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Architecture for Scalable, Self-human-centric, Intelligent, Secure, and Tactile next generation IoT

assist-iot

GUIDE FOR APPLICANTS to ASSIST-IoT Open Call #2

Table of contents

1. Introduction

1.1. ASSIST-IoT in a nutshell

ASSIST-IoT aims at designing, implementing and validating an open, decentralized reference architecture, associated enablers, services and tools, to support human-centric applications in multiple verticals. Instances of the architecture will be supported by key enablers, like edge/fog computing, (semi-)autonomy, distributed AI, smart devices, interoperability, Distributed Ledger Technology (DLT) atop a smart network infrastructure, with low latency capabilities, allowing execution of context-aware applications with new interaction interfaces (e.g. AR/VR/MR), etc. The solution will integrate AI-based functions transferring intelligence closer to the edge (data sources), including devices.

ASSIST-IoT is being carried out by a Consortium of 15 partners from 7 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.

ASSIST-IoT is committed to the creation of a **blueprint architecture** for next generation of Internet of Things, avoiding traditional centralized paradigms and cloud-based hierarchy, instead embracing distributed approach that allows scalable transference of processing power, intelligence and self-management closer to the edge. Moreover, thanks to change of paradigm from a centralized platform to a decentralized network grid of edge nodes, ASSIST-IoT will create novel seamless human-system interactions that will use beyond-SotA, interfaces (e.g. haptic ones) that have very strong requirements in terms of low latency and contextual awareness. Beyond this objective, ASSIST-IoT will provide methodology supporting implementation of this architecture. To validate the architecture, supporting tools, and the methodology, ASSIST-IoT will be instantiated in three real-world pilots with several scenarios to demonstrate feasibility of action results for future IoT: (i) port automation; (ii) smart safety of workers, and (iii) cohesive vehicle monitoring and diagnostics.

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

1.2. Technical objectives of the project

The objectives of the project are listed below:

- O1. Design, implementation and validation of an NGIoT Reference Architecture.
- O2. Definition and implementation of distributed smart networking components.
- O3. Definition and implementation of decentralized security and privacy exploiting DLT.

- O4. Definition and implementation of smart distributed AI enablers.
- O5. Definition and implementation of human-centric tools and interfaces.
- O6. Definition, deployment and evaluation of real-life pilots.
- O7. Establishment of an innovative cooperation and business framework.
- O8. Impact creation: Showcasing ASSIST-IoT and Disrupting the current market.

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

1.3. ASSIST-IoT Open Calls

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

- Validate and improve technical components of the architecture.
- Take up of ASSIST-IoT by application developers, domain experts and entrepreneurs to create new applications and services.
- Push ASSIST-IoT technology and service visibility on the market.
- Support an innovative, dynamic and industry open ecosystem around ASSIST-IoT results.
- Gather new market relevant inputs ASSIST-IoT components and finding industry experts to improve technical capabilities as well as filling possible missing functions, needed adoptions or modifications.

Both Open Call rounds are aimed at funding **innovative proposals** that will **enhance ASSIST-IoT**'s objectives **framed** (mandatorily) **within one** (out of its three) **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.

Consult **Appendix A -** to realise the different pilots and challenges available for Open Call #2.

2. ASSIST-IoT Open call #2

2.1. Applicability and eligibility criteria

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

- European SMEs
- Universities
- Research centres (RTOs)

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 ASSIST-IoT paradigm.
- The proposal must be contextualised to one of the three pilots (see 1.3).
- The proposal must directly tackle one of the challenges within one of the pilots (see 1.3).
- It is not necessary that the applicants are located in any of the pilot sites (Malta, Warsaw - Poland, Valencia - Spain, Germany).
- Entities awarded with a project funded under ASSIST-IoT Open Call #1 are not eligible in the second round of funding.

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 ASSIST-IoT 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 ASSIST-IoT Open Calls, a **budget of 480k€ is available** considering the following:

- A maximum of 8 proposals will be funded.
- The amount to be funded per proposal is **60.000€ in the form of lump-sum**.
- Maximum duration of projects is **9 months**, starting preferably on January 1st, 2023.

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.

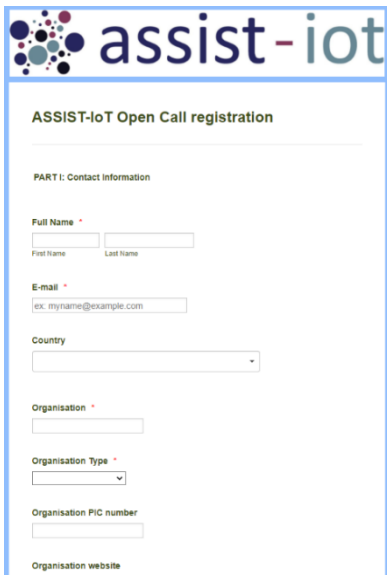
2.3. Proposal preparation and submission

