

Concertation Report Inter-cloud Challenges, Expectations and Issues



www.cloudwatchhub.eu | info@cloudwatchhub.eu | [@cloudwatchhub](https://twitter.com/cloudwatchhub)

1 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 to 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.

1.1 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-clouds¹ is materialised through internal clouds and interactions between public-private Clouds which is hardly automatized 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).

¹ 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].

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 paper².

² 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 Brokers 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	Interoperability 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 a cross cloud typologies Extended Workload Portability	CloudSocket, ENTICE, ModaClouds, mOSAIC, Paasage, SeaClouds, SSI CLOPS, 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, SSI CLOPS, 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-doud infrastructure SLAs performance New languages to express overall high performance including storage, compute, network Dependability and reliability between Cloud providers and consumers Dynamic workload balancing in multi-cloud context	ASCETiC, BEACON, CLOUDLIGHTNING, CloudSocket, CYCLONE, ENTICE,

	Cloud Infrastructures	Enable with inter-Cloud Service Provider connectivity	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

