RAINBOW NEWSLETTER

ISSUE 6, DECEMBER 2021

RAINBOW is a Research and Innovation Action funded 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.

RAINBOW VIRTUAL DEMONSTRATIONS

RAINBOW will be validated against three demanding applications, that include automated manufacturing, connected vehicles and critical infrastructure surveillance, in order **to demonstrate** both the **scientific innovations** and the **business value proposition** of its overall approach. In fall 2021 the consortium has designed and deployed the virtualized demonstrators of these three use cases to evaluate the early release of RAINBOW's Fog Computing platform.

Initially, each use case specified the required setup and microservices architecture. Then, the implementation plan along with the usage and interaction of the RAINBOW components and assets in each scenario was established. Furthermore, a set of baseline KPIs and metrics for the three demonstrations were also defined, under the scope of evaluating and validating the obtained results.

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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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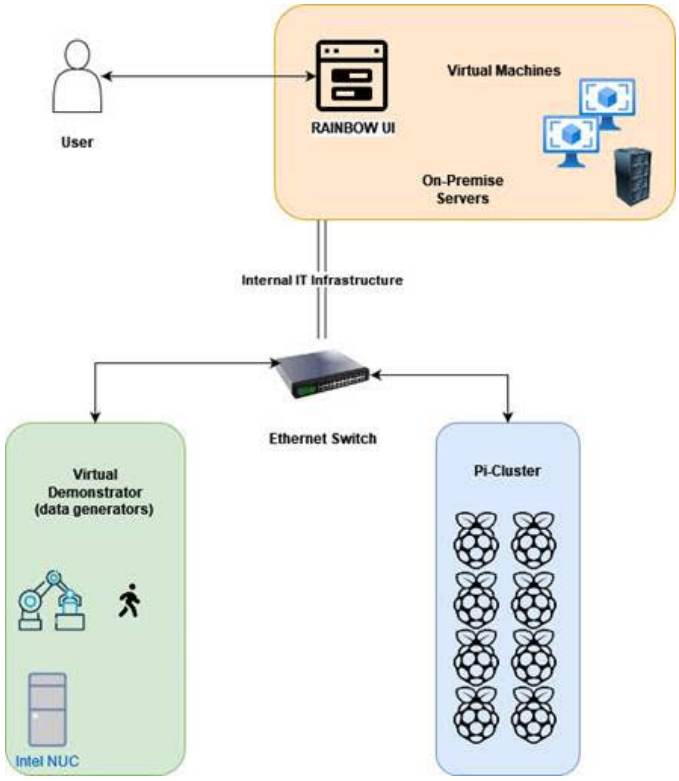
Look for our hashtags!

#RAINBOW_H2020
#FogComputing #Industry40
#EdgeComputing #secureIoT

https://rainbow-h2020.eu

HUMAN-ROBOT COLLABORATION

A Human-Robot Collaboration System relies on Edge / Fog Computing paradigm in order to achieve a **safer, more collaborative environment** in industries where humans and heavy-duty industrial grade robots can work in unison. The team members at **Bremer Institut für Produktion und Logistik GmbH** (BIBA) have developed a Virtual Demonstrator, which simulates an industrial workspace with basic robotic-arms and personnel in motion by modelling a human walking pattern. These models will generate data, albeit simulated data, to be consumed by the **Collision Prediction and Avoidance Algorithm**.



The RAINBOW Platform will provide deeper insights into how the algorithm can be scaled in real time if additional number of personnel or robots are introduced within the workspace. In order to achieve this result in real conditions, downtime of the services is required, which makes the combination of RAINBOW Platform and BIBA's Virtual Demonstrator a desirable match. Key system features that are important for this use case include the **Scalability of Services** in the Virtual Demonstrator and **Analytics Capabilities** of these services.

The initial virtual deployment revealed the **ease of deployment of services** for the Virtual Demonstrator through the use of RAINBOW Platform's intuitive user interface. After further testing and evaluation in the Virtual Demonstrator, in the next phase, the validated RAINBOW services will be applied to an actual Human Robot Collaboration System within BIBA's premises.

