Turning
cloud research into
innovative
software & services

Software &
Services & Cloud
Concertation
Meeting Report

May 2015

SEVENTH FRAMEWORK PROGRAMME

Horizon 2020

Disclaimer

Executive Summary

The third CloudWATCH Concertation meeting looked at **future directions for software services and cloud in Europe**, highlighting new opportunities for novel research and innovation to ensure Europe remains a world leader. The EC are investing heavily in research and innovation. There is a need for projects to push towards creating products and defining services with a mind to moving to market. The meeting took stock of how projects under Unit E2 Software, services and cloud computing are assessing potential go-to-market scenarios of their services including, user experience and potential barriers to uptake. It concluded with a call to action on the most pressing challenges for market uptake, defining practical steps that can be taken, which were:

> ❖ Projects are responding and adapting, but there is still work to be done in improving communication. In particular targeted messaging to potential markets and end-users should focus on services being delivered, benefits for end-users, with less technical speak and more plain English. This should come out more on project websites.
>
> ❖ Projects contributed to the portfolio of offers for trusted and secure services. 72 service offers were published. For the next iteration, these need to talk more to potential end-users in a more market-oriented way.

A further call to action came from the European Commission encouraging clustering and convergence on common themes and challenges, and re-use of technologies between projects. Since the event four such clusters have been formed and objectives already set. The clusters focus on the following topics:

- ❖ Software Engineering for Services and Applications
- ❖ Inter-Cloud challenges, expectations and issues
- ❖ Data protection, Security and Privacy in the Cloud
- ❖ New Approaches for Infrastructure Services

In parallel to this, CloudWATCH is undertaking a quantitative clustering analysis of 55 cloud projects under Unit E2 in order to discover meaningful clusters based on the NIST's common defining characteristics of cloud computing. This will inform the process of deriving technical standards profiles for each of these projects. It can also form the basis for identifying other future project clusters.

> ❖ Clustering projects has in the past proven to foster collaboration and improve results while reducing duplication of effort. With 32 projects funded under the first round of H2020 funding, these activities will need to be continuously updated. The quantitative clustering methodology being developed by CloudWATCH should make this easier.

Over 120 participants attended this the third CloudWATCH Concertation meeting which was co-located at the NetFutures 2015 conference[1]. All Framework Programme 7 Call 8 and 10 projects participated as weel as 32 new projects funded under the first Horizon 2020 call.

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[1] http://netfutures2015.eu/

Concertation meeting in numbers

Figure 1 Concertation meeting in numbers

Figure 2 A portfolio of offers for trusted and secure services

CloudWATCH also presented a portfolio of 72 stimulating service offers for trusted and secure services that will emerge from the E2 unit of DG CONNECT Software & Services & Cloud Computing.

The service offers were provided by each project and aim to provide a focus on the cloud ecosystem emerging from European research and innovation projects. It takes a pragmatic approach to market uptake and sustainable competitiveness for wider uptake and commercial exploitation.

72 Service Offers from participating projects	http://www.cloudwatchhub.eu/sites/default/files/CatalogA4_Web.pdf
All presentations from the event	http://www.cloudwatchhub.eu/turning-cloud-research-innovative-software-services

Table 1 Documents and related website contents

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1   Evolution toward project clustering

1.1   Background and Achievements to date

Previous CloudWATCH Concertation Events

The two previous CloudWATCH Concertation meetings took stock of all active projects that had received funding through Unit E2, as well as explored themes for LEIT 2016-2017 Programme. Selected success stories, new ideas around standards and go-to-market products and services were discussed and recommendations made.

A key theme was the **clustering and convergence between projects** on common themes and challenges, and re-use of technologies.   Core clusters were formed on cloud computing research, software engineering and open source research.

1.2   The landscape today

European research priorities have increasingly adapted to the fast evolution of cloud and related services. Developments taking place today in FP7 ICT (e.g. Call 8 & Call 10) and now demonstrated with successful Call 1 projects from H2020, range from big data and content, to the Internet of Things (IoT), cloud computing and the Internet of Services. These research and innovation activities will take us to a new era of digital societies and economies based on an agile, adaptive and dynamic collaboration between organisations, communities and individuals, with ubiquitous and instant access to information.

Currently, there are 71 active projects under Unit E2 as shown in the table below. The vast majority of these were represented at the Concertation meeting and contributed to the portfolio of offers for trusted and secure services.

FP7/H2020 Call	No. of projects still active (March 2015)
FP7 Call 8 – Cloud computing, internet of services and advanced software engineering	19 projects out of 22 projects[2]
FP7 Call 10 – Software engineering, services and cloud computing	17 projects out of 17 projects[3]
CIP Call 6	1 project (MO-BIZZ[4])
FP7 EU-Japan	1 project (CLOUT[5])
H2020 Call 1 – Advanced cloud infrastructures and services	32 projects[6]
H2020 EU-Japan	1 project (IKAAS[7])

Table 2 Overview of FP7/H2020 Calls and No. of Funded Projects

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[2] http://www.cloudwatchhub.eu/service-offers-2015-2016
[3] http://www.cloudwatchhub.eu/service-offers-2015-2016
[4] http://www.cloudwatchhub.eu/mo-bizz
[5] http://www.cloudwatchhub.eu/serviceoffers/clout-cloud-things-empowering-citizen-clout-smart-cities
[6] http://www.cloudwatchhub.eu/service-offers-2016-2018
[7] http://www.cloudwatchhub.eu/serviceoffers/ikaas-intelligent-knowledge-service-platform

1.3 Launching clusters to promote technology advancements and re-usability

The main goal of clustering activities is to accelerate the development and deployment of cloud computing and increasing Europe's ability to design and deliver innovative Internet services. Pearse O'Donohue and Francisco Medeiros, Head and Deputy Head, respectively, of DG-Connect's Unit 2 Software, Services and Cloud computing, set a clear challenge for projects at the Concertation meeting to establish clusters during the event.

Since the Concertation meeting, the following clusters have been established (See Section 1.3):

- ❖ Software Engineering for Services and Applications
- ❖ Inter-cloud Challenges, Expectations and Issues
- ❖ Data Protection, Security and Privacy in the Cloud
- ❖ New Approaches for Infrastructure Services

A common goal for the clusters is to create an environment where synergies are exploited to the benefit of the beneficiaries of H2020 grants. In particular clusters should collaborate on technical aspects, and also to identify trends in the market and engage in innovative ways to address such trends, beyond the usual dissemination and exploitation activities (normally covered by each Grant Agreement). For instance, as discussed during Net Futures, one goal could be to establish closer links to venture capitalists and actors in the business sector with a view to bringing products and services to the market. Effective go-to-market strategies will be one of the measures of success of each cluster.

