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GUIDE FOR APPLICANTS
to
aerOS Open Call #1

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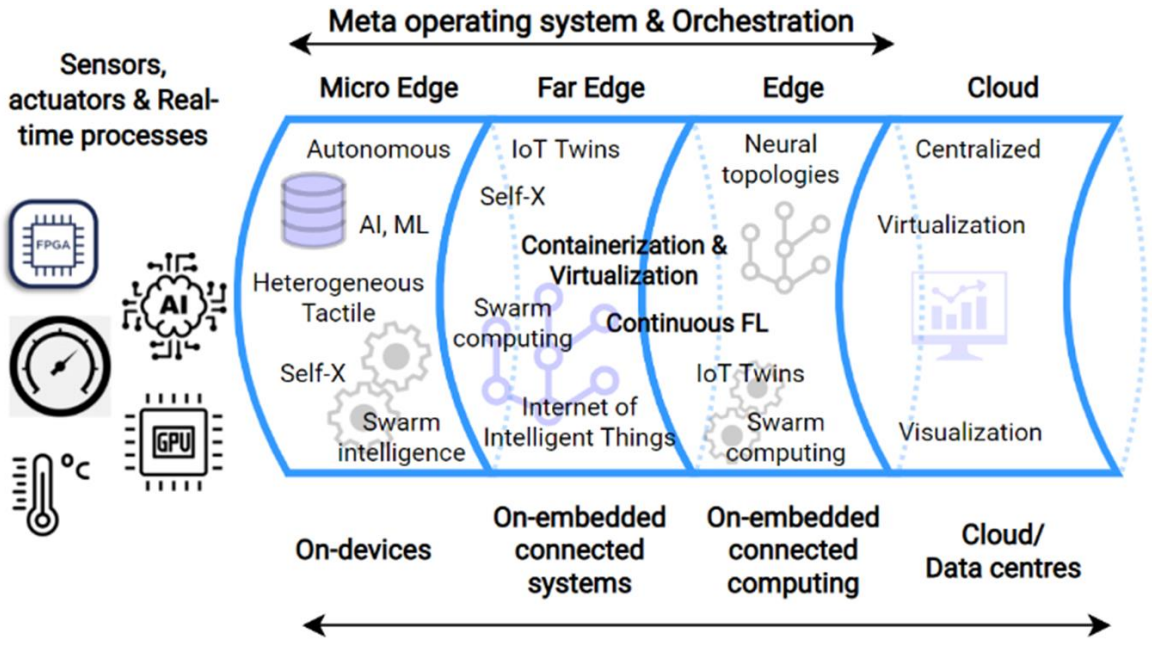
1. Introduction

1.1. aerOS in a nutshell

Transition to software-driven components and systems requires efficient integration of a variety of new vertically agnostic technologies and services. It requires data strategy, trusted data exchange frameworks, frugal AI on the (far) edge, and containerisation and virtualisation across complex value chains. Besides, collective decentralised decision-making, and system / network federation must be exploited to govern data exchange within models, applications and services across the IoT edge-cloud continuum. Here, meta operating system has to (among others) provide flexible orchestration mechanisms for combining and efficiently utilising the heterogeneous Infrastructure Elements (IEs) comprising the IoT edge-cloud continuum. In particular, it should support exposed standardised services APIs, hardware abstraction, cross-domain resource orchestration, and explainable/decentralised frugal AI. Moreover, aerOS will allow for distributed data management to make user-side applications more intelligent and proactive, and to provide foundation for hyper-distributed applications and services, closer to data sources and event-generating processes without sacrificing aggregated data analysis and insights. Additionally, aerOS will leverage concept of services as a "unifying abstraction", across resources (i.e., any physical or virtual IoT edge-cloud continuum resource, from device to far-edge, edge or cloud); across multiple infrastructure domains and service levels, supporting federation. Several aspects of aerOS will utilise the (semi)autonomous approaches, in particular these will include mechanisms for self-adaptation and self-healing of the Infrastructure Elements, based on self-observation.



aerOS is being carried out by a Consortium of 27 partners from 11 European countries, specialised in IoT, edge and cloud S/W and H/W technologies as well as in the verticals where the solution will be tested.

aerOS overarching goal is to design and build a virtualised, platform-agnostic meta operating system for the IoT edge-cloud continuum. As a solution, to be executed on any Infrastructure Element within the IoT edge-cloud continuum – hence, independent from underlying hardware and operating system(s) – aerOS will: (i) deliver common virtualised services to enable orchestration, virtual communication (network-related programmable functions), and efficient support for frugal, explainable AI and creation of distributed data-driven applications; (ii) expose an API to be available anywhere and anytime (location-time independent), flexible, resilient and platform-agnostic; and (iii) include a set of infrastructural services and features addressing cybersecurity, trustworthiness and manageability. aerOS will: (a) use context-awareness to distribute software task (application) execution requests; (b) support intelligence as close to the events as possible; (c) support

execution of services using "abstract resources" (e.g., virtual machines, containers) connected through a smart network infrastructure; (d) allocate and orchestrate abstract resources, responsible for executing service chain(s) and (e) support for scalable data autonomy.

To validate the architecture, supporting tools, and the methodology, aerOS will be instantiated in five real-world pilots with several scenarios to demonstrate feasibility of action results for future IoT: (i) manufacturing; (ii) computing near renewable energies, (iii) mobile agricultural machinery, (iv) smart maritime ports and (v) energy-efficient smart buildigns.

More information can be found online at project's website here: https://aeros-project.eu/

1.2. Technical objectives of the project

The objectives of the project are listed below:

- O1. Design, implementation and validation of aerOS for optimal orchestration.
- O2. Intelligent realisation of smart network functions for aerOS.
- O3. Definition and implementation of decentralised security, privacy and trust.
- O4. Definition and implementation of distributed AI components with explainability.
- O5. Specification and implementation of a Data Autonomy strategy for the IoT edge-cloud continuum.
- O6. Definition, deployment, and evaluation of real-life use cases.
- O7. Global ecosystem creation, maximisation of impact and Open Call conduction.

More information can be found online at project's website here: https://aeros-project.eu/objectives

1.3. aerOS Open Calls

aerOS has reserved a total of 900.000 € for supporting third parties enhance the scope of the project by joining the project via Open Calls. aerOS will perform **two rounds of Open Calls** where research entities and SMEs around Europe are summoned to:

- Validate and improve technical components of the aerOS meta operating system;
- Bring external actors (developers, domain experts, entrepreneurs, etc.) to create new solutions leveraging aerOS;
- Promote the visibility of aerOS architecture and outcomes on the market;
- Gathering new inputs from IoT, edge, network and industrial experts
- Extend application base of aerOS to other verticals outside the ones included in the proposal (domain-agnostic).

