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# CODECO

Cognitive Decentralised  
Edge Cloud Orchestration

## Report: CODECO First Industrial Workshop

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## Executive Summary

This report provides an overview on the CODECO first industrial workshop held in Munich, co-located with HIPEAC 2024 on January 18<sup>th</sup>, 2024.

The event was organised by fortiss and counted with the involvement of all CODECO partners. The workshop aimed at creating awareness to novel concepts under development as basis for a flexible and decentralized Edge-Cloud orchestration.

During the workshop, participants were able to get acquainted with the latest evolution on Edge-Cloud continuum; the CODECO data-compute-network; interact with a rich academic and industrial community.

The workshop provided:

- An overview concerning challenges and opportunities across the Edge-Cloud continuum.
- Presentations by industrial and academic on the most recent developments supporting a data-network-compute approach for Edge-Cloud orchestration.
- Hands-on sessions on the Eclipse CODECO open-source code, being developed in CODECO.

### Document Revision History

Version	Date	Description of change	List of contributors
v0.1	02.03.2024	Integration of notes taken during the workshop	L. Carvalho (FOR)
v0.2	25.03.2024	Integration of the final format	R. C. Sofia

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## Acknowledgements

Acknowledgements at least to all Task elements that are not authors of the deliverable.



# 1 Introduction

This report provides an overview on the CODECO first industrial workshop sessions and outcome. Its purpose is to provide a summary of findings presented and discussions held during the workshop.

The workshop was organized by the HE CODECO project, aiming at creating awareness to novel concepts under development as basis for a flexible and decentralized Edge-Cloud orchestration. During the workshop, participants shall be able to get acquainted with the latest evolution on Edge-Cloud continuum; the CODECO data-compute-network; interact with a rich academic and industrial community.

The main purpose of the workshop was to raise awareness to the first-year developments in CODECO, at a technological and use-case level.

The Workshop provided:

- An overview concerning challenges and opportunities across the Edge-Cloud continuum.
- Presentations by industrial and academic on the most recent developments supporting a data-network-compute approach for Edge-Cloud orchestration.
- Hands-on sessions on the Eclipse CODECO open-source code, being developed in CODECO.

## 1.1 Document Structure

This report covers the following aspects:

- Still in section 1, details concerning the structure of the meeting, agenda, and participants are provided.
- Section 2 gives insight into the sessions held.
- Section 3 provides an analysis on the impact raised by the event.
- Section 4 concludes the document, highlighting next steps.

## 1.2 Agenda

The agenda proposed for the workshop is provided in Table 1.

Table 1: CODECO Industrial Workshop agenda.

Time	Description
8:15-9:45	<i>Plenary session with keynote (main conference)</i>
9:45-10:00	Break
10:00-10:10	<b>Welcome and workshop overview</b> , Rute C. Sofia, fortiss GmbH, Germany
10:00-10:30	<b>The CODECO project</b> , Rute. C. Sofia, fortiss GmbH Overview on the project, goals, assets, and engagement possibilities
10:30-11:00	<b>Keynote speech</b> , Ricardo Noriega, RedHat “From Micro to Mighty: a journey from the datacenter to the edge.”
11:00-11:30	<b>Break</b>
11:30-13:00	<b>CODECO and its components: hands-on session</b> <ul style="list-style-type: none"> <li>• “CODECO Automated Configuration Manager”, Josh Salomon, RedHat</li> <li>• “CODECO Metadata Manager”, Luis Garcés-Erice, IBM, Switzerland,</li> </ul>



Time	Description
	<ul style="list-style-type: none"> <li>• “CODECO Seamless Workload Migration”, Harald Müller, Siemens AG, Germany</li> <li>• “CODECO Privacy preservation, decentralised learning and context-awareness”, Alejandro Espinosa, I2CAT, Spain</li> <li>• “CODECO Network Adaptation and Management”, Luis Contreras-Murillo, Telefonica, Spain</li> <li>• “Experimenting with the CODECO OSS Basic Operation Toolkit”, Vasileios Theodorou, Intracom-Telecom, Greece</li> </ul>
13:00-14:00	<b>Break</b>
14:00-15:30	<b>Selected CODECO use-cases</b> Chair: Panagiotis Karamolegkos <ul style="list-style-type: none"> <li>• “Use-cases overview”, Panagiotis Karamolegkos, University of Piraeus, Greece</li> <li>• Use-case P1: Smart Monitoring of the Public Infrastructure”, Yanlong Huang, Tingting Yuan, Xiaoming Fu, Göttingen University</li> <li>• “Use-case P4: Demand-side Management in Decentralized Grids”, Javier Serrano, David Jimenez, Universidad Politecnica de Madrid</li> </ul>
15:30-16:00	<b>Coffee Break</b>
16:00-17:00	<b>Panel: Different perspectives on the Edge-Cloud continuum</b>  Chair John Soldatos, Netcompany-Intrasoft  <b>Speakers:</b> <ul style="list-style-type: none"> <li>• COGNIFOG, Selma Azaiez, COGNIFOG Coordinator, CEA France</li> <li>• COGNIT, Paul Townend, Scientific Coordinator, Associate Professor, Umeå University, Sweden</li> <li>• CODECO, Rute C. Sofia, CODECO Coordinator, fortiss GmbH, Germany</li> </ul>
17:00-17:25	<b>Engagement Actions in CODECO</b> <ul style="list-style-type: none"> <li>• “The Eclipse CODECO GitLab”, Marco Jahn, Eclipse Foundation, Germany</li> <li>• “CODECO Experimentation Access”, Lefteris Mamatas, ATHENA, Greece</li> <li>• “The CODECO Research and Innovation Engagement Programme”, Vitor Vieira, INOVA +, Portugal</li> </ul>

