT Inovação also has branches in Oporto and Lisbon. In Latin America, the company has a subsidiary in São Paulo and, more recently, has set up a software development center in Salvador, both in Brazil. Since last year, the operation in Africa has been centered on a subsidiary company in Luanda, Angola.
PT Inovação promotes R&D cooperation and has privileged partnerships with major universities and centers of innovation, at both the national and international level. The company holds several certifications: Quality Management Certification System that complies with ISO 9001 standards, the ISO 14001 Environment Management Certification and the NP 4457 Management System for Research, Development and Innovation.

Relative Expertise / Experience

PTIN has a long record of participation in international collaborative projects through R&D programmes, namely CIÊNCIA, COST, RACE, ACTS, FP5, FP6, FP7, ORA, CTS, CELTIC, ESPRIT and EURESCOM, as well as participation in standardisation bodies (e.g. TM Forum, OMA, HGI, …). Recently, **PTIN** has been active in several projects and initiatives oriented to Future Internet topics. One of the focuses has been on SOAs, mainly in the framework of the FP7 **PERSIST**, **SWIFT** and **C-CAST** projects. Several papers on the topic have been already presented in major international conferences as well.

Key Personnel's CVs

Telma Mota received her diploma in Electrical and Computing Engineer in 1988 and her MSc in Telecommunications in 1994, both from the Engineer University of Porto. She has been a project manager at PT Inovação for more than 10 years and her main area of expertise is Service and Network Management, specification and design of open and distributed architectures. She started in the Planning Department of the Portuguese Telephone Company with the dimensioning of digital exchanges and then she joined the teletraffic planning group where she stayed for two years leading these activities. In 1994 she joined PT Inovação where she got more expertise in the most relevant service and network architectures such as IN, IN evolution, TINA, Parlay, IMS, TISPAN and MBMS. Since then she has been responsible for PTIN's participation in several ACTS/IST and EURESCOM projects. Currently she is responsible for the PTIN's Services and Platforms group, focusing on research and implementation of service platforms and control architectures.
Pedro Neves received his B.S. and M.S. degrees in Electronics and Telecommunications Engineering from the University of Aveiro, Portugal, in 2003 and 2006 respectively. From 2003 to 2006 he joined the Telecommunications Institute (IT) and participated in the DAIDALOS-I and DAIDALOS-II European funded projects. In 2006 he joined Portugal Telecom Inovação and participated in WEIRD (2006-2008), HURRICANE (2008-2010) and FUTON (2008-2010) European funded projects. Furthermore, since 2007 he is also pursuing a Ph.D. in Telecommunications and Informatics Engineering at the University of Aveiro, Portugal. He has been involved in six book chapters, as well as more than 30 scientific papers in major journals and international conferences. His research interests are focused on cloud computing/networking, service platforms, broadband wireless access technologies, as well as mobility and QoS management in *all-IP* heterogeneous environments.

B2.2.8. Fraunhofer FIT

Partner Full Name	Fraunhofer FIT		
Short Name	FIT	Country	Germany
Type	Research Organisation	Website	fit.fraunhofer.de
Official Logo			

Brief Partner Profile

The Fraunhofer Gesellschaft is Europe's leading research organization for applied research and Europe's second largest research organization in the field of information technology. The Fraunhofer Gesellschaft is an independent association, which currently - following the merger with GMD Research Centre for Information Technology GmbH - consists of 56 research institutes and a patent office. Its administrative headquarters are in Munich and in Sankt Augustin, while the research institutes are situated in all 16 of the German states. The institutes carry out R&D projects across a wide range of fields, on a contractual basis on behalf of both the private and public clients. Where multiple competencies are required, several institutes can collaborate on an interdisciplinary basis to provide a complete solution. The majority of the 11,000 staff members are scientists and engineers. They generate an annual research budget of more than 880 million €. The Fraunhofer Gesellschaft is a member of the European Research Consortium in Informatics and Mathematics (ERCIM), which has partners in 13 European countries. Most are independent research and development laboratories with strong links to local industry. ERCIM partners have generated about 400 spin-off companies and undertake joint developments.

Relative Expertise / Experience

Fraunhofer FIT participates in several national and international research projects. In context of the Sixth EU Framework Program FP6 for research and technological development Fraunhofer FIT coordinates the integrated project on eProfessional collaboration space (ECOSPACE) and is a leading partner in a number of other IP and STREP projects. Collaboration aspects, service oriented architectures and human computer interaction play a crucial role in these projects. Fraunhofer FIT members fulfil also a number of executive roles in professional and research committees related to collaboration technology.

Key Personnel's CVs

Prof. Wolfgang Prinz, PhD (FIT) has a PhD in computer science from the University of Nottingham. He is a director at Fraunhofer FIT (Institute for Applied Information Technology), division manager of the CSCW research department in FIT, and Professor for cooperation systems at the Technical University in Aachen. He is carrying out research in the area of Cooperative Systems, CSCW, Groupware, Communityware and Information systems. He participated in and managed several COST, ESPRIT, IST and national research projects.
Wolfgang Prinz published more than 70 papers and is member of a number of conference committees: Programme Chair of ECSCW'97, Co-Chair of GROUP'97 (ACM), Programme Co-Chair of WACC'99 (ACM) and M&C 2002, Co-Chair of E-CSCW 2001, member of the editorial board of the International Journal of CSCW (Kluwer), vice-chair of the Special Interest Group on CSCW of the German Informatics Society (GI), and he was chair of ACM SIGGROUP until 2004.

B2.2.9. ROMTELECOM S.A.

Partner Full Name	ROMTELECOM S.A.		
Short Name	RomTelecom	Country	Romania
Type	Telecom Industry	Website	www.romtelecom.ro
Official Logo			

Brief Partner Profile

Romtelecom is today one of the best rated companies in Romania with a tradition of more than 75 years on the telecom market.
Romtelecom is the incumbent telecommunications operator in Romania and has more than 10000 employees with presence all over the country.
Romtelecom offers integrated voice & data communications solutions that enable compelling communications services for people at home, at work and on the move.
Romtelecom is the leader in highly reliable fixed, mobile and converged broadband networking, IP related products & services and much more.
As a member of a global integrated operator group, the Hellenic Telecommunications Organization SA (OTE SA) and Deutsche Telekom Group, we leverage our respective strengths and are able to fulfill our Customers business needs with measured performance that meets globally recognized corporate responsibility standards.
Our Customer service team consists of experienced professionals, committed to working closely with partners to deliver the latest ICT technology, from triple play to complex, value-added solutions, sharing a collaborative vision. As a result, Romtelecom helps improve the overall customer experience, drive efficiency and accelerate business innovation.

Relative Expertise / Experience

Romtelecom offers professional integrated voice & data communications services for people at home, at work and on the move, requiring high quality of service (QoS), i.e. voice and data delivery. Although several telecommunication QoS monitoring solution exists, the complexity of deployed networks and the vast amount of parameters that should be taken into account in the QoS estimation make network monitoring a data- and computational- intensive process that should be executed distributed (at the several network nodes), providing an excellent scenario and use case for cloud computing prototypes.

Key Personnel's CVs

Dr. Nikolaos Golias is currently the Systems Integration Director, IT Directorate of RomTelecom. His main responsibilities are in the development and management of the enterprise-wide Information Technology strategy and in the planning and developing of business opportunities and implementation of integrated large scale solutions for internal and external customers. He has wide corporate management experience and held various positions in IT, Commercial and International Investments division of the OTE group. He holds a diploma in electrical engineering and a Ph.D from Aristotle University of Thessaloniki and has served as a research postdoctoral fellow in the Center for Integrated Systems, Stanford University. He is the author of several journal papers with contributions to several fields of electrical & computer engineering and has participated on numerous projects of the European Community, European Research Organizations, Stanford University and Intel Corporation.
Mr. Florin Zmaranda is currently ICT Development Director in System Integration Directorate of Romtelecom.
His main responsibility is to design and implement ICT integrated solutions for Romtelecom customers. He is also leading several major IT projects in Romtelecom for implementation of Operations Support Systems (as service activation, service testing, work force management) and ordering and workflow automation applications. He held a diploma in electrical engineering from Computer Science faculty of Timisoara University. He also has Diploma in Management from Open University Great Britain.

B2.3. Consortium as a Whole

B2.3.1. Description of the Consortium

The Cloud4SOA consortium (**Figure 17**) combines multidisciplinary competences and resources from academia, industry, and research community. It consists of **nine (9) partners** representing research institutes, universities, industrial partners (mainly SMEs), and end-users organisations (e.g. mobile operators, telephony and internet service providers), from **six (6) EU member countries**, i.e. **Spain, Ireland, Greece, Germany, Portugal and Romania** – one of them from the so-called new Member States (Romania). This multinational cooperation is essential in order to implement the rising requirements of the European Software and Services Industry and address the business needs of the end-user organizations (in particular the Small to Medium Sized Businesses) across the enlarged Europe in the area of **exploring the synergy of service oriented architectures and cloud computing**.

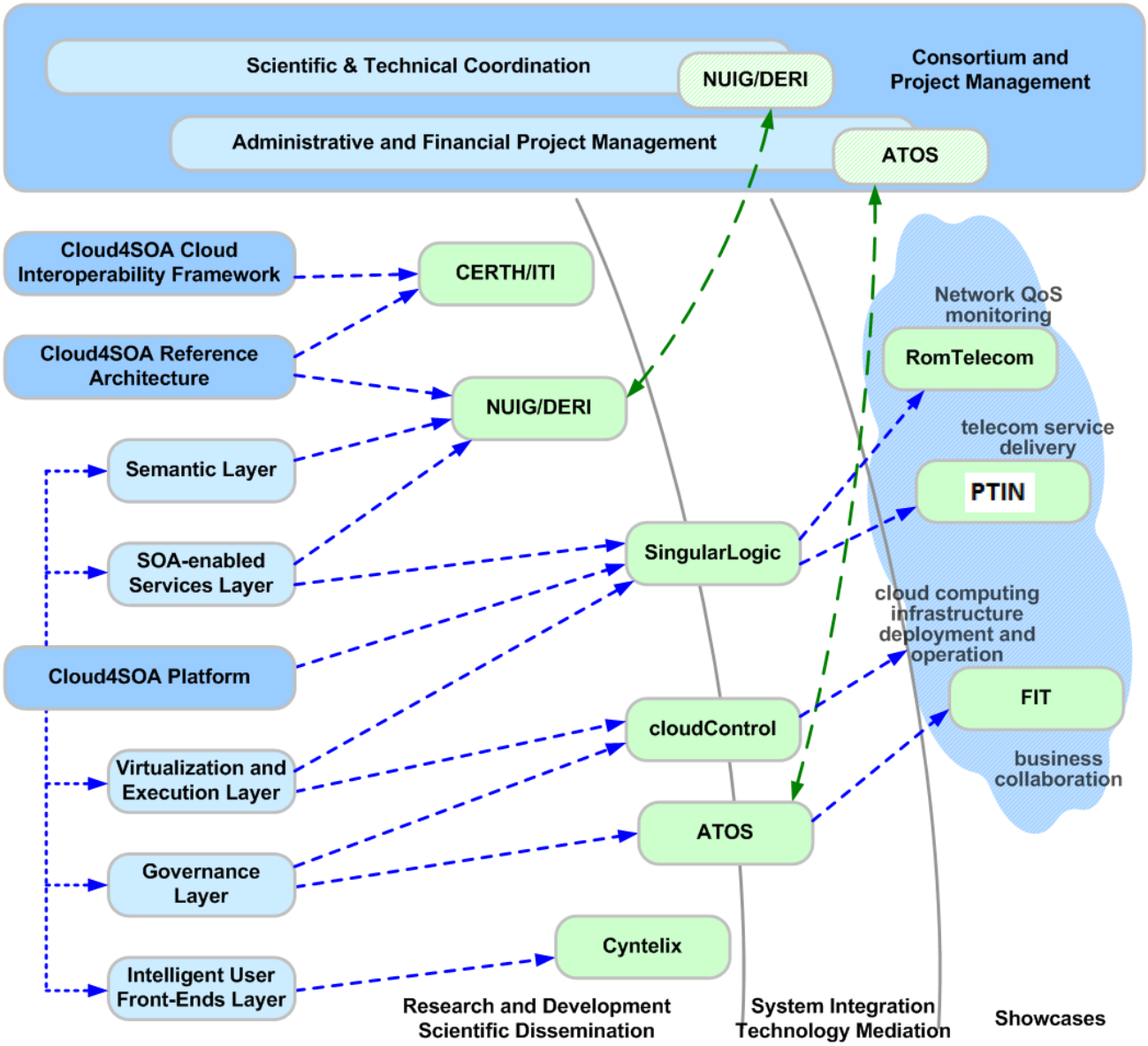


Figure 17 The Cloud4SOA Consortium and Partner's Area of Involvement

Thus, the Cloud4SOA project brings together a team of experienced partners dedicated to contributing, each in their respective area of expertise, to the successful implementation of the project objectives. Incorporating

- one **international information technology services company** & **NESSI partner** (ATOS), with an outstanding software and services engineering background and valuable expertise in Cloud Computing, Service-Oriented Infrastructures including Grid and Utility Computing addressing also the associated business delivery models;
- two **universities** (NUIG/DERI) and **research institutes** (CERTH/ITI), each one with rich experience in cloud interoperability, service-oriented architectures, service-oriented enablement, ontologies and semantic web technologies, semantic services and resources models, and semantic annotation mechanisms;
- one **cloud expert and vendor** (cloudControl), constituting a European **SME** that is specialised and operating in the area of cloud infrastructures deployment, operation, maintenance and governance, with vast interest in cloud interoperability, scalability and security issues;
- one **European Software SME** (Cyntelix), with rich experience in intelligent services end-users front-ends and widget solutions to quickly repackage existing content and services and syndicate them across multiple platforms
- one **technology provider and system integrator** (SingularLogic), with a rich experience in requirements analysis, interoperability technologies, ontologies, semantic web and web services technologies, software-as-a-service offerings, service-oriented application development, distributed services publication, discovery and composition, services lifecycle management, deploying commercial ICT solutions in showcases, and with large scale IT integration background; and
- three **end-users organizations** from the **telecom industry** (PTIN & RomTelecom) and the **groupware and business collaboration software market** (FIT), constituting potential users of interoperable cloud computing infrastructures and cloud-enabled data- and computational- intensive services, and with a vested interest in exploiting the synergy of service-oriented architectures and cloud computing in their own systemic and information infrastructures;

the Cloud4SOA consortium is well-positioned to deliver the results promised in this proposal.