First round of Open Calls aims at funding **innovative proposals** that will **enhance aerOS**'s objectives **framed** (mandatorily) **within one** (out of its five) **pilot**(s). In particular, Open Call proposals are expected to address **one specific challenge out of a list** of possible challenges formulated.

Consult **Appendix A -** to realise the different pilots and challenges available for Open Call #1.

2. aerOS Open call #1

2.1. Applicability and eligibility criteria

Only the following **type of entities** will be able to submit proposals:

- European SMEs
- Universities
- Research centres (RTOs)
- Individuals

Operational eligibility criteria for proposals will also be:

- Only one entity per proposal will be admitted, so activities in co-operation will not be considered eligible (no Consortia allowed).
- Proposals must contribute to the aerOS paradigm and stick to aerOS technological principles.
- (For Open Call #1) - The proposal must be contextualised to one of the five pilots (see 1.3).
- The proposal must directly tackle one of the defined challenges (see 1.3).
- It is not necessary that the applicants are located in any of the pilot sites (Navarre or Basque Country – Spain, Germany, Milano – Italy, Biel – Switzerland, Poland, Kaiserslautern – Germany, Limassol – Cyprus, Athens - Greece).

Administrative (and other) **criteria** are as follows:

- Proposals must be written in English in all their parts in order to be eligible.
- The applicants must base their proposals on original work and, going forward, any foreseen developments should be free from third party rights, or they are clearly stated in a specific section (Previous IP background – see Section 7 of Proposal Template).
- Applicants are not allowed to submit multiple applications. If that is the case, only the first submitted application will be considered.
- No entity with economic interest, family or emotional ties or any other shared interest ('conflict of interest') towards aerOS Consortium partners will be accepted as candidates for funding.
- All cases of conflict of interest will be assessed case-by-case, based on pertinent EU stipulations.

2.2. Funding

For the **first round** of aerOS Open Calls, a **budget of 420k€ is available** considering the following:

- A maximum of 7 proposals will be funded.
- A maximum requested amount of **60.000€ per proposal** might be accepted.
- Maximum duration of projects is **8 months**.

A table to indicate the budget of the proposal is included at the final page of the "Proposal template" within Applicant Package.

The form of financial support to be used will be a **pre-defined lump sum**. Funds will be provided to the third parties following the accomplishment of different milestones verified on the basis on the presentation of technical and financial reports. Payments will be: (i) pre-financing, (ii) one interim payment according to the results of monitoring actions, (iii) final payment.

In the lump-sum to be requested, the costs will be **eligible** ('eligible costs'), if they correspond to the lump sum set out in Annex 2 and if the corresponding tasks have been properly implemented in accordance with the Proposal submitted. In addition, to be eligible the costs must meet the following criteria:

i. they must be incurred in the period set out in Article 9.4 of the Collaboration Agreement (see Application Package), with the exception of costs relating to the submission of the technical report and financial statement (see Article 9 of the Collaboration Agreement);

ii. they must be identifiable and verifiable, in particular recorded in the applicant's accounts in accordance with the accounting standards applicable in the country where the applicant is established and with applicant's usual cost accounting practices;

iii. they must comply with the applicable national law on taxes, labour and social security, and

iv. they must be reasonable, justified and must comply with the principle of sound financial management, in particular regarding economy and efficiency;

In contrast, the following will be considered **ineligible costs**:

i. costs that do not comply with the conditions set out above (see Article 7.1 of the Collaboration

Agreement)

ii. costs reimbursed under another EU or Euratom grant (including grants awarded by a Member State and financed by the EU or Euratom budget and grants awarded by bodies other than the European Commission for the purpose of implementing the EU and Euratom budget).

A detail of the costs (and how to calculate them, regulation applicable, etc.) is given in the Collaboration Agreement template provided in the Applicants Package. Costs for the contribution (direct and indirect costs) are eligible ('eligible costs'),

For calculating the lump sum amount to be funded, financial support will be calculated following the criteria of economy, the funds will be assigned after the evaluation and selection of the different proposals and evaluation by the evaluators/panel of the value of the work to be delivered.

2.3. Proposal preparation and submission

The submission of proposals will be managed through a dual-channel procedure after proper registry per applicant. The procedure is divided in three steps that are explained here below:

(1) The applicant must fulfil an online form with data relative to the proposal. The form is divided in three parts, containing both mandatory and non-mandatory fields:

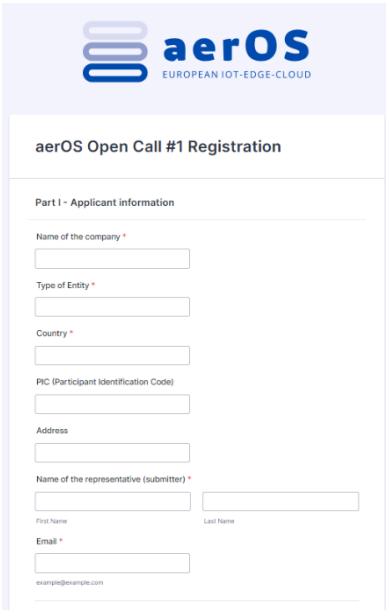
i. PART I: Data about the applicant: entity name, entity type, person registering the application, PIC of the entity, country and website.

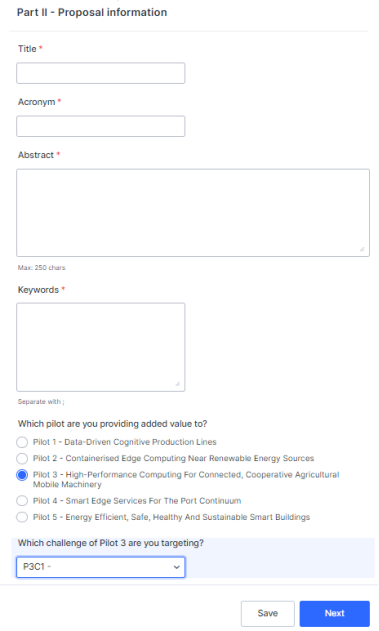
ii. PART-II: Key information of the proposal: name, acronym, abstract, keywords, pilot and challenge targeted.

iii. PART –III. – Statistical data.

iv. Ethics and GDPR Compliance

The form complies with all GDPR and ethical provisions as well as with aerOS procedures defined in deliverable D2.3. Informed consent and other legal details to ensure compliance with applicable regulations are included, designed in a secure way and including contact emails for addressing with any concern.





