
# Novel approaches and technologies for Cloud resource and service management

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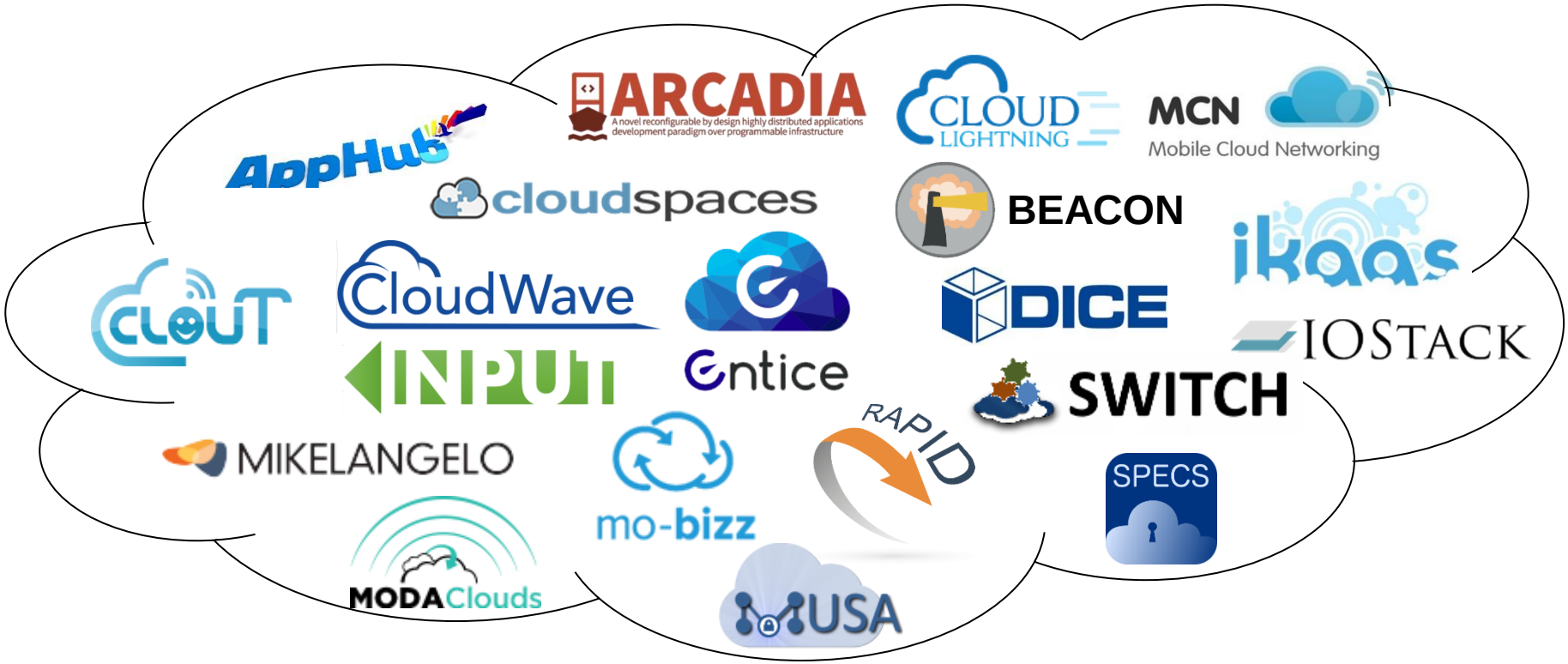
# Cluster membership

- Started in June 2015
- 20 actions/projects from H2020-ICT/FP7-ICT/CIP-ICT



# Cluster Objective

Forum

for discussing

the current research and innovation challenges

encountered at infrastructure-as-a-service level

and generated by the desire

to improve

the user experiences

and the efficient use of the available resources

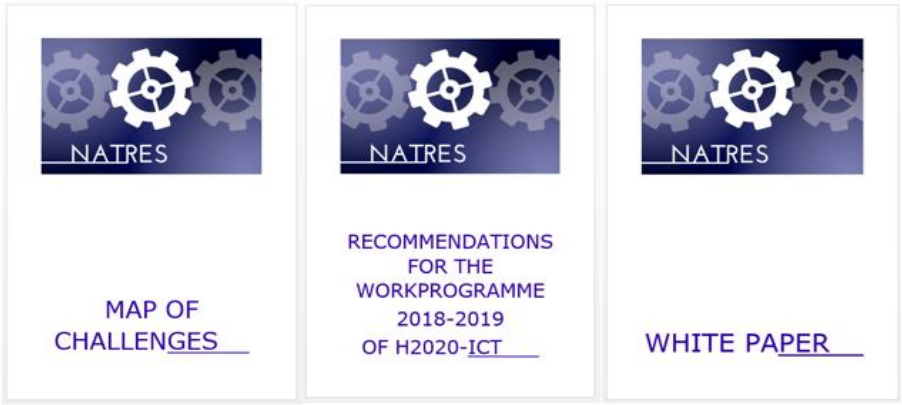
# Goals

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

# Achivements until current date

- Documents:
  - **Map of challenges**, Oct 4, 2015
  - **Recommendations for the WP18-19**, Dec 24, 2015, based on a questionnaire (Nov 2015)
  - **White paper,** Apr 15, 2016

