Training Material

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Abstract: This delivery will contain the final version of all course content for each training module ranging from basic level introductory materials to sophisticated results.

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Contents

1 Summary

In today's rapidly evolving and complex world, continuous learning and skills development have become vital for individuals, organizations, and societies to thrive. The training task of the FRACTAL project focuses on the development of comprehensive training materials that combine **online** and **face-to-face** learning modalities. By addressing the specific needs of diverse audiences, this task seeks to empower people and foster their professional development.

Training plays a pivotal role in equipping people with the knowledge, skills, and competencies to exploit the technology developed in the context of the FRACTAL project. The audience of this research project comprises a diverse range of learners, including **employees**, **professionals** and **students** across various companies and universities.

1.1 Achievements

Deliverable 9.9 Training Strategy and Plan provides valuable information that enables the evaluation of specific indicators to assess the progress and effectiveness of the work. These indicators serve as measurable benchmarks for evaluating the project's outcomes and impact. The following two subsections analyze highlights and lowlights.

1.1.1 Highlights

1.1.1.1 Online training sessions

- **Number of activities**:
  - 28 pre-recorded videos that will be available of the FRACTAL YouTube channel;
  - 9 presentations in the form of power-point slides will be available on the FRACTAL website;
  - 7 publicly available GitHub repositories containing code and examples;
  - 24 posters related to FRACTAL components and 8 posters for use cases available on https://fractal-project.eu/about/components/.
- **Contributors in Training**:
  - 21 partners contributed to the training material preparation.

1.1.1.2 F2F training sessions

- **FRACTAL @ CPS&IoT2023**: approximately 150 people, thereof 23 students;
- **FRACTAL @ RISC-V summit**: approximately 450 people, mixed audience of academia and industry. Around 100 students attended the main conference..

2 Introduction

This document reports the **deliverable 9.10 (D9.10)** entitled "Training Material" of the FRACTAL project. It includes a comprehensive training program that combines **online** and **face-to-face** learning modalities. This hybrid approach is designed to leverage the benefits of both formats while offering flexibility and personalized learning experiences.

2.1.1 Online training

The online component of the training program utilizes cutting-edge technology and interactive platforms to deliver engaging content, including video lectures, multimedia resources and demos. Learners can access the online materials at their convenience, allowing for self-paced learning and the flexibility to balance their training with other commitments. The online platform also facilitates collaboration and knowledge sharing among participants, fostering a dynamic learning community.

Online training material is structured as follows:

- **Pre-recorded Videos**: Available on the FRACTAL YouTube channel, these videos cover various topics related to the training program. They serve as a primary source of learning and provide in-depth explanations and hands on tutorial sessions;
- **Presentations**: include introductions to FRACTAL components relevant to the training. They offer insights into the theoretical aspects and practical applications of the training material. Presentations are in the form of supplementary slides;
- **Additional Materials**:
  - **GitHub Repositories**: Learners have access to repositories on GitHub, which contain relevant code, scripts, or other resources for further exploration and implementation.
  - **Posters**: Visual aids in the form of posters are available to summarize important information and concepts covered in the training.

2.1.2 F2F training sessions

Complementing the online component, face-to-face training sessions provide an invaluable opportunity for learners to engage directly with expert trainers and peers. These sessions, offer a rich environment for interactive discussions, practical exercises and hands-on experiences. The face-to-face element allows for deeper exploration of complex topics, personalized guidance, and real-time feedback, enhancing the overall learning outcomes.

The next section will provide all information needed to effectively use the training materials. These materials are thoughtfully categorized according to the respective work packages, ensuring easy navigation and access for learners.

3 Individual Training Activities

In this section, we present the individual training program proposed by the FRACTAL partners. The training material has been categorized based on the corresponding WP. This approach ensures a structured and systematic learning experience, allowing participants to easily navigate and access the relevant training content aligned with their specific areas of interest and expertise.

3.1 WP3 – Specifications & Methodology

3.1.1 Use of LEDEL tutorial

Brief description	WP/UC	Type	Link
In the github project site, instructions for using and installing the LEDEL. In addition, docker files and videos are available to the public so they can practice first steps with the LEDEL library and its environment.	WP3, WP4, WP8 / UC7	Online manual	https://github.com/project-fractal/WP3/tree/main/Components/WP3T35-03%20LEDEL

Table 1: Use of LEDEL tutorial

3.1.2 Hands on CVA6

Brief description	WP/UC	Type	Link
How to run Linux and a debug session on CVA6, based on the Genesys II development board and Eclipse IDE. Fully based on open-source building blocks.	WP3 / UC4	Online tutorial (github)	https://github.com/ThalesGroup/cva6-eclipse-demo (upcoming)