(2) Before submitting the form, the applicant must elaborate and attach a written proposal (**in PDF format**) according to the template and instructions set out in 2.3.1. Once done, the first two steps of the registration will be complete.

(3) To finalise the application, the applicant must send via email the proposal (same PDF file uploaded through the) form to opencall-aeros-project-eu@aeros-project.eu and to iglaub@upv.es as a password-protected ZIP file (*aerosopencall1*) including all relevant material. Applicants should also include a copy of the form as a proof-of-registration (confirmation received after form submission) also in PDF.

i. An acknowledge of receipt will be sent back to the submitter within 5 days after submission.

The application will be open and available to receive proposals from **October 1st, 2023** to **January 31st, 2024, 5 p.m. CET**. Incomplete proposals will not be evaluated.

2.3.1. Proposal template and instructions

Applicants must prepare a written proposal with a maximum of **15 evaluable pages** (cover and last page excluded) following the template included in the Application Package. Evaluators will be instructed to disregard any excess pages above the 15-page limit. The minimum allowed font size is 10 and the format provided in the template must be respected, included same page margins. The content must include (minimum, but not limited to) the following information:

1. **Administrative Information** (same as in the form indicated in 2.3).
2. **Idea**
    a. Main idea of the project and how it is related with the specific challenge.
    b. Innovation (how the project goes beyond already existing solutions)
    c. Technology underlying the project, providing enough block diagrams and illustrative pictures to understand the process and how it will work: standalone and interacting with aerOS.
    d. Observable and tangible results (application, GUI, software, hardware, protocol, methodology).
    e. Background of the solution (where it comes from, software it builds atop, etc.).
        * Here, it is worth mentioning that software development and hardware/firmware integration will need to be compliant with aerOS Technological Principles (see Appendix B in the Guidelines for Applicants.
3. **Relevance to aerOS**
    a. Describe how the idea matches aerOS overarching goals (https://aeros-project.eu/objectives/)
    b. (***For Open Call #1***) Describe how the solution will contribute to enhance the scope of the selected pilot? (https://aeros-project.eu/use-cases)
    c. Describe how it will enhance (and which part of) the architecture of aerOS. The technical scope of the components of aerOS architecture are available at the project website (D3.1 and D4.1).
4. **Impact and sustainability**
    a. Which is the expected impact of the solution during aerOS project?
    b. Which are the mid- and long- term indicators that could be monitored to measure the impact of your solution? Attempt to quantify such estimated impact.
    c. How will you ensure the sustainability of the work beyond the end of the funding? Please indicate any additional sources of funding/support you may need and how you plan to secure it
    d. Explain every expected publication (scientific paper, congress article, etc.).
    e. Standardisation and roll-out potential
5. **Implementation**
    a. Gantt of the project (Note that the duration of your projects must be 8 months)
    b. Explanation of the work plan (divided in tasks) as detailed as possible.
    c. Describe the necessary means to realise the idea (data, equipment, connectivity, access to infrastructure, systems, etc.).
    d. Milestones (max.4) and deliverables (max. 8 including reports and other – e.g., software).
        * Here, it is worth mentioning that deliverables and milestones should be aligned with the planned "technical reviews", that will trigger the corresponding instalments. For the first round of Open Calls, this timing will be: (a) Pre-financing review (after M1=May 2024 (b) Intermediate review (after M6=October 2024) and (c) Final review (after M8 – December 2024).
6. **Team**

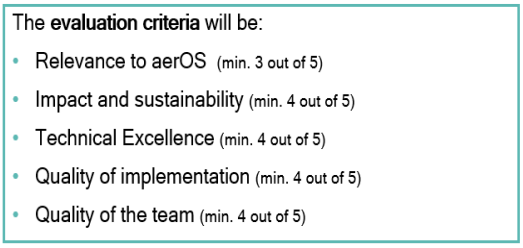
a. List the relevant members of your team, indicating gender (voluntarily), their relevant skills and experience.
b. Indicate the structure of the team and the roles and responsibilities that each member will be taking.
c. Experience of the organisation (relevant previous projects, services, contracts, etc.).

7. **Other relevant aspects**
   a. Which (if any) data do you intend to gather or produce? How much of this will be openly available?
   b. Do you rely on personal data? If so, how will you store this data? All pilots will be expected to comply with the General Data Protection Regulation 2016/679 (GDPR).
   c. Mention any IPR background existing.

2.4. Evaluation process

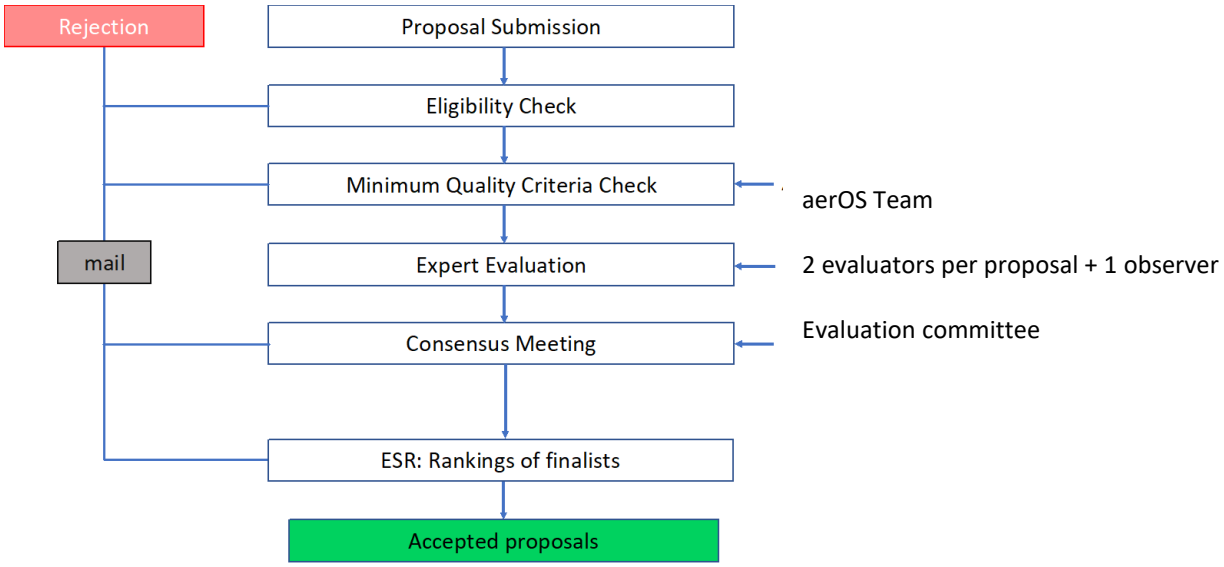
Received proposals will be evaluated and will be given a score upon which will be accepted or rejected to receive funding. The procedure will be crystal-clear, compliant with aerOS commitments to the European Commission. The process will be as follows:

