D2.1 Technology Round-up and Market Readiness Report

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This document gives an overview of the results emerging from the first CloudWATCH2 Concertation meeting held 20 April 2016 within Net Futures 2016 on "Clusters, collaboration and creating impact in the market". The document highlights the main outcomes of the event including topics recommended by the four EC thematic clusters for the Horizon 2020 ICT Work Programme 2018 – 2020. The event also examined how projects can better prepare and plan exploitation activities and the importance of dissemination and outreach to target stakeholders.

CLOUDWATCH2 has received funding from the European Union's Horizon 2020 programme - DG CONNECT Software & Services, Cloud. Contract No. 644748

CloudWATCH2 Mission

It is only when the innovation process is inclusive and open that we truly advance technology for humanity – from small businesses to public sector organisations and citizens as the new digital consumers. The use of open source software and open standards are becoming increasingly seen as enablers and levellers for public and private sectors alike, bundling skills to create new services and applications.

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.

CloudWATCH2 services include:

- 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.
- Impact meetings 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.
- Legal guidelines to the cloud for SMEs containing practical examples of cloud contracts' clauses that need to be assessed before purchasing cloud services.

Disclaimer

CloudWATCH2 (A European Cloud Observatory supporting cloud policies, standard profiles and services) is funded by the European Commission's Unit on Software and Services, Cloud Computing within DG Connect under Horizon 2020.

DOCUMENT INFORMATION

Document title:	Technology Round-up and Market Readiness Report
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Reviewer(s):	Michel Drescher, UOXF Frank Khan Sullivan, Strategic Blue
Target audiences:	European Commission EC-funded projects in particular from Unit E2
Keywords:	Cluster, Exploitation, sustainability, market
Deliverable nature:	Report
Dissemination level: (Confidentiality)	Public
Contractual delivery date:	31 April 2016
Actual delivery date:	30 June 2016
Version:	Final
Reference to related publications	N/A

Executive Summary

The Digital Single Market (DSM) in Europe is an unprecedented opportunity to create one of the biggest digital marketplaces in the world with cloud, the Internet of Things and the big data economy playing a central role.

Cloud computing has now reached a point where it is truly accessible to all types of organisations and pretty much a staple in the start-up culture, radically reducing the barriers to entry in any sector.

The challenge for Europe is to ensure it retains its leadership position in research and innovation on cloud software and services. This leadership not only depends on Europe's ability to innovate at the technological level, but also to demonstrate tangible business value. European research projects need to think strategically so that their results can make an impact on the market.

Through the Horizon 2020 programme, the European Commission has continued to invest in research and development in the software, services and cloud computing sector. The knowledge and understanding of current and future challenges that consortia of currently funded projects possess is key for charting a course for future Work Programmes and Europe can continue to advance in this field.

The first CloudWATCH2 Concertation meeting was held at the NetFutures 2016 event. The was a key event in highlighting the work achievements by projects in the four EC clusters to identify priority areas and challenges for the 2018-2020 Work Programme. The Concertation meeting saw each EC cluster outline these for the following themes:

- Software Engineering for Services and Applications.
- Data Protection, Security and Privacy in the Cloud.
- Novel approaches and technologies for Cloud resource and service management
- Inter-cloud Challenges, Expectations and Issues.

Recommendations from the clusters will contribute to a scoping paper produced by the European Commission in the summer of 2016.

With market forces driving adoption and take up of software and cloud services, European projects face a number of challenges when defining and implementing their exploitation plans. This Concertation meeting also highlighted best practices in establishing and carrying out exploitation activities. Key to this is to start as early as possible and in alignment with technological development. Projects not only need to start planning early, but also plot their outputs as the project evolves. In addition, to define the right route to market, projects need a proper understanding of the cloud market and supply chains within it.

The event also saw the updating of project Service Offers with projects updating on status, outlining exploitation and sustainability plans, as well as identifying target stakeholders and target vertical markets.

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The aim of the Concertation meeting, *Clusters, collaboration and creating impact in the market*, was to look at future directions for software & services and cloud computing, highlight new opportunities for research and innovation, identify commonalities both on a technical and target market levels, cluster and identify strategies to communicate results to a fast moving market.

Participants included active projects under the remit of the Unit CNECT.E2 Software & Services and Cloud Computing. The unit is currently responsible for 49 ongoing projects including joint EU-Japan (1) and EU-Brazil (3) projects. A full participant list and associated projects can be found in Annex 3. In addition, participating projects also updated the CloudWATCH2 Service offer catalogue[1] providing information on exploitation plans, target stakeholders and target vertical markets. CloudWATCH2 will evolve this into a searchable online catalogue of Service Offers and linked directly to the AppHub directory[2]. CloudWATCH2 will promote these services at a set of outreach workshops targeting European SMEs and governments end users.

1.1 Creating a resilient cloud market

Frank Khan Sullivan, Strategic Blue & CloudWATCH2

Presentation | CloudWATCH2 Roadmap v1

The Digital Single Market is no longer a vision. It is a reality. Businesses and consumers alike depend on access to public cloud computing infrastructure commonly referred to as Infrastructure-as-a-Service. This infrastructure is provided by 'hyperscale' vendors that lease out remote data processing and storage capacity for use by European businesses and consumers. Due to growing critical dependence on this infrastructure – the public cloud resources that underpin the Digital Single Market – it is necessary to understand measures that improve market transparency and resilience.

Who benefits and how: European companies running their businesses using software hosted on public cloud infrastructure, from high potential startups to established enterprises, benefit from contractual terms that are fair and pricing that is transparent. End consumers, potentially hundreds of millions of Europeans that access services through the Internet, ranging from video on-demand to visa application forms, who are otherwise unaware that these services are hosted on cloud infrastructure, indirectly benefit from a stable and resilient market. Governments backing 'cloud first' policies are more likely to fund projects that can procure cloud resources easily, on pricing that is transparently competitive. Finally, cloud vendors benefit from increased uptake of their services due to increased trust in the.

Digital Single Market Strategy: Europe's growing critical dependence on public cloud computing infrastructure ("essentiality") and the inequality of negotiating power between a vast number of users and

[1] http://www.cloudwatchhub.eu/service-offers & http://www.cloudwatchhub.eu/sites/default/files/A-portfolio-of-offers-for-trusted-and-secure-services_Web.pdf
[2] https://directory.apphub.eu.com/

a few hyperscale cloud vendors ("asymmetry") beg the question, "What could possibly go wrong with the cloud market?" It is the role of government to identify and plan against such, hopefully unlikely, Black Swan risks to our society.

Cloud computing has grown significantly over the past decade. Where once the majority of data processing and storage was 'local' to the device used, it is now delivered remotely as a service over the Internet. The sheer size of this new market and the value it represents to the overall economic output of Europe over the next decade makes it essential. By applying transferable knowledge gained from more established markets such as energy or financial services, we are able to encourage the cloud computing market to build in resilience to unforeseeable shocks. Cloud computing services that have so demonstrably advanced technology, research and innovation in Europe over the past decade must continue to grow in the right direction. Cloud services are clearly "Essential".

From the perspective of the cloud provider, whose primary focus is to increase adoption and utilisation of their own cloud services, there is a common need to promote trust in the wider market. The most visible efforts are those promoting data privacy and security. If customers lose trust, they try to leave. If they see no basis for trust, they don't use public cloud services in the first place. The deeper trends which illustrate barriers to real competition in the overall cloud market such as punitively expensive data withdrawal costs, unbalanced service level agreements and restrictions on resale that block the transfer of risk to those best placed to manage it, create a perception of "lock-in" which in turn creates a barrier to future adoption and utilisation of cloud services. When a cloud buyer perceives that they have no viable alternative and are unable to vote with their credit card or purchase order, they spread their discontent. Measures that independently facilitate financial and technical interoperability counter the perception of "lock-in", and increase trust in the wider market.

From the perspective of the cloud buyer that seeks to procure Infrastructure-as-a-Service, the direct on-demand price published by cloud vendors masks the complexity of its true cost. The lack of independently verifiable pricing information, or benchmarks, frustrates buyers attempting to make an effective comparison with other cloud services that are competing for their business. Opaque pricing strategies prevent buyers from obtaining a complete view of the market and makes it more difficult for a buyer to make an informed purchasing decision about the appropriate price premium to pay for differentiating qualities between providers. Without transparent pricing, a cloud user may be less able to switch vendors.

Considering the case of buyers already using cloud resources, discrepancies between what is billed compared to what is deployed or used, would prove difficult to resolve without independent metering where the price applied is verifiably correct. In the case of outages or technical failures where the provider is at fault, the terms of typical service level agreements used throughout the industry typically preclude the possibility of financial compensation for the buyer short of a pro-rata refund of any upfront reservation fee. When a buyer is unable to make a fully informed purchasing decision, to independently verify that they are being billed correctly, to receive restitution for failures that negatively impact their operations or are otherwise at risk from unilateral assignation of risk, it is typically because they are at a disadvantage relative to the vendor supplying the service. Such a market is said to be "Asymmetric".

With Europe's growing digital dependence on infrastructure they don't own, from companies with whom one cannot easily negotiate, we have to ask the question, "What could possibly go wrong?" Nobody likes the answers because they potentially invite comparison with the events leading up to the Global Financial Crisis or various electricity blackouts, and yet, we have to ask this question in order to understand measures that minimise the risk of a shock that could threaten the continued growth of the European Digital Single Market.

1.2 How projects can map priorities and future collaboration with the CloudWATCH2 Cluster app

David Wallom, Oxford University & CloudWATCH2

Presentation | CloudWATCH2 Cluster app

The CloudWATCH2 cluster application analyses detailed knowledge of the cloud computing landscape, and demonstrates how different cloud computing projects form natural clusters based on their common relationship to the defining features of cloud services using the NIST model of defining characteristics. This aspect of project clustering proves more helpful than the rather more obvious relationships based on common goals, aspirations and target audiences, which more often form the basis for project collaborations, or indeed the basis for identifying close competitors. The methodology addresses the challenge of quickly and effectively assessing a large and complex landscape of activities and quickly find structural patterns in that landscape.

Typical beneficiaries of such methodology are manifold;

- Cloud research projects can use the methodology to determine which other projects to contact and discuss overlapping interest to make the most out of the taxpayers' money that fund their activities;
- Industry (i.e. privately funded clusters of R&D projects) identify overlapping interests leading to better public-private partnerships to keep the projects going sustainably;
- Funding agencies that need to make an informed decision whether to fund a certain project or not: The methodology can assist and provide some of the much needed information;
- Cloud service providers can use the methodology to determine which of their potential customers align well with their own priorities, and are thus good candidates for converting an initial contact to a paying customer - it saves time and effort in selecting the best opportunities;
- (Cloud) Standards Development Organisations can use the methodology to quickly assess how to compose or facilitate the composition of a Working Group to stay focused on their ultimate goal.

The EC FP7 project CloudWATCH (2013-2015) was required to reach out and create a community from a large number of projects with multiple stakeholder groups in the Cloud computing landscape (whether EC-funded or not). The aim was to gather relevant information about their priorities and objectives in Cloud computing, and to turn that information into a profile of relevant standards.

