RAINBOW is a Research and Innovation Action funder under the EU Horizon 2020 framework programme, focusing on producing an open, trusted fog computing platform facilitating the deployment, orchestration and management of scalable, heterogeneous and secure IoT services and cross-cloud apps.

**Research Challenges**

RAINBOW’s research offering consists of a distinct set of tangible technical outcomes that will advance the state-of-the-art in the respective areas:

- **Cloud-service Modelling Language** for fog/edge applications
- **Orchestration Algorithms** to perform proper enactment at the orchestration level during runtime utilizing heuristic/pruning techniques
- **Efficient Data Storage, Querying and Processing** pipeline
- **Secure Zero-touch Configuration** of fog nodes with emphasis on zero-knowledge/collision-free identity acquisition in a mesh environment
- **Trust Enablers** that relate to Configuration Integrity Verification and Remote Attestation of fog applications

**Project Information**

**Title:** RAINBOW - A fog platform for secured IoT services

**Grant Agreement No:** 871403

**Call ID:** ICT-15-2019-2020

**Call Topic:** Cloud Computing

**Start Date:** January 1st, 2020

**End Date:** December 31st, 2022

**Coordinator:** UBITECH Ubiquitous Solutions

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- #RAINBOW_H2020
- #FogComputing
- #EdgeComputing
- #Industry4
- #secureIoT

[Horizon 2020 European Union Funding for Research & Innovation]

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 871403
RAINBOW considers a number of cornerstone technologies that will be re-used or even enhanced during the materialization of its architecture:

**Containerization and Orchestration**

RAINBOW is interested in the **definition of service graphs that represent applications using the micro-service paradigm**, and then provision of the micro-service in a pool of available Fog resources.

**Mesh Networking**

With RAINBOW aiming to operate on top of dynamic, heterogeneous and complex networks, problems such as **dynamic routing and IP assignment** have been tackled through the incorporation of a **reactive routing protocol** in combination with a high-level protocol for **Fog Node onboarding**.

**Trust Assurance**

RAINBOW will include the provision of secure, robust, and efficient runtime behavioural attestation and verification methods to check the internal state of an untrusted fog-based environment. By developing a **trusted framework for attestation** and **system assurance** it seeks to establish **fog/edge node communities of trust**.

**RAINBOW Demonstrators**

RAINBOW plans to test and validate its technology suite by three strong applications implemented through realistic scenarios and pragmatic conditions.

- Human-Robot Collaboration in Industrial Ecosystems
- Digital Transformation of Urban Mobility
- Power Line Surveillance via Swarm of Drones
Our platform will be materialized through a multi-layer architecture where each layer comprises a set of discrete components that interact with each other, while five distinct roles are identified as key actors in the RAINBOW ecosystem.
# RAINBOW Components

## Modelling Layer

### Service Graph Editor
- Author and maintain application templates of cloud-native components accompanied by requirements constraints

### Analytics Editor
- Create or edit analytic queries; declaration of optimization strategies and constraints

### Policy Editor
- Author and validate design-time and runtime policies

## Logically Centralized Orchestration

### Pre-deployment Constraint Solver
- Facilitate the identification of an optimal placement plan of a service graph

### Resource Manager
- Track available and allocated resources on every node

### Deployment Manager
- Implement a placement plan based on the state and availability of resources

### Resource & App-level Monitoring
- Collect and provide monitoring data regarding resource utilization from the underlying fog infrastructure

### Orchestration Lifecycle Manager
- Coordinate service graph deployment; check the fulfilment of Service Level Objectives; abstraction model of corrective actions; maintain consistent view of physical resources; conflict resolution

## Mesh Layer

### Mesh Routing Protocol Stack
- Secure onboarding and operation of a consistent network overlay among the fog nodes and the selection of a cluster-head

### Security Enablers
- Provide enhanced remote attestation mechanisms towards achieving privacy-preserving attestation and secure composability of the fog environment

## Data Management & Analytics Layer

### Data Storage and Sharing
- Store and provide access to collected data and metadata

### Analytics Engine
- Offer high-level analytics out of data stemming from IoT services and infrastructure scattered across the network

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In order to maximize its reach and impact, RAINBOW sought to establish a series of synergies and strong cooperation links with initiatives from the EU cloud computing community. In this context, RAINBOW has initially joined forces with Horizon 2020 projects H-CLOUD and PLEDGER.

**H-CLOUD** leads coordination and support activities for the consolidation and growth of the Cloud Computing research and innovation community in Europe, bringing together innovators, policy makers, cloud computing research, industry and users into an open, participatory and sustainable forum. The H-CLOUD Forum will strengthen collaboration to address challenges and opportunities at research, technological, policy, standardisation and organisational level to unlock the potential of cloud computing for all European stakeholders.

Find more at: [https://www.h-cloud.eu](https://www.h-cloud.eu)

**PLEDGER** aims to deliver a new architectural paradigm that will pave the way for next generation Edge Computing infrastructures, tackling the modern challenges and coupling the benefits of low latencies on the Edge with the robustness and resilience of cloud infrastructures. It will also allow Edge Computing users to understand the nature of their applications, research understandable quality of service metrics and optimise the competitiveness of their infrastructures.

Read more at: [http://www.pledger-project.eu](http://www.pledger-project.eu)
Congratulations to our colleagues from the Laboratory for Internet Computing, Department of Computer Science, University of Cyprus, who received the best demo award in the 5th ACM/IEEE Symposium on Edge Computing (SEC '20) for their work on Fogify, an open-source emulation framework easing the modelling, deployment and experimentation of fog testbeds. A scientific result that came through their excellent research work in RAINBOW.

More info on Fogify is available at its GitHub repository ➤ [https://ucy-linc-lab.github.io/fogify](https://ucy-linc-lab.github.io/fogify)