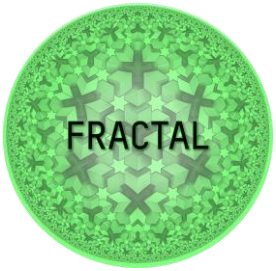

Training Strategy and Plan

Deliverable Id:	**D9.9**
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Abstract: The deliverable will identify the target audience, the training modules to be developed and the associated planning and scheduling of training development and quality control and reporting of initial courses.

ECSEL Joint Undertaking
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Contents

1 Introduction

Since the FRACTAL project will elaborate very innovative and novel technologies, a well-structured training strategy as one of the pillars that ensure project success as well as industrial uptake and sustainability of results is needed.

According to the FRACTAL project plan, dedicated training activities shall be performed in the course of task T9.3 – 'Training Activities', which formally starts at a later stage in M24. This delayed start of the task is well justified because it is mandatory to have mature results available before disseminating training intended for external audiences through publicly accessible channels.

In addition, it is necessary to continuously educate the internal members of the FRACTAL consortium during the project. In the very early stages, it was important to align everyone along the project goals. As the project continues to evolve the consortium must be made aware of intermediate results.

Effective technical training requires innovative packaging of knowledge including case-studies, exercises, support material and knowledge appraisal to be delivered through Internet-based training.

At this stage it has to be mentioned that in comparison to the technical tasks in FRACTAL, person-month efforts of partners directly dedicated for training are quite minimal. Consequently, we will join forces with the technical WPs and there is a plan to directly benefit from their achievements for training. WP leaders will encourage partners to prepare publicly available video presentations and tutorials, which will play a central role in our training strategy.

The current document describes the overall training approach from a project wide perspective and outlines how internal and external training is organized. In the widest sense training takes place whenever people learn about the FRACTAL project and our achievements.

The upcoming deliverable D9.10 – 'Training Materials' (M34) will include a summary and brief description of all the training materials (documents, presentations and videos) which will evolve in the coming months.

In the annual WP9 Reports D9.6 (M24) and D9.7 (M36) updates about training will be shown as well.

2 FRACTAL Training Activities

The training activities will support the FRACTAL project promoting the work done during the project by using appropriate and useful tools, methods and communication channels to ensure the adoption and exploitation of project results.

The goal is to engage different target groups with information adjusted carefully to their needs, raising awareness of those who could benefit from the project results, and encouraging multi-stakeholder dialogue.

Training activities will target two main groups for training industry and academia, regardless of whether they are part of FRACTAL consortium or are external members. We will approach each group with tailored offerings.

- **Industrial Training:**
  Skills and knowledge will be imparted through structured demonstrations and exercises around FRACTAL technologies.

- **Academic Training:**
  Training programs and academic courses for researchers working in academia will be targeted to support an understanding of the core technologies for research challenges.

Depending on their nature these training programs will be conducted via most suitable communication channels. There will be offerings available at our website or via the social media channels.

In some cases, academic partners will include FRACTAL topics within their university lectures. Here the related training material will be available for the students who take the course.

As part of the training plan, all the material will be publicly available.

3 Current Training Plan

General training activities have already started at the beginning of the project and will be actively pursued during the whole project duration with a continuous engagement of internal and external audiences.

The dedicated task T9.3 – 'Training Activities' will start quite late in M24. Main objective of this task is the preparation of appealing training material as well as the coordination and execution of special training activities.

The current training plan for FRACTAL was developed by considering five dimensions:

1. Objectives of the training
2. Target audience to be reached to achieve the objectives
3. Strategies to achieve objectives
4. Types of activities to implement the strategies
5. Feedback received and Metrics for success

The timeline of the training plan will be organized into three main phases (Phase1, Phase2, Phase3) as shown Figure 1.

Phase 1 (M1-M18) will focus on:

- **Alignment**
- **Training plan release**

Phase 2 (M18-M34) will focus on:

- **Kickoff Task 9.3**
- **Preparation of the training material**
- **Conduction of the courses**

Phase 3 (M34-M36) will focus on:

- **Feedback collection**

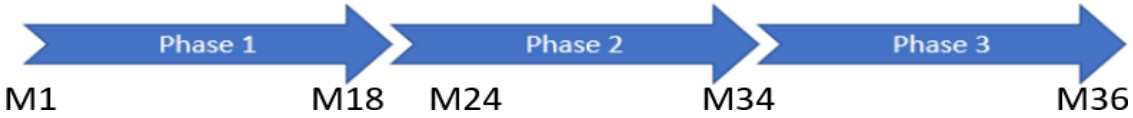

Figure 1: The three different phases of the training plan

3.1 Training Objectives

Four main objectives of the training have been identified (and they will be extended and further developed in the project):

- **Objective 1 – Adoption:**
  Foster the adoption of FRACTAL technology and solutions.