Table 2: Hands on CVA6

3.1.3 PULP training videos

PULP-based systems are being used as part of the FRACTAL HW platform. A comprehensive set of training videos has been made available on the PULP platform webpage in the PULP training section. Among the wide set of training material, the following videos are particularly relevant for FRACTAL developments:

Brief description	WP/UC	Type	Link
"A Deep Dive into HW/SW Development with PULP" A two-part video covering HW/SW development with PULP.	WP3 / UC3	Pre-recorded video	PULP Training (HW/SW) Part1 & Part2
"QuantLab: Mixed-Precision Quantization-Aware Training for PULP QNNs"	WP3 / UC3	Pre-recorded video	Prepare QNNs for Deployment on PULP Systems
"Deployment of DNN on Extreme Edge Devices"	WP3 / UC3	Pre-recorded video	Deployment on PULP Systems

Table 3: PULP training videos

3.1.4 Nuttx configuration demo

In this video you can see how the Posix compatible Nuttx RTOS is configured to the RISC-V based low-end platform e.g. Pulpissimo. By having standard Posix API's the existing software components can (semi)easily configured and build in.

Brief description	WP/UC	Type	Link
Short demo video that how to configure and build nuttx to the low-end RISC-V platform	WP3	Pre-recorded video	Xfractal.mp4

Table 4: Nuttx configuration demo

3.1.5 BAFFI FPGA fault-injection tool

BAFFI is a bit-accurate fault-injection tool for FPGA prototypes that has been developed in FRACTAL. Currently, BAFFI is able to inject hardware faults in RISC-V based FRACTAL nodes. BAFFI implements a novel hierarchical FFI approach, where fault-loads are defined at the level of hierarchical netlist with any required granularity, scaling from the entire modules selected from the design tree up to individual netlist cells (LUTs, registers, BRAMs or LUTRAMs). In addition, BAFFI supports common area-based FFI approach, where the granularity of target selection is determined by the area constraints (Pblocks). Supported fault models include bit-flips in configuration memory (combinational logic and routing), as well as bit-flips in registers and on-chip user memories.

Brief description	WP/UC	Type	Link
Video-presentation details the architecture and workflow of BAFFI tool, as well as the underlying bit-accurate hierarchical FFI approach. Illustrates application of BAFFI to several soft-core processors of varied complexity (NOELV, MC8051, Microblaze) prototyped on Xilinx FPGAs.	WP3, WP4 / UC7	Pre-recorded video	UPV_BAFFI_presentation.mp4
A video demonstration on how to setup and execute FFI experiments by means of BAFFI tool. Covers (i) the definition of failure modes and adaptation of testbenches for the design under test (DUT), (ii) configuration of hierarchical and area-based fault loads, (iii) tool invocation and run-time monitoring, (iv) analysis and visualization of results.	WP3, WP4 / UC7	Pre-recorded video	UPV_BAFFI_DEMO.mp4
Poster describes main features, methodology, architecture, and workflow of BAFFI tool. Illustrates sample BAFFI results in application to different soft-core processors, among others NOELV (SELENE platform).	WP3, WP4 / UC7	Poster	UPV_BAFFI_poster.pdf

Table 5: BAFFI FPGA fault-injection tool

3.2 WP4 – Safety, Security and Low Power Techniques

3.2.1 Diverse redundancy library

The diverse redundancy library is a software component enabling the execution of a function redundantly on two RISC-V cores with some predefined staggering to ensure diversity. The library uses a third core to run the monitor orchestrating the diverse redundant execution of the user function.

Brief description	**WP/UC**	**Type**	**Link**
Example of use of the library step-by-step as a form of demo/training	WP3, WP4 / UC7	Pre-recorded video	BSC-software-diverse-redundancy-library-demo-training.mp4 (also here) https://youtu.be/Mzyf9lLd85s

Table 6: Diverse redundancy library

3.2.2 OS Security Layer Integration

Brief description	**WP/UC**	**Type**	**Link**
Demo Video/Tutorial for building and compiling the YOCTO Security layer to get the SO image.	WP4	Pre-recorded video	FRACTAL - WP4T44-02 OS Security Layer - Integration Demo [1920x1080@60]

Table 7: OS Security Layer Integration

3.2.3 Adaptive Time-Triggered Network-on-Chip Architecture

The ATTNoC architecture is the underlying Network-on-Chip (NoC) architecture employed for interconnecting multiple cores within the FRACTAL HW platform. This architecture incorporates time-triggered capabilities and adaptability features. These attributes enable the NoC to seamlessly inject messages at predetermined intervals and dynamically adjust its schedule in response to contextual events, such as NoC resource faults. To provide comprehensive guidance on the ATTNoC, a series of training videos have been made available and can be accessed through the following tables.