In order to address this, CloudWATCH broke down this process into three major methodologies that are reliable and repeatable. The first methodology includes a phase of input data gathering, where stakeholders scored their project objectives on a numeric scale against a set of Cloud characteristics as defined within the NIST model of cloud computing. That raw data is then analyzed and processed combining several well-known and accepted statistical methods for data analysis. The outcome provides a fast and efficient grouping of projects with sufficient overlap in priorities and objectives, showing where the analyzed projects sit in the landscape. It further highlights the characteristics of importance to them as well as showing technically synergistic clusters of projects which will allow for quicker establishment of communications between projects that are technically aligned.

The second methodology takes these groupings further by applying Cloud computing architecture elements to these groupings, mapping candidate standards into it, and finally crystallize the results into strawman documents that facilitate discussion among grouped projects for a common approach on interpreting and implementing affected standards - and thus, eventually achieve interoperability.

Finally, the last element in this approach is to validate the available solutions post-implementation and apply software testing and quality assurance procedures to it, in collaboration with other Cloud interoperability projects and activities, such as the Cloud Interop plugfest initiative led and organized regularly by OGF representatives.

The CloudWATCH2 project (funded by the EC H2020 programme) has continued this work by further refining the methodologies, and promote their uptake and collaboration on all its aspects with international partners, following IEEE P2301 lead in this field. In addition, CloudWATCH2 has launched an online version of the cluster app (Beta version) and have requested that all projects complete this and can support EC clusters in identifying future collaboration points.

How do you use the app?

- **Add your scores:** Based on NIST's cloud computing characteristics, users should simply rank how important each characteristic is to their project.CloudWATCH2 will then verify input and inform the user when the scores have been added to the database.
- **Carry out an interactive cluster analysis and see where your project lies.** Use the tool to analyse the cloud landscape on-demand. Select the preset NIST cloud computing characteristics of your choice, or configure an individual set of characteristics to identify clusters. You can even set a maximum cluster distance to control the size and focus of computed clusters.
- **View our database and see how other projects have scored themselves.** Access the original scores of all projects and find out more about them.

Figure 1 Projects clustered by essential cloud characteristics

	On-demand self-service	Broad network access	Resource pooling	Rapid elasticity	Measured service	Massive scale	Homogeneity	Virtualisation	Low cost software	Resilient computing	Geographic distribution	Service orientation	Advanced security
100 Percent IT	0.8684	0.8054	2.0281	1.1094	0.7632	0.5247	1.3873	2.5185	-0.7775	0.7702	0.7104	-0.8284	1.2844
ARTIST	-2.2192	-1.8635	-0.2059	0.7985	0.3925	-0.6604	-2.9159	-2.3716	-1.1707	-1.5383	-0.9037	-0.3496	-1.7714
ASCETIC	-0.8610	-1.9658	-1.3117	1.0398	1.0519	1.2630	-1.0653	-1.2907	0.7838	0.6942	1.9436	-0.4022	-1.4582
BETaaS	-0.8088	-0.5242	0.1187	-0.0886	0.0772	-0.6558	-0.5182	-0.3373	-0.7677	-0.0098	-0.2596	-0.0648	0.2457
BNCweb	-0.1684	-0.4351	-1.9676	-2.3482	-3.0119	-1.9234	-0.6885	-2.8182	0.1449	-2.6003	-1.8981	-0.4439	-1.4413
BigFoot	0.2261	-0.5426	1.8099	1.7996	-0.2467	0.2496	-0.4800	0.3964	-1.3388	-2.1067	-0.0880	-2.5535	-1.4224
BrokerAtCloud	-1.9588	-1.0036	-0.0062	-1.3419	0.1334	-2.2840	-0.0681	-0.0145	-1.9848	1.6280	-0.1958	0.5049	2.4819
CELAR	-0.4639	-0.7882	0.0671	0.4255	0.3951	0.0695	-0.1511	0.0093	-0.3962	0.3987	0.7241	-0.5167	0.0330
COMPOSE	-0.5626	0.1735	-0.4612	-0.5590	-0.1184	-0.5115	-0.8514	-0.9214	0.0789	-0.3764	-1.0734	1.0053	-0.1755
Catania SG	1.3238	0.2143	-0.0385	0.0708	-0.8386	0.5719	1.1831	0.5475	0.5675	-0.4616	0.7613	-1.2395	-0.4753
Clarus	1.6004	1.3512	0.4800	0.4760	1.0314	1.5926	1.9699	2.3015	1.2567	2.0044	1.4747	0.6517	1.2536
CloudCatalyst	-0.3077	-0.4114	-1.1661	-1.7901	-2.1680	-1.7361	-0.3297	-1.7853	-0.3542	-1.6427	-1.3376	-0.4677	-0.5471
CloudLightning	1.4872	0.6708	0.6849	1.1177	-0.2426	1.3141	0.4714	0.6386	0.7222	-1.2191	0.2558	-1.0907	-1.3382
CloudLightning H2020	0.9696	0.4951	-0.7820	-0.2055	-0.6996	0.6747	0.1412	-0.5602	1.2729	-0.8668	-0.1553	0.0446	-1.1784
CloudScale	1.6623	2.3143	0.4706	1.1330	-0.0344	1.8303	-1.1750	-0.5378	1.9742	-2.7649	-2.1793	1.1591	-2.7686
CloudSpaces	2.1402	2.5085	1.5302	1.5666	2.1679	2.6871	1.8607	3.3154	1.6937	2.1457	1.1638	1.4892	1.2087
CloudTeams	2.1502	0.8281	-0.5248	-2.8884	-5.0507	-2.4719	2.2037	-0.5426	-0.5128	-3.5074	-1.7606	-2.8267	-0.4480
CloudWave	0.3428	1.5387	0.8933	0.8824	1.3149	1.0254	-0.5492	0.7028	0.6671	0.1077	-0.9550	1.7066	-0.0487
DICE	-2.1689	-2.5077	-0.6403	0.8550	1.5206	0.0471	-1.4358	-1.0411	-0.7889	1.4050	1.6302	-0.2605	-0.1036

Figure 2 A snapshot of Cluster analysis results

2 Identifying topics for the Horizon 2020 ICT Work Programme 2018 – 2020

Chaired by Francisco Medeiros, Deputy Head of Unit E2 Software, Services, Cloud computing

Presentation

Concertation meetings have been key in shaping Work Programmes for the European Commission. The CloudWATCH concertation meeting in September 2014 saw participants recommend themes for the LEIT 2016-2017 Programme. From this, two calls were closed just days before the 2016 Concertation meeting: ICT-06-2016: Cloud Computing, and ICT-10-2016: Software Technologies. Both were heavily subscribed and it is expected that over 20 new projects will be funded and commence later in 2016, including international cooperation projects.

The European Commission has initiated the preparation of the 2018-2020 Work Programme (WP) with a scoping paper to be prepared in summer 2016 with discussions with member states taking place between July and October 2016. Public consultation may occur in Q3 of 2016 while the WP will be drafted between November 2016 to June 2017. The WP is likely be adopted in 4Q 2017.

The four EC themed clusters announced at the 2015 Concertation meeting have a key role in supporting this process by providing white papers which include a set of recommendations for research challenges to be addressed by the 2018-2020 WP. These were presented and are outlined in the following sections.

2.1 Software Engineering for Services and Applications (SE4SA)

Elisabetta Di Nitto, Politecnico di Milano & Cluster Chair

Cluster website | Cluster white paper | Presentation

ICT and, in particular, software is more and more pervasive. It is affecting our lives, the services we can exploit, business, manufacturing, agriculture, health, and other fields in a way that could have never been even imagined a century ago.

Countries such as Taiwan, South Korea and USA spend a significant amount of their R&D investments in ICT, with Taiwan (more than 70%) and South Korea (more than 50%) mostly focusing on hardware, and USA (more than 40%) on both hardware and software. The situation in Europe varies from country to country, but in all cases ICT is significantly less prominent with about 20% of R&D investments for France and Germany[3].

Software does not require complex machinery to be developed, it can be created on personal computers that today are accessible to almost all people in society. This gives the impression that it can be developed by anyone with good technical skills and willing to learn a simple-to-use programming language. At the same time, its intangibility makes it invisible and, thus, suggests that it is only a minor part of the devices it controls including information systems, factory automation, medical devices for diagnostics, mobile phones, sensors, and so on, while in many cases, it is a core part of it. For these reasons, historically, there has been a tendency to direct investments and attention to the devices rather than to the software itself, and this has lead to important failures and the loss of significant quantities of money in the best cases.

Within 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 use of technologies and new paradigms, still ensuring productivity of processes and quality of software (performance, availability, evolvability, reliability, security and other such factors).

The SE4SA (Software Engineering for Services and Applications) cluster aims to facilitate 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. The following table provides an overview of current challenges identified by the SE4SA cluster so far and topics for the 2018-2020 WP.

SE4SA Cluster members

Aligned, AppHub, ARCADIA, Artist, CloudTeams, CloudWave, DICE, ENTICE, Envisage, HyVar, MODAClouds, MONDO, Prowess, RISCOSS, SeaClouds, S-CASE, Supersede, SWITCH, U-QASAR.

[3] Brandon Shackelford and John Jankowski, Information and Communication Technologies Industries Account for $133 Billion of Business R&D Performance in the United States in 2013, National Center for Science and Engineering Statistics, NFS, April 2016. http://www.nsf.gov/statistics/2016/nsf16309/

Table 1 Overview of current challenges identified by SE4SA cluster so far.

Challenge	Description	Action by cluster
Ensure that practitioners and institutions understand the importance of software engineering as a discipline per se, not strictly related to a specific application area	The lack of software engineering expertise or practices has caused software bugs that, in turn, have determined loss of significant quantities of money in the best cases. The last prominent case happened very recently, in February 2016, when the Japanise Hitomi spacecraft broke off for a problem that was caused by a number of software failures[4].	Analyse the field and provide evidence of the difficulties and complexity behind the development of core infrastructural software. In this context, highlight the importance of consolidating the software engineering discipline, which, despite the impressive achievements in the area of software technology, is probably one of the youngest scientific and technological disciplines, with only 60 years of history.
Increase productivity and quality through model-based techniques	Model-based approaches have the potential to create proper abstraction layers that allow users to focus on the important aspects of design, leaving aside details related to technological platform and deployment resources. This, in principle, may lead to an increase of productivity and quality. Consider advances with IBM OpenWhisk or AWS Lamda in the extreme case. Abstraction does lead to an increase in productivity. If leaving technical details aside, perhaps consider how many hours or how much money a developer saves by not having to be a systems administrator? Installing scripts for web applications or catalogues of VM templates reduces deployment time.	A number of projects within the cluster are addressing this issue, while none of them appear to tackle the issue of identifying proper metrics for measuring the increase of productivity and quality. The proposed approaches will be compared and gaps identified in order to solicit possible further research.
Manage development complexity and risks at design time and runtime	Complexity and risks should be clearly identified and somehow measured while developing and/or operating software. Such measurement enables proper control.	Some projects in the cluster have preliminarily addressed the problem of supporting stakeholders in the identification of risks and critical components and in identifying possible solutions to them. Further analysis and discussion is needed on this point that certainly opens up new challenges for future research.
Support the development of micro-service architectures	Micro-service architectures are a way to organise systems in terms of self-contained, stateless services that interact with each other through the mediation of some middleware like a message queue, and that can be individually scaled and reconfigured without impacting on the rest of the system.	Some of the projects in the cluster are working on micro-service architectures offering tools to support their development and operation. These tools range from new programming environments that simplify their development and composition, to verification, monitoring and control components to increase their