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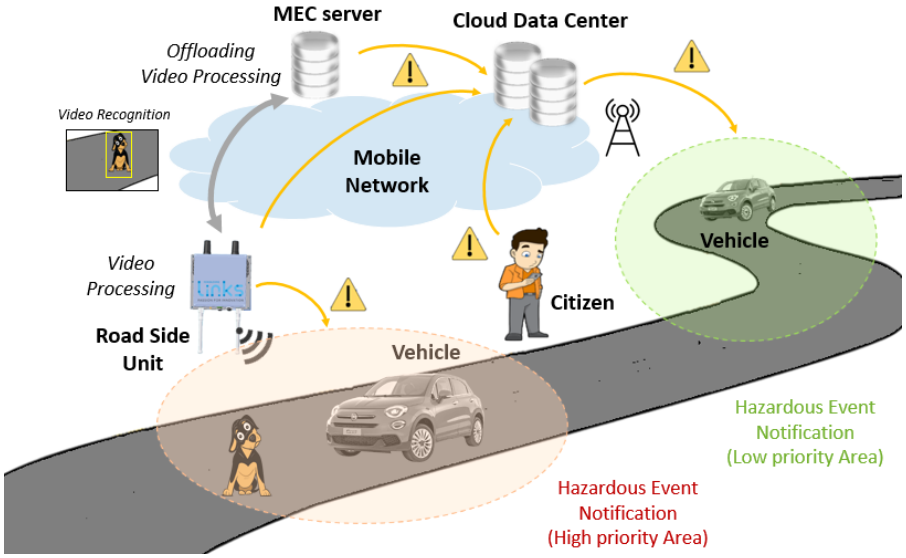
DIGITAL TRANSFORMATION OF URBAN MOBILITY

This scenario hinges upon a **real-time geo-referenced notification system for vehicles** traveling in urban areas about hazardous situations for the city mobility network, due to any possible cause (e.g., accidents, failure of road infrastructure, animals on the road, wrong-way driving). The notification system will be designed to collect signals issued by entities in urban areas (Vehicles, Road Side Units, and Vulnerable Users). Explicit notifications refer to those that are triggered directly (i.e., manually) by vulnerable users (citizens), who may want to report a hazardous situation. RSUs may trigger automatic notifications for sending log data to fog, MEC (Multi-access Edge Computing) and cloud, where AI/ML algorithms can infer alert conditions that should be reported. Each alert signal will be delivered with the available geo-localization information, allowing reports to be localized in the areas where the hazardous situation was detected.



The **Smart Orchestration** feature of the RAINBOW Platform will be providing a decentralized approach to **Trust** between fog nodes. The main demonstrable functionalities integrated with the RAINBOW Platform are:

- Migration of the recognition algorithm between RSU and MEC according to some metrics (e.g., network conditions, RSU load, application-level metrics) using **RAINBOW Orchestration**
- V2C (Vehicle to Cloud) secure V2X connection using the **RAINBOW Trust Enabler**

Some high-level KPIs/metrics are important for the examined use case and in particular, RSU power consumption and V2X messages latency:

- Average RSU power consumption expected to be less than 30W
- V2X messages latency between RSU and Vehicles expected to be less or equal than 300ms