With 33 new H2020 projects, in the area of cloud and software launched in 2015, a total funding of €100.75 million has been distributed among 208 beneficiaries. These resources are additional to on-going FP7 projects. Clearly, there is more than enough critical mass to achieve a significant impact.

A website dedicated to the clusters[8] is being completed at the time of writing.

1.3.1 Software Engineering for Services and Applications

Lead: Elisabetta Di Nitto, Politecnico di Milano, MODAClouds, SeaClouds and DICE

EC representative: Odysseas Pyrovolakis

Objective: In the last years the advancements in software engineering have lead to an increasing automation of aspects such as testing, deployment, management of new releases, and, at the same time, have allowed researchers and practitioners to identify new approaches for creating and operating software and services (think of DevOps as an example). However, we cannot stop researching.

The increased maturity of software engineering goes along with an increasing variety of societal and business needs, which, in turn, determines an increasing complexity and peculiarity of services and applications. This has lead to the development of fields like IoT, Big Data, Cyber-physical systems and to the introduction of new complex technologies (e.g., Spark, Storm) and even new "software-defined" paradigms for infrastructural resources. All these help addressing several problems but require specific expertise and skills.

In this context, the mission of software engineering is to offer the right tools and methods to guide users in all activities connected to the lifecycle of applications and services, through the usage of technologies

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[8] https://eucloudclusters.wordpress.com/2015/05/11/eu-projects-clusters/

and new paradigms, still ensuring productivity of processes and quality of software (performance, availability, evolvability, reliability, …).

This cluster aims at facilitating the discussion among the experts in the area to exchange experiences and competences and to identify research directions and challenges as well as common plans to address them. In particular, the specific objectives being pursued by the cluster are:

- ❖ Identify complementarities and synergies as well as possibilities for collaboration/results adoptions between projects;
- ❖ Identify new challenges and trends to influence the European research agenda;
- ❖ Organise common dissemination (publications, training and workshops);
- ❖ Identify effective go-to-market strategies for the outcomes of research projects.

Deliverables

- ❖ A white paper describing a map of the challenges in software engineering and of the initial solution being proposed.
- ❖ A common book
- ❖ A workshop or training initiative

Participants

- ❖ Aligned
- ❖ Artist
- ❖ DICE
- ❖ MODAClouds
- ❖ SeaClouds

More details on the cluster can be found here https://eucloudclusters.wordpress.com/software-engineering-for-services-and-applications/

1.3.2   Inter-Cloud challenges, expectations and issues cluster

Lead: Ana Juan Ferrer, ATOS, ASCETIC & STRATEGIC

EC representative: Jorge Gasos

Objective: Create a critical mass of projects addressing the topic of multi-cloud and inter-cloud approaches so to share experiences, collaborate on approaches and discuss challenges for adoption and future research.

Go to market strategy: The simultaneous or serial use of services from diverse heterogeneous cloud providers is a challenge in order to further develop Cloud market in Europe. While it presents a series of issues with regards to interoperability among of heterogeneous private and public clouds, services' comparability, portability, migration, networking,. It also offers innovative market opportunities in order to avoid vendor lock-in and for the development of new roles in the cloud market related to hybrid cloud models such as cloud aggregators and brokers. Today a number of research projects are analysing this problem from diverse perspectives and focusing on specific parts of the challenge. Within this cluster we aim to offer a forum in which to collaborate in order to elaborate a broad EU prospective of the Inter-cloud question.

Achievements to date: Application for networking session at ICT2015.

EU Interoperable cloud services & solutions report   **7**

CloudWATCH is funded by the EC FP7 - DG Connect Software & Services, Cloud. Contract No. 610994

1.3.3 Data protection, Security and Privacy in the Cloud

Lead: Erkuden Rios Velasco, Tecnalia & MUSA

EC representative: Francisco Medeiros

The Cluster was launched with the following preliminary approach that still needs to be agreed among the participants.

Objectives:

1. Maximize the impact of EU R&D project results in the areas of Data Protection, Security and Privacy by:

    a. Identifying synergies in the methods, tools and solutions proposed by EU R&D projects in the areas of Data Protection, Security and Privacy.
    b. Maximising the innovation over state-of-the-art and the advances on the common research areas.
    c. Collaborating in the organisation of joint dissemination events, such as joint Workshops and conferences, and collaboration in other joint dissemination actions such as joint papers and articles, etc.
    d. Encouraging joint efforts to push standards whenever possible.

2. Ensure the market orientation and adoption of EU R&D project results in the areas of Data Protection, Security and Privacy by:

    a. Providing in-depth analysis of market trends and needs in the areas of Data Protection, Security and Privacy products.
    b. Identifying alignment of exploitation strategies and models of EU R&D project results.

3. Help define the research and innovation needs in H2020 in the areas of Data Protection, Security and Privacy by:

    a. Collaborating with DG-CNECT in the definition of strategic research areas and topics for the strategic and work programmes.
    b. Providing feedback to DG-CNECT on the drawbacks and problems arising during the execution of the projects with respect to the impact achievement in order to look for solutions in future projects.

Participants:

- ❖ Representatives of EU R&D projects (preferably Technical Managers, Project Managers or research leaders) in the areas of Data Protection, Security and Privacy, including of course Cooperation and Support Actions.

- ❖ Representatives of Market orientation advisory group. The group should be composed of a limited set of: Investors (business angels, etc.), consultancy companies on innovation transfer, business models creation, etc.

Candidate participant projects and their focus are listed in the table below.

Project Name (focus)	
MUSA (secure multicloud)	**ALIGNED** (data integrity)
CLARUS (user centric privacy and security – crypto and non-crypto)	**SWITCH** (time critical apps)

ESCUDO-CLOUD (enforcement)	SLALOM (to embed security & privacy in cloud SLAs)
ENTICE (data ownership	SPECS (secure cloud SLAs)
SERECA (overcome trust in CSP)	A4CLOUD (accountability)
SUPERCLOUD (user centric security and dependability)	TRESCCA (embedded systems)
PAASWORD (access control)	SLA-Ready (SLAs for SMEs)
CLIPS (trusted computing)	

Table 3 Initial list of cluster candidate projects

Achievements to date: Application for networking session at ICT2015. The application clusterS and progress at the technical and market-orientation sides.