Brief description	WP/UC	Type	Link
HATMA: Demonstrate System Reactions to Context Events in NoC Architecture	WP4 / UC8	Video	HATMA Video
ATTNoC: Message Exchange and Dynamic Schedule Switching	WP4 / UC8	Video	ATTNoC on ZCU102 Time-Triggered Extension Layer for VERSAL NoC
AI Scheduling Component	WP4 / UC8	Video	AI scheduling VIDEO

Table 8: Adaptive Time-Triggered Network-on-Chip Architecture

3.3 WP5 – AI & Safe Autonomous Decision

3.3.1 Cloud Platform Stream data pre-processing

Ingestion (stream ingestion approach), storage and transformation of datasets in the Cloud Platform, involving the following components developed in WP5: Data Ingestion Service, Raw Data Object storage service, Data Transformation, S3 compatible data storage, Datasets version control and Data pipelines and workflows orchestrator.

Brief description	WP/UC	Type	Link
presentation of the FRACTAL platform, based on test case 3, an example of data injection on a cloud FRACTAL environment	WP5 / UC2	Pre-recorded video	FRACTAL_Cloud_Platform_Stream_Data_processing.mp4

Table 9: Cloud Platform Stream data pre-processing

3.3.2 Kubeflow & MLFlow Integration

Brief description	WP/UC	Type	Link
Two demos for Kubeflow and RISC-V	WP5, WP6	Presentation, videos, example code	presentation, videos, example code

The implementation of Test Case 4: Kubeflow, MLFlow integration	WP5, WP8	Presentation and videos	presentation and videos
The full demo session to install the Kubeflow/MLFlow on the OVH Cloud	WP5	Video	Fractal_kubeflow_deployment_26.09.22.mp4
The full demo session to install the Kubeflow/MLFlow on the OVH Cloud	WP5	Slides	Fractal_kubeflow_deployment_26.09.22.pptx
The GitHub repository for the MLFlow instructions	WP5	Documentation and example code	https://github.com/vahidmohsseni/k8s-mlflow
The GitHub repository for the Custom Orchestrator	WP5, WP6	Documentation and example code	https://github.com/vahidmohsseni/k8s-manager
Posters for F2F meeting	WP5, WP6	Poster	WP5T52-UOULU-Kubeflow.pptx

Table 10: Kubeflow & MLFlow Integration

3.3.3 Model Repository

Brief description	WP/UC	Type	Link
Posters for F2F meeting	WP5, WP6	Poster	WP5T52-UOULU-MLFlow.pptx

Table 11: Model Repository

3.3.4 Data pre-processing via End-to-End Learning

Hyper-parameter optimization for pre-processing is a complex and time-consuming procedure. The end-to-end learning methodology developed in the context of the FRACTAL project allows to obtains nearly optimal performance, while not requiring neither domain knowledge nor expensive greed search. An illustration is given in the context of image classification.

Brief description	WP/UC	Type	Link
Description of the methodology that allows for	WP5	Pre-recorded video with	Data pre-processing via End-to-End Learning

adaptive, efficient and oprimized data-preprocessing		presentation slides	

Table 12: Data pre-processing via End-to-End Learning

3.3.5 Cloud Platform Batch Data Processing

Ingestion (batch ingestion approach), storage and transformation of datasets in the Cloud Platform, involving the following components developed in WP5: Raw Data Object storage service, Data Transformation, S3 compatible data storage, Datasets version control and Data pipelines and workflows orchestrator.

Brief description	WP/UC	Type	Link
Demo of the bath data pre-processing capabilities of the FRACTAL cloud platform	WP5/UC 4, UC8	Pre-recorded video	FRACTAL_Cloud_Platform_Batch_Data_Processing.mp4

Table 13: Cloud Platform Batch Data Processing

3.3.6 Cloud Platform Model Optimization

Upload and storage of models in the cloud platform and optimize the model for Versal Platform, involving the following components developed in WP5: Images repository, Models version control, Model repository, Data pipelines and workflows orchestrator and Model preparation for Fractal Edge (Versal Xilinx Vitis AI).