The Cloud4SOA consortium has been selected to bring together the skills and expertise necessary to define and understand the interoperability, scalability and security issues of the cloud computing domain, as well as to specify and build the cloud interoperability framework and the reference architecture, the enabling technologies and the supporting tools that will allow the development and deployment of high-capacity services for end-users organizations.

In the frame of the Cloud4SOA project, we have identified **five main types of activities** that imposing respective roles of participants required. Thus, the Cloud4SOA consortium comprises five (5) types of expertise, getting together:

- outstanding **scientific and technological expertise** required to deliver an innovative, still technologically mature set of high-quality concepts, technologies, methods and tools;
- exceptional expertise in **systems integration and technology mediation**, as our experience shows that just delivering technology without further support to the end-users (i.e. showcases) will not work, while

significant effort and support is required, in identifying realistic scenarios, analyzing their current requirements, and applying the technical achievements and methodological procedures in order to build the showcases prototypes;

- thorough experience in practical **cloud-enabled services development, deployment and delivery** aspects, as well as identification and capturing of realistic requirements of **cloud infrastructures interoperability and scalability**, providing **real-world use cases** to serve as **pilot test-beds and proof-of-concept showcases** for proving and demonstrating the usefulness of the methods and tools to be developed, both at technical and business level;
- a collection of complementary **scientific dissemination** and **commercial exploitation** interests and capabilities, guaranteeing the project's impact; and
- longstanding experience (both at the institutional and the personal level) in **running, coordinating, managing, and successfully completing joint R&D projects** – national and international, of different size, including many FP6/FP7 STREPs and IPs.

In the next page, **Table 6** provides an overview of the partners and their specific Cloud4SOA-related role and expertise. Further details about the consortium participants including profiles, relevant expertise, expected benefits and CVs of key personnel can be found in Section 2.2.

B2.3.2. Complementarity between Participants

In **Table 7**, we summarize the key competencies and skills per partner that will be utilised for the realization of the project.

Although it might make the impression that our consortium structure contains some redundancy with the same expertise prevalent in different partner sites, all partners bring into the project a different focus of work and a different perspective of emphasis. Our experiences with prior European projects showed that a too small overlapping in the basic understandings, goals, and prior knowledge of project partners results in huge communication and negotiation problems which can be a serious risk for project success.

With the Cloud4SOA consortium we have a set of European partners, each of them with a unique focus and expertise, but all of them knowledgeable enough about the "whole picture" that a fruitful cooperation and cross-fertilization between the several roles, countries, and disciplines can be achieved.

It should also be mentioned that there already exist good relationships among some partners of this consortium, from past successful collaborations, which is expected to be valuable for a quick 'jump-start' of the project, as well as for a smooth running of operations throughout the project life-cycle.

B2.3.3. Sub-Contracting and Other Countries

Apart from the audits, **no other subcontracting is foreseen**, as the Cloud4SOA consortium gathers all the expertise required to deliver the results proposed, achieving all the project's objectives. Moreover, all the Cloud4SOA partners **come from EC member states** (i.e. Spain, Ireland, Greece, Germany and Romania).

Partner Name	Main Role in the Cloud4SOA Project	Expected Benefits
P1 **ATOS** Software Industry	ATOS is going to be the Project Coordinator of the Cloud4SOA project (as it has significant experience in large scale IT project management), undertaking the administrative and financial project management, the overall consortium coordination responsibility (WP10). ATOS will lead the Cloud4SOA-related market analysis and exploitation planning (WP9). In Cloud4SOA, besides management, dissemination and exploitation, ATOS will provide a wide and solid background on the SOA-enabled Services layer (WP4) and Semantics (WP2) as required by the RTD work proposed by Cloud4SOA. Its research activities mainly focus on Service Level Agreement management at different layers, software licensing management in distributed computing environments (WP5).	ATOS intends to exploit its wide experience in project coordination, as it has been shown in big Projects like BEINGRID, ORCHESTRA or SOA4All, to name a few. Besides management, dissemination and exploitation, ATOS will gain a solid background on the service- and semantics- layers proposed by Cloud4SOA. ATOS will investigate the potentials of Cloud Platforms Service Level Agreement management at different layers, software licensing management in distributed computing environments and try to aligning customer's needs with emerging cloud computing, grid and virtualization technologies. AtosSphere, a new Cloud offering by ATOS to its clients, will be a primary target to pass on knowledge and results from Cloud4SOA.
P2 **NUIG/DERI** University / Research Institute	NUIG (DERI) is a world-leading organization in the area of Semantic Web. As such, NUIG's main contributions in Cloud4SOA will focus on: - Studying the semantic interoperability problems and requirements in the Cloud (WP1); - Defining the Cloud4SOA Cloud Semantic Interoperability Framework (WP1); - Developing a lightweight service and computing resource vocabularies (WP2); - Developing semantically-enhanced service discovery mechanisms that will utilize the lightweight service vocabulary (WP3); - Developing service recommendation mechanisms that will capitalize on semantic technologies (WP3).	Through its participation in Cloud4SOA, NUIG expects to: - Explore the possibilities and the potentials of applying semantics in the Cloud, thus moving towards a semantic Cloud; - Progress their work in lightweight service and data vocabularies and formalize the life-cycle of such vocabularies (e.g. creation, dissemination, adoption, uptake, exploitation); - Develop semantically-enhanced service recommendation mechanisms and mechanisms that will harness the metadata that emerge from the actual usage of services; and - Gain knowledge and experience that could contribute to their standardization activities.
P3 **SingularLogic** Software Industry	At project management level, SingularLogic is going to undertake the quality monitor and assurance of all the deliverables (WP10). Moreover, SingularLogic intends to exploit its research experience through its involvement in the definition of the overall Cloud4SOA Cloud Semantic Interoperability Framework and Reference Architecture (WP1) and the development of the Virtualization and Execution Layer (WP6), and several components of the SOA-enabled Service Layer (WP4). In addition, SingularLogic will lead the integration of the several layers to be developed in WP2, WP3, WP4, WP5 & WP6 in a unified platform (WP7), and the development and deployment of two showcases: the Portuguese PTIN and the Romanian	SingularLogic aims to exploit the technological know-how acquired in the frame of past and currently active European-wide and national research projects in the knowledge domains of in cloud computing, software-as-a-service offerings, semantic web technologies, services lifecycle management, distributed services publication, discovery & composition, service-oriented application development, systems software development, and advance it through the participation in Cloud4SOA. Moreover, SingularLogic will gather significant experience in the aforementioned areas so as to utilize it on its already existing software products so as to make them even more competitive. Finally,

Partner Name	Main Role in the Cloud4SOA Project	Expected Benefits
	RomTelecom ones (WP8). Finally, SingularLogic will allocate significant resources on the market analysis, exploitation, and business planning activities targeted to the commercialization of the project's research results in Greece and Balkans though it direct subsidiaries in Cyprus, Bulgaria and Romania (WP9), as well as on the performance assessment of the Greek and the Romania showcases (WP8).	SingularLogic investigates the opportunity to become a leading cloud infrastructure provider in Greece, Cyprus and Balkans delivering interoperable, scalable and secure cloud-enabled services.
P4 **CERTH** Research Institute	CERTH has a very strong background and experience in SOAs, and domain, service and interoperability modeling. Hence, CERTH's main contribution will focus on: - Studying and modeling semantic interoperability in the Cloud (WP1); - Defining the Cloud4SOA Cloud Semantic Interoperability Framework (WP1); - Deriving a set of recommendations for building semantically interoperable Cloud platforms (WP1); and - Developing a lightweight service vocabulary (WP2).	Through its participation in Cloud4SOA, CERTH expects to: - Further enhance and expand their research on semantic interoperability by studying the interoperability problems and requirements in the Cloud; - Evaluate the transferability of knowledge on semantic interoperability issues from previous research in other domains, such as eBusiness and eGovernment. - Further progress their work towards extended SOAs that utilize lightweight semantics. - Acquire insights and valuable experience on state-of-the-art technological solutions for implementing all the above.
P5 **cloudControl** Industry-SME	cloudControl will provide its own developed web application platform to research autoscaling and cloud security of web applications provided as software as a service inside the cloudControl platform. Main involvement will be in the following two sub-systems of the Cloud4SOA Reference Architecture: the cloud governance layer (WP5) and the cloud virtualization and execution layer (WP6). Finally, cloudControl will actively participate in the Cloud4SOA platform integration (WP7), will deploy and deliver a cloud computing infrastructure for supporting the showcases services (WP7), and will maintain and govern the cloud-enabled operation of the showcases prototypes (WP8).	cloudControl itself will benefit directly from the technological aspect of the research. Results can be used to advance the cloudControl platforms already inherited scaling and security features.
P6 **Cyntelix** Industry-SME	Cyntelix will lead the implementation of the Cloud4SoA Intelligent Interfaces Layer, involving the user in the design process with rapid prototyping (WP3). The approach will be based on the use of widgets thus enabling the user to manage their Cloud applications in a centralized manner, irrespective of how the Cloud Widgets are distributed across different environments.	The Cloud4SoA widget framework is going to be integrated into the Cyntelix Beemway widget syndication platform, allowing Cyntelix to actively exploit its commercial cross-platform widget services in the emerging cloud market.
P7	PTIN will contribute to the identification and definition of end-user	Through its participation in Cloud4SOA, PTIN expects to gain

Partner Name	Main Role in the Cloud4SOA Project	Expected Benefits
PTIN Telecom Industry / Mobile Operator	requirements with regard to the cloud computing scalability and the delivery of high capacity and availability services to its customers (WP1). Moreover, PTIN is going to lead the development, deployment and performance evaluation of a novel showcase prototype (WP8), intending to combine the third-parties service-oriented multimedia application development with their deployment in a reliable, scalable & secure cloud computing infrastructure. Finally, PTIN is going to investigate market potentials of Cloud4SOA exploitable assets in the telecom industry at European level (WP9).	significant technological know-how, as well as a set of prototypes of cloud-enabling software tools that are going to allow PTIN to enhance its existing network infrastructure and deliver a next generation service delivery platform. PTIN is planning to effectively develop and deploy reliable, scalable & highly available multimedia services to its mobile subscribers, so as to increase their satisfaction and mobile usage rates.
P8 **FIT** Groupware Software Market	FIT is going to lead the Cloud semantic interoperability and scalability requirements collection, analysis and homogenization, from the end-users organizations point of view (WP1). In this phase, FIT will contribute its experiences in the development of interoperable service oriented systems. In addition, FIT will coordinate the activities concerning the as-is analysis, scope definition, use cases identification, prototype development, deployment, operation and performance evaluation of the three Cloud4SOA showcases (WP8). Moreover, FIT will contribute the BSCW system as a collaboration platform to the project. This platform will both be used as a coordination and research tool within the project. As a research tool is serves as a test-bed for a large scale collaborative application that is being transferred into a cloud environment. Finally, FIT will lead the project's clustering and dissemination activities (WP9)	FIT flagship collaboration solution BSCW is a central server hosted application. We expect that our project participation will result in a new product version that is capable of being hosted within a Cloud, which will result in new business opportunities. On the research aspect we expect new insights on concepts of collaborative systems within a Cloud environment.
P9 **RomTelecom** Telecom Industry / Fixed Telephony & Internet Service Provider	RomTelecom will provide significant contribution in the definition of the end-users requirements (WP1), with regard to the Cloud semantic interoperability and scalability challenges in the frame of the highly demanding (in terms of CPU power) Quality of Service (QoS) monitoring process. Moreover, RomTelecom will organize (as-is analysis, scope and use-cases definition), develop and deploy a showcase regarding the distributed execution of the data-intensive QoS monitoring services that require large-scale packet and data analysis (WP8). Finally, RomTelecom will analyze the cloud computing market and the commercialization potentials of Cloud4SOA research results in Balkans and in the eastern Europe (WP9).	RomTelecom will benefit itself directly from its participation in the project, by adopting part of the developed and delivered project results (e.g. framework, reference architecture, platform) in order to leverage the constant monitoring of the quality of the provided voice and data services. RomTelecom could utilize the innovative Cloud4SOA technologies for achieving faster identification of non-acceptable QoS levels and better reaction to them.

Table 6 Cloud4SOA Partners' Role and Expected Benefits

Cloud4SOA Required Competencies	Cloud4SOA Partners								
	ATOS	NUIG/DERI	SingularLogic	CERTH/ITI	cloudControl	Cyntelix	PTIN	FIT	RomTelecom
Research and Development Competencies									
Cloud Computing	☑	☑	☑	☑	☑				
Cloud Semantic Interoperability	☑	☑	☑	☑	☑				
Software-as-a-Service Offerings	☑		☑		☑				
Cloud Scalability Issues	☑				☑				
Cloud Security Issues	☑				☑				
Cloud Services Governance	☑		☑		☑				
Semantic Service Models		☑	☑	☑		☑			
Semantic Web Technologies	☑	☑	☑	☑		☑			
Decentralized Resources Registry			☑						
Cloud Execution Box			☑		☑				
Intelligent Service Front-Ends				☑		☑			
Service Mashing	☑	☑	☑	☑					
Advanced ICT Architectures	☑	☑	☑	☑		☑			
Software Development	☑	☑	☑	☑	☑	☑			
System Integration and Testing	☑		☑		☑	☑			
Showcases Organization and Execution Competencies									
Showcases Analysis & Scope Definition	☑		☑				☑	☑	☑
Showcases Planning and Operation	☑		☑		☑		☑	☑	☑
Showcases Performance Evaluation	☑		☑				☑	☑	☑
Technology Transfer Competencies									
Dissemination / Workshops	☑	☑		☑				☑	
Exploitation Planning	☑		☑		☑	☑	☑	☑	☑
Market Analysis	☑		☑		☑	☑	☑	☑	☑
Project Management Competencies									
Consortium & Project Management	☑	☑	☑						
Technical & Scientific Management	☑	☑		☑					
Quality Assurance	☑	☑	☑	☑	☑	☑			
Risk Management	☑		☑			☑			

Table 7 Partners' Competencies Matrix

B2.4. Resources to be Committed

B2.4.1. Management Level Description of Resources and Budget

The overall costs of the proposed Cloud4SOA project derive from the following four (4) eligible cost categories: a) personnel, labour costs (both direct costs and overheads), b) travel expenses and subsistence, c) workshops organization and dissemination material budget, and d) audits and subcontracting costs. Please note that **management costs** amount to **302.559 €** (being **7,3%** of total project costs).