## 1.3 Material

Description	URL
HiPEAC workshop	<a href="https://www.hipeac.net/2024/munich/#/program/sessions/8105/">https://www.hipeac.net/2024/munich/#/program/sessions/8105/</a>
Presentations and videos	<a href="https://doi.org/10.5281/zenodo.10868462">https://doi.org/10.5281/zenodo.10868462</a>
HIPEAC 2024	<a href="https://www.hipeac.net/2024/munich/#/">https://www.hipeac.net/2024/munich/#/</a>
When/Where	18 <sup>th</sup> January 2024, Garching (Munich), Germany
Lead	FOR
Partners	All partners participated.
Target stakeholders	Academia and research; Industry and SMEs; policy makers; end-user; developers.





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- All of the presented material is available via HiPEAC: <https://www.hipeac.net/2024/munich/#/program/sessions/8105/>
- The material is also available via Zenodo: <https://zenodo.org/records/10868462>

## 1.4 Format and Expected Outcome

The first CODECO industrial workshop corresponds to the first broad event in CODECO dedicated to overall dissemination of results. The proposed format targeted SMEs, ICT, academia and research.

The organizing committee decided to develop an organization co-located with HiPEAC as several projects focusing on cognitive computing, swarm computing and MetaOS were also represented in HiPEAC.

In Munich, the event has been organised by HiPEAC together with fortiss, being the venue the Leibniz Supercomputer Centre (LRZ), Seminarium 1, in Garching.

The workshop had as main goal to bring awareness to the latest CODECO developments, and to be a starting point to develop the CODECO community which will be further developed in the context of the CODECO Innovation and Research Community Engagement Programme (IRCEP), starting from April 2024.

Specific aspects to be worked after the event in cooperation with projects in the same topics are the development of a joint white paper that has as starting point the initial discussion (panel) held with other projects during the workshop, and propose a book based on a call for chapters involving the interested attendees.

## 1.5 Participants

The CODECO industrial workshop counted with 62 registered attendants. The audience integrated: researchers; students; SMEs.

## 1.6 Organizing Committee

- Rute C. SOFIA (Chair), fortiss GmbH, Germany
- Vitor VIEIRA, INOVA +, Portugal
- Josep MARTRAT, ATOS, Spain
- Vasileios THEODOROU, Intracom-Telecom, Greece
- Vassilis TSAOUSSIDIS, ATHENA, Greece
- Xiaoming FU, University of Göttingen, Germany
- Harald MÜLLER, Siemens AG, Germany
- John SOLDATOS, Netcompany-Intrasoft, Luxembourg
- Marco JAHN, Eclipse Foundation, Germany
- Rizkallah TOUMA, I2CAT, Spain
- Dimosthenis KYRIAZIS, University of Pireus Research Center, Greece
- Diego LOPEZ, Telefonica, Spain
- David JIMÉNEZ, Universidad Politecnica de Madrid, Spain
- Andries STAM, Almende
- Josh SALOMON, RedHat
- Luis GARCÉS-ERICE, IBM



## 2 Sessions

The Workshop started with an [introduction to CODECO](#) provided by its Coordinator, Rute C. Sofia, who explained the overall intention, vision of CODECO, and the current status of the architecture.

A keynote speech entitled “[From Micro to Mighty, a journey from the data center to the Edge](#)” has been provided next by Ricardo Noriega, RedHat.

The technical sessions were then started, first with a session on the components of CODECO, and then followed by a session on the CODECO use-cases.

The workshop counted with a panel discussion involving the coordinators of COGNIT and COGNIFOG, focusing on challenges and opportunities in the context of Edge-Cloud orchestration.

The final session related with an overview on engagement aspects in CODECO: open-source code, experimenting with CODECO, and the CODECO IRCEP programme.