1.3.4 New Approaches for Infrastructure Services

Lead: Dana Petcu, West University of Timisoara & ModaClouds & SPECS

EC representative: Maria Tsakali

Objectives: The cluster intends to be a forum for discussing the current research and innovation challenges encountered at infrastructure-as-a-service level generated by the desire to improve the user experiences and the efficient use of the available resources. The current trends are including the integration of special devices from high performance computing ones to mobile devices, the design of decentralised service-oriented systems, the improvement of the virtualization technologies, the overcome of portability and interoperability issues, or the automation the organisation and management of the beck-end resources. Cloud-based applications from the fields of Internet-of-Things and Big Data are expected to challenge the new services.

Goals:

- ❖ Define a map of the challenges related to the group topics that have been/are tackled by the projects and of the solution approaches that have been/are taken
- ❖ identify complementarities and synergies as well as possibilities for collaboration/results adoptions between projects, including common standardization bodies to be in contact with
- ❖ identify new challenges to influence the new research agendas by providing recommendations
- ❖ organisation of common dissemination actions like
  - o common publications (books, articles, white papers, newsletters) using the maps defined above and describing the current projects and the challenges for future research
  - o trainings and workshops

Participants:

- ❖ CloudLigthning
- ❖ Mikelangelo
- ❖ ENTICE

More details on the cluster can be found here: https://eucloudclusters.wordpress.com/new-approaches-for-infrastructure-services/

1.4 Quantitative Project Clustering for cloud standards profiles

How do we discover meaningful clusters among the diverse projects of Call 8, Call 10, and beyond? If we find meaningful clusters, is it then possible to build relevant technical standards profiles around such clusters?

CloudWATCH is undertaking a quantitative clustering analysis of 38 cloud initiatives, including projects funded by Unit E2, to inform the process of deriving technical standards profiles and to verify how well the NIST model fits and clarifies the landscape, both in its long and short forms.

We started our analysis with a dataset compiled by the CloudWATCH project representing 38 European projects and initiatives and scored against the full set of 13 NIST defining characteristics on an interval scale. The clustering procedure is based on the outcome of a Principal Components Analysis and several alternative clusterings based on different algorithms. The landscape was interpreted on a simultaneous biplot of the characteristic coefficients and component scores. As a natural extension of the biplot we derived a numerical interpretation that provides a ranking of the NIST characteristics for each cluster. We compared these interpretations and assessed the utility of parallel analyses based on both the long and short versions of the NIST defining character set.

A full overview of the methodology used will be available in CloudWATCH's report on cloud standards profiles development[9]. In addition a cluster tool[10] was developed to facilitate both the collection of data and analysis.

The analysis has led to the discovery of groups of projects that are consistent in their relationship to a set of well-defined general characteristics, and distinct from other such groups. These clusters are shown in the table below.

Cluster	Most important characteristics	Least important characteristics
Cluster 1 WeNMR OpenModeller CloudLightning Catania	On-demand self-service Massive scale Homogeneity	Service orientation Advance security Measured service Resilient computing
Cluster 2 Varberg Leicester city council CloudCatalyst BNCweb	Advanced Security Homogeneity Broad Network Access	Geographic Distribution Rapid Elasticity Massive Scale
Cluster 3 PANACEA Mobizz IOStack CloudSpaces	Homogeneity Broad Network Access	Low Cost Software Geographic distribution
Cluster 4	Measured Scale	On Demand Self Service

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[9] D4.3 Final report on cloud standards profile development
[10] http://www.cloudwatchhub.eu/cloudwatch-clustering-standards-profiles &
http://www.cloudwatchhub.eu/cloudwatch-project-input-quantitative-clustering-process

INPUT STORM CLOUDS Texel GEMMA CloudWave CELAR S-CASE U-QASAR COMPOSE BETaaS	Advanced Security Resource Pooling	Massive Scale Virtualization
Cluster 5 SeaClouds ASCETiC SeaClouds MODAClouds	Geographic Distribution Massive Scale Measured Service Rapid Elasticity	Homogeneity Advanced Security Broad Network Access

Table 4 CloudWATCH interpretation of clusters

These clusters of projects will form the basis for a further derivation of standards that are able to best support areas of commonality and create profiles which provide details as to how more generic recommended standards may be applied. CloudWATCH will develop and test a set of common standards profiles[11] around the federation of cloud services which can be easily adopted, thus driving the Cloud market into a state of commodity and utility.

In addition to this, CloudWATCH has established a collaboration with IEEE P2301 Guide for Cloud Portability and Interoperability Profiles [12].

The objective of the group is to develop a guide which advises cloud computing ecosystem participants (cloud vendors, service providers, and users) of standards-based choices in areas such as application interfaces, portability interfaces, management interfaces, interoperability interfaces, file formats, and operation conventions. Results from analysis of the clusters will contribute to identifying standards relevant to user needs. The cluster tool developed for this purpose may also be included as a reference for end-users to identify which standards are relevant to their needs.

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[11] A profile on a standard clarifies in an unambiguous way how a standard should be interpreted, explaining how to implement it based on a specific use case.

[12] https://standards.ieee.org/develop/project/2301.html

2   A move to market-facing products and services

The goal of the European Commission is to see projects establish effective go-to-market strategies and developing products and services that can be taken to the market. With a number of projects funded under Call 8, Cloud Computing, Internet of Services & Advanced Software Engineering, coming to an end in 2015, 14 these projects were invited to pitch their service offers to a panel of experts in order to gauge feedback the key open source results, benefits for end-users, unique selling points and the route to market.

Projects presenting: ARTIST, BIGFOOT, Broker@Cloud, CELAR, CloudScale, CloudSpaces, COMPOSE, LEADS, MARKOS, MODAClouds, OPENi, OSSMETER, PROWESS, U-QASAR.

A snapshot of these projects and references to their service offers can be found in Annex 1.

Session chair Michel Lacroix, European Commission, was joined by the following panellists who made some important recommendations:

❖ Sue Daley, Head of big data, cloud & mobile, Tech UK

❖ Gal Hammer, Senior Software Engineer, Red Hat

❖ Björn Hovstadius, Business Development Manager, EIT ICT Labs

❖ James Mitchell, Co-founder & CEO, StrategicBlue

2.1   Tips and recommendations on how best to take results to market

2.1.1   Clearer messaging for end-users

History has shown that it is not always the best solution that dominates a market, but rather one that is either brought to market quickest, or commercialised in the best way.