Personnel

The extent of this STREP project scope requires a significant variety of expertise, including: cloud computing, cloud interoperability, scalability and security issues, ontologies, service and resource models, semantic annotation, intelligent end-user interfaces, services front-ends, service lifecycle management, cloud governance, decentralized services and resources registries, integration technologies, requirements analysis, dissemination and exploitation planning, and experts in managing big projects. The Cloud4SOA consortium covers all of the required expertise in a very satisfactory way, as it encompasses major key actors in all the above areas. Here, the required person months per activity and participant are presented. The total person months required to carry out the activities of the project are **430**. Total **direct** personnel costs for the project amount 2.400.890 € (being **58% of the total project budget**).

In Annex II, we provide an overview of the resources per partner to be utilized during the Cloud4SOA project, as well as, the contingency plan of each partner in order additional resources to be mobilized.

Travel and Subsistence

Average costs per meeting per partner			
A	Number of Days	3	
B	Subsistence average daily costs	200,00 €	
C	Travel average costs	400,00 €	
D	**Total per person**	**1.000,00 €**	(A*B+C)
E	Number of Persons	2	
	Total per partner	**2.000,00 €**	(D*E)

Apart from the typical project review and rehearsal meetings (included in the management activities), Cloud4SOA consortium has planned regular consortium meetings approximately every sixth months (that are included in technical activities), in order to review the progress of the various activities and to update the goals for the next short-term period according to the needs that have arisen. In the figure below, an estimation of the meetings required is provided. Additional meetings will be held in order to resolve any issues that may arise during the course of the project, or to facilitate the progress of a specific working group. It is estimated that for each planned meeting and from each partner an average of two persons will travel for three days.

The **costs for each meeting** are estimated to approximately **2.000 € per partner**. According to the number of meetings planned by each partner, an average of each partner's travel budget is calculated. Some partners

appear to have more or less travel budget than the average, based on their individual estimations and the activities they are involved into. The estimated total costs for travel and subsistence are **234.000 €**.

Meeting Type		Related WP	Activity Type	Number of Meetings	Number of Travelling Partners	Meeting Type Costs	Participants
A	Review Meetings (after M12, M24 & M30)	WP10	MGT	3	9	**54.000,00 €**	All partners
B	Requirements Analysis Meeting	WP1	RTD	1	9	**18.000,00 €**	All partners
C	Framework & Architectural Design Meeting	WP1	RTD	2	6	**24.000,00 €**	All R&D partners
D	Technical Integration Meeting	WP7	RTD	2	6	**24.000,00 €**	All R&D partners
E	Showcases Preparation, Operation and Performance Evaluation Meeting	WP8	RTD	3	6	**36.000,00 €**	Three end-user partners, ATOS, SingularLogic, clouControl
F	Dissemination Events	WP9	RTD	21	1	**42.000,00 €**	All partners
G	Scientific Coordination Meetings	Task 10.2	RTD	3	6	**36.000,00 €**	All R&D partners
	Total Cloud4SOA project meetings			**35**		**234.000,00 €**	

Audit and Subcontracting Costs

Auditing costs have been planned for for ATOS, NUIG, SingularLogic, and CERTH as their budget requires an audit during the project's lifecycle. The average auditing costs, estimated based on each company's specific agreements and former experience, are about **2.500,00 €**. Thus, the overall audit costs are estimated to **10.000,00 €**. Apart from the audits, **no other subcontracting is foreseen**, as the Cloud4SOA consortium gathers all the expertise required to deliver the results proposed, achieving all the project's objectives.

Audits and Other Subcontracting			
Partner	**Average Audit Cost**	**Number of Audits (per partner)**	**Total Partner Type Audit Cost**
ATOS	2.500,00 €	1	**2.500,00 €**
NUIG	2.500,00 €	1	**2.500,00 €**
SingularLogic	2.500,00 €	1	**2.500,00 €**
CERTH	2.500,00 €	1	**2.500,00 €**
TOTAL		**4**	**10.000,00 €**

Workshops

During the Cloud4SOA project lifecycle, three (3) annual Cloud4SOA workshops is foreseen to be organized, two for presenting intermediate results and one at the end of the project. In conjunction, with the Cloud4SOA workshops, ICT concentration meetings and Cloud4SOA SIG Members meetings will take place. In the following the distribution of the resources estimated (**12.000,00 € per workshop and 4.000,00 € for dissemination material**) for these three workshops are presented.

CLoud4SOA Workshops Costs		ATOS	NUIG	FIT	TOTAL
A	Venue, Equipment and Print-out Material	6.000,00	6.000,00	6.000,00	18.000,00
B	Catering	2.000,00	2.000,00	2.000,00	6.000,00
C	Accomondation of Key Participants	4.000,00	4.000,00	4.000,00	12.000,00
D	Dissemination Material for all Events	4.000,00	0,00	0,00	4.000,00
	Total per partner	**16.000,00**	**12.000,00**	**12.000,00**	**40.000,00**

Other Countries

All the Cloud4SOA partners come from EC member states (i.e. Spain, Ireland, Greece, Germany, Portugal and Romania).

B2.4.2. Overall Cost Breakdown per Partner

	PP1	PP2	PP3	PP4	PP5	PP6	PP7	PP8	PP9	TOTAL
	ATOS	**NUIG**	**SingularLogic**	**CERTH**	**cloudControl**	**Cyntelix**	**PTIN**	**FIT**	**RomTelecom**	**PARTNERS**
Personnel Rate	5.410,00 €	7.000,00 €	6.000,00 €	5.500,00 €	3.527,00 €	8.000,00 €	5.220,00 €	5.400,00 €	5.000,00 €	
Overhead Type	ACTUAL	STFR	ACTUAL	ACTUAL	STFR	FLAT	ACTUAL	ACTUAL	ACTUAL	
Overhead Rate	28,00%	60,00%	60,00%	95,59%	60,00%	20,00%	100,33%	85,19%	50,00%	
Person-Months	94,5	40	77	55	55	31,5	23	29	24,5	**429,5**
Personnel Cost (Direct)	511.245,00 €	280.000,00 €	462.000,00 €	302.500,00 €	193.985,00 €	252.000,00 €	120.060,00 €	156.600,00 €	122.500,00 €	**2.400.890,00 €**
Travel and Workshops	46.000,00 €	42.000,00 €	30.000,00 €	32.750,00 €	30.000,00 €	24.000,00 €	20.000,00 €	32.000,00 €	20.000,00 €	**276.750,00 €**
Subcontracting (Audits)	2.500,00 €	2.500,00 €	2.500,00 €	2.500,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	**10.000,00 €**
Equipment	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	**0,00 €**
Sub-total Direct Costs	559.745,00 €	324.500,00 €	494.500,00 €	337.750,00 €	223.985,00 €	276.000,00 €	140.060,00 €	188.600,00 €	142.500,00 €	**2.687.640,00 €**
Overhead	155.882,94 €	193.200,00 €	295.200,00 €	289.159,75 €	134.391,00 €	55.200,00 €	120.456,20 €	133.400,00 €	71.250,00 €	**1.448.139,89 €**
Total Costs	715.627,94 €	517.700,00 €	789.700,00 €	626.909,75 €	358.376,00 €	331.200,00 €	260.516,20 €	322.000,00 €	213.750,00 €	**4.135.779,89 €**
EC Grant Requested	**425.154,34 €**	**396.900,00 €**	**424.900,00 €**	**473.651,99 €**	**271.887,40 €**	**251.400,00 €**	**135.872,41 €**	**244.250,00 €**	**113.250,00 €**	**2.737.266,14 €**
RTD Personnel Effort										
WP1	3	3	3	**15**	3	3	4	4	3	**41**
WP2	0	**17**	6	15	0	0	0	0	0	**38**
WP3	15,5	0	0	0	0	**16**	0	0	0	**31,5**
WP4	9	**11**	10	12,5	0	0	0	0	0	**42,5**
WP5	**22**	0	0	0	16,5	0	0	0	0	**38,5**
WP6	0	0	**22**	0	20	0	0	0	0	**42**
WP7	6	3	**19**	4	6	4	0	0	0	**42**
WP8	3	3	9	3	6	6	13,5	**18**	16	**77,5**
WP9	**18**	1	3	5	3	2	5	6,5	5	**48,5**
RTD Resources (MMs)	**76,5**	**38**	**72**	**54,5**	**54,5**	**31**	**22,5**	**28,5**	**24**	**401,5**
Average FTE (30 months)	**2,55**	**1,27**	**2,40**	**1,82**	**1,82**	**1,03**	**0,75**	**0,95**	**0,80**	**13,38**
RTD Costs										
Personnel Cost (Direct)	413.865,00 €	266.000,00 €	432.000,00 €	299.750,00 €	192.221,50 €	248.000,00 €	117.450,00 €	153.900,00 €	120.000,00 €	**2.243.186,50 €**
Overhead	127.082,20 €	181.200,00 €	273.600,00 €	286.531,03 €	129.732,90 €	53.200,00 €	117.837,59 €	131.100,00 €	67.000,00 €	**1.367.283,71 €**
Travel and Subsistence	24.000,00 €	24.000,00 €	24.000,00 €	24.000,00 €	24.000,00 €	18.000,00 €	14.000,00 €	14.000,00 €	14.000,00 €	**180.000,00 €**
Equipment										**0,00 €**
Other Costs	16.000,00 €	12.000,00 €		2.750,00 €				12.000,00 €		**42.750,00 €**
Total RTD Costs	580.947,20 €	483.200,00 €	729.600,00 €	613.031,03 €	345.954,40 €	319.200,00 €	249.287,59 €	311.000,00 €	201.000,00 €	3.833.220,21 €
RTD Fuding Factor	50%	75%	50%	75%	75%	75%	50%	75%	50%	
Grant Requested (RTD)	**290.473,60 €**	**362.400,00 €**	**364.800,00 €**	**459.773,27 €**	**259.465,80 €**	**239.400,00 €**	**124.643,79 €**	**233.250,00 €**	**100.500,00 €**	**2.434.706,46 €**
Management Costs										
WP10	**18**	2	5	0,5	0,5	0,5	0,5	0,5	0,5	**28**
MGT Resources (MMs)	**18**	**2**	**5**	**0,5**	**0,5**	**0,5**	**0,5**	**0,5**	**0,5**	**28**
Personnel Cost (Direct)	97.380,00 €	14.000,00 €	30.000,00 €	2.750,00 €	1.763,50 €	4.000,00 €	2.610,00 €	2.700,00 €	2.500,00 €	**157.703,50 €**
Overhead	28.800,74 €	12.000,00 €	21.600,00 €	2.628,73 €	4.658,10 €	2.000,00 €	2.618,61 €	2.300,00 €	4.250,00 €	**80.856,18 €**
Travel and Subsistence	6.000,00 €	6.000,00 €	6.000,00 €	6.000,00 €	6.000,00 €	6.000,00 €	6.000,00 €	6.000,00 €	6.000,00 €	**54.000,00 €**
Subcontracting (Audits)	2.500,00 €	2.500,00 €	2.500,00 €	2.500,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	**10.000,00 €**
Total MGT Costs	134.680,74 €	34.500,00 €	60.100,00 €	13.878,73 €	12.421,60 €	12.000,00 €	11.228,61 €	11.000,00 €	12.750,00 €	302.559,68 €
Grant Requested (MGT)	**134.680,74 €**	**34.500,00 €**	**60.100,00 €**	**13.878,73 €**	**12.421,60 €**	**12.000,00 €**	**11.228,61 €**	**11.000,00 €**	**12.750,00 €**	**302.559,68 €**
TOTAL COSTS	715.627,94 €	517.700,00 €	789.700,00 €	626.909,75 €	358.376,00 €	331.200,00 €	260.516,20 €	322.000,00 €	213.750,00 €	4.135.779,89 €
TOTAL EC FUNDING	**425.154,34 €**	**396.900,00 €**	**424.900,00 €**	**473.651,99 €**	**271.887,40 €**	**251.400,00 €**	**135.872,41 €**	**244.250,00 €**	**113.250,00 €**	**2.737.266,14 €**

In this section, we provide an overview of the breakdown of the all cost (per partner) identified and justified. Moreover, we have calculated the **maximum EC contribution**, based on maximum rates of reimbursement of eligible (both direct and indirect) costs specified in the grant agreement for different types of activities within the project (e.g. 75% for RTD activities of universities, research centres and SMEs).

Thus, the **EC requested grant** to the Cloud4SOA project's budget is **2.737.266,00 €**

B3. Impact

B3.1. Strategic Impact

B3.1.1. Expected impacts under Strategic Objective ICT-2009.1.2 and Thematic Priority (a)

"Cloud computing" is the latest example of an emerging new idea coming together with intensive battles, as large companies compete to exploit it. The idea is that computing will increasingly be delivered as a service, over the internet. Much of computing will no longer be done on personal computers in homes and offices, but in the "cloud": huge data centres housing vast storage systems and hundreds of thousands of servers. Web-based e-mail, social networking and online games are all examples of what are increasingly called cloud services, and are accessible through browsers, smart-phones or other "client" devices.