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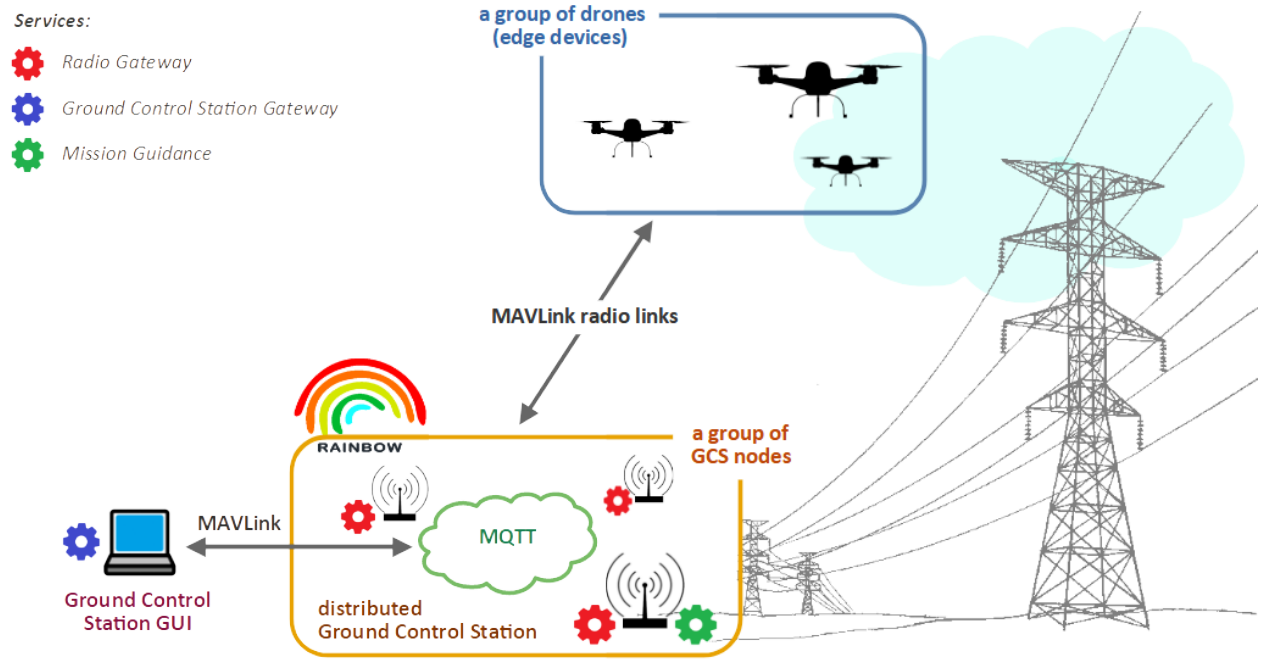
In the early-stage use case, some components of the full demonstration architecture are implemented to demonstrate the end-to-end chain between Vehicle, Road Side Unit, MEC, and Cloud. These include the Orchestration and service graph definition.

The final demonstrator will involve a vehicle and the RSU will be placed alongside the road so the PC5 short range connection will be used and the Citizen app will be developed. RAINBOW security and trust enablers with the remote attestation mechanisms will also be provided.

POWER LINE SURVEILLANCE VIA SWARM OF DRONES

This case regards the usage of a **swarm of drones to monitor and survey the status of power lines**. The novelty of this use-case stems from the **complete automation** of the surveillance process and the **significant increase in working range**. The main feature of the envisaged system is its ability to be quickly deployed in an area with no previously established infrastructure. Edge devices will be powered exclusively from temporary sources, while antennas will be placed on temporary masts; this will render the ad hoc deployment completely on-demand and highly mobile. Lastly, this use-case will consider the extension of active drone control radio range by employing a cellular-like handover mechanism considering a spectrum of application, network and physical-layer metrics.



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The **RAINBOW Orchestration** and **Data Management** components will significantly aid this use-case. Energy consumption will be limited for all edge devices in the network, via low-cost adaptive monitoring and dynamic adjustments of the drone data collection intensity and communication rate, considering drone locations and obtained images from the power-line under surveillance. Additionally routing optimizations, enabled by the RAINBOW Data Management and overlay mesh networks, will aid the use-case by providing optimal paths for video transmission within the ad hoc network. Efficient drone and mobile fog node computing resources are supported by the **RAINBOW Data Storage** mechanism, thanks to processing and storage being moved closer to the compute nodes, considering their geographic distribution. Lastly, RAINBOW supports **efficient resource allocation** by offering the underlying data processing engine and improving the scheduling of tasks and offloading to use a spectrum of metrics as computing and link establishment metrics.