The aim of the European Commission funding these projects is to foster commercially sustainable initiatives. Therefore, there needs to be an increased focus on how the project results are disseminated. The current process is focussed on demonstrating that the objectives promised in the funding applications have been met. For example, most of the projects have the same websites they had when they applied for funding, updated to specifically list the deliverables, in a format that would make sense to anyone auditing whether the projects should receive their full funding.

Project outputs communicated via the presentation and service offer need to be communicated clearly on the project website. The reader needs to understand what they are able to do with the service right now. The Unique Selling Point (USP) needs to take centre stage e.g. cost-effective.

Each project should develop, in the closing stages of the project, a separate website, which has the look and feel of a startup product website. Visitors should be able to understand the gist of what has been achieved, or what is on offer, within seconds of looking at the home page. There should be calls-to-action and ways of capturing leads for follow up by those who seek to commercialise these projects.

In addition, to ensure that results are readily usable so that other people find it convenient to take them up, editors are needed to handle the code and an electronic user and developer guide.

2.1.2   Partnerships with startup accelerators

A further suggestion for future funding rounds, is to partner with one or more startup accelerators or seed investment Venture Capital firms, so that each project is mentored by someone whose day to day job is commercialising early stage ideas, and creating businesses out of them. The level of funding being offered by the EC to these projects is many multiples of what the typical startup has as seed-funding, so

there should be an attractive proposition to take to startup accelerators who want to take a small stake in commercial companies that can be created as a result of EC-funded projects, possibly with founders who start off being members of those projects.

2.1.3   Taking Open Source Solutions to market

Area	Tips/Recommendations
Community	❖ Try to find an existing community to ramp up. ❖ Support the community in any way possible and as much as possible. ❖ Their feedback is invaluable (sometimes) and should be taken on board. ❖ Every contributor is also a user. ❖ Be responsive and fix bugs quickly
Scale Up	❖ Control the quality of code. ❖ Be transparent. ❖ Communicate to your users. ❖ Support your users (mailing lists, IRC, G+, twitter). ❖ Project infrastructure (issue tracker, testing, CI). ❖ Documentation is key and must be available.
Make a Product *(Quick Example)*	❖ Foreman[13] is a complete life-cycle management tool for physical and virtual servers. ❖ Linux Foundation: One Of The Top 10 Open Source Provisioning and Management tools 2014. ❖ Started as a gap filler to an existing tool, "puppet". ❖ Succeeded to create an active and growing community. ❖ Have a large user base. ❖ It is now sold as the "Red Hat Satellite server" product.

Table 5 Tips for taking Open Solutions to Market

2.2   How start-ups can access support EIT ICT Labs

The EIT ICT Labs Innovation & Entrepreneurship strategy[14] is driven by 8 Innovation Action Lines (see figure below).

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[13] http://theforeman.org/
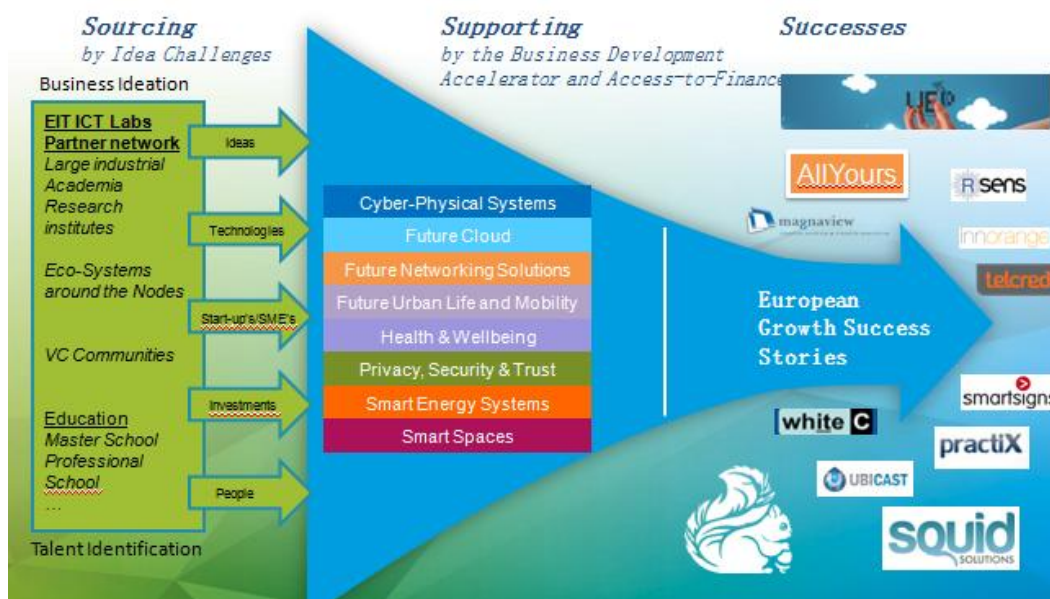[14] http://www.eitictlabs.eu/innovation-entrepreneurship/overview/

Figure 3 EIT ICT Labs Innovation & Entrepreneurship strategy

In each Action Line, the most promising research results, disruptive technologies and business strategies from the ecosystem and beyond are selected. These are then packaged in Innovation Activities and startups. The objective is to drive these innovations to succeed in world markets and become European success stories.

The sourcing of Innovation Activities takes place through our Call for Activities. Startups are sourced either through the **Idea Challenge**[15], the largest European startup contest in information technology, or through a direct application to the **Business Development Accelerator** (BDA)[16].

The BDA has a central role in the success of the Innovation funnel, as it coaches the entire funnel (Innovation Activities & Startups) with a focus on access to market - that is, customer adoption. Access to Finance is a team fully committed to helping BDA startups raise funds via a pan-European investor network.

2.3   LeanXcale – From funded initiative to award-winning start-up

LeanXcale is the result of several R&D projects funded by the European Commission, Spanish national government and Madrid regional government, led by former university professor Dr. Ricardo Jimenez. While the company was being incorporated several large companies from the financial sector have piloted the solution as early adopters. The research team was scouted by the local Business Development team and presented to the Idea Challenge contest in the topic of the Future Cloud Solutions in 2014. After winning the third prize, the company has entered the EIT ICT Labs coaching

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[15] http://ideachallenge.eitictlabs.eu/
[16] http://www.eitictlabs.eu/innovation-entrepreneurship/business-development-accelerator/

programme to boost its operation in terms of new customers, venture capital and partners. Operations have now started in the Co-Location Center of EIT ICT Labs in the IMDEA Software Institute in Madrid.