- **Objective 2 – Exploitation:**
  Strengthen the exploitation of the project results.

- **Objective 3 - Outreach:**
  Promote the potential of FRACTAL technologies to deploy new applications in addition to the scenarios already considered in the project.

3.2 Target Audience

According to the objectives, the following targets have been identified:

- **Target 1 – Students**:
  Computer science and engineering students.

- **Target 2 – Partners**:
  Partners of the FRACTAL project.

- **Target 3: - External Experts:**
  Researchers and developers in the application domains of the FRACTAL project.

3.3 Training Strategies

The strategy will be mainly based on targeted training activities to highlight the high-quality value and the innovation degree of the proposed solutions and to create expectations of new applications that may be available on the market soon. In detail, the overall strategy will be split into sub-strategies.

- **Strategy 1 – Standards:**

This training activity addresses the ISO26262 and ISO21448 standards. The goal is to train the partners of the Fractal project to develop hardware and software solutions that are compliant with the standards.

- **Strategy 2 – Open Source:**
  Training activity related to the use of open-source hardware/software and covering the main licensing schemes that can be exploited.

- **Strategy 3 – Technical Training:**
  Technical training activities that will cover the main platforms used in the FRACTAL project for example the Xilinx Versal ACAP and the PULP platform. Activities include examples of hardware/software setup to be applied in an embedded real-time domain. This activity will also mitigate the problems related to hardware and software incompatibilities identified in the Grant Agreement.

3.4 Types of Training Activities:

There is a wide spectrum of options starting from very traditional approaches, like face-to-face teaching in classrooms, to as far as completely digital training courses.

For FRACTAL training we need to find the optimum in effectiveness, given the limited overall effort that we have available to put into the preparation. Of equal importance is the very close link to all the other activities in WP9, like dissemination and exploitation.

Unfortunately FRACTAL project has started under severe restrictions to travel which has affected practically all in person interactions up to date. It is hard to make predictions on how this situation will develop, and we have to be prepared for the fact that no in-person meetings could take place during the lifetime of the project, which was certainly not taken into account during the preparation of the project. This has forced us to make necessary adjustments to our plans and three formats of training appear to be most suitable:

- **Activity 1 - Online Webinars with recording for offline viewing:**
  In many cases, a live tutorial, where technical content is presented to an audience is very suitable. These sessions can be recorded and archived. For example, in the early phase of the project the available hardware platforms (PULP and VERSAL) were introduced to the whole consortium in this way.

- **Activity 2 - Online Workshops with recording for offline viewing:**
  Whenever Technical Workshops take place there is great potential to extract valuable information that can be directly used as training material. For example, during the technical FRACTAL workshops as well as the EAB meetings partners present their achievements. Given the long duration of workshops, editing, and shortening of the recorded session must be done.

- **Activity 3 - Training Videos for public audience:**
  Short tutorial videos on YouTube promise to be a very effective training channel. For the second half of the project, we plan to launch a series of videos where partners present their main achievements in a very compact form. There will be videos covering standalone components as well as whole use case presentations.
  We will put special focus on the quality of the produced videos to have them in a standardized and visually appealing format.

3.5 Feedback Collection & Metrics of success

It is important to quantify the success and effectiveness of the training efforts with a small but meaningful set of KPIs.

- **KPI1 – Number of Activities:**
  For the remaining duration of the project the number of all training activities will be continuously monitored.

- **KPI2 – Contributors in Training:**
  The number of partners actively contributing to training will be another performance indicator.

- **KPI3 – Increase of Social Media Followers:**
  The increase in the number of followers evaluated one week after one individual training activity will be tracked.

- **KPI4 – Instant Feedback (Mentimeter):**
  In the end of live events the audience will be asked to rate the event in a range of 1 to 5. For training activities where we can make use of "Mentimeter", a weighted average of the events will be tracked. The weighted average of the ratings for all events will be tracked.