Brief description	WP/UC	Type	Link
Video of presentation explaining the basic model translation steps and operation of the automation	WP5 / UC5	Pre-recorded video	Upcoming

Table 14: Cloud Platform Model Optimization

3.3.7 MLBuffet tutorial

Brief description	WP/UC	Type	Link
MLBuffet video showing installation steps and usage of its functionalities	WP5 / UC1	Pre-recorded video	FRACTAL_MLBuffet_Training_Video.mp4

Table 15: MLBuffet tutorial

3.4 WP6 – CPS Communication Framework

3.4.1 Runtime Manager

The Runtime Manager component is a software module, installed on FRACTAL nodes, used to schedule tasks to be performed based on the input received. It also provides the load balancing feature which sends activities to be performed to a different node, when the executing node is busy, thanks to the interface with the Load Balancer component.

Brief description	WP/UC	Type	Link
GitHub repository with documentation	WP6, WP8 / UC6	Documentation and example code	https://github.com/project-fractal/WP6T62-03-Runtime-Manager
Poster for F2F meeting	WP6, WP8 / UC6	Poster	Runtime_Manager_poster

Table 16: Runtime Manager

3.4.2 The RISC-V implementation with QEMU and K3S-docker enabled

Brief description	WP/UC	Type	Link
GitHub repository with documentation and examples	WP6	documentation and example code	https://github.com/vahidmohsseni/risc-v-examples

Table 17: The RISC-V implementation with QEMU and K3S-docker enabled

3.4.3 Low-end orchestration demo

In this video you can see how top of the Posix compatible RTOS (Nuttx), the commercial orchestrations ported/configured/installed the and how it behaves from when monitored/controlled from the cloud.

Note1: The USB is for power only, all communication is wireless and high secure. Note2: On this demo we utilize Microsoft IotHub as at background, but also Google GCM and Amazon AWS may be utilized.

Brief description	WP/UC	Type	Link

Short demo video that presents how low-end orchestration behaves	WP6	Pre-recorded video	FractalLow-endOrchestrationDemo.mp4

Table 18: Low-end orchestration demo

3.5 WP7 – Integration and Verification

3.5.1 FRACTAL Construction Process

A lot of components have been built in FRACTAL. FRACTAL Features have been defined to add traceability from UC requirements to the selection of components required for the Use Case. This process has been mockup by using FIGMA and can be navigated.

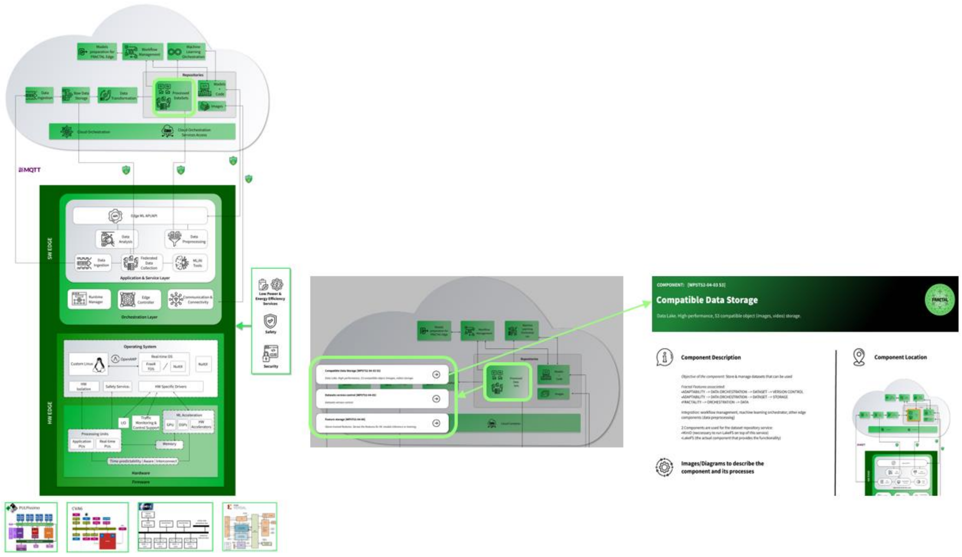


Figure 1: FRACTAL mockup

The mockup first shows the platform and cloud selection and enables to access the global view of the Big Picture. The Big Picture presents the parts of the system and enables to click on the distinct parts where the corresponding available components will be shown. Clicking on a component presents their corresponding presentation and startup poster.

You can also select a platform and start selecting the features considered for your UC as in a car configurator. Small descriptions appear to help on the selection of FRACTAL features. Being a mockup of the actual tool, UC6 feature selections have been marked. Under FRACTALITY and OPENNESS tabs, the user may click on View Configuration that will show the Big Picture just including selected components and the corresponding platform. In the mockup it is currently particularized for the UC6. If you click on Versal platform at the bottom, a poster presenting the Versal and how to start constructing it is shown.