The solution: LeanXcale offers a new disruptive approach to large companies who are willing to take profit from their data. Unlike traditional existing Big Data solutions, LeanXcale offers real-time analytics blending the capabilities of an operational database and the ones of a data warehouse in a single platform empowering its customers to implement professional solutions without the need to copy their data in time- and resource-consuming projects.

2.4 Towards transparent cloud pricing

Commodity trading of cloud services would benefit both buyers and sellers, but the industry's current pricing models are standing in the way.

Market sector targets

Most people are happy to pay a premium for a quality service, provided it is made clear what is charged for that premium. The same is true for buyers of cloud services, but the lack of comparability of service quality and pricing between the major cloud providers is holding back buyer trust in the market. Greater pricing transparency will be good for the cloud market.

Interoperability and portability: existing and emerging standards that can foster trust in the cloud

Major cloud consumers should adopt a multi-cloud approach, deliberately running benchmark tests on multiple clouds, and moving workloads to where the best price is available, on a performance adjusted basis. The effect of this will be to enable fair comparisons between cloud providers, enabling transparency in the premia being charged for higher quality services.

Business models to take new services to market – including spin-outs and new services transferring publicly funded research to the private sector

A traded market in cloud computing would allow financing models that are now commonplace in the energy markets to be used to cost-effectively finance the build-out of new cloud services, whilst significantly reducing risk.

Why cloud is a helping hand for SMEs?

The pay-as-you-go utility cloud model is crucial for allowing startup SMEs to innovate with their digital services more cost-effectively than ever before. Instead of buying physical servers outright, virtual servers can be rented for even just an hour, at a tiny fraction of the cost.

What is missing is the right cloud pricing model to bridge the gap between unpredictable "on-demand" hourly usage, and the 1 year or 3 year commitments, generally paid upfront, that are available from some cloud providers at a discount to on-demand.

3   The Perfect Pitch

The Perfect Pitch Panel session, organised by CloudWATCH/Trust-IT spotlighted the success of 7 projects coming from four different units. Each project was selected on merit by unit project officers to showcase best practice in innovation and taking results to market. The novel approach of informing the audience on the perfect pitches in a more informal setting with live music, audience participation, prizes and even a live cartoonist who illustrated the event[17].

3D LIVE: The mixed reality solution developed by **3D LIVE** delivers experiences that have never happened before for people online and people on location.

Click here for: **Project website |** Presenter: Mike Boniface, University of Southampton IT Innovation Centre

PRISTINE: Designing & implementing the internals of an innovative clean slate recursive inter network architecture (RINA) a solution developed by PRISTINE and presented by .

Click here for: **Project website** | Presenter: Miguel Ponce de Leon, TSSG

CoherentPaaS provides multi cloud data store management enabling organisations to use multiple data stores without barriers.

Click here for: **Service offer | Project website |** Presenter:Ricardo Jimenez-Peris, LeanXcale & Distributed Systems Lab, Universidad Politecnica de Madrid

COSMOS enabling smart city applications and developers to take full advantage of IoT technologies.

Click here for: **Project website |** Presenter: Andrea Rossi, ATOS

FORGE, is turning the large scale FIRE facilities into a learning resource. In particular embedding FIRE interactions within eBooks giving access to these world class facilities to learners across the globe.

Click here for: **Project website |** Presenter: John Domingue, Open University

ORBIT delivers approaches for high-performance fault tolerance into virtualized environments, which are applicable to scenarios of heavy workload, minimizing downtime to less than 700 msecs!

Click here for: **Service offer | Project website |** Presenter: Dimos Kyriazis, National Technical University of Athens

Wikirate's solution brings together tool for stakeholders to aggregate and analyse information to create transparent company ratings.

Click here for: **Project website |** Presenter: Vishal Kapadia, Wikirate

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[17] http://netfutures2015.eu/programme/perfect-pitch-panel/

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CloudWATCH is funded by the EC FP7 - DG Connect Software & Services, Cloud. Contract No. 610994

4 New EC projects funded in first H2020 Call

One-minute madness session presenting Novel Research and expected Impact from H2020 Call 1 projects. Service offers link to each: http://www.cloudwatchhub.eu/service-offers-2016-2018

4.1 ICT-07: Advanced Cloud Infrastructures and Services

Cloud computing is being transformed by new requirements such as heterogeneity of resources and devices, software-defined data centres and cloud networking, security, and the rising demands for better quality of user experience. The projects are oriented towards new computational and data management models (at both infrastructure and services levels) that respond to the advent of faster and more efficient machines, rising heterogeneity of access modes and devices, demand for low energy solutions, widespread use of big data, federated clouds and secure multi-actor environments including public administrations.

The projects funded will develop infrastructures, methods and tools for high performance, adaptive cloud applications and services that go beyond the current capabilities, strengthening the competitive position of the European industry, including SMEs on a time horizon beyond 2018 and building upon European strengths in telecoms and mobile infrastructures as well as software applications and services. The scope of the call covers the themes outlined in the figure below.
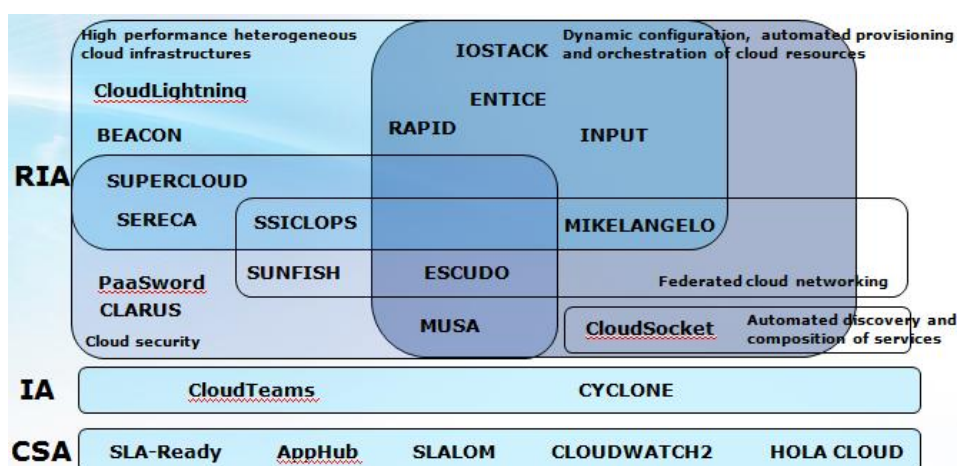

Figure 4 Cluster Diagram by H2020 ICT-07 Call Themes and Project Type

4.1.1 Research & Innovation Actions[18]

BEACON (www.beacon.eu): Delivering an homogeneous virtualization layer, on top of heterogeneous underlying physical networks, computing and storage infrastructures, providing enablement for automated federation of applications across different clouds and data centers.