As GARTNER analyst David Cearley stated during the Gartner Symposium in Orlando in October 2009, "*Cloud computing isn't going to be vapor much longer*"[23]. He continued on to say that cloud computing "*is complicated, poses security risks, and computing technology companies are latching onto the buzzword in droves, but the phenomenon should be taken seriously*". Cloud computing and software as a service are very promising. They make life easier and cheaper for consumers, since many cloud services are free, supported by advertising or subsidised by a minority of users who pay for a premium service. There are also benefits for companies. By switching to cloud-based services, firms can reduce complexity and maintenance costs, because everything runs inside a web browser. Providers of cloud services, meanwhile, can benefit from economies of scale. The ability to summon computing capacity from the cloud when needed will also give the software industry a shot in the arm. During the dotcom boom, the first thing a start-up had to do was raise the money to buy a room full of servers. If a website experienced a sudden surge in popularity, more servers were needed to meet demand. Today a capacity can be rented as needed, allowing cloud services to scale up smoothly. This lowers barriers to entry and promotes innovation and competition. It also presents an opportunity for companies that are hoping to create the cloud platforms on which other firms will offer services.

Initiatives such as Cloud4SOA will have a strategic impact towards new innovations in societal, governance and service domains, in order to ensure that the Future Internet fulfils its potential. The European market represents a potentially large opportunity for software as a service (SaaS), as increasing numbers of customers and providers become aware of the advantages of SaaS-based applications.

Software as a Service and the next generation of SaaS end-to-end solutions and platforms is now being popularized through the use of the term Cloud Services. Cloud services present new opportunities that enable significant cost savings, as well as offer the ability to integrate business processes and easily access data across the board for all business applications. The Internet of Services marks a shift towards the cloud-computing model, where infrastructure, software and services are hosted on the Internet rather than on PCs and private servers, and Cloud4SOA aims to support the realization of services on a cloud computing platform.

Cloud4SOA research and development activities are expected to address both the needs of individuals, as well as business needs common in several European SMEs like services for e-collaboration, online transactions, integration of supply or value chains and integration of front-end and back-office applications. The satisfaction of any of the above requirements can affect drastically the productivity and competitiveness of European SMEs

[23] http://news.cnet.com/8301-30685_3-10378782-264.html

and organizations. Enterprises throughout Europe strive to increase their innovation and competitiveness. **CloudControl**, which was **awarded the German SME Innovation Award last year** aspires to earn the award once again through its participation in this project, which will boost the services it can provide to its end users. With no doubt, the same can apply for all SMEs at a pan-European level. The potential offering and use of cloud services will make it possible for SMEs to offer their services on a European wide basis, and also promote electronic collaboration of SMEs clusters as well as B2B and B2C e-business for the integration of value chains, improvement of response times and reduction of cost.

With cloud computing representing a major shift in the way information technology is used it is of very high importance to ensure that the IT industry does not remain dominated by monopolies of single companies. To support competition in the cloud computing market there should be different providers to choose from for any kind of application. Developers developing applications should be able to choose between different platforms and should also be able to switch between platforms of different providers whenever needed. Cloud4SOA aims to assist towards this direction, aspiring to minimize the dependencies needed to execute an application by defining a specification and developing a reference implementation backing it up with good documentation and strong support. Through this European SME might be able to compete with the big US corporations currently dominating the cloud computing market.

The contribution of Cloud4SOA to the expected impacts listed in the work-programme, can be summarized in the following table:

Expected Impact	Cloud4SOA Contribution
A major contribution to the Future Internet in terms of service development, management and interoperability in an environment of converged IT, telecom and media platforms	The project aspires to create a reference architecture for SOA deployment. The vision of the project is to improve semantic interoperability and user-centricity in the cloud, to enable service oriented application design and management and to address the stove-pipe approach of isolated cloud islands encountered nowadays. To showcase its objectives, the project will involve key telecom players, such as PTIN and ROM telecom.
Deep technological advances in software/service engineering. New software technologies for improving scalability and predictability of distributed systems, improving responsiveness and throughput. A more competitive environment including infrastructure operators moved up the value chain with innovative service offerings on scalable infrastructure	The project aspires to advance the service engineering model through which cloud services are currently provided, through the interconnection of clouds, overcoming the barriers posed by isolated clouds. The interconnection of clouds will boost the scalability of distributed systems and services, improving both the quality and the quantity of the provided services to both individuals and enterprises. This will facilitate the development of a more competitive environment from which service providers will be benefited. The interconnection of clouds will facilitate the scalability of infrastructure which may be exploited by infrastructure operators and through which innovative and advanced service offering will be made feasible.
Lowered barriers for service providers, in particular SMEs, to develop services through standardised open (source) platforms and interfaces	The semantic interoperability between Cloud infrastructures will not only lower, but will actually crush several existing barriers for service providers, and in particular SMEs, since they will be able to utilise different clouds for the deployment of their services. The project will allow service providers, including SMEs to enter the cloud market offering specialized services of high quality that could be combined with other cloud services provided by third parties. Cloud4SOA will provide a foundation for a more rapid uptake of SaaS technologies by SMEs.

Massive uptake of high-added value services through innovative service front ends and a higher user empowerment and more advanced and dynamic online communities through platforms enabling "third party generated services".	Cloud4SOA will work towards a new business model, which will allow service providers, including SMEs to flourish in the cloud market as the users will be free to buy and combine services from multiple cloud providers, thus promoting competition. In addition, the project will allow users to design and deploy their services in the cloud through adaptable service front-ends (widgets) following a service oriented paradigm.
A strengthened industry in Europe for software, software services and Web services, offering a greater number of more reliable and affordable services, enabled by flexible and resilient platforms for software/service engineering, design, development, management and interoperability. Technologies tailored to meet key societal and economical needs	The project aspires to allow the user to have a direct interaction with her/his "clouded" applications and services. This includes the freedom to deploy new services or combine/edit existing services in a cloud. The project will facilitate the utilization of different clouds for the deployment of their services as well as the provision of specialized qualitative services combined with other cloud services provided by third parties. The technologies supported by the project are not only the future of the internet, but will facilitate the overcoming of several societal and economic barriers that hinder the provision of services to both individuals and enterprises.

In addition, the Cloud4SOA project addresses in particular one of the essential ICT strategic objectives, which is to *develop and validate innovative and efficient **ICT-based systems and services** in key application areas for the societal and economical development of the enlarged Europe, with a view to strengthening the integration of the IST European Research Area*". Cloud4SOA aims at developing a framework for the enabling of easy provision of service-oriented businesses applications. In this sense, the project focuses in supporting the distributed services sector. By facilitating the manageability of customizable cloud services applications and thus promoting the sustainability of future cloud services offerings by European SMEs and/or individuals, the project has a direct contribution to a wide range of European policies, directives and goals for the future of the software and services sector in Europe, and more specifically, to some key goals as set out in the Bled Declaration for a European approach to the Future of the Internet, namely:

- Designing and building the technologies and networking architecture for the Future Internet
- Creating the conditions for the development of innovation-friendly service oriented architectures
- Ensuring the robustness of the networks and create trust in the on-line world

B3.1.2. European Added-Value and Transnational Approach

The necessity of deploying a pan-European "alliance" for the provision of cloud services can be clearly extracted from the analysis of the strategic impact of the project and its contribution to the program objectives. Coordinated efforts from partners at a pan-European level are needed so as to ensure that the Future Internet fulfils its potential. The empowerment of individuals and enterprises at a national level may only present local new opportunities, while business processes and applications will still remain dispersed and isolated. The business needs for services for e-collaboration, online transactions, integration of supply or value chains and integration of front-end and back-office applications are common in the majority of the European SMEs, and as such they must be treated.

The potential offering and use of cloud services will enable SMEs to offer their services on a European wide basis, and also promote electronic collaboration of SMEs clusters as well as B2B and B2C e-business for the integration of value chains, improvement of response times and reduction of cost. Cloud services, as implied by their term, should not be restrained by physical boundaries, so that they may have an impact on the economic

and social environment of the enlarged Europe. The Cloud4SOA architecture will promote a broad offering of potentially transnational services as well as support the integration of heterogeneous information systems by enabling the implementation of services for a transnational offering in Europe.

In addition, the service development, management and interoperability in the converged IT, telecom and media platforms environment necessitates coordinated efforts from several European countries and not dispersed efforts by two or three major players at a national level. The European union dictates the elimination of barriers for service providers, in particular SMEs, to develop and provide enhanced services so as to increase their competitiveness at a pan-European level. The ultimate scope of a strengthened industry in Europe for the offering of a greater number of more reliable and affordable services, enabled by flexible and resilient platforms for software/service engineering, can only be achieved through the deployment of strategic cooperations between partners from several European countries, taking into consideration all potential aspects and barriers that could hinder this vision. Cloud4SOA aims at contributing to a variety of issues at a European level. Interoperability and e-collaboration services are currently very much clustered and isolated within Europe. A number of technological, organizational and cultural problems such as lack of integration, different business models, legal and technological constraints as well as different platforms limit the extension of such services. Cloud4SOA aims at developing a framework and innovative technologies for facilitating the offering of service-oriented applications both for businesses and for the individuals, taking into consideration all those aspects, such as intercultural and regulatory ones, of the enlarged Europe countries.

Cloud services may be the future of the computer industry. However, what seems sure about the future of the digital skies is that the company or companies that dominate it will be American. European or Asian firms have yet to make much of an appearance in cloud computing. Nokia, the world's biggest handset-maker, is trying to form a cloud with its set of online services called Ovi, but its efforts are still in their infancy. This is yet another reason why Cloud4SOA has such strategic importance for the enlarged Europe. It will assist in facilitating the establishment of Europe's presence in this cloudy scenery.

In order to maximize the European added value and impact of Cloud4SOA, the project's consortium will actively collaborate and develop synergies with other EU research activities in the areas of cloud computing, like STREAM, RESERVOIR, SHAPE, SLA@SOI, SOA4ALL, SERVFACE, S-CUBE FP7 projects and the NEXOF-RA reference service architecture. An indicative list of related national or international research activities that some of the Cloud4SOA partners are involved is provided in ANNEX VI.

B3.2. Exploitation and Dissemination of Project Results and IPR Management

B3.2.1. Dissemination Plans

Dissemination activities are very important for the project and aim to create and increase awareness about the Cloud4SOA solution and its benefits, to attract new potential users and customers, to increase the business opportunities as well as to receive feedback for the service value and acceptance and to pave the way for new business alliances. Thus, a solid dissemination strategy for the project is deemed a necessity, in order to make available to the public the project achievements and the lessons learnt. A dissemination strategy constitutes of dissemination policies; the planning of dissemination policies, which is a horizontal procedure along the overall project lifecycle, will start actively. Dissemination policies will be based on three major dissemination channels and their corresponding dissemination activities. Each dissemination policy will be designed as blend of

dissemination activities from one or more channels, with respect to the respective target group(s) that aims to address. The three channels and their component activities are:

1. **Online Dissemination**; A project public website will provide a first access point for interested business parties, organizations and individuals into the Cloud4SOA project. Key results will be published on that website, but also added-value services will be offered such as newsletters, mailing lists or synchronous and asynchronous communication with project participants. The long-term objective of the website is to create a community of interested parties (e.g. stakeholders and clients) around the project, to accelerate their involvement and to create awareness of the research results.
2. **Non-Electronic Dissemination**; Classical means of knowledge transfer such as articles in topic-specific journals, brochures (company newsletters), publications in broadcast media, business papers and monographs focus on the dissemination of project results, mainly to experts and professionals. Since non-electronic dissemination is expected to increase level of information need and involvement and invite interactive participation of interested parties, careful design of non-electronic intensive dissemination policies, that will guarantee high degree of knowledge promotion within targeted group(s), is needed.
3. **Interactive Dissemination**; the specific channel will offer a chance for personal interaction in academic, commercial and socio-economic conferences, EU organised events and conferences and trade fairs and exhibitions. The interactive channel of dissemination is intended for target groups with a high level of information need and involvement and it therefore provides information tailored to highly targeted audiences. The interactive channel will be the most efficient means for community building and has the highest impact on dissemination.

A multi-step and multi-channel dissemination strategy will be followed in order to reach different target groups, with information adjusted carefully to audience level of need / involvement. The industrial partners of the Cloud4SOA project will approach relevant industry-sectors, as well as their distributors and client networks. The academic partners will focus on disseminating the project results towards research institutes and universities across the enlarged Europe. All participating members will reach out to attract and raise awareness to other potential end-users and actors.

The dissemination of the Cloud4SOA project will be carried out in three main phases (**Figure 18**):

1. **Phase I** will cover the first 24 months of the project duration. The main purpose of this phase will be the creation of general awareness about project objectives and expected results. The project will be presented in conferences and workshops. Publications, elaboration of brochures, preparation and hosting of a project site as well as other promotion material will be deployed in order to create awareness among industrial, scientific and academic communities, as well as potential users of the Cloud4SOA results both at the national and EU level.
2. **Phase II** will be executed during the rest of the project, namely from M25, when the Cloud4SOA results will have been developed, until M36. The dissemination activities during this phase will aim at attracting potential customers of the Cloud4SOA results. The main output to be disseminated will consist of the project's concrete results, and the demonstrators that will be developed and will be made available for pilot demonstrations. The project's results will be disseminated via more focused dissemination activities, including presentations, workshops, publications and participation in relevant conferences and exhibitions. This will also assist in the project exploitation activities, since it will aim at the attraction of new customers. For this reason, several organizations and actors will be approached and contacted.

3. **Phase III** will be executed after the end (M36+) of the project and will aim at attracting potential customers of the Cloud4SOA results.

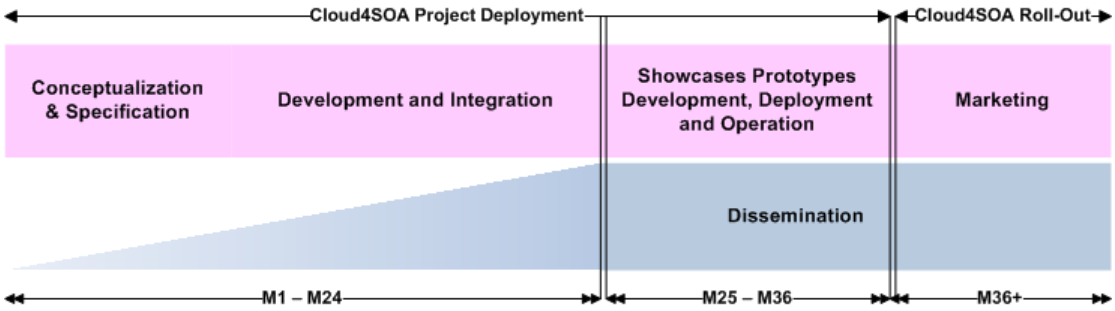


Figure 18 Cloud4SOA Dissemination Phases

An indicative and non-exhaustive list of the dissemination channels is summarized in ANNEX V.