[4] Alexandra Witze. Software error doomed Japanese Hitomi spacecraft, Nature News, 28/05/2016 http://www.nature.com/news/software-error-doomed-japanese-hitomi-spacecraft-1.19835

CLOUDWATCH2 has received funding from the European Union's Horizon 2020 programme - DG CONNECT Software & Services, Cloud. Contract No. 644748

		quality.
Equip software with simple to use self-adaptive mechanisms	Self-adaptation is not a new research area, but acquiring more and more importance for modern software that is executing in complex environments such as fog infrastructures.	Many projects in the cluster are focusing on defining various kinds of self-adaptation approaches. Once, again, the role of the cluster with this respect is to create a map of the various contributions and to identify gaps for further research.
Understand the requirements from complex domain such as big data and cyber physical systems and translate them into specific design methods and approaches	Big data applications are typically dealing with large quantities of unstructured data, produced by different sources and potentially showing different levels of quality. Moreover, these often have to be handled at a high speed otherwise they lose their relevance. Cyber physical systems are also producing and managing large quantities of data. Moreover, they need to be connected in a smart way with the surrounding environment to support proper sensing and actuation. In these scenarios, special-purpose design paradigms and quality assurance approaches are required. Moreover, issues such as privacy and security need to be addressed and the level of the engineering of system components.	Some of the projects of the cluster are focusing either on data intensive applications or on cyber physical systems and are working to offer solutions to the listed issues. Once again, the role of the cluster with this respect is to create a map of the various contributions and to identify gaps for further research.
Improve trust, transparency and interoperability	Improve trust, transparency and interoperability through the introduction of methods that allow (self/federated)-certification of outputs based on unanimously agreed procedures and standards.	Some of the cluster projects are partially working in this area and will provide inputs suitable for the next generation projects to continue to advance the reseaRch.
Exploit user feedbacks for software improvement	End-users are increasingly providing feedback through reviews, ratings and comments in online forums, app stores and social networks. While this represents an opportunity to involve end-users in software evolution processes aiming at improving the quality of the offered software applications and services, it calls for methods and tools for gathering end-user feedback that need to scale and enable automated analysis of feedback and contextual data to support requirements analysts, system architects, developers and project managers in decision-making tasks.	This area is well covered by one of the projects of the cluster and has the potential of opening up new research. By making it easy to collect user feedback (e.g. simple UX heat maps) it becomes easier to decide why a feature should be developed in response to demand from users, much in the same way an online petition works. Some of the best SaaS applications in the market exploit feedback well. Xero, an accounting app, has an active community. Trello, a collaboration tool, lets users vote on features. If it was easier for people to collect contextually relevant feedback in an automated way, the quality of the application likely increases because development time can be assigned quicker and with good reason – they have proof users want it.
Exploit the	So far, significant research activities have been conducted aiming at making	This area is being partially covered by some of the

programmability aspects of the underlying infrastructure	infrastructures programmable. The latest advancements in this context are occurring in the area of Software Defined Networking (SDN). From the software engineering perspective, it is important now to define application-level development approaches that give the possibility to exploit such programmability to improve the performance of such applications. It is worth noting how 'infrastructure as code' lessens the risks of human error as well as speeding up execution.	projects in the cluster, but will need to be investigated further in the years to come.

Table 2 Identified topics & recommendations

Topic	Description	Recommendation
Process, methodologies and productivity	In this context existing concepts need to be redefined for meeting the current needs of the industry. Development cycles become more and more shorter. Development and Operation teams start joining forces. New possibilities to easily gather user feedback and monitoring information have the potential to enable an informed evolution of software.	A new notion of productivity should be defined, where "lines of code" is no longer the measure of productivity, but software is measured in terms of its other qualities, usability, reliability, scalability. Shorter development cycles call for novel software production methodologies to actually enable controlled management of such short development cycles. With Devops there is also a need to shift deployment decisions and resource management from the deployment phase to the design phase of software engineering, making efficient use of resources and supporting architecture level analysis, optimization of deployment decisions. In this context, infrastructure-as-a-code approaches have a great potential that should be further investigated.
Design Patterns Development for A Systems Of Systems Approach	New patterns at the architectural level should describe the obligations/constraints to be fulfilled by the system in which the software is running, to validate and standardize them, and methods on how to apply them into a dynamic, ever-changing context environments.	As such, issues such as frame of references, unifying lexicons, visualisations, design architecture and interoperability, modelling languages, tools integration and simulation and analysis, should be tackled. Such patterns will allow software to reach a better level of quality. It further helps to communicate to non-experts how applications are built or what the technical foundations of a product are. Having a symbol for "database" is much easier way to communicate its importance than expecting a non-expert to understand long technical descriptions. And if more people can understand the concept, the more accessible projects become.
Quality guarantees	The rapid growth in the last years of agile delivery methods in the context of DevOps call for research to increase research in the areas identified on the right.	All aspects listed need to be tackled and addressed to guarantee quality-controlled software: Anti-fragility of systems, reduce the meantime-to-restore-service (MTRS), and develop accelerated methodologies to test quality through staging and canary testbeds. In parallel, although Big Data offers the ability to capture large amounts of monitoring data on the behaviour of an application, limited progress has been achieved in developing feedback analysis tools. Therefore, further research is envisaged in the architectural level, in the ability to pinpoint specific root causes of performance degradation in the application code, and in the application of machine learning methods to quality engineering. Finally, there is a shortage of standardised

		reference quality benchmarks for code and extra-functional properties in many classes of applications and domains.
Requirement engineering	There is the need for a radically divergent approach to capture emerging behavior and requirements from systems and users. Emerging technologies and trends are shedding light on potential research topics in this area.	The following are examples of aspects to be covered: -Multichannel big data analytics for requirements elicitation from large scale sites (like smart-city infrastructures which blend humans, machines and generally system characteristics and behaviour); -Novel methods for user engagement towards directly extracting requirements; -Indirect requirements extraction paradigms exploiting context-awareness of individuals (independently on the usage of a specific software) and yet respect individual's privacy; -HMI interface types taking into account CPS and new technologies that blend human and computer interactions and decisions; -Different kind of logics (both rational and behavioral), interconnection and interoperability with next-of-kin and other unrelated (at first sight) systems of a greater ecosystem.
Privacy and security	Special care with regards to privacy and security has to be given in complex distributed systems that in many cases have to handle big data volumes in a distributed way.	Important aspects to be considered are: -Identification of contextual system patterns related to privacy leaking code snippets; -Secure computation of data structures, approaches for establishing optimality of encryption levels, continuous source code assessment at design time as well as vulnerability assessment of the developed applications; -Secure packaging and placement mechanisms of the developed applications over programmable infrastructure; -Orchestration mechanisms supporting the secure and efficient policy-aware management of services and applications; -Real-time risk identification and assessment techniques along with the triggering of the appropriate mitigation actions; -Security and privacy mechanisms focused on distributed and big data applications.
Exploit the big data generated by software engineering processes	It is high time for software itself to benefit from the intelligence extracted from large sets of information such as software source code, commits and forks, bugs, warnings and notifications, issues from backtracking systems, logs of any kind, commits, demographics, coding patterns, requirements, user behaviours, user profiles, etc.	Aspects to be considered include: -Novel tools employing techniques of machine learning and data mining to reveal hidden knowledge aspects and extract information from sensor-based architectures; -Analysis of the evolution / discontinuation of application frameworks, open source components, analysis of user trends and preferences and behaviour with systems to better understand users' needs, tools and methods for identifying feature and performance improvement opportunities; -Identification of root causes of failures and system halts based on log files (massively big (>>GBs) or lightning-fast updating) coming from various complex distributed systems and infrastructures; -Exploitation of insights collected at runtime on symptoms and context changes to trigger adaptations, and perform predictive and prescriptive analytics for proactive planning and preparation of adaptation actions. For example, Cars that can drive themselves and doctors being

		able to diagnose patients in seconds thanks to this type of work. This has profound impact.
Open Source Software (OSS) Innovation	As most of the software today is based on open source platforms, it is very important to understand how to foster and accelerate innovation in open source. This requires the development of proper open source governance processes.	OSS production processes include organisational challenges aiming at the creation and management of communities of code contributors, reviewers, testers, first level users, etc. and a comprehensive development and communication approach combining existing tools under a set of common, formalized set of methodologies. Moreover, the following is required: -Decoupled architectures and production processes based on fault defensive and tolerant programming styles for distributed development teams with different skill sets, interests and motivations; -Methodologies and tools for impact analyses of code additions and modifications.

Next steps

The cluster is continuing to map the contributions of running projects and to identify new challenges and, thus, topics for future research. Also, it is acting as an instrument to enable the organization of common dissemination initiatives, the exchange of opinions and suggestions between members, etc. The forthcoming planned activities within the cluster will progress in this direction with the objective of offering to the research community updated research maps from the analysis of current projects and challenges for future research.

2.2 Data Protection, Security and Privacy (DPSP)

Erkuden Rios Velasco, Tecnalia & Cluster Chair

Cluster website | Cluster white paper | Presentation

The DPSP Cluster deals with hot topics in Cloud research and innovation: Data Protection, Security and Privacy, which are closely related to each other. The Cluster aims at increasing the impact of the integrating projects by identifying synergies and collaboration opportunities, exchanging knowledge and carrying out technical discussions to ensure the projects advance over the state of the art and provide value added solutions to the market. The innovation in cloud security and privacy go hand in hand with the advances in cloud technologies and services themselves. The Cluster gathers 25 EU-funded research projects that work on trust and security of cloud services. We believe that by working together, the projects can make a greater difference in EU cloud security solutions.

Cluster members

APPHUB, A4CLOUD, CLARUS, CLIPS, CLOUDWATCH2, COCO CLOUD, CREDENTIAL, ESCUDO-CLOUD, MUSA, OPERANDO, PAASWORD, PRISMACLOUD, SECCORD, SERECA, SLALOM, SLA-READY, SPECS, STRATEGIC, SUNFISH, SWITCH, TREDISEC, TRESCCA, WITDOM.

The Free Flow of Data initiative within the Digital Single Market poses new challenges with regards to data ownership, data location, data access and privacy, to name a few. The cluster members are currently discussing the importance of advanced security and data protection mechanisms to make the initiative a reality. The identification of challenges towards the next H2020 WP 2018-2019 made by the Cluster include a classification of the challenges according to the main working areas of the Free Flow of Data: Free movement of data, Location of data, Ownership, Interoperability, Usability, Access to (Public) Data, Certification, Contracts and Switch of CSPs.

In the Action by Cluster, the projects that have identified the challenge or are already working on it have been identified[5] as outlined in the tables below.

[5] https://eucloudclusters.files.wordpress.com/2015/05/dpspcluster-whitepaper-v3-1.pdf

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Table 3 Overview of current challenges identified by the DPSP cluster so far.

