



**Project Overview** 

.

## ARCADIA Project - Consortium

**Call**: H2020-ICT-2014-1/ICT-09 - Tools and Methods for Software Development

Start date: 01/01/2015

End date: 31/12/2017

Duration: 36 months

**Reference**: GA no 645372

**Budget**: 3,543,864 €

**Funding**: 3,543,864 €

<b>NUI Galway</b> OÉ Gaillimh	Insight Centre for Data Analytics, National University of Ireland, Galway	Ireland		
	Stiftelsen SINTEF	Norway		
Refer	Technische Universität Berlin	Germany		
cnit	Consorzio Nazionale Interuniversitario per le Telecomunicazioni	Italy		
Univerza <i>v Ljubijant</i>	Univerza v Ljubljani	Slovenia		
UBITECH ubiquitous solutions	UBITECH	Greece		
Contractions	WINGS ICT Solutions Information & Communication Technologies EPE	Greece		
Maggioli	MAGGIOLI SPA	Italy		
Additess Acceleration	ADITESS Advanced Integrated Technology Solutions and Services Ltd	Cyprus		

### Evolving applications requirements

- Application requirements are changing
  - horizontal scalability;
  - elasticity;
  - adaptability;
  - resiliency;
  - fault-tolerance characteristics.
- The design of reactive systems that are able to adapt based on their operational environment conditions is required.

### Software engineering approaches

- Design of reactive systems that are able to adapt based on their operational environment conditions.
- Include more "context-awareness" into applications and services.
- Independently orchestratable software components.
- Development and operations teams have to work closely together.

#### Network Softwarization and Programmable Infrastructure

- Novel virtualisation technologies.
- Packaging of software components in virtual machines (VMs), containers or unikernels.
- Network softwarization: providing network functionalities via software
  - Network Function Virtualization (NFV): service chains consisted of virtual network functions;
  - Software Defined Networking (SDN): network control directly programmable and underlying infrastructure abstracted for applications and network services.

## Need for alignment

- Novel software engineering approaches.
- Solutions for optimally deploying and managing applications.



## ARCADIA in a nutshell...



#### DISTRIBUTED APPS DEVELOPMENT ENVIRONMENT

Design and develop microservices using ARCADIA libraries. Define app-oriented metrics. Reconfigurable-by-design apps.



#### POLICY-AWARE ORCHESTRATION

Optimal app deployment using meta-heuristic algorithms. Enable real-time policy enforcement. ETSI NFV compliant.

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#### MULTI DATACENTER EXECUTION MIDDLEWARE

Exploit unikernel stacks. Support multi-IaaS scenarios. OpenStack-ready.



#### COMPONENT & APPLICATION DISCOVERY

Compose microservices-based applications. Discover. Reuse. Deploy.



### Arcadia Context Model





### Software Development in ARCADIA



Annotations are a form of metadata that provide data about a program that is not part of the program itself.



#### @ArcadiaMetric

(name="averageProcessingTime",

*description* = "URL hashing algorithm performance",

unitofmeasurement = "msec",

valuetype = ValueType.SingleValue,

**maxvalue** = "6000",

*minvalue* = "1",

higherisbetter = false)

### Web-based Development Environment

- ARCADIA IDE plug-in is integrated with the latest version of Eclipse Che that is the browser-based, cloud version of the classic Eclipse.
- Through the plug-in, developers can:
  - manage their previously generated API keys;
  - have a pre-compile validation of the ARCADIA annotations and developed microservices;
  - submit their code to the platform.



# Component and Service Graph Repositories and Composer

- Provide access to components developed within the Web-based IDE.
- View components details (configuration details, chainable parameters, metrics)
- Provide access to set of available and running service graphs.
- View set of components per graph.
- Manage service graphs (deploy, undeploy, monitor)

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Applications	Uploaded components							
Components	<b>⊕</b> Uploaded	© Dashboard	MENU / application / template					
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		Lusers	Components Com	nponent1, Component2,	Component3			

#### Policies Enforcement Mechanisms

- Policies enforcement during deployment (optimization engine) and runtime (rule based management system).
- During runtime:
  - Design and apply policies for runtime management of service graphs.
  - Context-aware execution of components and graphs taking into account conditions in the deployed ecosystem.
  - Assure QoS and QoE levels to end users.
  - Prioritize services/applications provision on behalf of the Service Providers.

## Policies Scope Overview

- A policy may be associated with a service graph and applied during runtime.
- Set of actions for:
  - Component lifecycle management
  - Manage component configuration parameters/metrics
  - Activate/deactivate virtual functions (e.g. scaling)
  - Manage allocated IaaS resources
  - Trigger alerts
- Conflict resolution based on specification of priorities.

### Policies Enforcement Framework

- Follow a continuous match-resolve-act approach.
  - match phase: mapping of the set of applied rules which are satisfied based on the data streams coming from a set of monitoring probes,
  - resolve phase: conflict resolution -if any- among the satisfied rules taking into account the pre-defined salience of each rule,
  - act phase: provision of a set of suggested actions to the orchestration components.
- Data monitoring and management processes are supported through a set of active and passive monitoring probes. Data is transformed to facts.
- Definition of rules per policy is supported through the Policy Editor in a per service graph basis, based on the concepts represented in the Context model.

### Policies Enforcement Framework



## **Optimisation Engine**

 Deploying a distributed application to a cloud infrastructure requires assigning and instantiating an execution environment for each software component while illustrating the communication links among them as required.

- Assignment of resources to execution environments and communication links has to :
  - Fulfil **requirements**
  - Satisfy objectives
  - Avoid **policy** violations
- Initial Assignment happens on a request to deploy and operate a new application
- Partial Reassignments <u>per application</u> are triggered during operation on required scaling to cope with workload or on required <u>migration</u> to keep on satisfying requirements.
- Full or Partial Reassignments for <u>one or more applications</u> are triggered for operating HDAs in order to <u>keep satisfying or better satisfy objectives</u> and <u>avoid</u> <u>policy violations</u>.

#### Implementation Optaplanner

- OptaPlanner is a constraint satisfaction solver. It optimizes business resource planning.
- OptaPlanner is a lightweight, embeddable planning engine. It enables normal Java<sup>™</sup> programmers to solve optimization problems efficiently. Constraints apply on plain domain objects and can reuse existing code.
- OptaPlanner combines sophisticated optimization heuristics and metaheuristics with very efficient score calculation.
- OptaPlanner is open source software (100% pure Java™, runs on any JVM)



### **ARCADIA Use Cases**

#### Security and Privacy Support in the FI-WARE Platform Use Case

#### **Encrypted VoIP Communications**

#### **Remote Patient Monitoring**



### **ARCADIA Use Cases**

High Performance Survivable Communications in Distributed IoT Deployments Use Case



### **ARCADIA Use Cases**

#### **Energy Efficiency vs Quality of Service (QoS) trade-off Use Case.**





# ARCADIA

A novel reconfigurable by design highly distributed applications development paradigm over programmable infrastructure



http://www.arcadia-framework.eu/



https://twitter.com/eu\_arcadia



https://www.linkedin.com/groups/6949809

#### Thank you!!!