The individual dissemination plans for all partners are listed in ANNEX III "Individual Dissemination Plans".

B3.2.2. Exploitation Plans

Aiming to facilitate the management of the project exploitation activities and taking into consideration the above mentioned issues, a generic exploitation model has already been prepared by the consortium partners.

The exploitation strategy that constitutes the basis of the Cloud4SOA Exploitation Approach will be based on 3-dimension decisions:

1. Definition of the exploitation assets (what is to be exploited?).
2. Decision on the exploitation model for each asset (how are we going to exploit it?).
3. Decision on the exploitation axe (where and in which promotion channels should we implement the exploitation policy of the specific asset?).

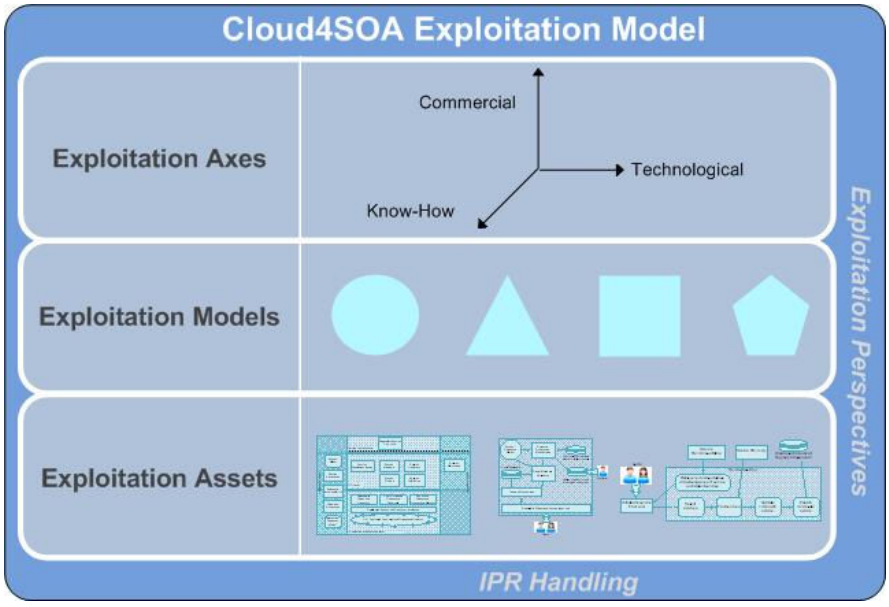


Figure 19 Cloud4SOA Exploitation Strategy

The Exploitation Model (**Figure 19**) consists of the following parts:

1. **Exploitation Axis**: are the different exploitation directions that the project results can follow. At this moment, the 3 high-level potential directions foreseen are the :
    a. Commercial Exploitation,
    b. Technological Exploitation
    c. Know-how exploitation.
2. **Exploitation Models**: Each Axis, depending on its characteristics might be implemented via different exploitation models. For example potential candidate models for the different exploitation axes can be:
    a. the application of results by one or more partners on their customers
    b. the set-up of a spin-off company
    c. the establishment of a licensing agreement with an external investor, etc
3. **Exploitable Assets**: In this early stage we have made an attempt to decompose the solution under development in several Exploitable Assets. Depending on each asset's nature, several exploitation models can be applied on each asset. Initially, the following Cloud4SOA exploitable assets have been identified:
    a. The Cloud4SOA Cloud Semantic Interoperability Framework
    b. The open, generic Cloud4SOA Reference Architecture
    c. The Cloud4SOA lightweight models for resources and service
    d. The Cloud4SOA platform
    e. Three Cloud4SOA showcases

Additionally, there are two points that the Cloud4SOA exploitation model needs to consider:

- **IPR Handling**: what are that IPR of each partner per each Asset; this will help to define the rights of the respective partners in any exploitation case.
- **Exploitation Perspectives**: in the beginning of the project these perspectives consist of each partner's expressed exploitation intentions with regard to the exploitation models & Assets, while towards the end of the project these perspectives are consolidated into more concrete decisions and specific exploitation roadmaps.

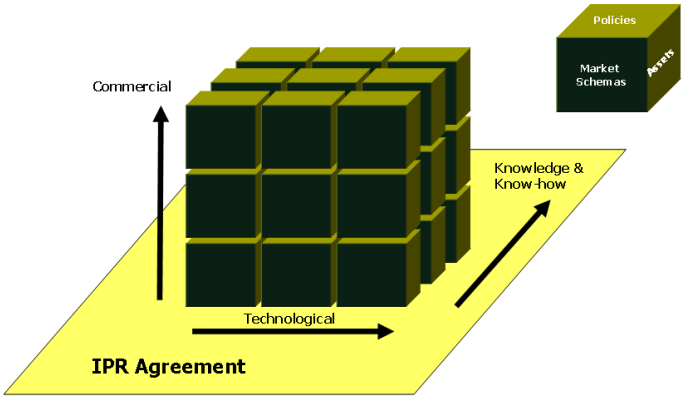


Figure 20 Cloud4SOA Exploitation Decision Cubes

The above answers create a set of "decision cubes" (**Figure 20**), which will be aggregated into a holistic exploitation strategy for each partner. The use and monitoring of the IPR issues derived from the shared and individual contribution of the partners into the creation of the exploitation assets will ensure that there is a clear understanding and agreement of the ownership of the assets, thus avoiding any potential conflict in the consortium.

The nature of the exploitable assets by themselves, as well as the nature of the Cloud4SOA partners, are not by themselves sufficient for the formulation of a holistic exploitation strategy. One must also take into consideration the Intellectual Property Rights and comply with these guidelines. No official document regarding the management of intellectual property will be produced and provided with the proposal. Under the light of the aforementioned, the Cloud4SOA industrial partners are primarily focused on the Commercial and the Technological exploitation axis, while the academic partners are primarily focused on the Knowledge and Know-How exploitation axis, building upon the knowledge acquired for the progression of the state of the art (**Figure 21**).

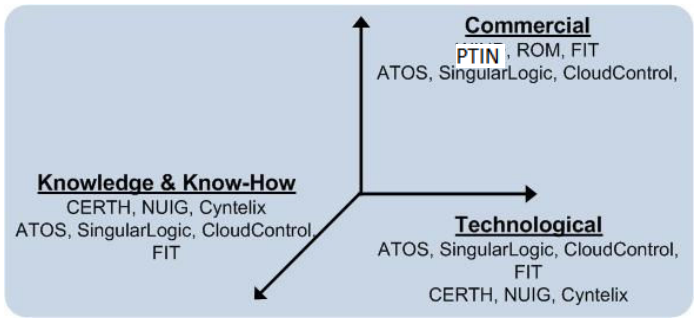


Figure 21 Cloud4SOA Consortium Partners Exploitation Perspective

Besides its focus on tangible results such as the Cloud4SOA demonstrators or tools as basis for commercialization, the consortium also looks at the full spectrum of exploitation opportunities and involves a wide a range of partners in the exploitation efforts. Examples embrace:

- the protection of results through IPR agreements,
- the transfer of Cloud4SOA results and know-how into further EU RTD projects,
- the identification of further research questions to be resolved,
- the commercialization of Cloud4SOA results through spin-outs respectively the creation of start-ups.

The individual exploitation plans for all partners are listed in Annex II "Individual Exploitation Plans".

B3.2.3. Market Analysis

The general idea that shared computing services can be accessible over the Internet and can expand or contract on demand, topped **Gartner's list of the 10 top technologies** that information technology personnel need to plan for. In order to understand the impact of cloud computing in the market, we should simply use as reference America's computing colossal. If you store more and more things online, and access more and more software through an ordinary web browser, it suddenly matters much less what sort of computer you have, and what kind of software it is running. This means Microsoft, which only just launched the newest version of its Windows operating system, could lose out, unless the software giant can encourage software developers

and users to migrate to its new suite of cloud-based services. Microsoft recently opened two data-centers that between them will contain more than half a million servers. It also released a new version of Windows for smart-phones and will also launch Azure, a platform for developers on which they can write and run cloud services. Its main rival is Google, which offers its own range of such services, and continues to launch new ones and interlink them more closely. Yahoo!, which is allied with Microsoft, and Apple also offer cloud services for consumers; specialists such as Salesforce and NetSuite do the same for companies. Amazon has pioneered the renting out of cloud-based computing capacity. Some firms will offer large, integrated suites of cloud-based services; others will specialise in particular areas, or provide the technical underpinnings necessary to build and run clouds. But battle has been joined.

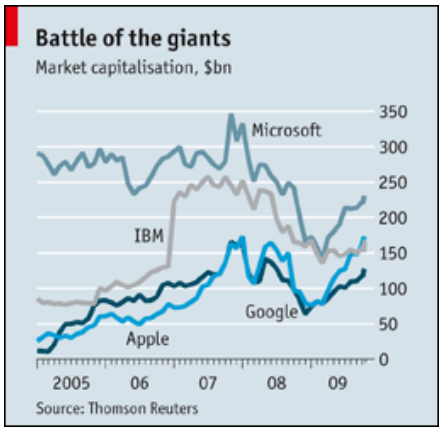


Chart A[24]

How big's your cloud?

	Apple	Google	Microsoft
Revenue*, $bn	34.6	22.3	58.4
Profit*, $bn	5.2	4.6	14.6
Market capitalisation latest, $bn	170.2	127.3	230.4
Employees*	32,000†	19,786	93,000
Share of key market, world, %	69† *(digital music)*	83 *(search)*	93 *(operating systems)*

Sources: Company reports; Net Applications; NPD Group
*Year ending June 30th 2009 †September 2008 ‡US only

Table A

The rise of cloud computing is not just shifting Microsoft's centre of gravity. It is changing the nature of competition within the computer industry. Although Windows still runs 90% of PCs, the fading importance of the PC means that Microsoft is no longer an all-powerful monopolist. Others are also building big clouds, including Google, a giant of the internet, and Apple, renowned as a maker of hardware, with a market capitalisation that now exceeds those of both Google and IBM, its original arch-rival (see chart A).

In the context of this emerging cloud services model and cloud computing market for delivering business and consumer services of all kinds, IDC[25] identifies two principal opportunities for IT suppliers from the growth of cloud services: a) being an **"IT Cloud Services Provider"** giving the IT supplier the opportunity to **deliver its own IT products or services to customers via the cloud model**; and b) being a **"Supplier to Business and Consumer Cloud Services Providers"** giving the IT supplier the opportunity to **support its customers' development, deployment and delivery of a wide variety of business and consumer cloud services**.

An IDC Cloud Services Forecast[26] (developed by a team of 30 IDC analysts) sizes IT suppliers' opportunity to deliver their own IT offerings to customers via the cloud services model, stating that, by **2012**, spending on IT cloud services will grow almost threefold, to $42 billion, accounting for 9% of total customer spending worldwide:

[24] http://www.economist.com/opinion/displaystory.cfm?story_id=14637206

[25] http://blogs.idc.com/ie/?p=195

[26] http://blogs.idc.com/ie/?p=224

Worldwide IT Cloud Services Spending: 2008-2012
(for Business Applications, Application Development/Deployment, System Infrastructure Software, Storage and Servers)

	2008	2012	CAGR
All Spending ($M)	383,274	493,713	7%
Cloud Services Spending ($M)	16,235	42,270	27%
Cloud as % of Total	**4%**	**9%**	

Source: IDC, October 2008

What is really attractive for IT suppliers regarding these forecasts is the growth trajectory of the Cloud model, which (at 27% CAGR) is over five times the growth rate of the traditional, on-premise IT delivery/consumption model. This rapid growth is being driven by the ease and speed with which users can adopt these offerings, as well as the cloud model's economic benefits (for users and suppliers alike) – which will have even greater resonance in the current economic crisis.

Additionally, in a research note[27] entitled "The Cloud Wars: $100+ billion at stake", Merrill Lynch analysts wrote that by 2011 the volume of cloud computing market opportunity would amount to $160bn, including $95bn in business and productivity apps (email, office, CRM, etc.) and $65bn in online advertising. Moreover, Gartner[28] forecasts that worldwide Cloud services revenue is on pace to surpass $56.3 billion in 2009, a 21.3 percent increase from 2008 revenue of $46.4 billion. The market is expected to reach $150.1 billion in 2013.

All these implications for IT suppliers are clear: during the next several years, IT suppliers must position themselves as leaders in IT cloud services or forfeit an ever-expanding portion of the industry's growth.

B3.2.4. Contribution to Standards and to Policy Development

Cloud4SOA is bound to build upon and actively contribute to existing standards. Therefore, the Cloud4SOA Special Interest Groups will be set up in order to raise the awareness, the use and the adoption of the Cloud4SOA Reference Architecture and models in the Cloud research and business communities within Europe and beyond. In this context, the **Cloud Semantic Interoperability Special Interest Groups** will also **come in contact with the CCIF in the United States** in order to share experiences and discuss the problems that hinder the growth and the uptake of Cloud efforts.

The Cloud4SOA consortium also plans to promote the Cloud4SOA Reference Architecture and service and resource models and **propose them as a basis for developing common specifications in standardization bodies** - such as **W3C, OGF and OASIS** - **of which NUIG, FIT and ATOS participate actively in many technical meetings and committees**. NUIG, in particular, has significant experience in standardization activities, as it is leading and participating in many working groups[29] like the SIOC[30] initiative, which recently became a W3C submission. ATOS is also involved in such working groups as the SLA-related GRAAP of OGF.

[27] The Cloud Wars: $100 Billion at Stake, Published by Merrill Lynch, May 7, 2008

[28] Forecast: Sizing the Cloud; Understanding the Opportunities in Cloud Services http://www.gartner.com/DisplayDocument?ref=g_search&id=914826&subref=simplesearch.