CloudLightning (http://cloudlightning.eu): Creating a self-organising and self-managing heterogeneous cloud.

SUPERCLOUD (www.supercloud-project.eu): New security and dependability infrastructure management paradigm.

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[18] Research & Innovation actions cover one or more of the following themes: High performance heterogeneous cloud infrastructures; Federated cloud networking; Dynamic configuration, automated provisioning and orchestration of cloud resources; Automated discovery and composition of services; Cloud security.

SERECA (www.serecaproject.eu): Removing technical impediments to secure cloud computing, and thereby encourage greater uptake of cost-effective and innovative cloud solutions in Europe.

SSICLOPS (https://ssiclops.eu): Scalable and secure infrastructures for cloud operations through techniques for the management of federated private cloud infrastructures, in particular cloud networking techniques within software-defined data centres and across wide-area networks.

IOSTACK (www.iostack.eu): A software-defined storage toolkit for big data on top of the OpenStack platform.

ENTICE (www.entice-project.eu): Decentralized repositories for transparent and efficient virtual machine operations.

RAPID (http://rapid-project.eu): A registration mechanism, which permits the accelerated entities to automatically find and connect to nearby accelerators with the required resources.

INPUT (www.input-project.eu): A novel infrastructure and paradigm to support Future Internet personal cloud services in a more scalable and sustainable way and with innovative added-value capabilities.

MIKELANGELO (http://mikelangelo.uni-goettingen.de): Providing the private cloud community with technologies for fast, agile, and secure Cloud and application deployments in diverse hardware environments.

ESCUDO (www.escudocloud.eu): Enforcing security in the cloud to uphold data ownership.

MUSA (www.musa-project.eu): Supporting the security-intelligent lifecycle management of distributed applications over heterogeneous cloud resources, through a security framework.

CLARUS (www.clarussecure.eu): A secure framework for storing and processing data outsourced to the cloud so end-users can monitor, audit and control their stored data while gaining the cost-saving benefits and capacity that cloud services bring.

PaaSword (https://sites.google.com/site/paaswordeu): A holistic data privacy and security by design Platform-as-a-Service Framework for Distributed Encrypted Persistence in Cloud-based Applications.

CloudSocket (www.cloudsocket.eu): A framework for a layered approach for managing the complexity of bridging the semantic distance from business process to workflow configuration of business processes in the cloud.

4.1.2   Innovation Actions[19]

CloudTeams (www.cloudteams.eu): A platform to bring together the software development community and prospective users, in a win-win relationship, by providing the environment where software teams interact with prospective customers, test their developments and collaboratively develop the business model where a software solution lies.

CYCLONE (www.cyclone-project.eu): Integrating Network-as-a-Service, application deployment, service access management, as well as end-to-end security solutions.

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[19] Platforms for trusted cloud systems. Collaborative development, adaptation and testing of open source software for innovative and trusted cloud-based services. Allow on-line collaboration across different platforms and different technical environments for geographically dispersed teams. Encourage the rapid prototyping and testing of open applications, including early and active involvement of users.

4.1.3 Coordination and support actions[20]

AppHub (www.apphub.eu.com): Facilitating the dissemination of open source software through a non-profit marketplace.

SLALOM (http://slalom-project.eu): Model SLA Technical Specifications & Legal Clauses for Cloud services for practical, safe & fair, and understandable technical and legal reference models to save time and resources.

CLOUDWATCH2 (www.cloudwatchhub.eu): A set of services to help European R&I initiatives capture the value proposition and business case so that they can take their outputs to market.

HOLA CLOUD (www.holacloud.eu): An advanced conference series producing and revising an annual technology roadmap and providing a venue for the members of the community to meet and exchange results and ideas for the future.

SLA-Ready (www.sla-ready.eu): User-friendly SLA services for SMEs including common vocabularies, SLO service and metrics, standardized SLA templates and tutorials.

4.2 ICT-09: Tools and Methods for Software Development[21]

The quality levels required for complex and critical systems for example in terms of reliability, resilience and automatic adaptation, still represent a major challenge given current software development methods and tools. Breakthroughs in this area could significantly improve the growth and competitiveness of the European industry and encourage faster innovation cycles. They could also foster a more competitive EU software industry, especially in the sector of large and interoperable software systems for industrial and public sector applications.
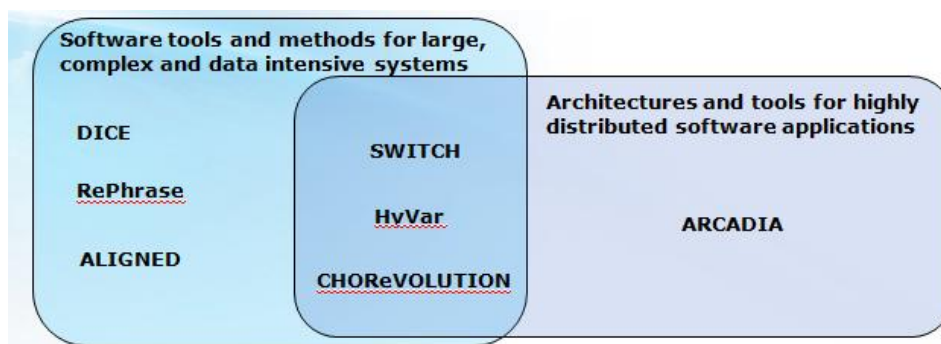

Figure 5 Cluster Diagram by H2020 ICT-09 Call Themes

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[20] Support to the definition of common reference models for SLAs in the cloud. Support for the adoption of cloud computing infrastructures and services by addressing legal, economic, and societal factors. Support to collaboration among research projects in the areas of software, services and cloud computing, including support to common dissemination / exploitation activities and roadmapping.

[21] Software tools and methods for large, complex and data-intensive systems: Tools and methods for incorporating integrity, robustness, reliability and resilience into evolving software systems across the complete software lifecycle, especially for complex and secure business-critical systems. Innovative means to manage the complexity of large software and data-intensive systems, including simulation, testing and verification. Software architectures and tools for highly distributed applications: Novel approaches to development, deployment, management and dynamic reconfiguration of distributed applications. Architectures and tools to maximise quality of experience in elastically scalable applications. Particular account should be taken of data location, latency and data throughput in heterogeneous cloud environments including specialised hardware resources and sensors.