In this sense, with the tool we target from FRACTAL Feature selection, to platform and component selection and finally to the FRACTAL platform construction and component usage.

Brief description	WP/UC	Type	Link
The general construction process to build a fractal node based on the construction processes applied on use cases, and the platform and components selected to be integrated	WP7, WP8 / All	Online manual / documentation	FRACTAL mockup

Table 19: FRACTAL construction process

3.5.2 Secure boot demo

In this video you can see how the secure boot works. At first a binary is signed with a private key. During the boot process a hash of the firmware is computed and verified with the public key. In case of success, the boot process is completed and the application is started. Otherwise, the boot process will fail.

Brief description	WP/UC	Type	Link
Short demo video that shows how to the secure boot works.	WP7 / UC3	Pre-recorded video	Secure_boot_demo

Table 20: Secure boot demo

3.5.3 AI-based control for thermal management

AI-based controls for thermal management reduces human effort on calibrating control strategies for thermal management in electric vehicle. It is developed as a part of WP7.

Brief description	WP/UC	Type	Link
Video displaying the example of data ingestion and initial processing.	WP5	Pre-recorded video	Confidential
Ongoing writeup of our efforts on Fractal.	WP7 / UC2	Blog post	Confidential

Video showing how do we do training process of RL based controller for Cabin Heating Mode Selection in BEVs.	WP7 / UC2	Pre-recorded video	Confidential
AVL data science exchange is a format to disseminate state of the arts results in AI/ML among the AVL skill teams and subsidiaries.	WP7 / UC2	Internal training material	Confidential
Training at ECS Summer school 2023 "Fascinating Electronics for a Cool World" 23rd August 2023. Topic: "RL-based BEV Thermal Management for Cabin Heating Mode Selection"	WP7 / UC2	Lecture	https://ecscollaborationtool.eu/summer-school-2023.html

Table 21: AI-based control for thermal management

3.6 WP8 – Case Studies, Specification, Benchmarking & Justification File

3.6.1 Face Detector

The Face Detector (FD) is a SW component, deployed on the Xilinx ZYNQ Ultrascale+/VERSAL composing the Totem Node, receives a video stream from the Runtime Manager (RM) component to detect if a person is in front of the totem and, in that case, to detect faces. Detected face images are then sent back to the Totem Node RM to be further dispatched to other SW components (i.e., Age Estimator and Gender Classifier). The FD component allows to obtain a frame centered on the user's face in front of the totem node. By using an image captured by the RM, by means of the camera positioned on the totem node as input, the FD component exploiting AI algorithms can automatically determine the faces inside the input image. FD is triggered by the RM, based on events. Once the recognition process is completed, the detected face is stored inside a JPEG image that can be read by the RM using shared memory.

Brief description	WP/UC	Type	Link

video tutorial on how this component is made, how it is integrated inside the UC and a brief hands-on session that explain how to instantiate this component on a XILINX Zynq UltraScale+.	WP8/UC6	Pre-recorded video	FRACTAL-Training-FD.mp4
Presentation slides on how this component is made, how it is integrated inside the UC and a brief hands-on session that explain how to instantiate this component on a XILINX Zynq UltraScale+.	WP8/UC6	Slides	FRACTAL-Training-FD.pptx

Table 22: Face Detector

3.6.2 People Density Estimator

The People Density Estimator (DE) is a SW component that takes as input a video stream received from the Runtime Manager (RM) component. The aim of this component is to provide an estimation of the density of the people located in the totem area. DE provides as output the density estimation and some performance metrics to the RM component. The RM component can configure the DE to re-use information partially processed by the People Detector component, to save computational resources.

Brief description	**WP/UC**	**Type**	**Link**
The first part of this video tutorial is about how this component is made and how it is integrated inside the UC. In the final part of the video tutorial will be presented a brief hands-on session that explain how to instantiate this component on a XILINX Zynq UltraScale+.	WP8/UC6	Pre-recorded video	DE_UNIMORE_Training.mp4
Presentation slides about the DE component.	WP8/UC6	Slides	UNIMORE_FRACTAL-Training-DE.pptx
Poster about the DE component.	WP8/UC6	Poster	DensityEstimator.pptx

Table 23: People Density Estimator

3.6.3 ROS2 on NOEL-V

VAL-UC7 SPIDER autonomous robot is using ROS2 as middleware for communication and data transfer between different components of the robot system. A publicly available Github page shows how to use ROS2 on a NOEL-V based system in the context of the use-case. The tutorial links all relevant information for installation of the system and provides an example setup to run a ROS2 node on NOEL-V and connect to external ROS2 nodes.