- All proposals will be pre-screened by a selected group of aerOS members to check eligibility and minimum quality compliance based on the criteria exposed in 2.1.
- A selected Expert Evaluation team will be selected per each proposal. This team will be composed of two external experts (with experience in the related fields) and an observer to guarantee impartiality. The selected experts will sign a declaration of confidentiality concerning the evaluation process and the content of the proposals they evaluate. They will also declare their absence of any conflict of interest for the assigned tasks.
- Every expert (two per proposal) will give a score (using a specific form) to each of the evaluation criteria (see the image at the right). The evaluation will need to be based on: i) Relevance to aerOS (min. 3 out of 5); (ii) Impact and sustainability (min 4 out of 5); (iii) Technical excellence (min 4 out of 5); (iv) Quality of implementation (min4 out of 5) (v) Quality of the team (min. 4 out of 5), and 19 as a global threshold over 25.



- Afterwards, the two evaluators will meet (selected group of aerOS members will be present) and will reach a consensus evaluation on the quality of each proposal. The result of that agreement (comments and scores) will be reflected on the Evaluation Summary Report (ESR), which will be agreed by both.
- ESRs will be ranked and will go through a final evaluation by a committee formed by PCC (Project Coordination Committee) members of aerOS and two external observers to guarantee impartiality. Applying criteria here will be:
  - **(For the 1st Open Call):** Balance on pilots. Each pilot will have, at least (if possible), one project assigned.
  - Adequacy to aerOS goals and technology stack.
  - Ranking stands: In case of applications receiving an equal score the criteria will be marks in criteria 1, criteria 3, criteria 4, criteria 2 and criteria 5.
- Notifications on funding or rejections will be sent out to applicants, together with any feedback, by **March, 31st, 2024.** Slight delays might be experienced.
- Once the Open Call evaluation is finalised, representatives of the selected proposals will be invited to sign a Collaboration Agreement (final version included in the application package) with UPV to become third party. During the Collaboration Agreement signing process, the selected applicants will have to provide all relevant documentation concerning their legal and financial status (including mandatorily

providing PIC – Participant Identification Code), as well as any amendments in their technical proposals according to the comments received by the evaluators during the evaluation process, if applicable.



2.5. Joining the Consortium

Successful applicants **will be required to sign a collaboration agreement*** with Universitat Politècnica de València (partner UPV), the Project Coordinator, on behalf of the aerOS Consortium in order to be able to receive the funds.

*Note: The Application Package currently published in aerOS's website contains a **draft** Collaboration Agreement Model. This must be interpreted as a guiding template for the Collaboration Agreement that will need to be signed. aerOS Consortium **reserves the right to add minor modifications** during the period of final formalisation of the document to be signed.

Selected entities will thereof enter the Consortium of aerOS as **third parties of the Project Coordinator**. The draft collaboration agreement with the rights and obligation assumed by the third party is included in the Applicants Package. The applicant (if accepted to be funded) will be requested to fulfil the indicated fields. From then on, all managing aspects will be dealt with via communication with the Project Coordinator. Likewise, any question/issue related with technical/operational participation in the project will be conducted through the leader of task T1.4 of aerOS (Ignacio Lacalle – UPV – iglaub@upv.es).

2.6. Timeline summary

The following figure aims at illustrating the whole process, including timing and deadlines of the different steps. Applicants will be asked to stick to the indicated dates.

	1st Open Call Schedule	
Sept-23	Announcement	M13
Oct-23 to Jan-24	Submission Phase	M14-M17
Feb-24 to Mar-24	Evaluation Phase	M18-M19
Apr-24	Start Participation	M20
Nov-24	End Participation	M27

- Opening of Open Call application submission window: October 1st, 2023

- Closing of Open Call submission = Deadline for applications: January 31st, 2024
- Communication of the results: March, 31st, 2024
- Expected start of action: 3rd/4th week April 2024[1]
- Expected end of action: 3rd/4TH week November 2024[1]

2.7. FAQs

This section exposes the main FAQs that the members of the Consortium that have previously participated in Open Call tender procedures have experienced:

FAQ#1: What is aerOS?
aerOS is a project funded by HE programme aiming at designing and building a virtualized platform-agnostic meta operating system for the IoT-edge-cloud continuum. As a solution, to be executed on any Infrastructure Element of such continuum, aerOS will be independent from underlying hardware and operating system (s). More information can be found at: https://aeros-project.eu
FAQ#2: What is aerOS Open Call #1?
aerOS has reserved a total of 900.000 € for financially supporting third parties enhance the scope of the project by joining the project via Open Calls. aerOS will perform two rounds of Open Calls where research entities and SMEs around Europe are summoned to present proposals fitting one of the project pilots, targeting specific challenges. aerOS Open Call #1 is the first of those two rounds.
FAQ#3: Could I apply to aerOS Open Calls?
Only SMEs, Research entities (RTOs)and Universities and individuals can apply to aerOS Open Call. In addition, entities must also comply with specific legal requirements that can be found at the draft Collaboration Agreement.
FAQ#4: How could I apply to the funding?
Via visiting the form: https://form.jotform.com/232704048855055 fulfilling mandatory fields and properly submitting the Proposal using the Proposal Template. All of the previous must be done **before January 31st, 2024, 5 p.m. CET**.
FAQ#5: Is there a checklist of steps to be conducted?
Actions to be completed are: ➢ Check articles in the Collaboration Agreement. ➢ Fulfil the form (at least, the mandatory fields) and accept the Ethics and Legal terms. ➢ Upload through the form the Proposal (to be elaborated using the provided template) in PDF. ➢ Sending an email to opencall-aeros-project-eu@aeros-project.eu and iglaub@upv.es with the Proposal in PDF (compressed in a ZIP file using indicated password). ➢ Receiving an acknowledge receipt from the Consortium.
FAQ#6: Which activities qualify for financial support?
The first round of aerOS Open Calls aims at funding innovative proposals that will enhance aerOS' objectives framed (mandatorily) within one (out of its five) pilot(s). In particular, Open Call proposals are expected to address one specific challenge out of a list of possible challenges formulated by each pilot. Check Guide for Applicants for further info.
FAQ#7: How many applications could I submit?
Only one proposal per applicant will be considered for evaluation. Multiple submissions of the same proposal can be made: the last one received by email (with corresponding acknowledge of receipt) will be considered.
FAQ#8: Which are the evaluation criteria that will be applied?
The evaluation will be based on: i) Relevance to aerOS (min. 3 out of 5); (ii) Impact and sustainability (min 4 out of 5); (iii) Technical excellence (min 4 out of 5); (iv) Quality of implementation (min4 out of 5) (v) Quality of the team (min. 4 out of 5), and 19 as a global threshold over 25.
FAQ#9: How would I be joining the project?