The **Deployment Time** is important as it is the time it takes to deploy a new instance of the scenario in RAINBOW. Furthermore, the **Security Incidents** metric is important as the RAINBOW system is expected to contribute to improving the functioning of the drone system in both aspects (e.g., broken radio link, battery failure, overlapping flights due to bad coordination, copters collision, operator mistake, etc.). Lastly, **Service Availability** that concerns the net time of inspection flights in relation to the total flying time.

All components of the initial stage deployment are dockerized software-in-the-loop instances of the respective modules: (a) the Ground Control Station (GCS) that enables the control of drones, (b) a group of edge devices (the drones – components of the swarm), (c) a group of small RAINBOW-enabled single-board computers with radio modems to support coordination of drones over large areas, (d) a Radio Gateway, a GCS Gateway and a Mission Guidance service, and (e) an MQTT broker which allows services running on GCS nodes to communicate with each other without considering the physical topology of the network.

Further works will start from extending Radio Gateway service with an implementation of the drone handover procedure. At the same time, focus will be placed on developing the Mission Guidance service, tasked with assigning flight routes to individual drones. Work on the system will conclude with its preparation for deployment on real hardware, including the deployment of RAINBOW on nodes. After the above has been implemented, the (now physical) system, will undergo field tests using physical drones, GCSs and antenna masts.

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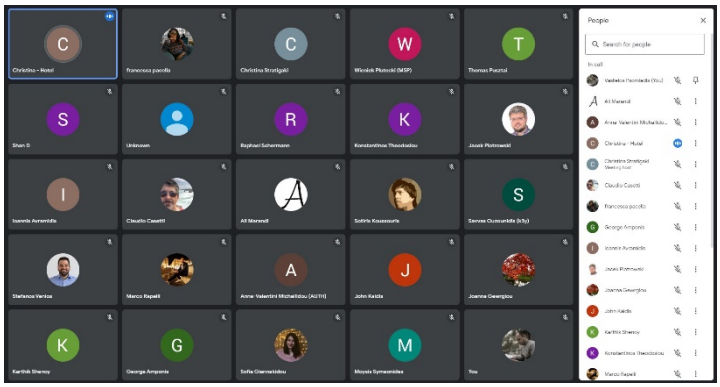
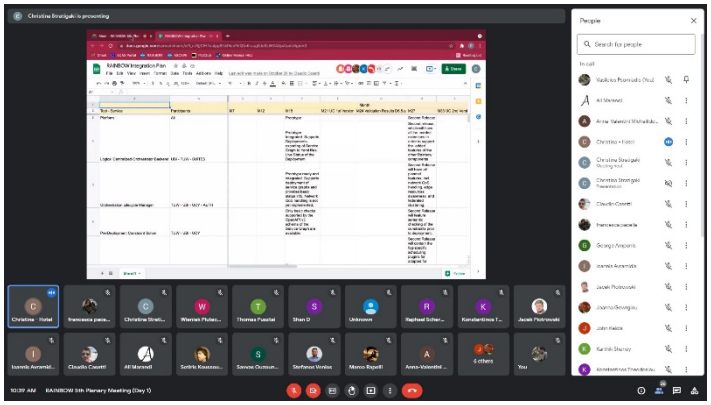
RAINBOW 5TH PLENARY MEETING

The 5th Plenary Meeting of the RAINBOW project took place on the 16th and 19th of November 2021. Following a hybrid approach, a team of partners met physically in Athens, with others joining online. Representatives of the 15 members of the RAINBOW consortium discussed altogether progress and integration aspects towards the next release of RAINBOW's Fog Computing platform. The project coordinator, **UBITECH Ltd**, organized and supported the whole process during the two-day meeting. During the meeting, all partners had the chance to present the progress of their tasks, along with the challenges, potential opportunities and future plans related to their implementation.