DICE (www.dice-h2020.eu): A novel UML profile and tools that will help software designers reasoning about reliability, safety and efficiency of Big Data applications.

ALIGNED (http://aligned-project.eu): A software and data engineering methodology to build and maintain IT systems that use big data on the web.

SWITCH (www.switchproject.eu): Software methods and tools for the entire lifecycle of time critical cloud application.

HyVar (www.hyvar-project.eu): A framework for hybrid variability to address continuous software evolution in distributed systems.

CHOReVOLUTION (www.chorevolution.eu): CHOReVOLUTION adds the automated synthesis of dynamic and secured choreographies to existing choreography technologies. This makes these technologies able to support stringent application requirements in terms of dynamism and cross-organization security.

ARCADIA (www.arcadia-framework.eu): A novel reconfigurable by design highly distributed applications development paradigm over programmable infrastructure.

4.3 EUJ-1 Technologies combining big data, internet of things in the cloud[22]

iKaaS (http://ikaas.com): Build a city model based on healthcare information, population changes, changes in the city such as infrastructure, physical environments in order to estimating the future shapes of a city.

4.4 ICT-35-2014: Innovation and Entrepreneurship Support[23]

PICSE (www.picse.eu): Creates a flexible and agile procurement model to purchase cloud services that will allow public research organisations take advantage of the best the cloud market has to offer.

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[22] http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/3051-euj-1-2014.html
[23] http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/98-ict-35-2014.html

6 Towards a transparent and trusted cloud in Europe

6.1 European Commitment to Research and Innovation

6.1.1 EC Investment

Through several EC communications from 2012 to 2014, the European Commission as continuously shown commitment to research and innovation:

> **COM(2012)529 of 27 September 2012: unleashing the potential of cloud computing in Europe**
>
> *"…make full use of other instruments, notably through research and development support under H2020 on long term challenges specific to cloud computing as well as assisting the migration to cloud-based solutions"*

This statement has been backed by significant resources allocated to support cloud computing research and innovation within the H2020 LEIT ICT WP2014-2015 with additional funding possibilities: under H2020 Societal Challenges and through other H2020 instruments e.g. SME Instrument (figures below).

> **COM(2014)442 of 2 July 2014: towards a thriving data-driven economy**
>
> *"… H2020 and national R&I programmes can address relevant technical challenges: from data creation and actuation through networks, storage and communication technology to large-scale analysis, advanced software tools and cyber security"*
>
> *"In order to encourage R&I on business intelligence, decision support processes and systems supporting SMEs and web-entrepreneurs, H2020 addresses descriptive and predictive data analytics, data visualisation, artificial intelligence and decision-making software tools and algorithms"*
>
> *"… future R&I actions under H2020 will address the optimal use and configuration of cloud computing solutions for data analytics and advanced infrastructures and services"*

FP7 ICT Work Programmes

- ❖ WP 2007-2008 (Call 1): Service and Software Architectures, Infrastructures and Engineering: €120 million
- ❖ WP 2009-2010 (Call 5): Internet of Services, Software and Virtualisation: €110 million
- ❖ WP 2011-2012 (Call 8): Cloud Computing, Internet of Services and Advanced Software Engineering: €70.0 million
- ❖ WP 2013 (Call 10): Software Engineering, Services and Cloud Computing: €41.5 million

EC funding for Software & Services and Cloud Computing (over 7 years):

- ❖ €341.5 million + some FI-PPP projects + €10.0 million (PCP)
- ❖ More than €50 million/year on average

Total EU contribution in FP7: €351.5 million:

- ❖ Number of projects: 95
- ❖ Average: €3.7 million/project

6.1.2 Preparation for the H2020 WP 2016-2017

As part of the public consultation process for preparing the LEIT 2016-2017 Programme, the second CloudWATCH Concertation meeting (September 2014) established a set of recommendations on the WP themes of cloud computing, software engineering, and open source research. Francisco Medeiros, Deputy Head of Unit, Unit E2 Software & Services, Cloud Computing, DG CONNECT, European Commission, explained the outcome of this Concertation meeting will also feed into this process. The EC are very keen on the next WP taking into account the recommendations of active projects at both meetings.

Based on these outcomes, the Work Programme will go through a series of internal procedures before the 2016-17 calls are published in the 4th quarter of 2015.
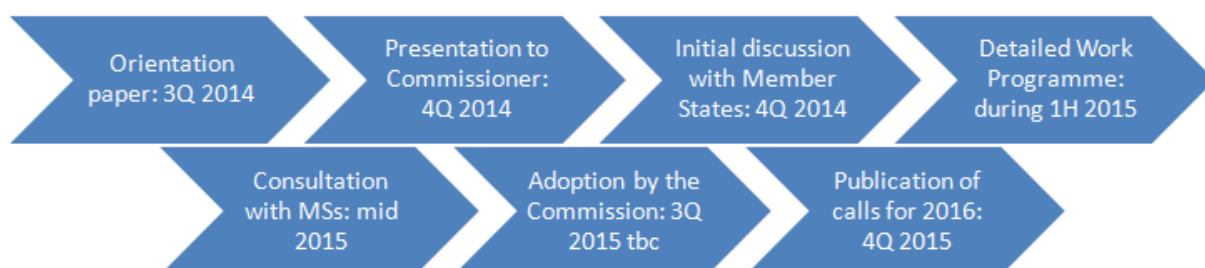

Figure 6 Internal EC procedures towards WP publication

H2020 WP2016-2017 timeline:

- ❖ 5 March 2015: first discussion by MSs Committee
- ❖ 20 May 2015: second discussion by MSs Committee
- ❖ June 2015: inter services consultation
- ❖ July 2015: formal opinion by MSs Committee
- ❖ September 2015: Commission adoption
- ❖ October 2015: presentation at ICT 2015 Event (Lisbon, 20-22 Oct)
- ❖ Publication of Call for Proposals

CloudWATCH is funded by the EC FP7 - DG Connect Software & Services, Cloud. Contract No. 610994

7 Conclusions

One of the objectives of the Digital Single Market Strategy (DSM) is creating long-term growth potential. Europe needs a digital market that allows new business models to flourish, start-ups to grow and industry to innovate and compete on a global scale. The European Commission's programme for Software, Services and Cloud gives companies and research institutions the freedom to innovate technically in cloud computing. This is how European research and innovation initiatives bring continuous improvements and deliver services and solutions with increasing value for the digital single market.