Challenge	Description	Projects addressing issue
Full control of data flow	Control of whole flow including data in transit and data in use, but also data at rest, meaning controlled access and usage of data across country and cloud boundaries. Context based access control policies are part of this challenge.	COCO CLOUD, ESCUDO-CLOUD.
Efficient searchable encryption	For enabling to efficiently search and edit the encrypted data stored and processed in the cloud.	PAASWORD
Privacy preserving cloud-based (identity) services	Improved and novel cryptographic methods to securely protect, store and share (private) data, including encrypted identity data.	CREDENTIAL
Fully secure APIs	In order to enable to securely communicate the identity and user attributes (authentication and authorization) among cloud services.	PAASWORD
Data Protection legal framework transparency.	For both cloud consumers and cloud providers.	CLARUS, CLOUDWATCH2
Definition and enactment of fine-grained security policies.	Integration and composition of security and privacy policies across different cloud services.	STRATEGIC
Security-aware SLA management support for security and privacy terms formalisation, negotiation, composition, monitoring, continuous assurance and automation.	All these applied to multi-cloud or federated cloud-based applications and cloud-services themselves.	MUSA, SPECS, SLA-READY, SWITCH
Risk assessment frameworks for applications at scale	Innovative frameworks to assess risk in multi-technology and distributed applications mixing cloud, IoT, Big Data, or mobile addressing security assurance, automated deployment, monitoring and decision making.,...	MUSA
Secure dynamic composition of cloud services	Including dynamic benchmarking and brokering of Cloud services for multi-cloud scenarios as well as federation of clouds.	PRISMACLOUD
Cloud Security Certification.	Based on cloud security standards and auditing schemes.	CLOUDWATCH2
Security- and privacy-by-design in cloud services.	Advanced mechanisms and tools to support the security and privacy intelligence from the early stages of the design of the services.	PRISMACLOUD, CLARUS
Continuous control of security, privacy conditions and obligations, and adherence to them	Including continuous monitoring, assurance, enforcement, and automated reaction in inter-clouds, multi-cloud, federated clouds.	COCO CLOUD, SUNFISH , MUSA, ESCUDO-CLOUD.
Efficient secure and privacy-preserving multi-tenancy in Infrastructure, Platform and Software as a service models.	Including deduplication on encrypted multi-tenant data, or mechanism for checking integrity and availability of multi-tenant data.	TREDISEC
Improve market readiness of security and privacy solutions from projects.	Providing an online marketplace that enables the digital single market to access innovative open source applications with guidance on	APPHUB, CLOUDWATCH2

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	sustainability and future project exploitation.	

Table 4 Identified topics & recommendations

Topic	Description	Recommendation and benefit to future cloud market
There is a need of fully understanding the technical implications of the Free Flow of Data initiative with respect to cloud security, privacy and protection of data.	The European Commission is currently working on a Legislative Proposal on Free Flow of Data (due in Nov 2016) which would mean a change in cloud context towards the realisation of the Digital Single Market vision.	Elaboration of a Whitepaper to discuss in deep the technical problems and possible solutions towards the completion of the Free Flow of Data Initiative, which will serve to clarify which are the current results in the projects that are already (partially) supporting some of the solutions.
There is a need for specialised discussions to provide value added innovation on cloud security and privacy.	As cloud security, data protection and privacy are very much related to each other, the cluster grouped the challenges identified in order to organise the discussions with the aim to better understand the implications and propose solutions.	Creation of working groups within the cluster for allowing specialised discussions on the technical issues: Security and privacy-by-design, Trust & Interoperability (Chaired by CloudWATCH2), and Advanced data protection mechanisms.
There is a need for improving market readiness and usability of security and privacy solutions from projects.	The European Cloud Economy needs the cloud R&I space include standards, transparent pricing and better uptake of new services. The clustered projects need to think strategically, looking at technology and business model as part of the same equation. While challenging, interoperable cloud services play a very important role in extending the market and in bringing business benefits to both the supply and demand sides.	Strongly collaborate with DG-CNECT Cloud CSAs like APPHUB and CLOUDWATCH2 to support the Cluster achieving in its mission of increasing the market impact of the projects' technological results.
There is a need to improve accessibility and communication with the wider market.	The deliverables and outcomes of projects across clusters must be communicated effectively in order to engage with industry stakeholders and identify areas of future collaboration.	An online directory of projects that uses simpler language to describe what a project does, which stakeholder it is relevant for and the correct process for engaging with a project on the projects' terms.

Conclusion and actions for the DPSP Cluster

In 2015 the Cluster set the basis for a fruitful collaboration among the clustered projects towards increasing their impact. Following this, in 2016 the Cluster started the work for joint results and dissemination activities.

Among other results, two major deliverables have been produced so far: a) the Map of synergies between the clustered projects, which identifies the commonalities and gaps in research topics and approaches of the projects[6] and b) the Whitepaper on data protection, security and privacy challenges of multi-cloud applications in the Digital Single Market[7]. In this Whitepaper the need of further research on cloud technologies' security was identified, particularly towards the full completion of the DSM Initiative #14: Free flow of data. For example, the need of extending the research on: security- and privacy-by-design in cloud, full control of data flow, efficient searchable encryption, fully secure APIs, Security-aware SLA management support, Definition and enactment of fine-grained security policies, Continuous control of security and privacy conditions and obligations and adherence to them, Efficient secure and privacy-preserving multi-tenancy in Infrastructure, Platform and Software as a Service models and Cloud Security Certification.

The evolution of the collaborative actions in the near future will lead to the elaboration of a second Whitepaper, this time focused on the future technological solutions needed for the Free Flow of Data initiative, and identification of the pieces of work already available in the projects that have initiated the path towards such solutions.

Other joint dissemination actions are also taking place. For example, the Cluster is working on its active participation in Cloud Forward 2016 where the member projects intend to take profit of not only the research work presentation tracks but also of the SME event where the projects would make direct contact with potential stakeholders of their solutions.

All the information about the Cluster results and planned activities can be found at the cluster webpages[8].

2.3 Novel approaches and technologies for Cloud resource and service management (NATRES)

Dana Petcu, West University of Timisoara & Cluster Chair

Cluster website | Cluster white paper | Presentation

NATRES cluster is 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 include the integration of special devices from high performance computing to mobile devices, design of decentralised service-oriented systems, improvement of the virtualization technologies, overcoming portability and interoperability issues, or automation of

[6] https://eucloudclusters.files.wordpress.com/2015/05/dpsp_cluster_map-of-synergies_v2-0.pdf
[7] https://eucloudclusters.files.wordpress.com/2015/05/dpspcluster-whitepaper-v3-1.pdf
[88] https://eucloudclusters.wordpress.com/data-protection-security-and-privacy-in-the-cloud/

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organisation and management of back-end resources. Cloud-based applications from the fields of Internet-of-Things and Big Data are also expected to challenge the new services.

Twenty actions partially funded by European Commission in FP7/CIP/H2020-ICT programmes are actively participating to NATRES activities. NATRES results until now are reflected in (1) a map-of-challenges; (2) a white paper; (3) recommendations for the next work programme; (4) common disseminations actions in form of workshops, scientific papers, exhibition booths.

The cluster members are confident that resource and service management remain a challenging topic to be further addressed in the future ICT programmes as many related problems have not yet found a proper solution. Examples of such problems are the seamless integration of Cloud resources and service into application development tools or with other distributed or specialized systems, the full automation of datacentre services to reach multiple objectives like energy efficiency and high level of service quality service, or diversification of the Cloud services.

Cluster members

AppHub, ARCADIA, BEACON, CloudLighthning, CloudSpaces, ClouT, CloudWave, DICE, ENTICE, iKaaS, INPUT, IOStack, Mikelangelo, Mobile Cloud Networking, Mo-bizz, MODAClouds, MUSA, RAPID, SPECS, SWITCH.

The following tables provide an overview of current challenges identified by the cluster so far[9] and identified topics & recommendations for the 2018-2020 Work Programme.

[9] details at: https://eudoudclusters.files.wordpress.com/2015/05/map-of-challenges2.pdf

Table 5 Overview of current challenges identified by the cluster so far

Challenge	Description	Projects addressing issue
Deployment and management of resources: in a decentralised, autonomous way	Improving the efficiency of deployed resources; deploying of resources efficiently - use of low overhead, very efficient virtual technology stack.	-**iKaaS** is developing distributed autonomic resource (cloud, IoT) allocation mechanisms, taking into account service needs and resource capabilities and availability. -The Dynamic Real-time Infrastructure Planner subsystem in **SWITCH** prepares the execution of the applications by defining an optimal virtual runtime environment from one or more Cloud providers, and deploying the platform required by the application. -**ClouT** is developing a mechanism to manage several different kind of distributed sensors and actuators (legacy, IoT based, virtualized and "sensorized" devices). The received data are treated as real-time data for some applications and are stored in a cloud storage to be used as historical data. -**SPECS** provides solution to deploy services in Cloud according to SLA life cycle. It offers tools that automatically enforce and monitor security properties -**INPUT** is moving cloud services closer to mobile end-users and smart devices in an autonomous, energy-efficient, and dynamically fashion, in order both to avoid pointless network infrastructure and data centre overloading, and to provide lower latency to services; -**RAPID** will develop a secure peer-to-peer model where almost any device can operate as an accelerated entity and/or as an accelerator serving other less powerful devices.
Software defined execution models	Software defined networking; Software defined data center	-At the core idea of the **SWITCH** environment, a new development and execution model, an application-infrastructure co-programming and control model, will be developed for time-critical Cloud applications. The new model brings together the application composition, execution environment customisation, network programmability and runtime control, which are normally treated in separated processes, into one optimisation loop based on the time critical requirements. -**INPUT** is enabling personal and federated cloud services to natively and directly integrate themselves with extended software defined networking and network function virtualization technologies close to end-user SDs in order to provide new service models. One of the **SPECS** case studies focuses on adoption of SLA in ngDC (next generation Data Centers).
Data storage	Infrastructure service	**-ClouT** will provide a CDMI Cloud Storage to store sensor data and binary data objects (such as images or videos). The storage will be fully compliant with CDMI 1.1.1 specification and will provide scalability and elasticity to store a virtually unlimited amount of data and to manage sudden bursts. -**SPECS** provides a mechanism for End-to-End Encryption, offering even metrics to be used to grant the security in an SLA. SPECS provides an application for Virtualized Cloud Data storage protected with SLA.
Resilience and scale	Optimality; Large-scale experiments	-The ASAP subsystem in **SWITCH** autonomously manipulates the application and runtime environment to maintain optimal system level performance against time critical constraints. **-ClouT** manages and storages a virtually unlimited amount of data that will be available to citizens especially in case of emergency (e.g. natural disaster). The availability in case of emergency is one of the key use cases of ClouT. The team is working on an intercontinental demo involving the four pilot cities to show how data will be able to be shared, computed and used in real time across two continents.