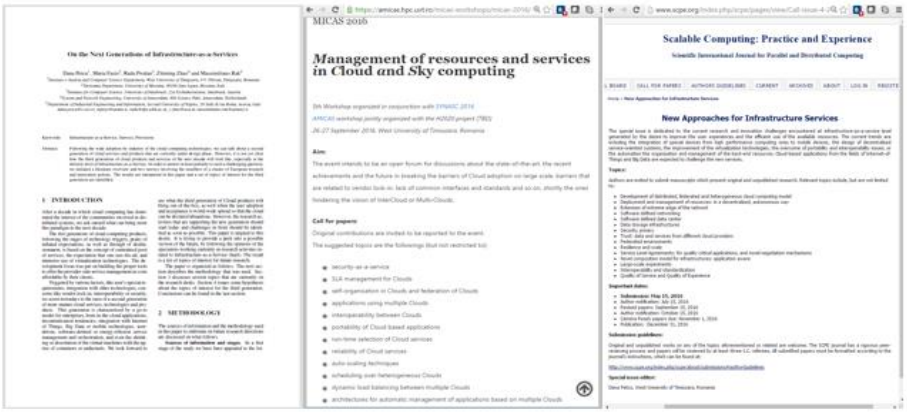
**Public documents:**




- Joint dissemination:
  - **MICAS 2015**, 21 Sept 2015, 1 tutorial, 6 action presentations
  - **Booth at NetFuture 2016**, 20 Apr 2016
  - **Paper at Closer 2016**, 24 Apr 2016

**Dissemination:**

CLOSER 2016 | MICAS 2015/2016 | CFP @ SCPE, 2016



# Example from Map-of-challenges


## 4.1 Research point of view

The following table identifies which cluster initiative is working on topics identified in H2020-LEIT-ICT-2016-6.

| Research subjects as in WP 2016-2017[6] | AppHub | ARCADIA | CloudLightning | ClouT | ENTICE | iKaaS | INPUT | Mikelangelo | Mo-Bizz | MODAClouds | MUSA | RAPID | SPECS | SWITCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Development of distributed, federated and heterogeneous cloud computing model | | X | X | | | X | | | X | | X | X | | X |
| Deployment and management of resources: in a decentralised, autonomous way | | X | X | X | X | X | X | | | X | X | X | X | X |
| Extension of extreme edge of the network | | | | | | | X | | | | | | | X |
| Software defined networking, | | X | | | X | | X | | | | | | | X |
| Software defined data center | | | | | | | X | | | | | | X | |
| Data storage infrastructures | | | | X | X | | | | | | | | | |
| Security, privacy | | | | | | X | | | | | X | X | X | |

# Recommenations for WP18-19


1. Support the **evolution of the Cloud towards its omnipresence**, freeing the service consuming software from the Cloud services
2. 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
3. Support the **evolution of the Cloud computing model towards the integration with machine-to-machine computing**
4. 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

# White paper: gaps analysis



## 3. Gap analysis

ARCADIA will provide a Holistic Novel Approach for the development of Reconfigurable-By-Design Highly Distributed Applications (HDAs). The envisioned Framework entails many innovative aspects, as far as the entire lifecycle management of HDAs is concerned. Thus; radical innovation aspects are introduced to Application Development phase, to Application on-Boarding phase and to Application execution phase. Regarding Application Development, ARCADIA Framework will use extensibility mechanisms that are provided by many third-generation- programming languages (e.g. JAVA) in order to create an Annotation Toolkit. This Toolkit will allow an HDA developer to provide source-code-level annotations that will refer to re-configurability aspects (e.g. balancing policies, QoS even Networking-level security). Although programming- language extensibility mechanisms are extensively used (the last four years) by many widely-adopted toolkits (Spring, Hibernate, JEE etc) there is no prior-paradigm of an extensibility mechanism that targets Infrastructural Reconfiguration.

Most current cloud service providers offer basic network functionalities including network instantiation, network isolation, and address management. However, these network services are very limited and do not allow users to have advanced control over these virtual networks. The cloud network model should evolve to an on-demand provisioning model that, relying on the existing virtualization technologies, enables users to define customized virtual networks, to have advanced control over network configuration, and to implement advanced features (e.g. scalability, performance, QoS, security, and federated networking support). There are some basic network functionalities that are currently offered by most cloud infrastructures, such as the OpenNebula or OpenStack-based clouds, that allow users to instantiate virtual networks, to manage addresses, and to isolate traffic from different networks. However, these functionalities have to be extended with advanced network functionalities, in order to design challenging future cloud infrastructures, able to improve the network management both inside the cloud and across different clouds.