[1] These dates may vary depending on the speed of reaction, signature process and associated paperwork.

Selected entities will enter the Consortium of aerOS as third parties of the Project Coordinator after the signature of a Collaboration Agreement based on the template provided in the Application Package.
FAQ#10: How amount of funding can be requested and which are the eligible costs?
A maximum requested amount of 60.000€ per proposal might be accepted. The form of financial support to be used will be a pre-defined lump sum.
FAQ#11: Which should be the duration of the project?
All proposals must have a duration of 8 months.
FAQ#12: When will I find out whether the proposal has been accepted?
Notifications on funding or rejections will be sent out to applicants, together with any feedback, by **March, 31st, 2024**.Slight delays might be experienced.
FAQ#13: Could I be eligible for the 2nd round of Open Calls?
If you have been granted funding in the 1st round, you are not eligible. Otherwise, all entities are eligible in so far as they meet the global eligibility criteria.
FAQ#14: Which will be the differences between Open Call #1 and Open Call #2?
First, more budget is reserved for round #2. Second, it will focus on applying aerOS to verticals outside of these considered in the project rather than to expanding aerOS' original pilots. Also, additional challenges will be proposed.
FAQ#15: Who can I contact to get more information about the Open Call?
You can contact the following addresses: opencall-aeros-project@aeros-project.eu, iglaub@upv.es, info@aeros-project.eu

For what regards aerOS particularities, the Consortium will maintain a frequently asked questions (FAQ) section available in https://aeros-project.eu/open-call-faqs . This page will be continuously updated according to the feedback and questions received from applicants. Follow the website and also social networks accounts of the project to get more information about the open call.

Appendix A - Pilots and challenges

A.1 - Specific challenges

Action will assess and verify its results in five pilots, representing: (i) manufacturing, (ii) renewable energy sources, (iii) agriculture machinery, (iv) smart maritime ports and (v) smart buildings. Each pilot will include different scenarios, in which the meta-OS architecture, including different technological pillars and aerOS services will be executed and validated. For **this first aerOS open Call, every applicant must select one of the following pilots** to frame their application within. It is, however, possible, to still submit a generic application, that should bring benefits in general to one of those verticals.

More information about the five pilots and their particular scenarios can be found online at project's website here: https://aeros-project.eu/use-cases/ A detailed description of the content of the pilots can be found at deliverable D2.2 available at project's website.

Pilot 1: DATA-DRIVEN COGNITIVE PRODUCTION LINES

The use case aims to deploy and validate MAL4 cognitive production processes in 4 public-private Pilot Lines (PL) located in: INNO Didactic Factory at AIC – Automotive Intelligence Center (Bilbao, Spain), MADE Competence Centre & POLIMI Industry 4.0 Lab facilities (Milano, Italy), SSF open factory lab at SIPBB (Biel, Switzerland), SIEMENS INNOVATION CAMPUS in factory automation headquarter (Nuremberg, Germany). The sites offer 5000 m2 of cutting-edge I4.0 production systems and bring together over 500 companies.

This pilot is divided in three scenarios:

1. Green manufacturing (zero net-energy) and CO2 footprint monitoring
2. Automotive Smart Factory Zero Defect Manufacturing.
3. AGV swarm zero break-down logistics & zero ramp-up reconfiguration for lot-size-1 production.

The open challenges defined for Open Call applicants to tackle are depicted in the following table:

Code	*Name*	*Description*
P1C1	Real time footprint monitoring in production processes	Implement a system that can measure and communicate the environmental footprint of production processes in real time. The environmental footprint is a comprehensive indicator that covers 16 environmental impacts, such as climate change, water use, resource depletion, and toxicity. The system should be able to collect and analyse data from various sources, such as sensors and other equipment operation parameters, along the manufacturing process (e.g Product specific data, process machine data such as temperature, humidity, energy consumption...) . The system should also be able to provide reliable, verifiable, and comparable information to the stakeholders, such as manufacturers, consumers, regulators, and investors by feeding a preliminary DPP (Digital Product Passport). The system should also be able to support decision making and optimization of the production paths to reduce the environmental footprint and improve the sustainability performance.
P1C2	Optimization of AGV paths	To find the best way to plan the routes of automated guided vehicles (AGVs) in logistic processes by facing some difficulties, such as avoiding collisions, adapting to dynamic environments, and minimizing the travel distance and time. The challenge requires optimizing the AGV paths in logistic processes, taking into account various factors and constraints, such as the layout of the environment, the location and demand of the tasks, the number and capacity of the AGVs, the traffic rules and safety regulations, and the energy consumption and maintenance costs, in