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Service Level Agreements	SLAs for quality critical applications and novel negotiation mechanisms	-The **SLA-Ready** Common Reference Model (CRM 1st iteration, June 2016) describes, promotes and supports the uptake of cloud service level agreements, by providing a common understanding of SLAs for cloud services. It provides a common understanding of SLAs for cloud services, integrating: SLA components like terminology; SLA attributes; Service Level Objectives (SLOs); guidelines; best practices. -The Dynamic Real-time Infrastructure Planner (DRIP) subsystem in **SWITCH** prepares the execution of the applications by creating a Service Level Agreement with the resource provider(s), and deploying the platform required by the application. **-SPECS** proposes an advanced Security SLA Model, as an extension of WS-Agreement, that enable to concretely represent security in SLAs. Moreover SPECS offers a Security Metric Catalogue, built on top of existing standard and tools offered at the state of the art. SPECS offers a Security negotiation module, devoted to negotiate SLAs according to end users needs. **-MUSA** studies how to offer Security SLA for multi-cloud applications. **-RAPID** builds tools that monitor offloaded performance of tasks when executed on the cloud. The SLA model will provide the mean to access to the monitoring information related to the agreed QoS aspects, in such a way it will be possible to determine whether SLAs are being fulfilled or not. It will be able to deal with several monitoring platforms, since it allows for customization through a system of plug-ins.
New models of services	Novel composition model for infrastructures: application aware	-At the core idea of the **SWITCH** environment, a new development and execution model, an application-infrastructure co-programming and control model, will be developed for time-critical Cloud applications. The new model brings together the application composition, execution environment customisation, and runtime control, which are normally treated in separated processes, into one optimisation loop based on the time critical requirements.
Quality assurance	QoS and QoE	-In **iKaaS**, service quality related metrics have been identified and are being considered by the service provisioning mechanisms The Dynamic Real-time Infrastructure Planner (DRIP) subsystem in SWITCH prepares the execution of the applications by semantic modelling and linking of different QoS/ QoE attributes and defining an optimal virtual runtime environment from one or more Cloud providers. -The **INPUT** framework exploits the monitoring of network and cloud QoS, and the perceived QoE of end-customer in order to enable a smart and energy-efficient management of resources. **-RAPID** take into account QoS/QoE attributes in order to select the appropriate accelerators per client. The QoS attributes of a task/application are instructed by the developer at implementation time. The SLAM monitors if these QoS attributes are satisfied, and notify the user if this is not the case.
Virtualization technology	Performance increase in virtualised IO	**-RAPID** uses OpenStack platform with KVM hypervisor on the cloud side to host different flavors of virtual machines. Each virtual machine will accommodate one acceleration server.

Table 6 Identified topics & recommendations

Topic	Description	Recommendation and benefit to future cloud market
Cloud middleware	The software needs to be described in abstracted space and needs to be practically hardware agnostic. The recent Lambda architecture, in which code is executed in response to an event, ensures an important step in moving away from server-centric design. The Cloud becomes a generic compute engine, and the developers do not need to organize the resources as they simple just run the code. The application should be able to form automatic and fleeting associations of hardware and software resources according to their needs. Application developers should not worry about provisioning servers, storage, or communication as the provisioning process will happen automatically. New software systems need to be developed to deal with the likely minute-to-minute failures of the consumed resources.	Support the evolution of the Cloud towards its omnipresence, freeing of the Cloud service consuming software from the Cloud services, by ensuring that the new generation software, or existing modular or event-reactive ones, will be able to be described to an abstract level that is service agnostic, will be able to form automatic and transparent combinations of hardware and software resources according to its needs, while resource provisioning, deployments, runtime migrations, multi-tenancy with cost-effectiveness and data protection, or the recovery from minute-to- minute failures will be managed automatically
Datacenter services	Cloud management and orchestration needs to be aligned with various products and services. Consequently, everything from orchestration to database tools will evolve. Datacentre operators can add value to cloud orchestration through network awareness and integration of cloud orchestration with their network management platforms. Software-defined security will become part of the software-defined datacentre. The datacentres need to be like biological organisms: having different states, growing and shrinking according to workloads, automatically corrected and changed. Low-power processors will be able to treat many workloads in the highly automated datacentres to support massively federated, scalable software architecture. Technologies currently limited to supercomputing will make it into the mainstream.	Support the evolution of the software-defined datacentres as ecosystems, in which services are abstracted from infrastructure, changes and updating are done automatically based on intelligent orchestration or new database tools, security is software-defined; such ecosystems should enable warehouse-scale computing using purpose-designed chips, new services like supercomputing on demand or massively federated, scalable software architecture with orchestration through network awareness.
Cloud model evolution	Inverse cloud models, like machine-to-machine computing or geo-distributed cloud, are alternatives to the bandwidth-intensive Cloud approach. However, Fog nodes for example, are implemented using embedded systems, in industrial control boards or home routers. Their limited memory, storage and computation is main challenge in their	Support the evolution of the Cloud computing model towards the integration with machine-to-machine computing, solving the challenges of separate technology stacks and dealing with limited memory, storage and

	integration into the Cloud architecture to enable the execution of application logic. Their integration will leverage containers as virtualization technology for application delivery and execution. The success of Fog computing depends on the resilience of the smart gateways directing tasks on an Internet teeming with IoT devices. This smartening will rely on features such as out-of-band access, automatic detection and recovery from outages, cellular connectivity, or high-level security.	computation capacity of the edge devices, speed of deployment, resource distribution, cost-effective scalability, resilience, easiness of management or security.
Cloud service market orientation	The future of cloud service is related service consumer mobility. Data generation activities among users and the need to access this data from anywhere using any device has propelled the demand for personal cloud for real-time data access and its sharing. Specialty Clouds will raise through their ability to avoid specialized hardware acquisition costs and outdated equipment.	Support the evolution of the Cloud services towards diversification, ensuring special features like those sustaining user mobility, user as service provider, service composition, personal data service configurability, or speciality Cloud services.

Conclusion and next actions for the Cluster

According to the general opinion of the NATRES cluster members and the result of online questionnaire, the evolution of the infrastructure-as-a-service model and market in the future will follow four main directions: significant changes in the support of data application development, datacenters reorganisation, model evolution towards smooth integration with other models, market orientation towards specialization and personalization.

NATRES cluster intends to support the early development of the new concepts in these four main directions by creating the framework for collaborations between its cluster members. In parallel with the challenges and recommendations, NATRES has identify the gaps between the user needs and the available technologies that will not be covered by the current cluster actions. These can be the subjects for new collaborations between the cluster members and beyond in the frame of the incoming actions.

The collaborative actions that are foreseen for the near future are related to exchanges of best practices as well as common dissemination actions in form of scientific papers or white papers, workshops or trainings organisation, journal special issues.

The list of incoming activities as well as other details about the former activities of NATRES cluster (including their results) can be found at: https://eudoudclusters.wordpress.com/new-approaches-for-infrastructure-services/

2.4 Inter-cloud Challenges, Expectations and Issues

Ana Juan Ferrer, ATOS & Cluster Chair

Cluster website | Cluster white paper | Presentation

The simultaneous or serial use of services from diverse heterogeneous clouds is a challenge in order to further develop the Cloud market in Europe. While it presents a series of issues with regards to interoperability among heterogeneous cloud typologies, private and public clouds, services' comparability, portability, migration, networking, and increased uptake of cloud services across Europe. 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. Switching providers relies on access to information that allow stakeholders to make comparisons. Lessons from switching energy providers, mobile phone providers, insurance providers, etc. can help provide guidance on such market opportunities.

Despite the achieved advances and commercial uptake, Cloud technologies and models have yet to reach their full potential. Many Cloud capabilities need still to be further developed and researched, so to allow their exploitation into a full degree. All along the Cloud stack (SaaS, PaaS, IaaS) commercial product developments today are based into proprietary solutions that drive to a vendor lock-in situation for the existing adopters. In this context, the realisation of multi-clouds[10] is materialised though internal clouds

[10] Multi-Cloud is defined as the serial or simultaneous use of services from diverse providers to execute an application [1]. At business level, Hybrid Cloud is the term commonly used, Gartner [3] defines hybrid Cloud as the coordinated use of cloud services across isolation and provider boundaries among public, private and community service providers, or between internal and external cloud services. A number of scenarios demonstrate these serial or simultaneous interactions among hybrid heterogeneous private and public clouds and across all cloud layers (IaaS/PaaS/SaaS)[4].

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and interactions between public-private Clouds which is hardly automatised and, in any case, automatic. In addition, security, trust and legal compliance issues still act as barriers for a wider uptake.

Whilst more developed Inter-cloud scenarios, such as Cloud Bursting, Cloud aggregation and Cloud brokerage exist theoretically, real implementations marginally exist and they are tailored for specific cases. To reduce the effort and time associated to the adoption of cloud, developers need to be able to develop an application regardless of where it is released, structuring and building it in a vendor agnostic way so that it is possible to deploy on the provider that best fits the requirements at the moment thus realizing the "develop once deploy everywhere" paradigm. There is a lack of understanding in the market about the financial or procurement aspects of this.

There are a number of motivations for embracing multi-cloud set-ups. From a provider's perspective this includes greater scalability and wider resource availability, and greater cost efficiency and energy savings. From a customer perspective, this includes avoiding vendor lock-in and distribution across geographies for reducing latency, the addressing of legal constraints and enabling high availability.

Today Cloud Computing market is still far from adopting an open and competitive model in which cloud resources act like in conventional markets. Lack of interoperability and adopted standards together with intricate regulatory context, inflexible pricing models and not adequate SLAs are recognised as the main obstacles to Cloud adoption. However, in order to realize a full Multi-Cloud market vision additional aspects need to be developed into Inter-cloud management such as: provisioning, metering and billing, privacy, security, identity management, fine grained QoS and Service Level agreements, consideration of diversity of resources (compute, data and network).

The use of standard or agnostic interfaces for cloud services would allow the developers to migrate cloud application among cloud platforms with minimum effort. This alignment need to be achieved at all cloud levels and across different models of clouds (including local/edge clouds).

Automatic porting of existing applications and software systems (in particular legacy systems) from on premise platforms to a cloud platform need to be supported by suitable methodologies and tools to facilitate and speed up the migration.

The cluster has carried out initial work in order to prioritise the identified Research Areas. The analysis has classified Research Areas according to Business Impact and Timeframe for realisation. In addition, priority of the Research Area as a whole has been assessed based on priority of the associated challenges. This process has been performed by a survey completed by cluster participants.

The following tables show the various challenges and priorities identified by the cluster members for inter-cloud to become a reality. Each area and challenge is ranked in order of priority. In addition to the analysis of priorities among Research Areas, it is important to remark that all proposed Research Areas have its roots in already developed and on-going research work as the table shows. Considering these is significant in order to allow future convergence of research results, research programmes' cohesion, as well as, overall resources optimisations.

Further details on each challenge and priority can be found in the cluster white paper[11].