**Autonomic Clouds features are only partially available today.** The main characteristics that are distinguishing an Autonomic Cloud from current Clouds are: follows a contextual behavior through methods of self-management, self-tuning, self-configuration, self-diagnosis, and self-healing; presents itself as a robust and fault tolerant system; it is easy to manage and operate the services and deployments by using techniques for the design, build, deployment and management of resources without human involvement. Such level of automation is not yet achieved and will not be achieved soon. This is clearly proved by the current approaches in HPC Cloud were bare metal and classical pre-allocation style are still dominating.

The introduction of Cloud in IoT paradigm solves two main gaps in smart cities context:

1. Lack of elasticity and scalability "on demand", that force municipalities to overprovision their premises of useless hardware to face potential data or processing bursts increasing dramatically costs or to renounce to face them
2. Difficulties to introduce new services based on data collected from sensors or actions available by actuators because legacy development models are expensive and slow.

In its architecture, ClouT includes support for open source Infrastructure as a Service platforms, an elastic Platform as a Service, including Service Mashup Tool, making it easier to continuously develop cloud applications that scale dynamically according to the workload, Big Data technologies to analyze and make use of data collected and offers a dynamic, elastic, auto-provisioned cloud storage behind a standardized RESTful API. All of this while maintaining focus on bringing cloud advantages to smart cities.



*Cluster of European Projects on Clouds*
*NATRES: Novel Approaches and Technologies for Cloud Resource and Service management*

As data-intensive applications run on complex massively parallel systems, **scalability** issues are often encountered by quality assurance tools or monitoring systems. Adaptive and fast reactive systems should be designed in the near future to cope with the fast development of Big Data technologies. Moreover, the Big Data technologies are currently evolving to allow innovative data mining methods to be applied and the Cloud-based services should keep track of these evolution.

There is an ongoing trend in the virtualization area towards container services, as opposed to traditional full operating system stack virtualization. Containers are provided in repositories, are more lightweight, and faster to instantiate and operate compared to VM images. Allowing optimization on containers is an open topic on the agenda of the ENTICE project that needs further research and development. The open security issues in the ENTICE environment and cloud computing in general need further investigation and research to allow universal commercial usability.

iKaaS believes that in a multi-cloud environments there are many challenges that need to be tackled. Apart from the well acknowledged big data analytics issues, data representation needs to be unified among a variety of clouds. That applies to both IoT data themselves (i.e. a mobile phone doesn't send GPS location annotated in X way and another mobile phone sends annotated in Y way) but also to the representation of cloud resources and service components so that they can all be considered together for cloud-aware service optimization purposes. In addition, many security and privacy considerations need to be tackled that don't exist in single cloud environments. Ensuring also interoperability among clouds both in terms of virtualized functionalities themselves and the overlaying cloud management software is also an issue that needs to be addressed so that service components can be instantiated and migrated -when need be- among various clouds with different owners and different underlying capabilities and technologies.

In the specific Smart City contexts considered, the scenario specific needed data processing and knowledge generation functionalities themselves also have room for improvement and this is verified by the numerous project publications in the respective fields.

Major issue in improving the performance, security and overall behavior of the HPC, HPC Cloud and Cloud applications is legacy. Especially in HPC field, legacy applications and programming languages are still used due to their high-performance under specific tasks. Quite the same holds for Cloud area, as applications mature and are simply supported, patched, but not actively (re-)developed. Thin layering, introduction of flexibility, reduction of complexity and improvement of performance - all these fields remain to be addressed during and after MIKELANGELO, as the new approaches (e.g., microservices, containers), in the end require re-engineering or even re-write of the applications.

Speed of service instantiation is greatly influenced by the particular cloud management framework and type of virtualisation. If virtualisation approaches are to be further placed into production they need to be fast and small. It is common for over one million packets per process to processed but in order to do so new approaches such as unikernels and libraryOS's are required. Another potential for addresses the high performance requirements of the telecoms sector is to invest more research into rackscale hardware architectures and the supporting resource management software required, however as with any new hardware platform the current costs associated make this cost-prohibitive especially when the cloud computing zeitgeist revolves around the idea of commodity hardware.

Model-driven engineering techniques have proven to be useful for the management of Multi-Cloud resources. However the **automatic generation of the codes for Multi-Clouds** starting from abstract model is still an objective far to be achieved due to the diversity of the Cloud services and services that are currently available.

# Instead conclusions

- **Incoming actions:**
  - **CFP for SCPE**, open access, 15 May 2016
  - **MICAS 2016**
  - **CloudForward 2016**
- **Web site:**

  https://eucloudclusters.wordpress.com/new-approaches-for-infrastructure-services
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