Brief description	WP/UC	Type	Link
Tutorial how to run a ROS2 node on NOEL-V based platform and configure the node to communicate with Ethernet to ROS2 system.	WP8 / UC7	Tutorial / Documentation	https://github.com/project-fractal/VAL-UC7

Table 24: ROS2 on NOEL-V

4 Joint Training Activities

This section highlights the joint training activities. The training material has been divided into two formats: online and face-to-face sessions. This strategic division allows participants to engage in a flexible learning experience, with online sessions offering convenience and accessibility, while face-to-face sessions provide valuable opportunities for in-person interaction and practical hands-on training.

4.1 Online Material

4.1.1 Systems Connectivity

This training session is a joint collaboration between **UOULU** and **HALTIAN**.

Brief description	**WP/UC**	**Type**	**Link**
Systems connectivity poster		Poster	Systems Connectivity
The Systems connectivity: PostgreSQL, Docker, K3s, Mosquitto, and RISC-V in qemu		Pre-recorded video	D6.1 training
The Systems connectivity: PostgreSQL, Docker, K3s, Mosquitto, and RISC-V in qemu		Slides	T6.1 demo.pptx

Table 25: Systems Connectivity

4.1.2 Cloud Platform ML-workflow

The Cloud Platform ML-workflow is a joint collaboration between **RULEX** and **UOULU**. Upload and storage of models in the cloud platform, training/retraining the models from a set of Data and storage of the resulting model, involving the following components developed in WP5: Images repository, Models version control, Model repository, Machine learning pipeline and ML pipeline connection to model repository

Brief description	**WP/UC**	**Type**	**Link**
This video will present the machine learning workflow	WP5 / UC2, UC4, UC8	Pre-recorded video	FRACTAL_Cloud_Platform_ML_Workflow.mp4

inside the FRACTAL platform			

Table 26: Cloud Platform ML-workflow

4.1.3 Runtime Bandwidth Regulator

The Runtime Bandwidth Regulator (RBR) component is a joint collaboration between **UNIMORE** and **UNIVAQ**. The RBR is a bandwidth regulation hardware design composed of a monitoring and a throttling system that can be integrated inside generic accelerator clusters targeting FPGA-based systems. The main objective of this component is to dynamically regulate memory bandwidth of COTS platforms to mitigate the memory interference problems.

Brief description	**WP/UC**	**Type**	**Link**
Pre-recorded video about motivation, main idea how to use RBR component on a ZUS+.	WP3/UC6	Pre-recorded video	RBR_UNIMORE_Training.mp4
Presentation slides on motivations, main idea and how to use RBR component on a ZUS+.	WP3/UC6	Slides	Training-WP3T32-09.pptx
Poster to illustrate the main features of the RBR component.	WP3/UC6	Poster	WP3T32-09-UNIMORE_UNIVAQ-Runtime_Bandwidth_Regulator.pptx

Table 27: Runtime Bandwidth Regulator

4.2 Face to Face Training Sessions

4.2.1 FRACTAL at the summer school on Cyber-Physical Systems & Internet-of-Things

4.2.1.1 Introduction

On June 6, 2023, FRACTAL project was presented on the Cyber-Physical Systems and Internet-of-Things (CPSIoT'2023) summer school in Budva, Montenegro. The FRACTAL event was held by project partners **LKS**, **UNIMORE** and the project coordinator **IKERLAN**, to present the innovative features and advancements of the

FRACTAL project. In order to facilitate broader access and ensure global participation, the presentation was also transmitted using Zoom. Figure 2 reports the schedule of the first day at CPSIoT'2023, where the FRACTAL project was presented.

CPS&IoT'2023 Summer School on
Cyber-Physical Systems and Internet-of-Things
Budva, Montenegro, June 6-10, 2023