[11] https://eucloudclusters.files.wordpress.com/2015/05/inter-cloud-pp_dec-2015.pdf

Priority level	Inter-cloud research areas	Associated future research challenges	Projects working / that have worked in this area
High	Service Discovery and Composition	Automatic discovery and composition of services Automatic API Alignment and Software-defined everything	ENTICE, CYCLONE, mOSAIC, SWITCH
High	Dynamic Configuration, Provisioning, and Orchestration of Cloud Resources	Multi-Cloud improved application assembly and automation Self-* across a diversity of cloud deployments . Cloud Broker specialization for addressing specific vertical sector needs Novel decentralized Inter-cloud computing continuum Novel Orchestration and placement methods for hyper distributed cloud	CLOUDLIGHTNING, ModaClouds, mOSAIC, PaaSage, OPTIMIS, SeaClouds
High	SLAs & QoS	Intelligent Broker SLA Standard Representation Monitoring of QoS and application level monitoring SLA-based cloud service/application management	ASCETiC, mOSAIC, ModaClouds, SeaClouds, , SWITCH, OPTIMIS, CLOUDLIGHTNING
High	Interoperabililty and portability	Switch services among cloud typologies and providers without efforts Develop once deploy everywhere Interoperability to cope with Cloud heterogeneity and application mobility Universal Semantic Service Automatic migration of in house application to the Cloud and across cloud typologies Extended Workload Portability	CloudSocket, ENTICE, ModaClouds, mOSAIC, PaaSage, SeaClouds, SSICLOPS, SWITCH
Medium	Network Management	To guarantee new paths for optimizing transfer of data among clouds, among IoTs and clouds-IoTs Extension to Cloud Federation concept and tools Enablement of responding more fluidly to changes in user demand at inter-cloud level but also at the edge level DevOps Agile development and deployment considering network management	BEACON, CYCLONE, SSICLOPS, SWITCH
Medium	Business Process Management	Cross-layer and Scalable Multi-Cloud Workflows and BPaaS Smart business-to-IT alignment Flexible Cost Models Smart Business Intelligence through cross-layer BPaaS Evaluation Cross-layer BPaaS Monitoring & Adaptation 2 Challenge Cross-layer BPaaS Monitoring & Adaptation Intelligent Allocation of BPaaS across cloud levels	CloudSocket, mOSAIC, SWITCH
Medium	Security mechanisms across clouds	Auditability in Cloud Federated Cloud Networks Security mechanisms for application integrity Definition of Security and network-aware application requirements Federated Authentication for non-Browser HTTP Applications Federated Authorization Policies and Use Cases	CloudSocket, BEACON,OPTIMIS, ENTICE, CYCLONE
Medium	High Performance Heterogeneous	Monitor and guarantee inter-cloud infrastructure SLAs performance New languages to express overall high performance including storage, compute, network Dependability and reliability between Cloud providers and consumers	ASCETiC, BEACON, CLOUDLIGHTNING, CloudSocket,

CLOUDWATCH2 has received funding from the European Union's Horizon 2020 programme - DG CONNECT Software & Services, Cloud. Contract No. 644748

	Cloud Infrastructures	Dynamic workload balancing in multi-cloud context Enable with inter-Cloud Service Provider connectivity	CYCLONE, ENTICE, ModaClouds, mOSAIC, PaaSage, SeaClouds, SSICLOPS, SWITCH
Low	Distribution across locations for reducing latency, address legal constraints and enable high availability	Novel High Availability mechanism across hybrid cloud models Legal aspects Scalability across clouds based on demand Cross-cloud VM/container image distribution SLAs	CloudSocket, BEACON, ENTICE, SeaClouds, OPTIMIS

3 Best practices for exploiting and sustaining project outputs

The Concertation meeting also focussed on strategies for projects to improve exploitation and sustainability strategies. At the 2015 Concertation meeting projects each provided service offers to show how outputs will address pain points of target end users. This was published as an online service offer catalogue[12] and has been promoted by CloudWATCH and now CloudWATCH2. At the 2016 Concertation meeting 37 projects updated their service offers and added information on exploitation plans, target stakeholders and target vertical markets. These will be evolved by CloudWATCH2 into a searchable catalogue of service offers and linked directly to the AppHub marketplace. CloudWATCH2 will promote these services at a set of outreach workshops targeting European SMEs and governments end users.

The Concertation meeting was an opportunity for projects to highlight best practices in this area. Pearse O'Donohue, Head of Unit E2 Software, Service and Cloud computing, European Commission, commented that it was pleasing to see recommendations on exploiting results made at the 2015 Concertation meeting had been addressed by projects. An important takeaway for all projects is the importance of effectively communicating and disseminating project outputs so that project outputs can truly make an impact on the European market.

3.1 The path to exploitation and sustainability

Frank Bennett, iCloud Limited

European projects face a number of challenges when defining and implementing their exploitation plans. To define the right route to market, projects need a proper understanding of the cloud market and supply chains within it. Projects not only need to start planning early, but also plot their outputs as the project evolves.

The software industry is a hive of creativity that is undergoing four disruptive drivers of change:

1. Cloud Computing
2. Move from licensed software to subscription software services (SaaS)
3. Increased competition due to low entry point for developers and globalisation
4. Open Source Software

Customers look to suppliers to advise them how software can support their digital transformation. In turn software vendors need to understand who customers turn to for advice and how their products get to market. The software industry supply chain has many actors and the primary sales models are:

- Sell TO - Direct to customer with a direct sales force
- Sell THROUGH - Indirect to customer through partners to include Distributors and Marketplaces
- Sell WITH – vendor and partner combine their respective value to customer

More recently Co-Creation has gained popularity in response to change in customer buying behaviour and customer's expectations of their suppliers. Co-Creation is applicable to the work of the EU and it's project partners and subject of a book with the title 'From Selling to Co-Creating'. Think Uber and AirBnB as examples of co-creation where software creates a mutual valued outcome for consumers and providers and sits at the heart of the sharing economy.

[12] http://www.doudwatchhub.eu/service-offers & http://www.cloudwatchhub.eu/sites/default/files/A-portfolio-of-offers-for-trusted-and-secure-services_Web.pdf

CLOUDWATCH2 has received funding from the European Union's Horizon 2020 programme - DG CONNECT Software & Services, Cloud. Contract No. 644748

The sales model is a product of the business model and talks to the core discussion of exploitation and sustainability. The business model is the reference point in any organization that talks to how an organization creates, delivers and captures value. For that reason it is something that everyone in an organization needs to know. Online resources are available when you Google 'business model canvas' although many engage an external facilitator for the development of the canvas to challenge and provide objectivity.

Upon inception, or even in the process of a grant application, projects should develop a business model canvas to understand its exploitation and sustainability potential. That will evolve over time and the canvas is the enduring reference point to record the evolution for project reviews and discussions with other stakeholders (e.g. industry partners, other project owners).

3.2 ARTIST – The ARTIST Club

Leire Orue-Echevarria Arrieta, Tecnalia

Service offer | Website

About ARTIST

ARTIST targets mainly software owners who need to modernize their applications and business model towards the cloud. ARTIST focuses on the modernization of applications based on three pillars that in most occasions cannot be tackled independently. The business model modernization and the selected deployment model involves some architectural constraints in the application. Furthermore, for companies offering their applications as a service, a transformation in the organizational processes is also needed in order to support the delivery of these services.

The ARTIST project (Advanced software-based seRvice provisioning and migraTIon of legacy Software) was funded under the Seventh (FP7 - 2007-2013) Framework Programme for Research and Technological Development.

Creating the ARTIST Club

The ARTIST Club[13] is the driving force behind the successful ARTIST Project. The main aim of the ARTIST Club is to promote and extend ARTIST's outcomes, namely the open source tools, the ARTIST approach and the methodology. The ARTIST Club is governed by a legal contract, signed by most of ARTIST partners, who have already defined, and agreed, a roadmap for both upcoming marketing and technical related activities in order to keep the ARTIST results available to the community as well as sustainable.

Launching the ARTIST Club was a long process requiring a lot of analysis, both from outside and the inside the project. The analysis of external forces included an in-depth study of competitors and their current status, and what the market demands. The internal reflection followed another line of analysis. Firstly, the consortium needed to understand what the project's value chain was, namely, the main activities that comprise the project and their interrelationship. Once this was clear, the next step was to analyse the different business scenarios identifying which activities of the ARTIST value chain generate revenue, which of these activities generate costs, and finally, which activities are carried out by third parties, that is, they are outside the ARTIST consortium. This was carried out in a workshop at a project general assembly and involved the whole consortium. It led to the identification of eight business scenarios which was later extended following a study of pro's and con's, and coverage of the value chain and the verdict (retain as potential business scenario / reject as potential exploitation means).

[13] http://www.artist-project.eu/content/get-involved

These business scenarios were then contrasted with the individual interests of the partners in terms of set-up costs, risks, which are most beneficial, and so on in order to select the joint exploitation and sustainability strategy. During the discussions held at consortium level, it was agreed that anyone involved in the value chain could stand to benefit from an open ARTIST project, and that given the individual interests in the partners' individual exploitation plans. The ARTIST consortium partners the most interested in continuing the sponsoring, promotion and maintenance of the ARITST outcomes. Consequently, the selected joint exploitation strategy has been based on forming a perpetual ARTIST consortium, initially with members of the original ARTIST consortium but also open to any other organisations interested in the added-value of the ARTIST tools, vision, and realised in the form of the ARTIST Club.

For the feasibility of the ARTIST Club , the Business Model Canvas was used. The consortium analysed the key activities of the ARTIST Club (based on the value chain), the key customers, costs and revenues, and defined the mission and value proposition of the club.

The ARTIST Club has a governance structure, namely a managing director, a technical director and a marketing director, who are in charge of defining and carrying out the business plan of the ARTIST Club, taking into consideration the market needs and the technical roadmap defined for the ARTIST assets.

3.3 ClouT - Cloud of Things for empowering the citizen clout in smart cities

Isabel Matranga, Engineering Spa

Service offer | Website

About ClouT

ClouT is a collaborative Europe – Japan project that has developed a smart city platform which benefits from the latest advances in Cloud Computing and IoT domains. The ClouT platform provides the capability to acquire and manage data coming from heterogeneous sources in quasi real-time and offers a set of platform level tools and services aiming at facilitating IoT application development and deployment. At the basis of ClouT is the availability of data, data coming from different sources (IoT, citizens, web etc.) and in different formats; data which is not only captured, circulated and processed on-the-fly, but that that can also be stored for historical analysis or ex-post processing. The ClouT platform enables smart application developers to access and use a wide variety of information to combine and create innovative and efficient smart city applications/services. Prototypes of the ClouT platform have been deployed in four cities: Santander (Spain), Genoa (Italy), Mitaka (Japan) and Fujisawa (Japan).

The path towards making ClouT's results sustainable

There is increased attention towards the identification of ways to make the research project results sustainable after the end of the project. The challenges project teams have to face in reaching such objectives must not be underestimated. In this paper we share the experience of the ClouT project focussing on two important issues that arise when we need to deal with exploitation, value proposition, customers, business models etc. within research projects:

1. the different way of approaching these activities and the difficulty in establishing a common ground among the Consortium partners that work in different contexts (e.g. universities, research centres, SMEs, large enterprises)
2. the translation of the innovative technological results of the project, into something that can be easily understood and the value proposition of which can be perceived by the outside world.

One of the first and key steps the ClouT team took at the early on in the project lifetime, was to find a common language inside the Consortium when discussing activities regarding business modelling and related topics.