		order to avoid saturation in the assembly line, outsourcing to other production lines considering environmental aspects (e.g most efficient & carbon neutral path).
P1C3	Remote operation of CMM (Coordinate Measurement Machines)	To enable the remote operation of coordinate measurement machines (CMMs) that can measure the geometry and quality of physical objects with high accuracy and precision. CMMs are devices that use probes or sensors to sense discrete points on the surface of the object and display them in a digital format. The challenge requires a low latency control and monitor the CMMs from a distance, using a computer or a mobile device. The system should also provide real-time feedback and data visualization to the users, as well as enable the communication and collaboration among different stakeholders. The system should also ensure the security and reliability of the data transmission and storage.
P1C4	Managing industrial production applications with Behaviour Trees	The solution sought should be capable of controlling complex algorithms, particularly through behaviour trees or other Low Code Tools, which are essential for managing complex industrial production flows with flexible automation assets. Using such tools should not necessitate extensive coding or deep programming knowledge, instead providing a visual interface for managing, modifying, and executing these algorithms. This effectively reduces the dependence on manual coding. Additionally, the solution should allow users to visually construct and alter decision paths in low code tools such as behaviour trees using straightforward features such as drag-and-drop. The flexible, adaptable solution needs to be user-friendly and accessible to users ranging from beginners to experts, ensuring that the accuracy and functionality of production flows are not compromised.
P1C5	AGV travels optimization	To train an AI/ML algorithm there is the need to generate a synthetic dataset of simulated product orders over time (integer numbers) arriving from simulated companies outside. The dataset should be able to highlight some possible faults/inefficiency of the automatic factory, for example bringing saturation of the line or alternating high demand periods with low demand periods and let the system solve/improve/optimize the AGV travels management system. This challenge would require the creation of such data set. Then, drawing from these data, the challenge would appreciate the creation of an automatic real-time random order generator that simulates the orders arriving from simulated companies outside and a data monitoring dashboard that shows these data on the screen.
P1C6	Designing Plug-and-Produce Factory Modules for Agile Production Environments	The challenge is to design and develop a generic, CE compliant and modular production asset that can be easily integrated into a factory as plug and produce factory modules. These assets should be designed to be flexible and adaptable, allowing for frequent changes in their mission and position within the factory. The challenge is to create a system that enables easy and seamless integration of these modules into the factory environment, including the communication via OPC UA and/or ROS2, without compromising efficiency or productivity. The modules should be designed to be easily interchangeable, allowing for quick reconfiguration of the factory layout to accommodate changing production needs. The ultimate goal is to create a highly agile and responsive factory environment that can rapidly adapt to changing market demands and production requirements. Examples: Handling or Quality Inspection machineries.
P1C#	Global	Others fitting within the global challenges descriptors (see **A.2** -

Pilot 2: CONTAINERISED EDGE COMPUTING NEAR RENEWABLE ENERGY SOURCES

Use case will be driven by partners CF and ELECT. It will allow management of containerised edge data centres developed by CF and located directly at energy sources, connected to the smart infrastructure and providing cloud continuity. It will be deployed and validated at renewable energy centres operated by ELECT, in Poland.

This pilot is divided in two scenarios:

1. Green Edge Processing.
2. Secure Federation of edge/cloud.

The open challenges defined for Open Call applicants to tackle are depicted in the following table:

Code	*Name*	*Description*
P2C1	Advanced context-specific energy level prediction on the edge	The motivation for this challenge is provided by the following scenario. Consider a computing solution that uses UPS (Uninterruptible Power Supply) to avoid full discharge of an element carrying out some tasks when we do not have main power source from renewable energy source. Here, tasks processing should be interrupted before a certain UPS battery level and delegation of tasks should be suspended after determining the appropriate battery level. When the power is back the system should restore the tasking and usage of the edge computing solution. Here, an elaborated algorithm is needed that should take into account UPS battery level, time, weather forecast, size of workload and any other use-case/environment specific parameters that may help in predicting the energy level at the edge. Core of the challenge is to boost the accuracy of prediction of energy consumption of hardware items during workload execution in order to estimate time to shutdown, that will in turn be used by aerOS orchestration algorithms. This challenge can be further extended by taking into account temperature of the container, servers and predict time to over/under heating that will hinder functioning of an element.
P2C2	Carbon intensity prediction	To limit aerOS environmental impact and contribute to the goals of European Green Deal a conscious energy consumption is required. Smart management and scheduling tools of aerOS call for information on carbon intensity of available energy across Europe. aerOS, in pilot P2, could benefit from solid, actionable current and predicted emission data to optimize workload distribution and processing both spatially and temporally. Essentially perform energy-intensive activities in place and time that offers the energy with lowest carbon intensity. In the scope of this challenge, a prediction algorithm is expected that combines publicly available data to produce a map of carbon intensity across Europe, with special emphasis in the Poland region (where the pilot takes place). Spatial and temporal resolution will be deciding factors in the evaluation process.
P2C#	Global	Others fitting within the global challenges descriptors (see **A.2** -

Pilot 3: HIGH PERFORMANCE COMPUTING PLATFORM FOR CONNECTED & COOPERATIVE AGRICULTURAL MOBILE MACHINERY

Use case will be driven by partners JD and TTC. The smart agriculture HPCP-F use case will be deployed and validated in John Deere European Technology Innovation Center in Kaiserslautern (Germany).

This pilot is divided in two scenarios:

1. Cooperative large-scale harvesting.
2. CO2 neutral intelligent farming.

The open challenges defined for Open Call applicants to tackle are depicted in the following table:

Code	*Name*	*Description*
P3C1	Low-cost dust detection system	During secondary tillage, a large amount of dust can be generated if the soil is dry, blocking the view of the ground. Currently, a LIDAR is used to detect the dust, but it is expensive. To guarantee a reliable use of cameras analyzing the ground, a more cost-efficient system or methodology [both hardware and software solutions are possible] is needed to enable wide adaptation. This

		should detect the dust and provide a metric representing the degree of current visibility restriction or the quality of current possible ground detection.
P3C2	Seamless wireless communication in challenged agricultural environments	In many agricultural fields, coverage by terrestrial radio networks is often insufficient. However, digital agriculture requires connectivity to the Internet as well as between the machines in use, to enable effective processing of tasks in the fields. In order to further put technological advancements in digital agriculture into practice, a system is needed that enables seamless, uninterrupted, low-latency communication to the Internet in these challenged fields as well as when transitioning to such fields.
P3C3	Cost effective, short-range sensor fusion for full area coverage around moving vehicles/machinery	Work processes become more and more autonomous so reliable object detection and classification in the proximity of moving vehicles/machinery is essential. For moving vehicles/machinery it is essential to have full coverage of short-range area surveillance around the vehicle. In particular to the rear, often machine parts block vision of certain sensors and create blind-spots. Additional complexity is added by harsh-environmental, out-door conditions, which shall not lead to degradation of the performance (fog, rain, snow, uneven terrain, etc.). Also the machine itself may add unfavourable effects, such as vibration, heat, etc. The existence of high bandwidth connections of the vehicle cannot be guaranteed, which leads to an embedded solution. A solution by combining a diverse set of sensors and fusing the data may be the obvious approach. The analysis shall cover the performance requirements on the computing and data bandwidth to be mastered in the embedded solution and a qualification of advantages, disadvantages of the chosen sensor combinations in several aspects: performance of object detection/classification, cost and installation complexity, etc.
P3C#	Global	Others fitting within the global challenges descriptors (see **A.2** -

Pilot 4: SMART EDGE SERVICES FOR THE PORT CONTINUUM

The logistics pilot will be driven by the Industrial partner EUROGATE and the scenarios will be deployed and validated in the container terminal located in the Port of Limassol (EGCTL), which is the largest port in Cyprus. EGCTL amalgamates the activities of container handling, reefer services and industrial storage and it is a critical node of the European sea-logistics supply chain. Since 2017 EUROGATE has invested more than 30 M€ in the CHE of the terminal improving the QoS while reducing both arrival/departure idle times and cargo delivery time.