[29] http://www.deri.ie/research/working-groups/

B3.2.5. Management of Intellectual Property and Other Innovation-related Activities

For every partner of the consortium, it is very important to have explicit rules on how to access Pre-Existing Know-How and foreground knowledge and how to ensure the protection of intellectual property. Therefore, the project partners will draft a Consortium Agreement including IPR Issues to support common and individual dissemination and (if applicable) exploitation strategies. An agreement will be developed taking into account the following preliminary agreements:

- Concerning exploitation of the project results, it is the understanding of the Consortium that *knowledge and pre-existing know-how* will be made *available to the Consortium members in favorable conditions* if they are *necessary to perform the research and relative work in this project*. The placement of Pre-Existing Know-How into the project will be detailed in the Appendix of the Consortium Agreement. Herein, every single partner is entitled to describe their own Pre-Existing Know-How.
- *Foreground knowledge is owned by the contractor generating such information or result*. Each contractor shall make *available* its foreground knowledge, on a royalty-free basis, to other contractors to the extent that such information is *necessary for the production of their own foreground knowledge within* the project. If it is not possible to determine exactly the ownership of that foreground knowledge, e.g. several contractors participated in that specific development ownership will be shared by the pro ratio effort invested by each contractor.
- *Pre-existing know-how and foreground knowledge* will be made *available*, on a royalty-free basis, *to the other project partners for dissemination, research and academic purposes* in respect to the intellectual property rights of the partner generating this knowledge.
- *Pre-existing know-how and foreground knowledge* will be made *available to the other project partners for exploitation purposes at favorable conditions*, with respect to the normal commercial conditions applied by the granting partner.

The Project Coordination Team will develop the agreement on IPR issues to be included in the Consortium Agreement. It will regulate obligations and rights of the participants, and will be prepared and signed by the partners. The Consortium Agreement will make explicit reference to important administrative points including decision procedures within the project, risk management strategies, legal aspects regarding software to be used/produced in the project and more. The Consortium Agreement specifies administrative processes, defines access rights to Pre-Existing Know-How, knowledge, dissemination rules, and IPR. Legal documents such as the Consortium Agreement as well as use and exploitation plans are envisaged to minimize the conflict potential within the consortium and thus will be adapted to the typical requirements of the consortium members of the project.

A preliminary exercise has been done to identify potential artifacts applicable to IPR and will be examined and developed further as the project progresses. By default, these results are considered under joint ownership by the consortium, although further analysis and classification would be applied to the Consortium Agreement and even further in potential exploitation agreements, if applicable.

Cloud4SOA Cloud Semantic Interoperability Framework and Cloud4SOA Reference Architecture

- **Semantic Layer**
  - Service Model
  - Resource Model
  - Semantic Annotation Mechanism
  - Semantic Interoperability Engine

[30] http://sioc-project.org

- **SOA Layer Components**
  - Service Discovery Component
  - Service Mashing Component
  - Service Recommendation Component
- **Intelligent Interfaces Layer**
  - Integrated development environment
  - User interaction model
  - Cloud widgets
- **Governance Layer**
  - SLA management Component
  - Rule-Based Engine
  - Policies Definitions and Enforcement
  - Repository & registry
- **Virtualization and Execution Layer**
  - Interoperable Clouds overlay network infrastructure
  - Cloud Infrastructure Maintenance and Execution environment algorithms
  - Cross-Cloud Deployment Scripting Language

The topic of licenses will be analyzed during the project lifespan under its exploitation and management activities, WP9 and T9.1. Before this further analysis, preliminary examples include the following:

Resource Models, algorithms and specifications could apply to Creative Commons Licensing to help facilitate the adoption of specifications by the Cloud community. Some software prototypes and tools could be under the Apache license or EU open-source license, but will be analyzed further beyond the Consortium Agreement.

An open-source license and such practices will be under analysis because of its clear benefits to the idea behind Cloud4SOA: uptake of such a platform requires a level of accessibility by the community, and the project must take this important aspect into account. Even in its development, this potential would give valuable feedback to the consortium, such as through the already planned Cloud4SOA Special Interest Group.

The Cloud4SOA platform will be proportionally divided amongst all partners under such joint-ownership, with emphasis to give all partners the necessary user rights to exploit the potential of the platform towards their axis.

B4. Ethical Issues

The Cloud4SOA partners will **abide by professional ethical practices** and **comply with the Charter of Fundamental Rights of the European Union**[31]. Each Cloud4SOA partner has created an environment that promotes responsible conduct and fosters integrity by individual researchers.

The European Commission directives on ethical rules for the 7th Framework Programme are primarily concerned with issues outside the scope of this project. In fact the project will be treating information on companies and organizations while there are no plans to treat personal data (whether identified by name or not). However, should this happen, all the information related to individuals (including pictures and digital signature, if any) will be managed after explicit consensus and in compliance with the European and national legislation of the countries of interest.

Therefore, **no ethical issues** are concerned with the present Cloud4SOA project, as it is testified by the table below.

	YES	PAGE
Informed Consent		
- Does the proposal involve children?	NO	
- Does the proposal involve patients or persons not able to give consent?		
- Does the proposal involve adult healthy volunteers?		
- Does the proposal involve Human Genetic Material?		
- Does the proposal involve Human biological samples?		
- Does the proposal involve Human data collection?		
Research on Human embryo/foetus		
- Does the proposal involve Human Embryos?	NO	
- Does the proposal involve Human Foetal Tissue / Cells?		
- Does the proposal involve Human Embryonic Stem Cells?		
Privacy		
- Does the proposal involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)	NO	
- Does the proposal involve tracking the location or observation of people?		
Research on Animals		
- Does the proposal involve research on animals?	NO	
- Are those animals transgenic small laboratory animals?		
- Are those animals transgenic farm animals?		
- Are those animals cloning farm animals?		
- Are those animals non-human primates?		

[31] CHARTER OF FUNDAMENTAL RIGHTS OF THE EUROPEAN UNION (2000/C 364/01). Signed in Nice, 7th December 2000, Available at http://www.europarl.europa.eu/charter/pdf/text_en.pdf

	YES	PAGE
Research Involving Developing Countries		
- Use of local resources (genetic, animal, plant etc)	NO	
- Impact on local community (capacity building i.e. access to healthcare, education etc)		
Dual Use		
- Research having directly military application	NO	
- Research having the potential of terrorist abuse		
ICT Implants		
- Does the proposal involve clinical trials of ICT implants?	NO	
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	YES	

Actual Conformance

The project consortium confirms that it will assure that if the items mentioned hereunder are applicable to the project they will be conformed to.

- **Directive 95/46/EC (Protection of personal data)**
- **Opinion 23/05/2000** of the **European Group on Ethics in Science and New Technologies** concerning 'Citizens Rights and New Technologies: A European Challenge' and specifically those relating to:
  - ICT (Protection of privacy and protection against personal intrusion)
  - Ethics of responsibility (Right to information security)
  - Article 15 (Freedom of expression and research and data protection)

The project will ensure that the consortium agreement (or addendums thereof) is constructed to enable such assurances to be formally made and adhered to by consortium partners.

In addition, with respect to Directive 95/46/EC (Protection of personal of data), individual work packages will be specifically requested to ensure that any models, specifications, procedures or products also enable the project end users to be compliant with this directive.

Projected Conformance

The consortium confirms that it will assure the items mentioned hereunder are conformed to. However, as it stands, it is believed that none of the below are applicable to the activities that are intended to be conducted within the project:

- Current national legislation and regulations applicable to the research activity
- Charter of fundamental rights of the EU

Where applicable, and if any aspects of the above are deemed necessary, the project will ensure that the consortium agreement (or addendums thereof) are constructed to enable such assurances to be formally made and adhered to by consortium partners.

B5. Consideration of Gender Issues

The Cloud4SOA project is in line with the **European policy[32] of equal opportunities for women and men** and takes a pro-active approach in promoting gender equality, while taking into account the specificities, interests, and life patterns of each gender. The issue of gender equality is therefore addressed at the Project Coordination Committee (PCC) level, where specific actions addressing the principles to be respected and actions to be taken are properly accounted for.

The following table summarizes the situation regarding women and men participation at the moment of Cloud4SOA proposal preparation.

Partner	% women to be involved	% men to be involved	Plan to bring more women	Links with women scientists or students organization
ATOS	40	60	Additional women will be mobilized from the enterprise resource pool if necessary. ATOS policy is not only to not discriminate, but to actively support the participation of women in all business sectors.	Tight relationships with several universities and research institutes.
NUIG	40	60	N/A	N/A
SingularLogic	30	70	Employ additional women if possible	Tight relationships to the "Greek Women's Engineering Association"
CERTH	25	75	N/A	N/A
CloudControl	0	100	We are envisaging hiring an additional system administrator and a developer beginning of the next year. Those are possibly females	Currently none but planned to be created in the future
CYNTELIX	50	50	Additional resources will be recruited, but it will be the best resource regardless of their gender.	N/A
PTIN	40	60	N/A	Tight relationships with several universities and research institutes.
FIT	40	60	Encouragement and guidance of students who will be employed after graduation	N/A
RomTelecom	0	100	N/A	N/A

According to the available elements at this stage, the initial participation of women accounts for ~35% and most partners declare their commitment / plans to increase this percentage in case adequate candidates can be found. Although still rather unbalanced, these figures represent a good improvement over the overall numbers of the past periods, e.g. in FP5, less than 20% women involved in research projects and 11% in coordination positions.

At the Cloud4SOA Project Coordination Committee level a number of specific actions / principles are defined to promote equality:

- Specific recommendations are given to all partners encouraging the increase in the involvement of women in the project activities.
- Gender specificities will be discussed at the board level and appropriate directives will be implemented in the project handbook.

[32] Gender Equality, European Commission webpage, http://ec.europa.eu/employment_social/gender_equality/index_en.html

- Through the nine (9) partners, a special “channel” to motivate women students to get engaged in this research area will be established.

Annexes

Annex I. Key Performance Indicators

The technical achievement and other project benefits, including tentative indicators, are summarised in the following table. Please note the indicators will be revised and updated in the course of the project in order to reflect the detailed user needs and related technical objectives of the project.

Objective	Indicator	Technique that could be used to measure the performance indicator	Milestone	Target value
SCIENTIFIC AND TECHNICAL OBJECTIVES				
Objective I: To identify and analyze the interoperability and portability problems within the Cloud by carrying out a comprehensive analysis which includes studying the State of the Art and reviewing the stakeholders' opinions	1. The analysis results in an all-inclusive list of interoperability problems.	1.1 Select random interoperability problems that appear in the three pilots and check whether these are included in the list.	M1	95% of the interoperability problems have been identified and documented.
	2. The list reflects the most interoperability important problems that the Cloud vendors (especially the smaller ones) face.	2.1 cloudControl will go through the list and check its completeness.	M1	99% of the most important interoperability problems that the Cloud vendors face have been identified and documented.
Objective II: To resolve the most important Cloud interoperability and portability problems through the Cloud4SOA Reference Architecture, which introduces a open generic architecture for an interoperable Cloud.	1. A generic Cloud Interoperability Framework will be defined.	1.1 Apply the Cloud Interoperability Framework in the project's pilots and evaluate the results.	M2	95% of the interoperability problems have been addressed.
		1.2 Share and discuss the Cloud Interoperability Framework with related research projects and try to gain consensus.	M2	The community adopts the Cloud4SOA Cloud Interoperability Framework.
	2. Data will be transparently exchanged between different Cloud platforms	2.1 Verify that no technical, semantic or other interoperability issues arise when data are being exchanged between different Cloud platforms.	M2	95% of the interoperability conflicts have been addressed.
	3. Applications can be moved from one Cloud provider to the other – no vendor-lock.	3.1 Verify that customers' applications can be easily moved from one Cloud provider to another with minor burden on the customers' site.	M2	A customer can move his/her application from one Cloud provider to another with minimum cost and work effort.

	4. The Cloud4SOA Reference Architecture is valid.	4.1 Select a software architecture validation methodology.	M3	The Reference Architecture complies with the requirements set by the methodology.
	5. The Cloud4SOA Reference Architecture is generic and extendable.	5.1 Check architectures produced by related projects in order to evaluate whether the Cloud4SOA Reference Architecture covers their aspects, e.g. their architectural components map to the Cloud4SOA ones.	M3	90% of the aspects of related architectures are covered by the Cloud4SOA Reference Architecture
	6. The components of the architecture fulfil the requirements and implement the desired functionalities	6.1 Define component tests with specific inputs and expected outputs.	M3	Each component test's output complies with the expected output.
	7. The Cloud4SOA service and computing resource vocabularies are simple, well-defined, reusable and extendable.	7.1 Evaluate the vocabularies in terms of coverage, reusability, structure and extensibility.	M4	The vocabularies contain a limited set of core terms and the relations between the terms are valid. The vocabularies are well-documented.
	8. The Cloud4SOA components are modular and reusable.	8.1 Verify that the Cloud4SOA components have well-defined interfaces and are documented accordingly.	M4	All the components have well-defined interfaces and are well-documented.
Objective III: Implement, deploy and evaluate the usability, applicability and adaptability of the Cloud4SOA Reference Architecture by developing a proof-of-concept platform (including a set of models and tools) which will be	1. Each of the two Cloud4SOA pilots addresses the requirements of its respective application domain.	1.1 Evaluation of the Cloud4SOA pilots by the end-users.	M7	Evaluation results are Good (or equivalent) or above.

applied in different scenarios and setups across the enlarged Europe.				
Objective IV: Establish a Special Interest Group on Cloud Interoperability which will allows us to generally act as a reference point and community building process for the Cloud interoperability discussion in Europe and beyond and to promote amongst others the awareness, the use and the adoption of the Cloud4SOA Reference Architecture and models in the Cloud research and business these communities.	1. A technical committee or common specification proposal to a standardization boy is established.	1.1 Share and discuss the Cloud4SOA Reference Architecture and models with related research projects and businesses and try to gain consensus.		The community adopts the Cloud4SOA Reference Architecture and models.
	2. The Cloud Interoperability Special Interest Group collaborates with research initiatives outside Europe, e.g. CCIF.	2.1 Contact non-European communities and establish bilateral collaborations, organize discussions and meetings.		Non-European communities are made aware of the Cloud4SOA Reference Architecture and models.
PROJECT MANAGEMENT OBJECTIVES				
Consortium Management and Quality Assurance	1. On-time submission of deliverables	1.1 Percentage of deliverables submitted on-time	-	> 95 %
	2. Quality of the deliverables	2.1 Result of internal reviews	-	Good (or equivalent) or above
		2.2 Percentage of rework requests for deliverables by the Commission caused by inappropriate quality	-	< 20 %
	3. Successful passing of Commission reviews	3.1 Result of Commission reviews/assessment	-	Good (or equivalent) or above

Annex II. Description and Mobilization of Resources

Partner	ATOS
Resources to be Mobilized	ATOS will be actively involved in almost all Cloud4SOA work packages, and will also undertake the overall administrative consortium management. For this reason it is foreseen that six persons with expertise in the corresponding fields (one senior project manager, one market analyst and four senior researchers / engineers) need to be involved throughout the whole duration of the project.
Additional Resources Mobilization Plan	In the un-probable case that the aforementioned persons are insufficient for meeting the project needs in time and with quality, then ATOS will involve additional resources from its significant resource pool, with the employees' profiles matching the project needs.