4 FRACTAL Training Activity Plan

Within FRACTAL joint training activities are planned which are shown in the following table.

Training activity	**Partners involved**	**Month planned**	**Audience**
Versal platform introduction	PLC2	M3	Consortium
PULP platform introduction	ETH	M3	Consortium
First Technical workshop	All FRACTAL partners		Consortium
Second Technical workshop	All FRACTAL partners	M17	Consortium
Third Technical workshop	All FRACTAL partners	TBD	Consortium
UC training session	UC Leaders	M24-30	Consortium + External
WP3 main results - session recordered from EAB meeting	WP3 Contributors	M24-M30	Consortium + External
WP4 main results - session recordered from EAB meeting	WP4 Contributors	M24-M30	Consortium + External
WP5 main results - session recordered from EAB meeting	WP5 Contributors	M24-M30	Consortium + External

WP6 main results - session recordered from EAB meeting	WP6 Contributors	M24-M30	Consortium + External

Table 1: Plans for FRACTAL training activities

5 Individual Training Plans

The individual training plans for each involved partner are presented in the following table.

Partner	***Individual plans for training***
IKER	*IKER is responsible for deliverable D5.4, belonging to task T5.2 (WP5), of which is also the task leader. Within this deliverable will be included a handbook for the configuration and use of the Cloud Platform modules developed in this task.* *Also, within this task, some test cases will be recorded in video for their use as demos on the 2nd Review meeting and as tutorials for the Use Cases*
BSC	*Jaume Abella (BSC) teaches functional safety as part of the subject "Automotive Embedded Systems" in a Master program at the Universitat Politecnica de Catalunya (Spain). Jaume covers aspects related to new safety-related technologies and solutions and will include some of the safety-related solutions developed in FRACTAL in the course. Such course is also shared with colleagues at BSC, hence enabling additional training chances across the large Computer Science department at BSC (~300 people).*
UPV	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
PROINTEC	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
INDRA	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
IFT	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
CAF	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*

SML	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
ZYLK	*ZYLK will prepare a video tutorial for training on MLBuffet, the Open- Source model server tool developed in the context of T5.4 (WP5). It will be public and accessible for anyone interested in running this tool.*
LKS	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
RULEX	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
AITEK	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
UNIVAQ	*Giacomo Valente (UNIVAQ) teaches "Advances in Computing Technologies" course in a Master program at University of L'Aquila (Italy), and RISC-V foundations as part of the "Computers Architectures" course in Bachelor program at University of L'Aquila (Italy). The courses also cover aspects related to acceleration of Artificial Intelligence workloads, that focus on convolutional neural networks (as developed in FRACTAL).* *Luigi Pomante (UNIVAQ) teaches "Embedded Systems" course in a Master program at University of L'Aquila (Italy). The course covers also aspects related to the integration of different workloads on heterogeneous platforms and includes also concepts developed in FRACTAL.*
MODIS	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
UNIMORE	*UNIMORE will prepare a training activity on the Fractal technologies in "paradigms and programming languages" and*

	"industrial computer science" courses held in the Computer Science and Computer Engineering courses degree. *The training activities involve seminars regarding the Fractal Node infrastructure and the technology developed by UNIMORE.*
UNIGE	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
ROT	*ROT will prepare a training course in collaboration with the partner company Innovation River, focusing on the work carried out in WP4 about data compression techniques for low-power services, and the work in WP8, for UC6, about communication between nodes and load balancing.*
AVL	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
SIEM	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
VIF	*VIF will prepare training material for partners to demonstrate the application of the safety standard ISO 26262 and the security standard ISO/SAE 21434. The material will be based on the use-case 7, the SPIDER autonomous robot. Further, VIF is cooperating with the Graz University of Technology and provides a master thesis with a focus on security analysis using the ISO/SAE 21434 with use-case 7.*
SIEG	*Daniel Onwuchekwa teaches a masters course titled "embedded control". It is a subject in Mechatronics at the University of Siegen. Some solutions, such as the design approaches (state machines) and methodology derived from the fractal project, will be integrated into the course. In addition, project topics regarding use-cases such as UC8 (Automotive shuttles) will be taught for student projects.*
QUA	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*