This pilot is divided in two scenarios:

1. Predictive maintenance of Container Handling Equipment.
2. Risk prevention via computer vision in the edge.

The open challenges that have been defined for Open Call applicants to tackle are depicted in the following table:

Code	***Name***	***Description***
P4C1	Low-cost accurate GPS	Centimetre accuracy D-GPS is an interesting feature in the port environment to monitor the location of assets, but hardware is too expensive. Using normal GPS receivers and performing a post-processing of the signal can alleviate the costs and keep almost same location accuracy. The goal of this challenge is to propose and implement a (new hardware) PoC of a location system providing real time location with a precision of a few centimetres.

P4C2	Secure private mobile network	A port container terminal is a relatively large outdoors area. In general, the connectivity of the different assets is provided by the installation of fiber optics, which leads to very high deployment costs. The goal of this challenge is to test a wireless network infrastructure that can guarantee enough coverage for the future connected straddle carriers (whose data will be collected and transmitted) along the pilot area under test. Moreover, since the sensitive information to be transmitted, regular public 4G/5G networks are seen as direct candidates for malicious attacks. Thus, the challenge aims at the deployment and test of a private 4G/5G network deployment that can guarantee privacy and security in the transfer of telemetry data acquired in all port assets. Innovation must be clearly posed by going beyond current commercial approaches that have proven insufficient in such environments.
P4C3	New predictive maintenance or computer vision use cases	Project partners predictive maintenance use cases are focused on trolley wire rope enlargement and load cell measurements. New predictive maintenance use cases (new AI services), such as tyre pressure monitoring are of interest. On the other hand, pilot is already developing computer vision AI models for detecting deformations in containers, but the live video feeds can be used to develop models for improving workers' safety, like detecting Straddle Carriers or other yard equipment below an STS crane under operation (these cases are not under the current scope of the pilot).
P4C4	3D digital twin visualization	Pilot partners already provide 2D visualization of some port assets (cranes, buildings, container blocks, etc.) taking as baseline an AutoCAD model of the terminal. In order to provide a more close to real life environment, this challenge seeks extending 2D visualization to a 3D environment using real-time location information of assets and asset status data visualization (mostly using telemetry data and container stock information). Here, connection to aerOS is relevant in terms of being able to dynamically plot and visualize values related to the objects represented in the 3D model.
P4C#	Global	Others fitting within the global challenges descriptors (see **A.2** -

Pilot 5: ENERGY EFFICIENT, HEALTH SAFE & SUSTAINABLE SMART BUILDINGS

Use case will be driven by partners COSM, NCSRD, FOGUS, INF and UPV. It will demonstrate gains of the aerOS architecture in an edge deployment for energy efficient, sustainable, flexible and health-safe smart buildings. The use case will be will be deployed and validated in an office enterprise building of COSMOTE (Athens, Greece).

This pilot is divided in two scenarios:

1. Intelligent Occupational Safety and Health.
2. Cybersecurity and data privacy in building.

The open challenges defined for Open Call applicants to tackle are depicted in the following table:

Code	***Name***	***Description***
P5C1	5G SA IOT Gateway	The pilot would benefit from the incorporation of 5G SA IoT gateways. Current commercial versions do not provide open gateways that could be used for installing aerOS functionalities. In addition, it would be needed that such gateways would work in a 5G standalone fashion and would operate inside a Smart Building (several of them would be appreciated). In addition, the gateway should include capabilities of SDN, NFV (virtual network functions) and Network Applications. Innovation is sought in this challenge with regards to plug & play nature for an agile deployment in the Pilot 5 of aerOS.

P5C2	Energy Consumption Calculation	The goal of this challenge is to found an energy consumption calculation system for a sensorised building. COSMOTE Lab building incorporate a series of sensors across various floors (more info in D2.2). The challenge would be to deliver a smart algorithm to calculate the energy consumption of the activities taking place in the building, alongside a system for gathering such metrics and exposing them to the aerOS meta Operating System. Accurate measurements and predictions would be required in order to fine-tune the actions that will be actioned upon aerOS innovations.
P1C#	Global	Others fitting within the global challenges descriptors (see **A.2** -

A.2 - Global challenges

- Z.o.oContainerised modules forpporting distributed mechanisms/functionalities required for multiple domains (i.e., not domain specific) of IoT edge-cloud continuum.
- AI/ML libraries and tools to be integrated in aerOS, that complement and expand the existing artifacts provided by the project and/or AI/ML services working over aerOS core and supporting features to enhance the scope of one project use-case. Here, contributions related to distributed frugal AI with explainability (close to the edge) will be particularly thought.
- Smart networking components, which can be incorporated into the virtualised smart networking topology of aerOS. Networking layer components should be based on different standards higher-level communication standards (e.g. OPC UA, TSN, 5G etc.) or proprietary networking solutions.
- Value-adding application service components. Application service layer components should exploit major standards and be integrated with aerOS API. Advanced virtualisation mechanism for smart objects, including context-aware mechanisms and transfer of virtual objects between servers and cloud platforms.
- New smart data and semantics components related to trust, aggregation, security or any sovereignty realm feature that might enhance the application of aerOS in a use-case.
- External Validation of the overall aerOS solution (architecture, deployment and modules) in an IoT-edge-cloud validation environment.
- Extension, advanced application, innovative proposal over DevPrivSecOpcs methodology for aerOS deployment in projects' use-cases.
- External owned products/systems that can be integrated with aerOS features to deliver relevant applications/services to an aerOS use-case.
- Own-developed Infrastructure Elements (hardware and software) compliant with aerOS architecture to be tested and deployed on-premises in an aerOS use-case scenario.
- Innovative usage of aerOS orchestrator to demonstrate further efficiency, network throughput, analytics capabilities or other relevant improvements.
- Application of advanced multi-scale and multi-plane analytics using aerOS software (and own if required) using use-cases datasets and infrastructure.
- Smart Device layer components to complement project's use-cases based on different low-level communication standards (e.g., Zigbee, 6LowPan, WIFI, Bluetooth, IEEE 802.15.4, NFC, etc) or on ad-hoc proprietary device solutions.
- Developing and using aerOS self-* functions including self-adaptation and self-healing of the Infrastructure Elements, based on self-observation in the addressed verticals.
- Practical application of semantic technologies supported by aerOS available functions and/or extending aerOS capabilities by application of semantic technologies.
- Development of Digital Twin solution profiting aerOS deployment in the IoT-edge-cloud continuum, addressing the different verticals and providing benefits in terms of execution, traffic reduction and real-time analytics latency reduction.