Goals of the 5th Plenary Meeting

- Clear understanding of the current development state of RAINBOW's technological components
- Integration aspects and guidelines, current state of individual components, and a workplan towards the 2nd release of the RAINBOW platform
- Demonstrations' integration and deployment aspects, business KPIs
- Monitor and intensify dissemination and communication activities
- Initial planning of RAINBOW's exploitation strategy





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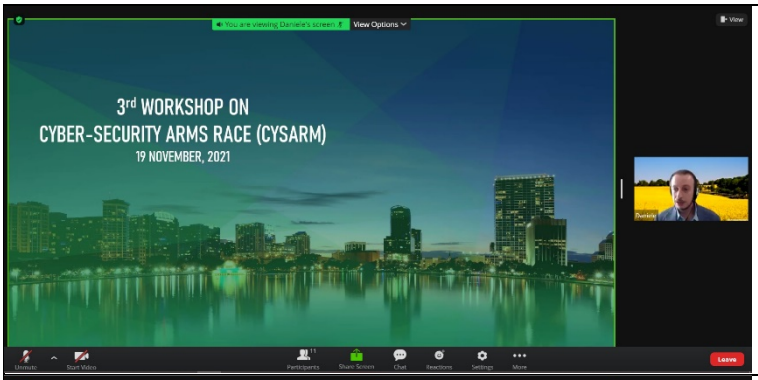
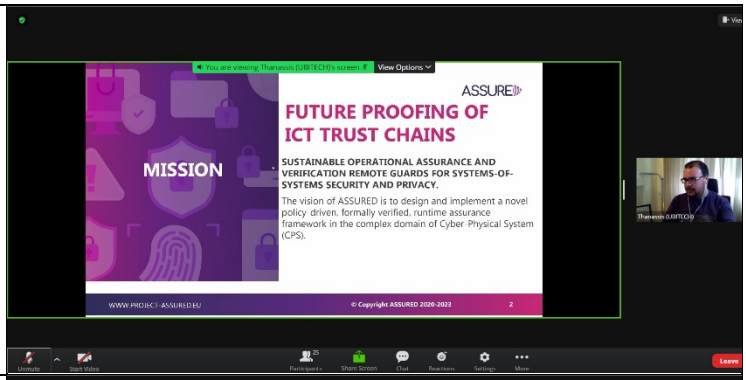
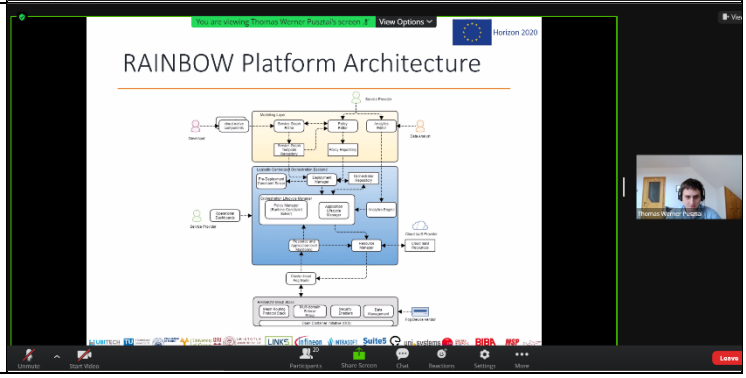
RAINBOW IN CYSARM 2021

RAINBOW was among the sponsors of the **3rd Workshop on Cyber-Security Arms Race** (CYSARM), that took place virtually on November 19, 2021, co-located with the 28th ACM Conference on Computer and Communications Security, Seoul, South Korea. Together with **ASSURED**, **C4IIoT** and **PUZZLE** H2020 projects and along with other participating researchers, various facets and trade-offs regarding cyber-security were discussed. During the event, RAINBOW presented the **novelty** and **advanced features** that its fog computing platform is bringing to the next generation IoT services and cross-cloud apps along with the guarantees of network security, data protection, identity management and resource integrity.







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