Partner	NUIG
Resources to be Mobilized	The Digital Enterprise Research Institute at NUIG is a research organization staffed with over 120 researchers working in the area of semantic technologies and social computing. NUIG plans to engage two cluster leaders, a postdoc researcher and three PhD students during the project. The overall coordination of NUIG's contribution will be under Prof. Stefan Decker, who is the Director of the institute
Additional Resources Mobilization Plan	NUIG will be actively involved in WP1 Cloud4SOA Framework and WP3 Cloud4SOA Semantic Service Layer. NUIG can tap for expertise in its pool of top-class researchers and can easily adapt to possible demand for extra resources or expertise. Moreover, resources significant for the coordination of the teams will be contributed as NUIG's own contribution to the project.

Partner	SingularLogic
Resources to be Mobilized	SingularLogic will utilize a large amount of manpower resources for – among others - the involvement in the research and development activities of the Cloud4SOA Interoperability Framework, Reference Architecture and Platform, as well as for the integration and testing activities and the development of the WNID- and RomTelecom- specific showcases. In addition, SingularLogic will allocate significant resources on the market analysis, the dissemination and exploitation activities, as well as on the business planning activities. The work allocated to SingularLogic will be carried out by the R&D unit, which deals exclusively with the implementation and management of EU-funded projects. All the personnel of the unit has a strong experience in running ICT projects as well as a deep knowledge of all administrative and related issues related to the management of an ICT project. SingularLogic will utilize three software engineers (full-time involvement) and the R&D Director (part-time involvement) for the whole duration of the project.
Additional Resources Mobilization Plan	The effort required in the specific time-period of the project may exceed the resources allocated initially. In this case, SingularLogic will be able to mobilize the additional resources required from the 80 software engineers of the R&D department specializing in software development technologies and system integration techniques.

Partner	CERTH

Resources to be Mobilized	CERTH/ITI will utilize four persons for the whole duration of the project; a Coordinator, a Senior Researcher, and two Researchers. All utilized personnel have strong experience in the implementation and management of EU-funded projects and a deep understanding of ICT.
Additional Resources Mobilization Plan	Most of CERTH/ITI resources will be utilized during WP1, WP3 and WP4. The resources commitment percentage is not clear yet. However, CERTH will make sure that there are enough human resources at hand at any time of the project in order for all CERTH responsibilities to be timely and qualitatively fulfilled.

Partner	**CloudControl**
Resources to be Mobilized	Apart from the cloudControl participant manager, two software engineers and one system administration are going to be actively involved in the project, providing their specific field of expertise.
Additional Resources Mobilization Plan	We are currently scheduling to hire additional technical staff beginning of next year – at least three software engineers and one system administrator increasing our delivery capacity for both commercial projects and research initiatives. These new resources could potentially be mobilized as well.

Partner	**Cyntelix**
Resources to be Mobilized	The Research Director will be involved from the onset. In addition, an existing project manager will be involved along with two widget engineers and developers.
Additional Resources Mobilization Plan	New hires will be carried out to carry out the research to be dedicated, albeit supported by existing researchers and developers according to expertise requirements.

Partner	**PTIN**
Resources to be Mobilized	PTIN will mainly be involved in the Showcases Development and Overall Performance Evaluation, as well as in the Innovation Management, Dissemination and Exploitation of the project results. For this reason, the enterprise foresees that three persons, one project manager a technical manager and a market analyst will be sufficient in order to cover the project needs. These members will be actively involved throughout the whole duration of the project.
Additional Resources Mobilization Plan	If necessary, PTIN will allocate additional personnel from its resources pool, so as to cover the project needs. From the enterprise perspective, the company will be able to cover the project needs without facing any problems

Partner	**FIT**
Resources to be Mobilized	FIT will utilize up to three persons for the whole duration of the project; a Coordinator, a Senior Researcher, and one Researchers. All utilized personnel have strong experience in the implementation and management of EU-funded projects and a deep understanding of ICT as well as the BSCW system that will be contributed by FIT as application platform.

Additional Resources Mobilization Plan	Most of FIT resources will be utilized primarily within WP4, WP7, and WP8. The resources commitment percentage is not clear yet. However, based on the size of the involved research department (~20 researchers) FIT will make sure that there are enough human resources at hand at any time of the project in order for all FIT responsibilities to be timely and qualitatively fulfilled.

Partner	**RomTelecom**
Resources to be Mobilized	ROM Telecom will utilize three persons for the whole duration of the project. The company will mainly participate in WPs 8 and 9, and the persons allocated are anticipated to be able to fully meet the project needs.
Additional Resources Mobilization Plan	If additional personnel is required for the project, the company will mobilize current employees with expertise in the field. The company has the personnel required to cover the project needs

Annex III. Individual Dissemination Plans

Partner	ATOS
Target Groups	ATOS provides solutions and services to large multi-national clients in carefully targeted industry sectors. Thus, trying to stay in line with its policy, ATOS dissemination plan will mainly target the industry sector and more specifically: - Existing and potential future business partners - Existing and potential future business customers
Planed Activities	ATOS dissemination policy as regards Cloud4SOA will be incorporated in the overall dissemination policy of the enterprise, which includes: - the enterprise web site - participation in trade-fairs and exhibitions - presentation in topic-specific media like journals and magazines Apart from the individual dissemination policy, ATOS will also dynamically participate in the overall dissemination strategy of the consortium. ATOS also manages the website IT-Tude.com (developed through the BEinGRID project), and full collaboration will be used to leverage the project's awareness and progress.

Partner	NUIG
Target Groups	Research community, academia, industry
Planed Activities	NUIG plans to disseminate the results of our research by publishing them in high profile conferences and journals, as well as by presenting them to prospective industry customers.

Partner	SingularLogic
Target Groups	- Software partners - Software products clients - Greek, Cypriot and Balkan software industry
Planed Activities	During the course of the project, information about the project will be disseminated to a wide range of stakeholders in the relevant business and research communities: - Publication on the SingularLogic website - Contribution to EU organized events and conferences - Publications in topic-specific journals and brochures - Press releases

Partner	CERTH
Target Groups	Research community, industry
Planed Activities	Major dissemination activities include the publication of articles in relevant journals and conference proceedings; conferences (indicative list below) will also be used for article presentations and wide dissemination to different stakeholders. Moreover, CERTH will utilise viral marketing techniques such as word of mouth to other projects' partners in order to spread news and achievements of the project.

Partner	CloudControl
Target Groups	Customers Competitors Interested individuals
Planed Activities	We are planning to present our developments and findings at various Cloud Camps, Barcamps as well as mention them within our regular press releases. We also have an frequently visited blog (serverwolken.de) that covers various topics in the cloud computing field.

Partner	Cyntelix
Target Groups	- widget community (developers, users and commercial clients) - researchers - web2.0 community
Planed Activities	- developer workshops to promote the user of Cloud4SoA to integrate the available services in widget development, potentially creating a developer base of new services - networking activities with other EU research projects in the area of enterprise interoperability, front-end services and widgets - publications in relevant conferences (eg: World Wide Web, European Semantic Web conference, etc) - industry events such as Web2.0 Expo and PICNIC where we woudl showcase the prototypes

Partner	PTIN
Target Groups	PTIN dissemination activities will aim at attracting both individuals as end users of the enhanced services, as well as business partners for future collaborations. The dissemination activities will target mainly the industrial sector, as well as publications in major international conferences and journals.
Planed Activities	PTIN aims at promoting the provision of enhanced services mainly through channels with broad public acceptance, such as the enterprise web site and presentations and advertisements in mass media, such as the television, magazines and newspapers. Workshops are also planned to disseminate the Cloud4SOA results within PTIN business partners. In addition, it will disseminate the results through participation in trade-fairs, exhibitions and international conferences.

Partner	FIT
Target Groups	Fraunhofer dissemination targets at the research community, universities and by technology transfer to industry.
Planed Activities	- Fraunhofer will disseminate the research results - on their project web page - through our public BSCW server - by creating a Fraunhofer flyer - by research papers submitted to conferences and workshops - at presentations of other projects, with other project partners - in Fraunhofer media like journals, newspapers, magazines - by participating in EC conferences and meeting distributing flyers and presenting the project presentation at fairs like CeBIT at the Fraunhofer stand

Partner	ROM Telecom
Target Groups	- End users (mobile subscribers)

Planed Activities	- Telecom Industry - Enterprise web site - Mass media presentations - Magazines

Annex IV. Individual Exploitation Plans

Partner	ATOS
Exploitation Goals	Much like the enterprise overall exploitation strategy throughout the years, ATOS participates in Cloud4SOA for a number of reasons: • It aspires to expand its business portfolio and create new partnerships • It sees it as a chance to solidify its position in the RTD arena. • It evaluates it as a project of strategic importance in the field, and its participation in it will pave the way for future activity in the domain
Topic / Domain	The participation in the project targets the cloud services domain, whether it involves: • The research sector and/or • The industrial sector
Approach and Activities	ATOS business approach is based on establishing long-term partnerships that encourage success through mutual benefit. Thus, the individual exploitation approach of the enterprise will be based on ATOS overall exploitation strategy and will be twofold: • The research oriented results will be exploited in the know-how domain so as to build upon this knowledge gained and incorporate it in future research projects • The marketable results will be exploited in the technological and commercial domain so as to incorporate it in existing solutions and provide enhanced solutions / services. These will be integrated in the overall marketing approach of ATOS. AtosSphere, a new Cloud offering of ATOS for its clients, has been highlighted by the CEO as a integral part of its future services, and such lessons learned and project results will be used to better ATOS's competitiveness in the arena.

Partner	NUIG
Exploitation Goals	Our main objectives are to disseminate the SIOC-based Social Web Ontology both within research and industry. One the one hand this will contribute towards the wider adoption of the Cloud4SOA Reference Architecture and models and could lead to their standardization. On the other hand opportunities for enterprise development partnerships will be created.
Topic / Domain	*Topic:* Semantic models and technologies, SOAs, Cloud Computing *Market*: European and Irish research projects *Target*: Scientific community, academia, industry
Approach and Activities	NUIG intends to make the research community and industry aware of the Cloud4SOA Reference Architecture and models. By organizing open discussions, tutorials and presentations we plan to gain consensus on them and to encourage the community to adopt this them. This will contribute towards a standardization effort similar to that of other Reference architectures, e.g. CERA (Peristeras et al. 2009), and models, e.g. SIOC. Furthermore, NUIG plans to organize bilateral sessions with prospective industry partners to assess eventual schemes for the development of enterprise partnerships. This will lead to either the specialization of technology for the partners' purpose or (joint) commercialization opportunities. At the same time, we intend to exhibit our results within international exhibit events tailored towards industry (e.g. CEBiT).

Partner	SingularLogic
Exploitation Goals	SingularLogic's business domain lies in close collaboration with industry, especially SMEs. SingularLogic believes that the cloud computing technologies, methods and tools that will be utilized in the project will become of broad interest inside software SMEs sector in the forthcoming years. SingularLogic intends to play an active role in this process as a system integrator and local software-as-a-service provider, so SingularLogic target is to identify opportunities for technology transfer into industry, e.g. by integrating the software components developed in Cloud4SOA in future collaborations with industrial partners.
Topic / Domain	SingularLogic aims both at the research sector and high-tech industry markets
Approach and Activities	The Cloud4SOA exploitable results will be integrated into the regular and professionally organized marketing activities of SingularLogic. These include newsletters, presence on suitable trade fairs, exhibitions and conferences, regular press releases and preparation of high-quality project flyers.

Partner	CERTH
Exploitation Goals	CERTH, already participating in a large number of research and commercial projects, intends to significantly improve their current competencies in the domains of SOAs, service modelling, interoperability and semantic technologies and models. At the same time, CERTH intends to acquire a solid understanding of Cloud computing technologies, problems and potentials. Furthermore, CERTH expects to increase their consultancy skills and portfolio to further enhance provision of relevant consultancy services.
Topic / Domain	*Topic*: SOAs, service modelling, interoperability, semantic models and technologies *Market*: European and Greek research and consultancy projects *Target*: Scientific community, industry
Approach and Activities	CERTH intends to make the research community and industry aware of the Cloud4SOA project results. This will be achieved by organizing and participating in open discussions, tutorials, presentations and international exhibit events. CERTH also plans to approach industry partners in order to explore potential schemes for the establishment partnerships. This will lead to the specialization of the Cloud4SOA results to the industry partners' needs and to their commercialization.

Partner	CloudControl
Exploitation Goals	We are planning to use the findings to optimize the way our own cloud hosting platform works.
Topic / Domain	We are currently working on an integrated development and hosting platform.
Approach and Activities	We will actively engage in researching the cloud maintenance and governance and cloud virtual execution box layers. Further we will bring in our current knowledge and provide testing accounts to our own platform for hosting web applications.