The sessions main outcome are described next.

### 2.1 Session 1: CODECO Overview

Rute C. Sofia presented the CODECO overview, focusing on the CODECO key contributions, and status of its architectural deployment. An introduction to the components was provided, to assist the audience in understanding better the sub-sequent sessions.

### 2.2 Session 2: Keynote Speech

Red Hat Principal Software Engineer Ricardo Noriega de Sota presented an overview of the edge computing landscape and a demo highlighting the potential of AI at the edge during a keynote presentation. The talk addressed challenges faced during edge adoption and explored the state of the art in open source for developing and scaling services across cloud and edge environments.

### 2.3 Session 3: CODECO and its Components, Hands-on Session

### 2.4 Session 4: Panel, Challenges and Opportunities

Moderated by John Soldatos, Netcompany-Intrasoft, the panel had as main objective to present to the audience three different approaches (COGNIFOG, COGNIT, CODECO) to managing heterogeneous resources and services across the cloud/edge/IoT continuum, along with characteristic use cases. During the course of 45m, the coordinators of the 3 projects introduced the projects, challenges, and next steps. Then, technological enablers and technical approach of the different projects was discussed. Finally, the panel debated on current applications and use-cases, with emphasis on their business & socio-economic benefits (e.g., cost reduction/efficiency, power/energy efficiency, enhanced privacy, new opportunities for SMEs etc.)

The panel started with a series of presentations by the projects, and questions directed to the panellists by the moderator, Jon Soldatos:



- **Overview of COGNIFOG Project (Selma Azaiez):** Selma introduced the COGNIFOG project, which shares commonalities with CODECO and COGNIT. COGNIFOG, aims to cover the entire value chain of edge computing, and focus on flexibility, adaptability, orchestration capabilities, load balancing, and energy monitoring. The project emphasizes security, green monitoring, and end-to-end authentication.
- **Overview of COGNIT (Paul Townsend):** Paul discussed the cognit project, which introduces serverless computing as its unique selling proposition (USP). He highlighted the challenges posed by the complex and dynamic nature of edge computing systems. COGNIT aims to simplify deployments for developers and SMEs using serverless computing while leveraging AI orchestrators to manage scalability across the system. The project focuses on smart cities, energy and cybersecurity.
- **Comparative Analysis and Project Differentiators:** Rute facilitated the comparison between the projects, emphasizing CODECO's focus on orchestration based on data computation and networking. While COGNIFOG and COGNIT prioritize energy efficiency, performance, and multi-criteria adaptability, CODECO aims to achieve readiness and resilience through open-source collaboration.
- **Jon's comments:** He explains that the project aims to develop a sovereign cloud edge stack for Europe, primarily targeting private cloud operators and developers.

The panel interacted with the audience during the final part. Relevant questions in this context were:

- Jon Soldatos queried about the technology enablers and beneficiaries of the projects.
  - Selma – Highlighted the use case providers as enablers for COGNIFOG, focusing on private deployments for industrial organizations.
  - Paul – Emphasized serverless computing's role in simplifying deployments for developers and SMEs.
- Audience expressed interest in the economic dimension of the project and the challenges of monetizing edge computing technologies.
- They discussed the slowing trend of edge computing adoption and question the key actors and business models driving adoption.
- They enquired about the vision for building applications with serverless functions and the potential for marketplace of pre-made functions.
- Questions also focused on the economic viability of edge computing technologies and the key adopters driving adoption.
  - How can one monetize the edge, from IoT, and who would be the customers?
- Who is going to use that technology or adopt this technology?
- Do you really need latencies less than 10 or 15 milliseconds?
- How do you monitor the system without having massive overhead when you are training these models and retraining the models?
- To whom are we making this for?
- Can we use supervised learning, unsupervised? When do we retrain the hyperparameters?

## 2.5 Session 5: Engagement Actions.

The final session related with an overview on engagement aspects in CODECO: open-source code, experimenting with CODECO, its experimentation framework, and the *CODECO Innovation and Research Community Engagement (IRCEP)* programme.



### 3 Highlights



Figure 1: HIPEAC 2024 CODECO First Industrial Workshop.

### 4 Summary of the Event and Next Steps

This report provides input concerning the development of the CODECO first industrial workshop, and presents main findings derived from the talks and exchange of information with the attendees.

This workshop was intended as an inception event for CODECO, targeting in particular industry, developers and research. The workshop provided insight into the first 12 months of development of CODECO.

The next steps are:

- The articulation of a white paper on orchestration aspects, to be released in quartal 3 of 2024, involving other projects.
- The articulation of a call for chapters for a new book. The call for chapters will be directed to the current registered attendants, and to related projects.
- The further development of the CODECO community via the IRCEP programme.