Schedule

Day 1, Tuesday 6 June:
08:00-09:00 Registration
09:00-09:15 Event Chairs and Special Guests
Title: Opening Ceremony of the CPS&IoT'2023 Summer School, and MECO'2023 and CPS&IoT'2023 Conferences
09:15-10:15 Andreas Burger, Robert Bosch GmbH, **DE**
Keynote: Future Cyber-Physical Systems – between Digital Twins and Metaverse **10.15-10.30 Break**
10.30-11.00 Lech Jóźwiak, TU/e, **NL**
Title: Introduction to the CPS&IoT'2023 Summer School
11.00-12.30 Lech Jóźwiak, TU/e, **NL**
Title: Green CPS and IoT for Green World
12.30-14.00 Lunch Break
14.00-15.30 Sakir Sezer, NVIDIA, **UK**
Title: DPU Technology: Redefining next generation Datacenter Security
15.30-17.00 Kevin Mika, Uni-Bielefeld, **DE** and Piotr Zierhoffer, Antmicro, **PL**
Title: VEDLIoT – Accelerated AIoT
17.00-17.30 Break
17.30-19.00 Aizea Lojo and Juan Besga, Ikerlan, **ES;** Iñaki Paz, LKS, **ES;** Gianluca Brilli and Paolo Burgio, from Unimore, **IT;** Martin Matschnig, Siemens, **AT**
Title: FRACTAL: A Cognitive Computing Platform Node for the Edge
Day 2, Wednesday 7 June:
09.00-10.00 Jürgen Becker, KIT, **DE**

Figure 2: First day schedule at Cyber-Physical Systems & Internet-of-Things summer school

4.2.1.2 Program

The detailed information about the face to face FRACTAL training event are:

1. **FRACTAL project presentation**: an overview of the project;
2. **System & components**: the Fractal system developed to meet the objectives of the project, as well as its relationship with the components developed in the different work packages;
3. **Node building process**: the building process to build the Fractal nodes for a specific application, depending on its features;
4. **Use-Case six**: a real example of FRACTAL node building, using one of the use cases implemented in the project (UC6 Smart Totem).

4.2.1.3 Conclusion

Figure 3: Presentation of the FRACTAL project at CPSIoT'2023

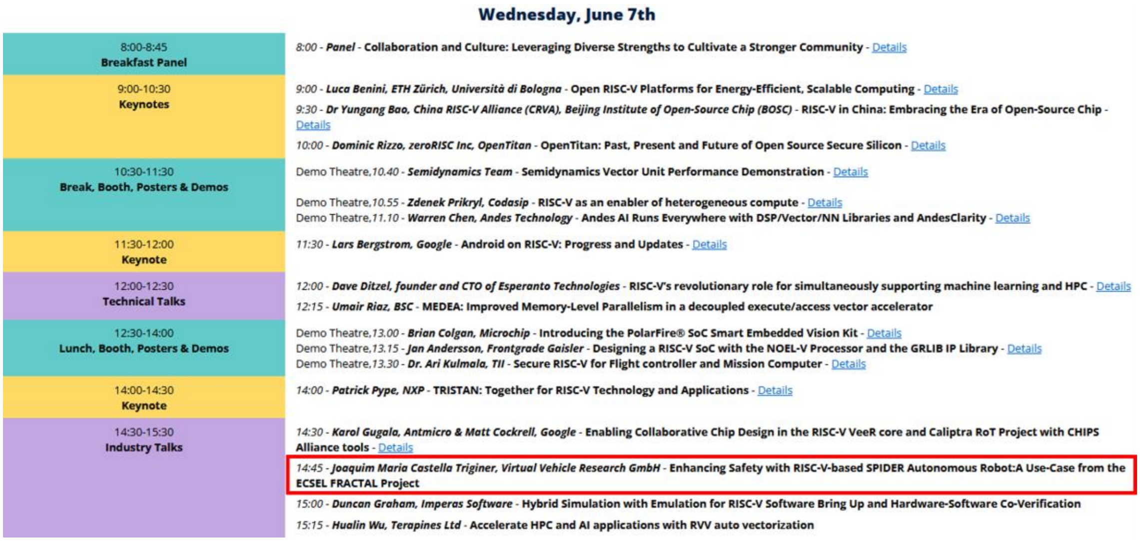
The conference itself had a considerable attention, attracting approximately 150 people from various domains and backgrounds. 23 people of whom were students accepted at the summer school.

4.2.2 Enhancing Safety with RISC-V-based SPIDER Autonomous Robot: A Use-Case from the ECSEL FRACTAL Project

The SPIDER use case of the ECSEL FRACTAL project demonstrates the safety capabilities developed in the project on a RISC-V platform. The use case demonstrates the integration of a diverse redundancy service and a multicore interference monitoring service. These services allow the SPIDER co-execution of safety-relevant and machine learning tasks, while implementing fail-operational capabilities on a single computing device.

The use-case was presented in a short talk at the RISC-V Summit Europe in Barcelona on the 6th of June 2023. As reported in Figure 5, the use-case was presented in the second day of the summit, with a dedicated 15 minutes talk, presented by **Virtual Vehicle Research GmbH**.