With the difference in experience and background of the members of the Consortium, this led to interesting, fruitful and multi-view discussions but also difficulties with communication between the outreach team and the technical team. Marketing-oriented partners and more technical-oriented partners need to tightly cooperate in order to better understand what are the project results, what are the main features, what needs do they satisfy, why should users choose the project result and not another solution and so on. Furthermore, it is imperative that these questions are answered early on in the project and not left unanswered to later. Indeed, in ClouT we established an iterative process during which the initial ideas and assumptions were then re-discussed. This often lea to new or refined conclusions.

The initial ideas on what the value proposition of an R&D project result is, are usually too focused on technical features which are surely interesting and can satisfy one or more users needs. However, when it comes to taking results out of the research lab and into the real-world, this needs to be re-worked in order to, translate the "technical solution" into the "solution that addresses customer/user's needs" and one with the customer/user can easily understand.

More technically-oriented people know exactly what the technology is doing and are eager to let everyone know how smart and innovative it is. However, it is vital that they understand the value in translating technological features into solutions which relieve pain and gain creators so that customers can understand their value. Customers are not really interested in what and how the technology 'does it' as long as it addresses their needs.

Within a consortium, partners running pilots pay a key role in this as they represent the easiest way to have insight on potential customers needs. They can be the first testers of the assumptions made as well as proof and advocates of how the solution has made their lives better.

There are a number of tools and methodologies available online that can support the project teams in performing the above activities. For ClouT we decided to use the tools and methodology proposed by Osterwalder and Co. that can be found on the Strategyzer website: https://strategyzer.com/.

These tools supported ClouT in different ways: in using the same terminology, in identifying the value proposition, in analysing potential business models but also in representing all the information collected in a simplified and visual way making it easier to involve all partners in thinking, sharing and discussing exploitation and business model related topics.

3.4 The S-Case exploitation plan - From roots to fruits

Vlassis Vlassiou, Aristotle University of Thessaloniki

Presentation | Service offer | Website

About S-Case

S-CASE[14] aspires to greatly boost software building productivity by simplifying the development process. Use of S-CASE allows a front-end developer to easily build fully functional web-applications by

[14] http://www.scasefp7.eu/

implementing the back-end functionality as well. S-CASE minimizes time-to-market and maximizes throughput for any given software project.

The S-CASE webbook[15] provides SW developers with a step-by-step methodology that guides them from defining the software requirements of their envisaged application to building ready-to-deploy software.

S-CASE produces software is fully tested and documented, while it inherently supports features such as state-of-the-art authentication and authorization, efficient search, data schema creation and external 3rd party services integration.

All in all, the S-CASE Eclipse plugin ecosystem comprises a credible way to rapidly scaffold highly sophisticated Web Services, while at the same time eliminates manual Source Code typing and debugging time.

S-CASE Marketing Strategy overview

The cornerstone of the S-CASE marketing strategy has been to design promotion & engagement activities right from the start of the project, even before producing any reliable research results.

Our main goal was to communicate the S-CASE concept to stakeholders fitting specific developer/company profiles, generate our target groups and promote their engagement to the platform. Based on their feedback, adjustments on the S-CASE concept (and marketing strategy) were made.

Our dissemination and exploitation activity plan aimed to first approach developers (who are keen to test new ideas), introduce them to S-CASE, then, through targeted activities, involve them whenever a new version of the platform was released. A marketing strategy toolkit (see annex 1) was setup, comprising targeted newsletters and segmented social media campaigns, developer hackathons, EXPO participation and B2B meetings/live demos (for company users).

A parallel goal was market research, for identifying user needs and competition, thus a data survey collection plan was also carried out with communication & engagement activities. In order to gain valuable insight, our goal was to engage users to take a survey before and after familiarizing themselves with the S-CASE platform,

The ultimate goal of our strategy was to deliver a solid business model with “clean” revenue streams, good knowledge of competition as well as expenses budgeting per business activity.

Identification of Target Group & User Pools

The first developer user segment we initially recognized were front-end junior level developers. The main user-pools we drew contacts from:

- Front-end developers that work inside business environments (i.e Advertising & Marketing companies), where there is a need of using tools to develop prototype Web/Mobile applications with minimum effort (and cost).
- Front-end developers from freelancer communities that lack experience and expertise for producing back-end functionality (web service design and deployment, authentication and authorization).

Market research channels

[15] http://s-case.github.io/webbook.html#1

Market research channels where designed and activated to optimize potential user profiles including web polls[16] and surveys[17].

Launching Activities - How we do it

A marketing kit was assembled defining the best way to handle initial communications as well as upcoming interest for the project. It was clear that in order to meet the needs of our intended users we had to make marketing assets as accessible and responsive as possible. Similarly, we needed to make sure that our messaging was distinct, in terms of the value propositions we have identified, but also in terms of the S-CASE story; whether aimed at developers or their bosses. In all our marketing material we identified the following messaging flow:

> **Step 1**: **Define the target group, address them with a simple proposition:** *Do you have an idea for a mobile or web application?; Do you need to build a fully compatible service or part that can be used in SW applications?*
>
> **Step 2: Define the problem for the particular audience:** *Imagine a tool that helps you produce software by simply INSERTING your Web Service or application component IDEA; Imagine a platform that allows developers to locate existed web services and SW parts that can be easily integrated to their own SW project skipping rebuilding time.*
>
> **Step 3: State the Solution to the problem:** *S-case provides developers a way to discover and select the right pieces to complete the software puzzle; S-case platform can even suggest the right way to integrate software components and services with minimum effort; Letting you rapidly prototype components and services on your journey to the complete application*
>
> **Step 4** Engagement step for DEV and roadmap for SW houses with a clear Call To Action (CTA): *In video active link to S-case Download or Platform Demo through Facebook Login Capability besides creating an emailed account*

4 Conclusions and Next Steps

The first CloudWATCH2 Concertation meeting provided an opportunity for the four EC clusters to showcase the results of their first year of activities by identifying challenges and priorities for the 2018-2020 Work Programme. The work of the clusters represents a step forward for the European Commission and the projects in terms of tangible evidence that projects are coming together and contributing collaboratively to lay out a way forward towards the Digital Single Market. The Clusters also hosted information stands at the Net Futures 2016 event. CloudWATCH2 supported the Data Protection, Security and Privacy cluster in organising the stand and provided material such as a dedicated pop-up banner for the cluster, a rolling ppt to which projects contributed and CloudWATCH2 fliers.

The day before the Concertation meeting (19 April) CloudWATCH2 participated at a meeting organised by the clusters. Here it was agreed that Lucio Scudiero, ICT Legal & CloudWATCH2 will chair the working group on Trust, interoperability and data protection. Michel Drescher, Oxford University & CloudWATCH2 also presented a workshop on the Cluster Application.

[16] https://freeonlinesurveys.com/p/m11vV9Z1?qid=818304

[17] Feedback to improve DEV community - https://www.surveymonkey.com/r/Preview/?sm=G2MOdw7FE_2FzQ7_2BaxNS3PNNctUJSzgt57pYUiqyrtSTc_3D ; Assessing S-CASE methodology (after S-CASE exhibition) - https://www.surveymonkey.com/r/Preview/?sm=Rnwv2e8PikOl4Z9rqYblAt40Wzzsj1c7XL2KIQN4S7I_3D

In addition, the day before the event saw the communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on ICT Standardisation Priorities for the Digital Single Market. Key to the success of a digital single market are interoperability and portability standards for Cloud Computing that are ubiquitous, pervasive, and compulsory, and are enforced on a European and national level. Non-standardised markets proliferate segmentation, ring-fencing and often national-first interest. Standardisation, on the other hand, lowers the market-entry barrier for both service providers and service consumers.

CloudWATCH2 has since responded to the communication, identifying how outputs from CloudWATCH (2013-2015) and CloudWATCH2 address standardisation for interoperability, portability and security. Information has been provided on CloudWATCH2 online tools and services which help to educate CSCs on these issues as well as cloud contracts, how SMEs and public administrations can better manage risk and the impact of greater standardisation and transparency in terms of the continued growth of the cloud market. Indeed, since the Concertation meeting CloudWATCH2 has contacted all active projects in Unit E2 to answer a simple survey which will be used to provide a mapping of standards in use in FP7 and H2020 projects, identify the most common standard implementation use cases, pinpoint gaps in standards and provide a list of recommended priorities for new standardization efforts

The Concertation meeting was also a key opportunity to showcase outputs of the project so far. Firstly, the CloudWATCH2 Cluster Application which should be used by both projects and the clusters to identify natural clusters of projects based on their common relationship to the defining features of cloud services based on the NIST model of defining characteristics. Since the Concertation meeting CloudWATCH2 has been driving forward this activity firstly by improving the user experience of the tool and then by working with projects who have provided data and highlighting the benefits of using the tool to identify projects with similar or the same priorities.

Secondly, the Concertation meeting saw the further evolution of the Service Offer Catalogue with projects enriching their service offers by providing further information on target stakeholder groups and target vertical markets. By combining this information with the technical priorities collected through the Cluster Application, CloudWATCH2 will now provide an improved Service Offer Catalogue with services searchable by these categories. In addition, service offers have been linked directly to the AppHub Directory.

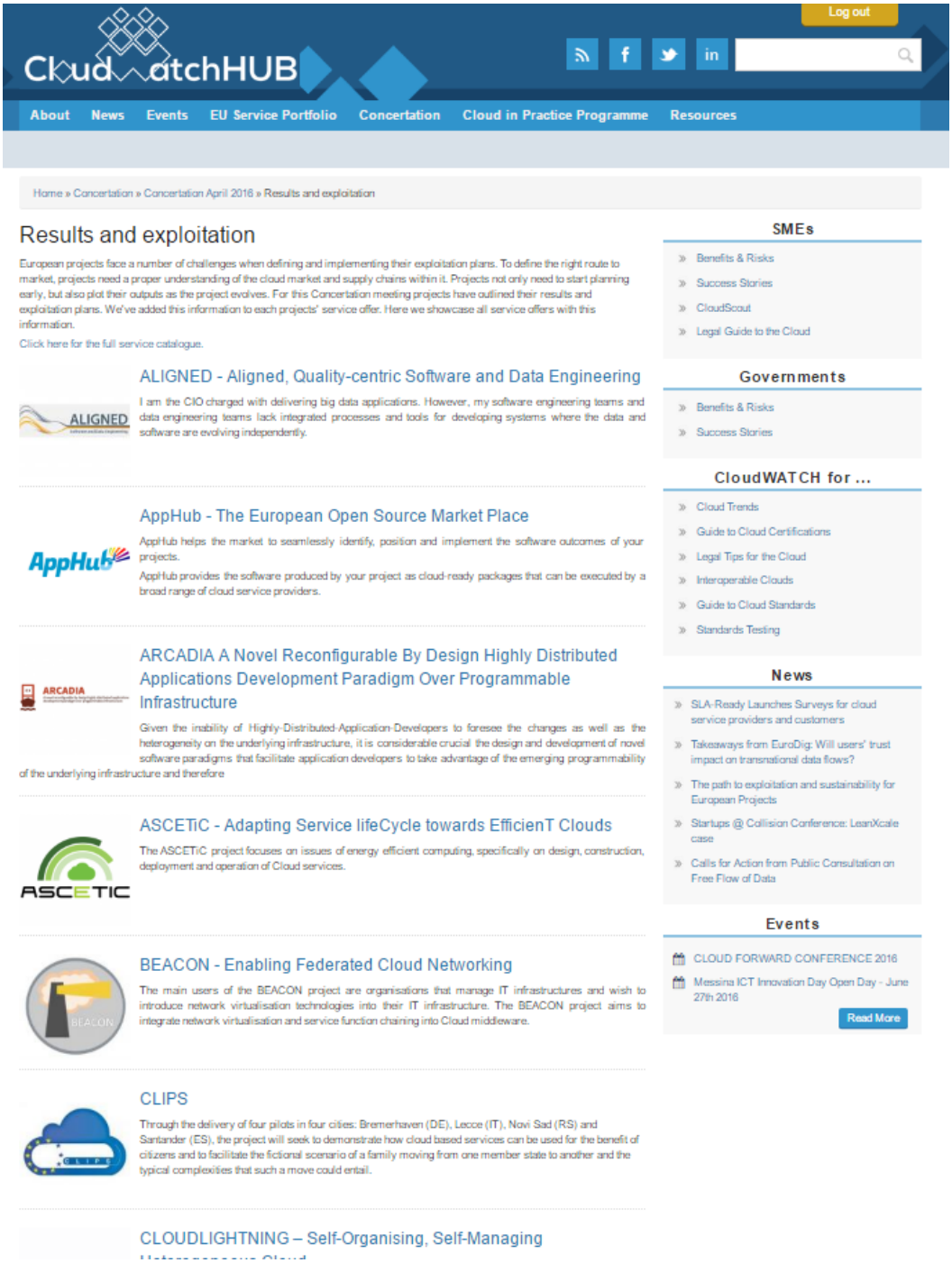
Thirdly, the first iteration of the Preliminary Roadmap to a Cloud Market Structure Encouraging Pricing Transparency was presented at the event outlining a set of recommendations for policy makers and industry. Since the event, CloudWATCH2 has been supporting the procurement process for the HNSciCloud project and this will make up a case study for the next iteration of the Roadmap in July 2017.