THA	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
ETH	*As a major group working on Open Source Hardware, ETH Zurich is very active in various training activities. The PULP platform has a dedicated training page: https://pulp-platform.org/pulp_training.html which contains recorded tutorials of more than 18 hours on various aspects of the PULP platform which is being used as one of the hardware nodes in FRACTAL.* *In addition, Luca Benini and Frank Gurkaynak are widely engaged in teaching activities and give lectures at ETH Zurich on Digital Circuit Design, FPGA implementations, IC design and testing, System on Chip Design as well as lectures on Machine Learning on Microcontrollers.* *The teaching activities of ETH Zurich also include hands-o projects with students doing their Semester/Bachelor and Master theses with topics directly related to the research being done as part of FRACTAL.* *In addition, Luca Benini and Frank Gurkaynak give lectures as part of the HiPEAC ACACES summer school that covers topics that are being investigated as part of their efforts in FRACTAL.*
ACP	*ACP supports student projects related to their UC in the FRACTAL project at ETH Zurich.*
UOULU	*Lauri Lovén (UOULU) was the responsible person for running the "Big Data Processing and Applications" course in 2021 (in lieu of Ekaterina Gilman, responsible person for the course). The course content includes a general introduction to big data fundamentals, data storage, batch and stream data processing, data analysis, privacy and security & big data use cases, touching concepts closely related to the work developed in WP5, of which UOULU is the leader. Number of enrolled students (2021):130. Data is not yet available for 2022, as the course is yet to start.* *Mickaël Bettinelli (UOULU) runs the "Distributed Systems" course, focusing on the major design paradigms used for the*

	implementation of distributed systems. The course content includes the related topics of architectures, processes, communication, naming, synchronisation, consistency and replication, fault tolerance, security & case studies. It is particularly relevant to FRACTAL in the context of edge computing, in essence a distributed system, by designing a cognitive edge node. Number of enrolled students (2022): 85 *The target audience of both courses includes M.Sc. students from the Computer Science and Engineering Program and other Students of the University of Oulu, i.e, it is potentially opened to a total universe of 13 500 students (from 8 Faculties of UOULU). In addition, UOULU is part of the FItech Network (https://fitech.io/) offering courses for an even wider audience, ranging from high school students to degree students and adult learners, via contact and/or online teaching.*
OFFC	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*
PLC2	*PLC2 provides professional training on the Versal ACAP devices and other potential Fractal Node base technologies like Zynq MPSoC. This allows audiences to create own Fractal nodes from the start, PCB level to device content, and informs on the underlying concepts to enable the Fractal node features. In the PLC2 portfolio there are also specific training on the basics and practice of AI on FPGAs and acceleration that are the underpinnings of Fractal node deployment.* *Various of these trainings will be extended to explicitly cover aspects of the Fractal node platforms and so provide in depth insight into involved technologies. Such sections would be referring to the Fractal platform deliverable if there is a public release available.* *In addition to this there will be focused materials and Fractal sessions on various levels for our customers, through PLC2 Design, and a starter / introductory webinar for the broader technical community.*
HALT	*HALT will prepare training material for partners and external stakeholders to demonstrate the FRACTAL node architecture*

	design. It will also provide the on-demand general training on IoT operations and processes.
BEEA	*Partner has no dedicated effort in T9.3 but will contribute in the scope of the technical WPs*

Table 2: Individual plans for training

6 Conclusions

The current deliverable gave an outline of the overall training approach in the FRACTAL project. The initial FRACTAL training plan was developed along five dimensions - Objectives, Targes, Strategies, Activities and Metrics.

Table 3 gives an overview of how the five dimensions relate and shape the training plan.

Strategy	Objectives	Targets	Activities	Metrics
Standards	Adoption	Partners	Webinar	Number Followers Feedback Contributors
Open Source	Adoption Exploitation	Partners	Webinar Workshop	Number Followers Feedback Contributors
Technical Training	Outreach	Students Partners Ext. Experts	Webinar Workshop Video	Number Followers Feedback Contributors

Table 3: FRACTAL Training Plan at a Glance

Major obstacle for training in FRACTAL is given by the situation that only few members of the consortium are formally involved in T9.3 – 'Training Activities' with significant efforts. To mitigate this issue an agreement for support by the technical WPs has been achieved.

The document includes a summary of the planned joint as well as individual training activities. Progress in training will be continuously monitored and reported in the annual WP9 reports as well as in the periodic reporting.

7 List of figures

8 List of tables

9 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