Partner	Cyntelix
Exploitation Goals	Cyntelix Corporation has a strong experience in the commercialization of research outcomes from Cyntelix research, as products or/and services. The development and research divisions work closely together, which leads to short lead times in productization of research results. Some of the research results contribute to the improvement of existing products/services, whilst others lead to the launch of new products and services, with their own business models. In the latter case, Cyntelix creates a business programme for the product/service until the business becomes sustainable, at which point a spinoff company is created. The company has strategic interest in the research results of Cloud4SOA project since it has a good potential to complement our widget distribution platform (www.beemway.com). Our client base includes several "A" brand corporate clients, such as Coca Cola, MTV, KLM, TomTom, etc, which have widgets with a viral distribution involving a community of 500.000 to 1.000.000 users. A key characteristic of the web2.0 paradigm is the empowerment of the users, enabling each person to be not only a consumer, but also a producer of both content and services. Our strategy for widget technology and associated business involves engaging the largest number of users. The merge of widget technology with cloud technology opens a new market opportunity that has not been explored as of yet.
Topic / Domain	*Topic:* Intelligent Widget-based Service Front-ends, Personalized Cloud Interfaces *Market*: European and Irish research projects *Target Groups*: Industry
Approach and Activities	- Newsletters and information leaflets - Business and Technological demonstrators to existing and potential partners

Partner	PTIN
Exploitation Goals	PTIN acts inside the PT Group as an instrumental company that supports all the companies of the group in terms of new technologies and applications development. Therefore PTIN must leave at the leading edge in the telecommunications arena. One of the key PT Group companies is the mobile operator, which has approximately 7 millions of subscribers and leads the Portuguese mobile telecommunications market. PTIN is joining this project with high expectations in making sure that the experimental results are of high value for real implementation, to provide consulting services to the PT companies or to motivate the systems suppliers to adopt Cloud4SOA solutions.
Topic / Domain	PTIN will aim at both the Portuguese and European service provision market towards enterprises and individuals, as well as to the African and Latin American markets.
Approach and Activities	PTIN will try to integrate the exploitable results of the project in its marketing activities. Towards this direction, the enterprise will establish a business plan for the commercialization of the enhanced, value added services, and deploy a model through which they will be provided and exploited.

Partner	FIT
Exploitation Goals	Fraunhofer will exploit the results through technology transfer projects with industry. With BSCW we will exploit the project results through our spinoff OrbiTeam.
Topic / Domain	Target Domain is the research community as well the IT-domain.
Approach and Activities	The Fraunhofer approach for exploitation is mainly through technology transfer as well as licensing through spinoffs.

Partner	ROM Telecom
Exploitation Goals	- Meet customer demands - Provide value added services to enterprises and individuals - Acquire technological know-how regarding this type of services - Solidify its position on the market - Expand its market-share - Establish co-operations at European level
Topic / Domain	- Enhance its service provision portfolio towards enterprises and individuals
Approach and Activities	- Commercialize the new value-added services - Develop an exploitation/marketing model for the provision of these services. - Participate in exhibitions and trade-fairs so as to familiarize the enterprises and individuals with the new service provision portfolio

Annex V. List of Potential Dissemination Channels

Event Short Name	Event Type	Short Description
ESWC	Conference	European Semantic Web Conference
ISWC	Conference	International Semantic Web Conference
KCap	Conference	International Knowledge Capturing Conference
EKAW	Conference	International Conference on Knowledge Engineering and Knowledge Management Knowledge Patterns
WWW	Conference	World Wide Web Conference
WI	Conference	Web Intelligence Conference
Elsevier JWS	Journal	Journal of Web Semantics (http://www.websemanticsjournal.org/)
IEEE TKDE	Journal	Transactions on Knowledge and Data Engineering (http://www.computer.org/tkde/)
IJMSO	Journal	International Journal of Metadata, Semantics and Ontologies (https://www.inderscience.com/browse/index.php?journalID=152)
IJSWIS	Journal	International Journal on Semantic Web and Information Systems (http://www.ijswis.org/)
ACM-GROUP, CSCW, COOP-IS, COOP, CRWIG	Scientific conferences	Conferences for groupware and colleaboration etchnologies
CEBIT	Exhibition	Exhibition of project results at the Fraunhofer stand in the world largest computer fair in Hannover (yearly).
ICT event	Conference	Major EU FP conference with high level representation and visibility of EC funded projects.
PCI	Conference	Pan-Hellenic Conference on Informatics
ESWC	Conference	European Semantic Web Conference
ISWC	Conference	International Semantic Web Conference
Elsevier JWS	Journal	Journal of Web Semantics (http://www.websemanticsjournal.org/)
IJSWIS	Journal	International Journal on Semantic Web and Information Systems (http://www.ijswis.org/)
IEEE INTELL SYST	Journal	IEEE Intelligent Systems (http://www.computer.org/portal/web/intelligent/home)
Cloud Camp	Conference	Various conferences tackling the topic of cloud computing held on various locations across Germany (e.g. www.cloudcamp-frankfurt.de).
Barcamp	Conference	Open conferences held regularly at various cities in Germany. Topics are often new technological developments and new methods discovered.

Annex VI. Similar Research Initiatives of the Consortium

Programme & Objective	Project Acronym	Partners Involved	Short Description	Relevance to our Initiative
FP7 ICT	**SOA4ALL**	ATOS	Service Oriented Architectures for All (SOA4ALL) is a Large-Scale Integrating Project funded by the European Seventh Framework Programme, under the **Service and Software Architectures, Infrastructures and Engineering** research area. SOA4ALL aims at realizing a world where billions of parties are exposing and consuming services via advanced Web technology: the main objective of the project is to provide a comprehensive framework that integrates complementary and evolutionary technical advances (i.e. SOA, context management, Web principles, Web 2.0 and semantic technologies) into a coherent and domain-independent service delivery platform.	ATOS coordinates the SOA4ALL project being responsible for the administrative, financial and day-to-day monitoring of the project. In the context of SOA4ALL, ATOS research activities mainly focus on service web infrastructure and service construction, SLA management at different layers, software licensing management in distributed computing environments.
FP7	**NEXOF-RA**		The mission of NEXOF-RA is to address comprehensive service-oriented software system architectures and specifications. NEXOF-RA (NEXOF Reference Architecture) project is the first step in the process of building NEXOF the generic open platform for creating and delivering applications enabling the creation of service based ecosystems where service providers and third parties easy collaborate.	In the frame of NOXOF-RA, ATOS exploited its expertise is in Cloud Computing, Service-Oriented Infrastructures including Grid and Utility Computing.
FP6 IST (FP6-IST-5 35208)	**ECOSPACE**	NUIG, FIT, Cyntelix	ECOSPACE pursues the vision that by 2012 every Professional in Europe is empowered for seamless, dynamic and creative collaboration across teams, organisations and communities through a personalised collaborative working environment. ECOSPACE will result in new working paradigms and metaphors for eProfessionals, a user-centric platform enabling the interoperability of innovative collaboration tools and services. It will empower users to easily build-up and deploy on-demand virtualised and knowledge rich collaborative environments. (http://www.ip-ecospace.org/)	In the context of ECOSPACE, NUIG, FIT and Cyntelix collaborated in order to develop a reference architecture for collaborative work environments (CERA) (Peristeras et al., 2009) and a set of user, data and service models for facilitating the interoperability between different CWEs. The knowledge and the experience gained there during these tasks will be used in Cloud4SOA for developing the Cloud4SOA Reference Architecture and the Cloud4SOA service and computing resource models.
FP6 IST	**NEPOMUK**	NUIG	NEPOMUK brought together researchers, industrial software	In the context of NEPOMUK, NUIG developed a

Programme & Objective	Project Acronym	Partners Involved	Short Description	Relevance to our Initiative
(FP6-027705)			developers, and representative industrial users, to develop a comprehensive solution for extending the personal desktop into a collaboration environment which supports both the personal information management and the sharing and exchange across social and organizational relations. (http://nepomuk.semanticdesktop.org)	set of semantic user, data and service models. The knowledge and the experience gained there during these tasks will be used in Cloud4SOA for developing the Cloud4SOA service and computing resource models.
Science Foundation Ireland (SFI/02/CE1/I131)	**LION**	NUIG	The mission of the Líon project in DERI, NUIG is to develop technologies and applications to create a social semantic information space. From the very beginning, the Web was a medium that helped to create communities and to connect individuals and communities - which may be communities of interest or practice and which also include businesses. The developed Semantic Web standards allow for a greater automation of information dissemination and connection of these communities. (https://lion.deri.ie/)	The experience that NUIG gained from LION mainly in the life-cycle of lightweight service models and standardization which can be highly beneficial for Cloud4SOA. Moreover, the synergies that NUIG made with the research communities and the industrial partners that participated in the LION can provide a pool for possible future partnerships for the exploitation of the Cloud4SOA results.
Science Foundation Ireland (SFI/02/CE1/I131), *OKKAM Project* (ICT-215032) and *ROMULUS project* (ICT-217031)	**Sindice**	NUIG	Sindice is a search engine for the Semantic Web. The Sindice project deals with building scalable APIs to locate and use RDF and microformat data as found on the Web. The use of Cloud Computing is fundamental for Sindice to reach its scalability goals during the entire preprocessing phase and in particular to perform harvesting, storage, and data transformation (Mika & Tummarello, 2008). Hadoop[33] and HBase[34] are software layers that are utilized by Sindice to access Cloud computing functionality. (http://sindice.com/)	Through the development of Sindice NUIG has familiarized with Cloud computing technologies and has acquired valuable hands-on experience, which is required and will be utilized during the implementation phase of Cloud4SOA.
Science Foundation Ireland (SFI/08/CE/I1380)	**WebStar**	NUIG	The goal of the WebStar project is to build a Web Science Laboratory, which will dramatically lower the barriers for performing large scale experiments involving Web Data alone or in conjunctions with other datasets as needed. The WebStar cluster will be used for large scale web data processing, using Cloud Computing paradigms, e.g. Map Reduce (Dean & Gemawat, 2004).	In the context of WebStar NUIG has acquired valuable hands-on experience on Cloud computing technologies and on Cloud infrastructures, which is required and will be utilized during the implementation phase of Cloud4SOA.

[33] *http://hadoop.apache.org/core*

[34] *http://hadoop.apache.org/hbase*

Programme & Objective	Project Acronym	Partners Involved	Short Description	Relevance to our Initiative
			The outline specification of the WebStar cluster is as follows: • 45 x Dual Opteron Data Nodes (16GB RAM, 4 x 1TB HD) • 3 x Dual Opteron Name Node (32GB RAM, 2 x 1TB HD) • 2 x Dual Opteron Indexing Node (32GB RAM, 4 x 1TB HD) • 2 x Dual Opteron Login Node (8GB RAM, 2 x 1TB HD) In total 52 nodes, with 416 processor cores, 896GB memory and 198TB of raw storage.	Moreover, the WebStar cluster can be used in Cloud4SOA as a test-bed for deploying and validating the Cloud4SOA prototypes in a laboratory environment, before their actual deployment at the pilot sites.
FP7	**TARGET**	Cyntelix	The main aim of TARGET is to research, analyze, and develop a new genre of Technology Enhanced Learning (TEL) environment that supports rapid competence development of individuals by means of emotionally engaging serious games. Within the learning process, TARGET generates a personalized cognitive learning plan for the learner, which consists of a series of game scenarios. The stories are created on the fly and each learner has his own particular experience of a story. TARGET will analyze data in order to find the best learning path for the users. Still, TARGET will allow the use of different ontologies, therefore matching and relating between concepts must be done in order to be able to have a representative data analyses. Phenomenography represents a potential approach, in order to collect information about the same situation from different points of views (i.e from different learners using different ontologies). Phenomenography will be employed to analyze how different people reason and conceptualize the same phenomenon, and how this is expressed in the concepts from the employed ontologies. In this way, matching or other types of relations between concepts from different ontologies can be achieved.	The TARGET responsive environment relies on the SoA paradigm and uses semantic annotation for the knowledge assets in its knowledge ecology. The semantic reasoning and matching with different ontologies
FP7 ICT	**WeKnowIt**	CERTH	The main objective of WeKnowIt is to develop novel techniques for exploiting multiple layers of intelligence from user-contributed content, which together constitute Collective Intelligence, a form of intelligence that emerges from the collaboration and competition among many individuals, and that seemingly has a mind of its own.	CERTH will rethink the methods for the automatic generation of collective intelligence and semantic analysis developed in WeKnowIt and will examine how these can benefit the bottom-up development and evolution of the Cloud4SOA service and computing resource models and semantic annotation components.

Programme & Objective	Project Acronym	Partners Involved	Short Description	Relevance to our Initiative
FP7 ICT	**OASIS**	CERTH, SingularLogic	OASIS introduces an innovative, Ontology-driven, Open Reference Architecture and System, which will enable and facilitate interoperability, seamless connectivity and sharing of content between different services and ontologies in all application domains relevant to applications for the elderly and beyond.	CERTH and SingularLogic can establish links between the two projects, as both of them focus on the developments of model-driven open reference architectures which aim at facilitating interoperability and data exchange. Thus, experiences and good practices may be shared.
FP6 IST	**SemanticGov**	CERTH, NUIG	SemanticGov aims at building the infrastructure (software, models, services, etc) necessary for enabling the offering of semantic web services by public administration (PA)	CERTH and NUIG gained significant experience from SemanticGov, especially in the areas of semantic service modeling and semantic interoperability. This experience will be used in Cloud4SOA in order to develop the Cloud4SOA service model and to define the Cloud4SOA Cloud Interoperability Framework.
EU MODINIS Programme	**MODINIS LOT 2 Study On Interoperability at Local and Regional Level**	CERTH	The main objectives of the MODINIS IOP Study project were: • To identify relevant good practice in interoperability and include them in the eGovernment Good Practice Framework • To conduct a good practice study on interoperability at local and regional level, • To exchange and disseminate experience in eight workshops which will be organised both in Brussels and in Member States	In the context of the MODINIS IOP Study, CERTH worked mainly on an interoperability framework and a set of good practices and recommendations on how to build interoperable eGovernment applications. These valuable experience and expertise will help the Cloud4SOA consortium define the Cloud Interoperability Framework and the recommendations on building interoperable applications in the Cloud.

Annex VII. References and List of Related Publications of the Consortium

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