Appendix B - aerOS Technological Principles

B.1 - Architecture design and diagram

The aerOS IoT cloud to edge system comprises multiple aerOS domains, each consisting of a collection (at least one) of Infrastructure Elements (IEs). Infrastructure Element is the fundamental building block of the aerOS system. It provides the computational infrastructure necessary to deploy and manage workloads and it can be any physical or virtual entity that supports containerised workloads. IEs are deployed within or connected to an aerOS domain and play a crucial role in hosting and executing containerised applications or services. As a minimal execution unit, it is the base of the aerOS stack, as it exposes the minimum capabilities needed to support workload execution, enhanced with a set of lightweight aerOS integration enablers.

An **aerOS Domain** constitutes a complete aerOS execution environment. It can be formed by (at least) one or more IEs. There are two prerequisites that make a set of connected compute and network resources an aerOS domain. The first is that these compute resources are integrated as IEs, as described above; thus, being capable to support workloads execution and provide a minimum set of aerOS integration capabilities, e.g., manageable network functionality. The second factor is that a set of core, basic, aerOS services are deployed on top of these IEs (or this IE as domain can be a single IE). So, in conclusion, an aerOS domain can be defined as a group of IEs which share the same set and instance of aerOS basic services.

The basic services of aerOS are:

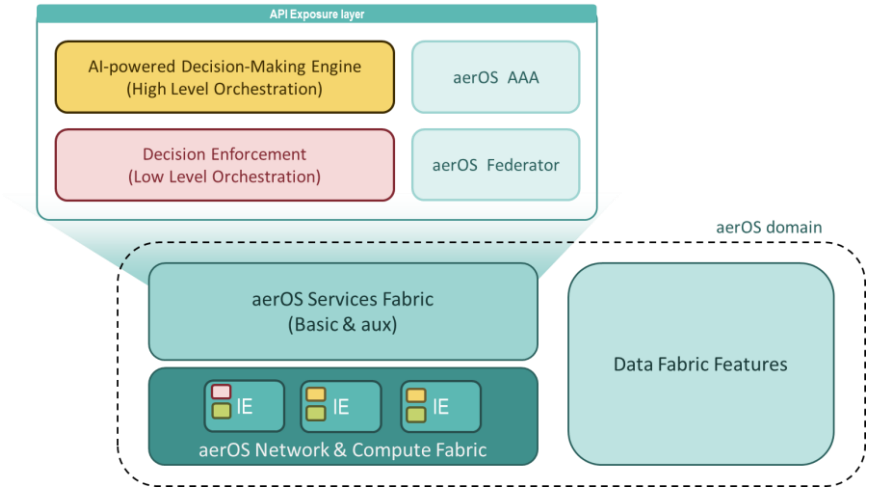
- **Federation service**, which is provided by the federator component. Federation service is responsible to generate cross-subscription for the distributed state achievement, and registrations to other aerOS domains and enable thus domains and IEs state propagation across the continuum, and orchestration requests forwarding. We must highlight here that federator requests and information can be propagated between domains thanks to the employed mechanisms implementations (NGSI-LD).
- **Orchestration service,** which is responsible to receive user described intentions, regarding IoT services deployment, and encompasses decision support systems, trust management services, to translate to actual deployment requests and finally deployments on IEs.
- **Data fabric services**, which are implemented within each aerOS domain and take care of the identification, collection and, in an interoperable way, integration of the data, and then enforce the required governance policies. Finally, they provide all the mechanisms to discover, connect, and retrieve data from other aerOS domains, as data fabric is a layer running across the continuum.
- **Security services**, which integrate authentication, authorisation and access policies based on roles and identities.

Additionally, other aerOS services enable aerOS to act as an intelligent and secure Meta-OS able to establish and manage the continuum, reside possibly within each aerOS domain some of which we have already mentioned before.

- **Trust management services**, which can exploit the aerOS data fabric provisions and calculate a trust score per aerOS domain or even node, to guide the domain orchestrator to the most appropriate choices.
- **AI decision support services**, which can again leverage on data retrieved by the data fabric, to provide input to the orchestrator regarding best placement, either locally or to another domain.
- **Analytics services**, which can provide insights into data, decision-making, and data processing for other components upon request.

Each aerOS domain, on top of these services, exposes a comprehensive and efficient Application Programming Interface (API) to communicate with stakeholders, agents, and other domains.

Next figure displays an absolute minimal and schematic representation of an aerOS domain, where just the immediate identifiable continuum enablers are highlighted.



This should help Open Call applicants to understand the basic aspects of aerOS technological principles, enough to build competitive proposals for applying to Open Call #1 of aerOS.

By design **aerOS is not a centralised solution**, and it is this framework that architecturally makes all provisions for establishing appropriate mechanisms needed to achieve a fully federated and decentralised architecture among the aerOS domains.

B.2 - Technologies selected for the meta Operating System

Based on the descriptions above, the applicants to the Open Call might bear in mind a tentative list of technologies (some of them are being discussed/integrated/dismissed/confirmed at the moment). This should allow to build a more comprehensive technological approach of the submitted proposals. The fact of aligning with aerOS technological principles and technical selections are aspects to be taken into consideration, and that will also be analysed by external reviewers. It is worth noting that aerOS has a clear commitment towards open source. Thus, the usage of the following (or other) OSS technologies will also be appreciated for applications.

Network virtualization and communication in the continuum:

Cilium, Zenoh, Wireguard

Data Fabric and services integration

NGSI-LD, OpenAPI, BehaviorTree, DCAT

Data semantic interoperability and annotation:

Akka, Scala, MQTT Mosquitto, Apache Jena

Packaging tools

Helm charts, OSM VNF and NS packaging approaches

AI and MLOps

OpenFaaS, Grafana, TensorFlow, AugLy, Larq, InterpretML, AIX360, KubeFlow, MLFlow, Flower

Cybersecurity, privacy and trust

KrakenD, KeyCloack, IOTA, OpenID Connect, Suricata

Orchestration, messaging, event monitoring and notifications:

Prometheus, Kopf operators, Kafka

Container management framework and related commodities:

Docker, Kubernetes, K3s, KubeEdge, ClusterAPI

Visualization and representation of the continuum

Vue.js, Spring