Finally, and related very much to the Roadmap, the event saw a workshop dedicated to how projects can better carry out exploitation activities and target market uptake. The session was chaired by an external expert in Frank Bennett, a Cloud Computing specialist who advises ITC companies on business model design and go-to-market with partners. The session highlighted best practices from a number of projects and showed how projects had taken on board recommendations from the 2015 CloudWATCH Concertation meeting.

Since the Concertation meeting, CloudWATCH2 has provided tailored support to the MUSA project on how their project outputs can be deployed and to which user groups, and what commercial alternatives are already available. CloudWATCH2 will organise highly tailored Business Modelling Workshops for up to 3 projects from the EC clusters. The purpose will be to advise them on their exploitation and sustainability planning. With the second Concertation Meeting planned for April 2017, CloudWATCH2 will follow up this activity at the CloudForward 2016 conference organised by the HolaCloud project. CloudWATCH2 will also support a joint workshop targeting SMEs in collaboration with three other Coordinated Support Actions: AppHub, HolaCloud and SLA-Ready.

5 Annex 1 - Project service offers

Projects provided services offers for the Concertation meeting and were published on the CloudWatchHUB.EU. These can be accessed here www.cloudwatchhub.eu/results-exploitation



6 Annex 2 - S-CASE Dissemination Kit

Main Dissemination Web portal: http://www.scasefp7.eu

One Page Engagement portal: http://s-case.github.io/

B2B Video for Software Houses: Available at: https://www.youtube.com/watch?v=QHMHxXn4zR0

The B2B video was designed to appeal to the business element of software houses. The "developers boss", someone who would care firstly about the commercial value of S-CASE. How much it would save them in terms of time, and money, was the primary message we knew we wanted to convey here. Accordingly we designed a short video that would explain the problem, explain how S-CASE helped solve it, and then direct them to our website.

In addressing the non-technical CTO of a company we knew we needed to focus on the 'customer' and the direct value that S-CASE could bring in terms of making software development faster, and therefore less costly, and streamlining business objectives for an audience that would be time-poor and initially more sceptical than a software developer may be.

B2C Video for Software Developers: Available at: https://www.youtube.com/watch?v=wvqtPoXSeic

Demo Videos

We have created a set of more 'technical' demonstration videos that directly appeal to software developers. You can view these demos by following these links:

REST Wizard: https://www.youtube.com/watch?v=DFoeUFUlBDI

MDE Engine: https://www.youtube.com/watch?v=YuyeZlMW8_Y

Eclipse plugin demo: https://www.youtube.com/watch?v=VdrOVXA9zNU

Social Media Channels

https://www.facebook.com/SCasefp7/

https://twitter.com/scasefp7

https://www.linkedin.com/groups/5146583/profile

Newsletter Engine - Mailchimp example:

http://us12.campaign-archive1.com/?u=5c5c8ab5069415ee5ac873d63&id=4e76bd0c12

7 Annex 3 - Participants

Name	Surname	Organisation	Project
Jose	Aznar	i2CAT Foundation	Cyclone
Frank	Bennet	EuroCloud & Cloud Industry Forum	n/a
Bojan	Božić	TCD	ALIGNED
Roberto	Bruschi	CNIT	INPUT
Giuliano	Casale	Imperial College London	DICE
Roberto	Cascella	Trust-IT Services	CLARUS
Valentina	Casola	University of Naples Federico II	SPECS
Cristina	Chesta	Concept Reply	HYVAR
Jose	Costa-Requena	Cumucore	SSICLOPS
Peter	Deussen	Fraunhofer FOKUS	AppHub
Roberto	Di Bernardo	Engineering Ingegneria Informatica SPA	CLIPS
Elisabetta	Di Nitto	Politecnico di Milano	DICE
Michel	Drescher	Oxford University	CloudWATCH2
Nicholas	Ferguson	Trust-IT Services	CloudWATCH2
Ana Juan	Ferrer	ATOS	Ascetic
Antonella	Fresa	Promoter srl	HOLACLOUD
Eva	García	RTDI.SL	HOLACLOUD
Stelios	Georgoulas	Surrey University	IKaaS
Panagiotis	Gouvas	UBITECH	PaaSword
Kevin	Hammond	University of St Andrews	RePhrase
Scott	Hansen	OpenGroup	MONDO
Einar Broch	Johnsen	University of Oslo	ENIVISAGE
Gregory	Kastoros	Intel	CloudWave
John	Kennedy	Intel	MIKELANGELO
Hugo	Kerschot	I Spractices	ECIM
Frank	Khan Sullivan	Strategic Blue	CloudWATCH2
Sotirios	Koussouris	National Technical University of Athens	CloudTeams
Gorazd	Marinic	iMinds	ECIM
Philippe	Massonet	CETIC asbl	BEACON
Isabel	Matranga	Engineering Ingegneria Informatica SpA	ClouT
Francisco	Medeiros	European Commission	n/a
Edmundo	Monteiro	University of Coimbra	EUBrazil Cloud Forum
Spiros	Mouzakitis	National Technical University of Athens	
Pearse	O'Donohue	European Commission	n/a
Adegboyega	Ojo	Insight Centre for Data Analytics	ARCADIA
Rui	Oliveira	University of Minho	Coherent PaaS
Leire	Orue-Echevarria	TECNALIA	MUSA
Dimitris	Papaspyros	National Technical University of Athens	
Marta	Patino	Technical University of Madrid	Coherent PaaS
Dana	Petcu	West University of Timisoara	CloudLightning
Sabine	Posdziech	European Commission	n/a
Radu	Prodan	University of Innsbruck	ENTICE
Antonio	Puliafito	University of Messina	BEACON
Augustin Gonzalez	Quel	Ariadna	STORMCLOUDS
Erkuden	Rios	TECNALIA	MUSA
Maria	Tsakali	European Commission	n/a
Dirk	van Rooy	European Commission	n/a
Arthur	van der Wees	Arthur's Legal	SLA-Ready
Massimo	Villari	University of Messina	BEACON
Vlassis	Vlassiou	Aristotle University Of Thessaloniki	S-CASE
David	Wallom	Oxford University	CloudWATCH2
Robert	Woitsch	BOC Asset Management GmbH	CloudSocket

8 Annex 4 - Agenda

Clusters, collaboration and creating impact in the market

Unit E2 Software services and cloud computing Concertation meeting

20 March 2016

Room: STUDIO | NetFutures 2016, Brussels

@cloudwatchhub | @CnectCloud | @netfuturesEU | #netfutures16

Agenda

08:30 – 09:00	**Registration & Networking Coffee**
09:00 – 09:30	**Thinking Cloud Services for Government, Business and Research** Chair: Nicholas Ferguson, Trust-IT & CloudWATCH2 Coordinator • **CloudWATCH2 – Supporting your services for Government, Business and Research** Nicholas Ferguson, Trust-IT & CloudWATCH2 Coordinator • **Creating a resilient cloud market and opportunities for EC projects** Frank Kahn Sullivan, Strategic Blue • **Mapping priorities and future collaboration for your projects** David Wallom, Oxford University
09:30-10:40	**Identifying topics for the Horizon 2020 ICT Work Programme 2018 - 2020** Chair: Francisco Medeiros, Deputy Head of Unit E2 Software & Services, Cloud Computing, DG CONNECT, European Commission • **Introduction – Francisco Medeiros** • **Software Engineering for Services and Applications** Elisabetta Di Nitto, Politecnico di Milano & Cluster Chair • **Data Protection, Security and Privacy in the Cloud** Erkuden Rios Velasco, Tecnalia & Cluster Chair • **Novel approaches and technologies for Cloud resource and service management** Dana Petcu, West University of Timisoara & Cluster Chair • **Inter-cloud Challenges, Expectations and Issues** Ana Juan Ferrer, ATOS & Cluster Chair

10:40 – 11:10	**Networking break**
11:10 – 12:20	**The path to exploitation and sustainability** Chair - Frank Bennett, iCloud Limited *European projects face a number of challenges when defining and implementing their exploitation plans. To define the right route to market, projects need a proper understanding of the cloud market and supply chains within it. Projects not only need to start planning early, but also plot their outputs as the project evolves. The purpose of this session is to show projects how to create a business model. Our expert will give selected projects insights into how best to tell a story around it including how to create a business model* **Introduction – Frank Bennet, iCloud Limited** **Talking Exploitation and Sustainability** *In this part of the session we will be hearing about the results and exploitation plans from more mature projects. How have they identified target audiences and how are they reaching out to them? What future sustainability paths are open to them and how do they plan to achieve this?* **Panellists** • **ARTIST** – Leire Orue-Echevarria Arrieta, Tecnalia • **AppHub** – Cedric Thomas, OW2 • **ClouT** – Isabel Matranga, Engineering • **S-CASE** – Vlassis Vlassiou, Aristotle University of Thessaloniki • **ECIM** – Hugo Kerschot, ISPractice **Constructing business models** *This hands-on exercise will give practical guidance on how to frame and answer key questions about your business model for your project assets. Participants will be asked to complete a business model canvas and consider issues such as value propositions, key resources, customer segments and revenue streams.*
12:20-12:30	**Closing remarks** Pearse O'Donohue, Head of Unit E2, Software & Services, Cloud Computing, European Commission
12:30 Meeting Close & Lunch	