The strategy makes this specific reference "*the Commission will launch a European Cloud initiative including cloud services certification, contracts, switching of cloud services providers and a research open science cloud.*"

CloudWATCH (1/9/2013 – 31/8/2015) and CloudWATCH2 (1/9/2015 – 31/8/2017) are in a prime position, via the CloudWATCHhub.eu, to provide a comprehensive overview on how the European Research and Innovation (R&I) projects may contribute to the objectives of the DSM via their results. Projects need to think strategically and show how they are marketing their "cloud services" to potential markets and end-users in a more market oriented way.

CloudWATCH2 takes a pragmatic approach to market uptake and sustainable competitiveness for wider uptake and commercial exploitation. It provides a set of services to help European R&I initiatives capture the value proposition and business case as key to boosting the European economy.

- **A cloud market structure roadmap with transparent pricing** to enable R&I projects to chart exploitation paths in ways they had not previously considered, or help them avoid approaches that would not have been successful.
- **Mapping the EU cloud ecosystem of products, services and solutions emerging from EU R&I projects.** Identifying software champions and best practices in mitigating risks associated with open source projects, and ultimately, enable faster time-to-value and commercialisation.
- **Concertation for clustering and convergence on common themes and challenges.** Re-use of technologies will also be of paramount importance.
- **Promoting trusted & secure services** through roadshows and deep dive training sessions. Giving R&I initiatives a route to users at major conferences or in local ICT clusters.
- **A portfolio of standards for interoperability and security** that can facilitate the realisation of an ecosystem of interoperable services for Europe.
- **Cloud interoperability testing** in an international developer-oriented and hands-on environment. Findings will be transferred into guidance documents and standards.
- **Risk management and legal guides** to the cloud for private and public organisations to lower barriers and ensure a trusted European cloud market.

The next Concertation meeting will be organised by CloudWATCH2 as part of its wider mandate to provide a set of services to capture the value of European R&I initiatives in the digital single market and ultimately benefit the European economy.

8   Annex 1 – Research & Innovation Outputs: Open source solutions and services coming to the market from R&I initiatives and their impact on the European market.

The following projects pitched their service offers.

ARTIST is for software owners or consultants who need to modernize several similar applications towards the cloud. It's an end-to-end solution that provides the client with the modernized software. A tool-supported methodology supports the user to perform the modernization.

Click here for: Pitch Presentation| Service offer | Project website

Presenter: Leire Orue-Echevarria Arrieta, Tecnalia

BigFoot is a platform-as-a-service solution for processing and interacting with large volumes of data. Bigfoot builds upon and contributes to the apache Hadoop ecosystem and the apache OpenStack project. Key differentiating benefits provided by BigFoot include: Analytics-as-a-Service; Resource allocation mechanisms; In-situ querying of RAW data; High-level languages.

Click here for: **Pitch presentation | Service offer | Project website**

Presenter: Daniele Venzano, Eurecom

Broker@Cloud provides a unique holistic solution for quality assurance, optimization, failure prevention and recovery brokerage mechanisms together with a baseline framework for building new cloud service brokerage mechanisms.

Click here for: **Pitch presentation | Service offer | Project website**

Presenter: Ewald Quak, SINTEF

CELAR delivers a fully automated and highly customisable system for elastic provisioning of resources in cloud computing platforms..

Click here for: **Pitch presentation | Service offer | Project website**

Presenter: Nectarios Koziris, NTUA

CloudScale provides an engineering approach for building scalable cloud applications and services.

Click here for: **Pitch presentation | Service offer | Project website**

Presenter: Gunnar Brataas, SINTEF

CloudSpaces has created **StackSync.** StackSync is a secure open source Personal Cloud that ensures zero-knowledge for the cloud provider and enables users to retake control of their information.

Click here for: **Pitch presentation | Service offer | Project website**

Presenter: Pedro Garcia Lopez, URV

COMPOSE aims at enabling new services that can seamlessly integrate real and virtual worlds through the convergence of the Internet of Services (IoS) with the Internet of Things (IoT).

Click here for: **Pitch presentation** | **Service offer** | **Project website**

Presenter: Benny Mandler, IBM

LEADS proposes Data-as-a-Service as a solution to the need for small actors to take advantage of big public data, by mutualizing the costs of extracting, storing and processing public data, while offering rich and extensible possibilities, including privacy-protecting querying on public and private data including data updated in real-time, and more.

Click here for: **Pitch presentation** | **Service offer** | **Project website**

Presenter: Pierre Sutra, University of Neuchâtel

The MARKOS Prototype provides user friendly querying and browsing web tools to inspect the structure of the open source code available on the web.

Click here for: **Pitch presentation** | **Service offer** | **Project website**

Presenter: Andrea Nicolai, T6 Ecosystems

The MODAClouds solution allows the design, development, and re-engineering of existing components into software modules that operate directly on multiple Clouds.

Click here for: **Pitch presentation** | **Service offer** | **Project website**

Presenter: Elisabetta Di Nitto, Politecnico di Milano

OPENi inspires innovation in the European mobile applications industry, by radically improving the interoperability of cloud-based services and trust in personal cloud storage through the development of a consumer-centric, open source mobile cloud applications platform.

Click here for: **Pitch presentation** | **Service offer** | **Project website**

Presenter: Eric Robson, TSSG

OSSMETER provides a platform and over 200 independent and reliable metrics for evaluating open source technologies. Measuring both the quality of the code and the quality and level of activity of the surrounding support communities, OSSMETER enables the comparison of different open source technologies both as they stand today and also their history and evolution.

Click here for: **Pitch presentation** | **Service offer** | **Project website**

Presenter: Jurgen Vinju, Centrum Wiskunde & Informatica

Prowess Effective and efficient testing automation techniques and tools focusing, in particular, on web services-based systems and cloud computing.

Click here for: **Pitch presentation** | **Service offer** | **Project website**

Presenter: Clara Benac Earle, Universidad Politécnica de Madrid

U-QASAR's a flexible Quality Assurance, Control and Measurement Methodology to measure the quality of Internet-related software development projects and their resulting products.

Click here for: **Pitch presentation** | **Service offer** | **Project website**

Presenter: Silvia López, Innopole

CloudWatch

**A European Cloud observatory supporting
cloud policies, standards profiles & services**