Figure 4: Presentation of the UC7 at the RISC-V summit



Wednesday, June 7th

8:00-8:45 **Breakfast Panel**	*8:00* - ***Panel*** - **Collaboration and Culture: Leveraging Diverse Strengths to Cultivate a Stronger Community** - Details
9:00-10:30 **Keynotes**	*9:00* - ***Luca Benini, ETH Zürich, Università di Bologna*** - **Open RISC-V Platforms for Energy-Efficient, Scalable Computing** - Details *9:30* - ***Dr Yungang Bao, China RISC-V Alliance (CRVA), Beijing Institute of Open-Source Chip (BOSC)*** - **RISC-V in China: Embracing the Era of Open-Source Chip** - Details *10:00* - ***Dominic Rizzo, zeroRISC Inc, OpenTitan*** - **OpenTitan: Past, Present and Future of Open Source Secure Silicon** - Details
10:30-11:30 **Break, Booth, Posters & Demos**	Demo Theatre,*10.40* - ***Semidynamics Team*** - **Semidynamics Vector Unit Performance Demonstration** - Details Demo Theatre,*10.55* - ***Zdenek Prikryl, Codasip*** - **RISC-V as an enabler of heterogeneous compute** - Details Demo Theatre,*11.10* - ***Warren Chen, Andes Technology*** - **Andes AI Runs Everywhere with DSP/Vector/NN Libraries and AndesClarity** - Details
11:30-12:00 **Keynote**	*11:30* - ***Lars Bergstrom, Google*** - **Android on RISC-V: Progress and Updates** - Details
12:00-12:30 **Technical Talks**	*12:00* - ***Dave Ditzel, founder and CTO of Esperanto Technologies*** - **RISC-V's revolutionary role for simultaneously supporting machine learning and HPC** - Details *12:15* - ***Umair Riaz, BSC*** - **MEDEA: Improved Memory-Level Parallelism in a decoupled execute/access vector accelerator**
12:30-14:00 **Lunch, Booth, Posters & Demos**	Demo Theatre,*13.00* - ***Brian Colgan, Microchip*** - **Introducing the PolarFire® SoC Smart Embedded Vision Kit** - Details Demo Theatre,*13.15* - ***Jan Andersson, Frontgrade Gaisler*** - **Designing a RISC-V SoC with the NOEL-V Processor and the GRLIB IP Library** - Details Demo Theatre,*13.30* - ***Dr. Ari Kulmala, TII*** - **Secure RISC-V for Flight controller and Mission Computer** - Details
14:00-14:30 **Keynote**	*14:00* - ***Patrick Pype, NXP*** - **TRISTAN: Together for RISC-V Technology and Applications** - Details
14:30-15:30 **Industry Talks**	*14:30* - ***Karol Gugala, Antmicro & Matt Cockrell, Google*** - **Enabling Collaborative Chip Design in the RISC-V VeeR core and Caliptra RoT Project with CHIPS Alliance tools** - Details *14:45* - ***Joaquim Maria Castella Triginer, Virtual Vehicle Research GmbH*** - **Enhancing Safety with RISC-V-based SPIDER Autonomous Robot:A Use-Case from the ECSEL FRACTAL Project** *15:00* - ***Duncan Graham, Imperas Software*** - **Hybrid Simulation with Emulation for RISC-V Software Bring Up and Hardware-Software Co-Verification** *15:15* - ***Hualin Wu, Terapines Ltd*** - **Accelerate HPC and AI applications with RVV auto vectorization**

Figure 5: Second day schedule of the RISC-V summit held in Barcelona

https://riscv-europe.org/media/proceedings/posters/2023-06-06-Joaquim-Maria-CASTELLA-TRIGINER-abstract.pdf

Brief description	**Type**	**Link**
Abstract that introduces the SPIDER autonomous robot use case.	2-pages abstract	Enhancing Safety with RISC-V-based SPIDER Autonomous Robot: A Use-Case from the ECSEL FRACTAL Project

Video presentation of the SPIDER autonomous robot use case.	Recorded video	Enhancing Safety with RISC-V-based SPIDER Autonomous Robot: A Use-Case from the ECSEL FRACTAL Project

Table 28: Enhancing Safety with RISC-V-based SPIDER Autonomous Robot: A Use-Case from the ECSEL FRACTAL Project

5 List of figures

6 List of tables

7 List of Abbreviations

ACAP	Adaptive Compute Acceleration Platform (technology by Xilinx)
EAB	Extended Advisory Board
PULP	Parallel Ultra Low Power (project by ETH Zurich)
UC	Use Case
WP	Work Package