



ARCADIA

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A Novel Reconfigurable By Design Highly Distributed Applications Development Paradigm Over Programmable Infrastructure



Editorial

Dear Readers,

Welcome to our fourth issue of **ARCADIA** Newsletter that we would like to present to you! Here you can find updated information on the progress of our project and read news related to **ARCADIA**, which we hope will be of interest to you.

In this issue, we have prepared the following selection of articles in order to provide a deeper look into the work being done in the context of the EU-funded project **ARCADIA**:

- ♦ How the ARCADIA framework could support interoperability in the Internet of Things sector
- ♦ Report on the 2nd ARCADIA workshop that was organized in conjunction with the ITC28 congress
- ♦ Dissemination activities in the second semester of 2016
- ♦ 1st review meeting in Brussels and plenary meeting in Nicosia

We will regularly keep you updated with the most recent news about the status of the project, the consortium dissemination activities and a recommendation of conferences that might be of interest to you. Moreover, we kindly invite you to also regularly consult our website: <http://www.arcadia-framework.eu>

We are happy to invite you to follow our activities with this newsletter and we are looking forward to your feedback.

Yours sincerely,

The **ARCADIA** consortium

Project details

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Supporting interoperability in Internet of Things An opportunity for the ARCADIA framework

The constantly increased variety of available hardware and software solutions for the IoT sector is facilitating the development of novel applications, but at the same time the lack of standardized or widely accepted means of interaction, deployment and configuration is seriously hindering the IoT's potential. The ARCADIA framework, as a novel application development paradigm, can be used to enable the cooperation between software components designed and implemented independently and based on various technologies, so that they can form enhanced, distributed, cloud applications.

ARCADIA applications are based on a micro-service model and are governed by a sophisticated policy manager. Each ARCADIA application consists of several autonomous components, which can communicate with each other based on a service graph and policy rules defined by the developers. Each component can be stored in a public or private registry on the ARCADIA platform and it can be re-used on other applications. To create an ARCADIA component, developers can transform their legacy applications by either using specific JAVA annotations, if applications are java-based, or by wrapping them using java interfaces. This means that the ARCADIA framework doesn't force developers to re-write their existing applications from scratch, since any stand-alone application can be converted to an ARCADIA-compatible component.

The "heart" of the framework is the Smart Controller. Starting from the development, this module is responsible for interpreting the annotations used in a component, finding and deploying the required dependencies of a component and finally generating the unikernel, which is the purposed-build virtual machine image for cloud deployment. Moreover, by monitoring the components, Smart Controller is responsible for scaling and reconfiguring the application based on optimization algorithms.

In order to have a valid ARCADIA component, a minimum of four JAVA annotations have to be used in the application; "@ArcadiaComponent" that declares the name and the version of the component and three more that define the lifecycle management methods to be called by the

Smart Controller; however, developers can use as many annotations as their application requires in order to offer metrics or configuration parameters. Moreover, developers can use annotations that define dependencies of the component, for example the requirement for a database or vice versa the definition of an interface for other components to depend on it.

There aren't any forced naming conventions and thus, there is no need for heavy code refactoring of existing applications. For example, as shown in the code snippet below, by annotating a method with "@LifecycleInitialize" the framework will know which method to call before starting the component. There are similar annotations for start and stop functions namely "@LifecycleStart" and "@LifecycleStop". The final component is either a purposed-build unikernel that can be run under a hypervisor on any cloud infrastructure or a simple application that can be run on bare-metal machines like a raspberry Pi, ideal for IoT usage.

One of the main issues with IoT applications is the huge variety of hardware and software vendors, and more specifically the consumption of the different data types each of them produces. With the ARCADIA framework, a component running on an IoT gateway can consume data from different sensors, and then offer them as metrics to the ARCADIA platform or provide an interface for other components to access them, by using simple annotations. Developers can then use these datasets in any way their application requires, for example store them in a database or create a pipeline for Big Data analysis.

Internet of Things applications can take advantage of the different features of the ARCADIA framework. For example, by using policies, metrics and re-configuration parameters, developers can control IoT devices like actuators or motors through the gateway component. Moreover, the exploitation of the annotations for discovering in the ARCADIA repository components that are necessary for implementing an application, multiplies the available options for developers; the necessary adaptations for ensuring interoperability are responsibility of the Smart Controller, which will set the optimal configuration through the ARCADIA agent of the object under control.

```
@ArcadiaComponent(componentname="myIoTController", componentversion="1.0.0")
public class GatewayController{
    // - Private/public fields
    public GatewayController() { /*...*/ }
    /** Initialize sensor attributes, establish sensor-gateway connections, etc */
    @LifecycleInitialize
    public void sensorsInitialization() { /*...*/ }
}
```



Scientific workshop organized by ARCADIA



The second ARCADIA workshop (PROCON 2016) was held on 12th September 2016 in Würzburg, Germany, during the 28th International Teletraffic Congress (ITC28). ITC 28 is technically co-sponsored by IEEE Communications Society (IEEE ComSoc) and the Information Technology Society within VDE (ITG VDE) and in cooperation with ACM SIGCOMM. The workshop provided a forum for leading researchers from academia and industry to present and discuss the latest advances and developments in design, modelling, measure-

ment and performance evaluation of communication systems, networks and services, focusing on the development of highly distributed applications and cloud infrastructures. Additionally, a platform for Fog Computing was presented and topics related to Software-Defined Networking and Cloud Service Placement were discussed.

The workshop was entitled as "First International Workshop on Programmability for Cloud Networks and Applications" and it provided a single track and one-day program, including a keynote, demonstrations and six papers' presentations. The keynote talk was given by Robert Birke, IBM Zurich Research Laboratory, Switzerland. His research focuses on virtual resource management for large scale data centers, aiming at optimizing the application latency, system throughput, and resource efficiency, particularly energy. His talk reflected the IBM view on contemporary cloud architectures and addressed existing and upcoming challenges in this area. The demonstration at the workshop was presented by CNIT, University of Catania and Telecom. It was entitled as "An SDN/NFV Telco Operator Platform for Multipoint Video Live Streaming: Design and Prototyping". Two ARCADIA members namely Dr. Panagiotis Gouvas from UBITECH and Dr. Stefan Covaci from Technical University Berlin participated, presented a research paper and showed the latest demo of the ARCADIA toolkit and orchestrator to get feedback from the audience. They have also discussed and replied to all the questions set by the audience.



Dissemination activities

Consortium members have presented ARCADIA concepts in the following events:

- International Conference on Communications and Electronics (ICCE 2016), July 27-29, 2016, Ha Long Bay, Viet Nam
- Cloud Forward Conference 2016, October 2016, Madrid, Spain.
- 2nd EAI International Conference on Interoperability in IoT, October 26-27, 2016, Paris, France.
- 9th ACM SIGPLAN International Conference on Software Language Engineering (SLE2016), 31 October-1 November, 2016, Amsterdam, the Netherlands.
- Second International Workshop on Sustainable Data Centres and Cloud Computing (SD3C), December 2016, Shanghai, China



1st review meeting in Brussels / 5th plenary meeting in Nicosia



The first review meeting of the ARCADIA project was held on 9th September 2016 in Brussels. The outcome was successful and the recommendations made by the reviewers were handled by the consortium till the end of 2016.

The 5th plenary meeting of the ARCADIA project took place in Nicosia, Cyprus, (30 Nov—1 Dec) hosted by ADITESS. The preparation of the revised documents as requested by the reviewers was discussed, as well as the progress of the software modules development. The implementation of the three ARCADIA use cases was also a central point of the discussions during this meeting.

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