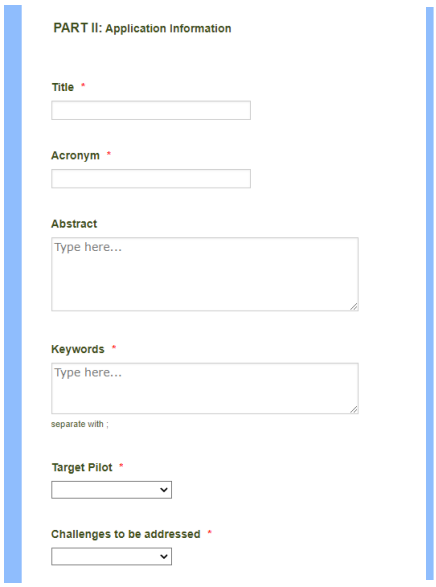
The submission of proposals will be managed through a dual-channel procedure after proper registry per applicant. The procedure is divided in three steps that are explained here below:

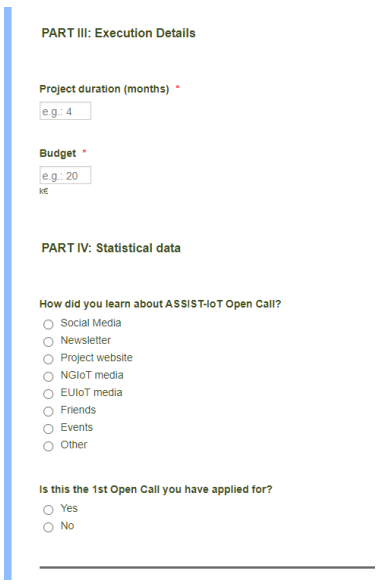
(1) The applicant must fulfil an online form with data relative to the proposal. The form is divided in three parts, containing both mandatory and non-mandatory fields:

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. – Execution details, including duration and budget requested for the proposal.
iv. PART – IV: Statistical data.

The form complies with all GDPR and ethical provisions as well as with ASSIST-IoT 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-assist-iot-eu@assist-iot.eu and to iglaub@upv.es as a password-protected ZIP file (*assistiotopencall1*) 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 **July, 1st, 2022** to **October 14th, 2022, 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 of the selected pilot.
    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 interacting with ASSIST-IoT.
    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 ASSIST-IoT Architectural guidelines (mainly relevant: enablers encapsulation, containerisation/virtualisation and OpenAPI). Please, consult in detail the **Appendix B - Technical framework** and **Appendix C – ASSIST-IoT architecture summary.**
3. **Relevance to ASSIST-IoT**
    a. How the idea matches ASSIST-IoT overarching goals (https://assist-iot.eu/objectives/)
    b. How the solution will contribute to enhance the scope of the selected pilot. (https://assist-iot.eu/use-cases)
    c. How it will enhance (and which part of) the architecture of ASSIST-IoT.
4. **Impact and sustainability**
    a. Which is the expected impact of the solution during ASSIST-IoT 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 max. duration for OC#2 is 9 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).

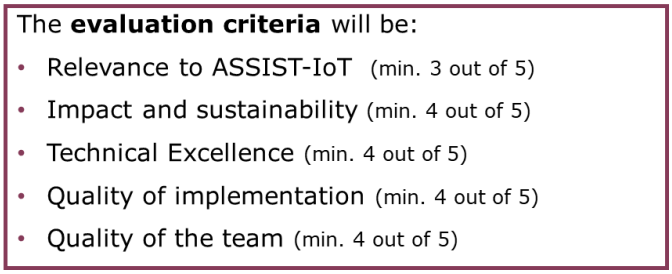
* Here, it is worth mentioning that deliverables and milestones should be aligned with the planned "payment milestones", which for the second round of Open Calls are: (a) Pre-financing payment (after M1 - January 2023), (b) Intermediate payment (after M6 – June 2023) and (c) Final payment (after M9 – September 2023).

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

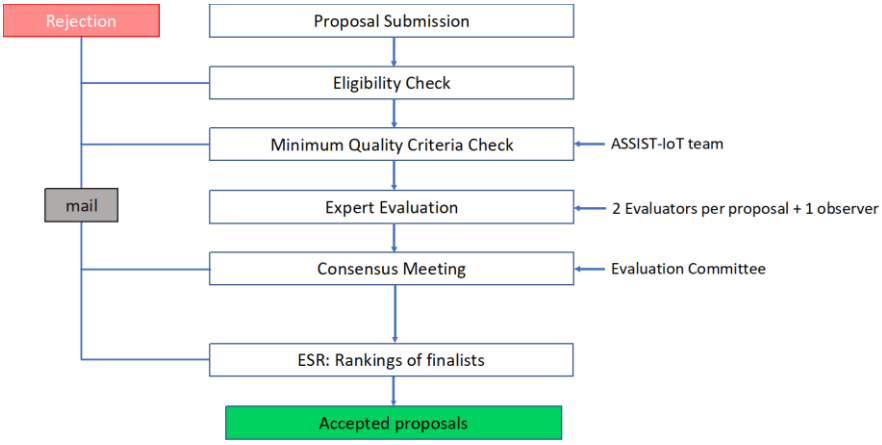
Received proposals will be evaluated and will be given a score upon which will be accepted or rejected to receive funding. The procedure will be crystal-clear, compliant with ASSIST-IoT commitments towards the European Commission. The process will be as follows:

- All proposals will be pre-screened by a selected group of ASSIST-IoT 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 no conflict of interest.
- 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 ASSIST-IoT (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 ASSIST-IoT 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 result in Evaluation Summary Report (ESR), which will be signed by both.
- ESRs will be ranked and will go through a final evaluation by a committee formed by PCC (Project Coordination Committee) members of ASSIST-IoT and two external observers to guarantee impartiality. Applying criteria here will be:
  - Balance on pilots. Each pilot will have, at least, one project assigned.
  - Adequacy to ASSIST-IoT.
  - 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 **December 20th, 2022.**
- Once the Open Call evaluation is finalised, representatives of the selected proposals will be invited to sign a Collaboration Agreement (final version -**NOT open to negotiation**- 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.



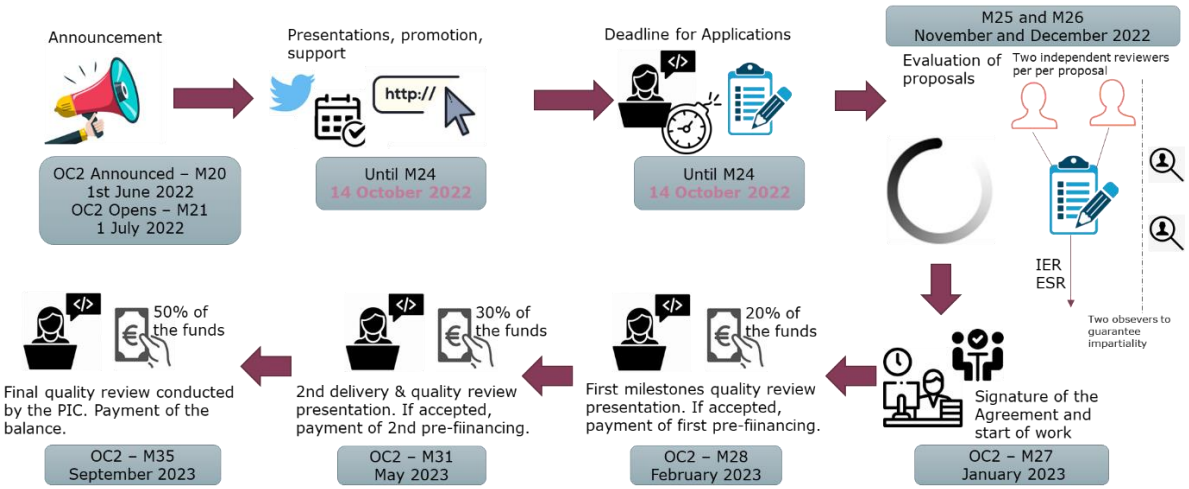
2.5. Joining the Consortium

Successful applicants **will be required to sign a collaboration agreement** with Universitat Politècnica de València (partner UPV), the Project Coordinator, on behalf of the ASSIST-IoT Consortium in order to be able to receive the funds. This CA (included in the Applicants Package) is **NOT open to negotiation.**

Selected entities will thereof enter the Consortium of ASSIST-IoT as third parties of the Project Coordinator. 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 while any question/issue related with technical/operational participation in the project will be conducted through the leader of task T7.4 of ASSIST-IoT (Prodevelop, S.L. – partner PRO).

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.



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 ASSIST-IoT?**
ASSIST-IoT is a project funded by H2020 programme aiming at designing, implementing and validating an open, decentralised reference architecture for the Next Generation Internet of Things, associated enablers, services and tools, to support human-centric applications in multiple verticals. More information can be found at: https://assist-iot.eu
FAQ#2: What is ASSIST-IoT Open Call #1?
ASSIST-IoT 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. ASSIST-IoT 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. ASSIST-IoT Open Call #2 is the second (and final) of those two rounds, which has been assigned a total of 480.000€ for awarding proposals.
FAQ#3: Could I apply to ASSIST-IoT Open Calls?
Only SMEs, Research entities (RTOs) and Universities can apply to ASSIST-IoT Open Call. In addition, entities must also comply with specific legal requirements that can be found at the draft Collaboration Agreement.
FAQ#4: **How can I apply to the funding?**
Via visiting the form: https://form.jotform.com/221812189680358, fulfilling mandatory fields and properly submitting the Proposal using the Proposal Template. All of the previous must be done **before October 14th, 2022, 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 (this model is not open to negotiation, please just consult the articles to ensure compatibility with your legal teams). ➢ Fulfil the form (at least, the mandatory fields) and accept the Ethics and Legal terms. ➢ Send via email the proposal as indicated in the Guidelines for Applicants (to be elaborated using the provided template) – through email to opencall-assist-iot-eu@assist-iot.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?**
Both Open Call rounds will aim at funding innovative proposals that will enhance ASSIST-IoT's objectives framed (mandatorily) within one (out of its three) 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. Guiding principles are: (i) validating (at least a part of) ASSIST-IoT's architecture and (ii) providing added value to any of the pilots. 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 ASSIST-IoT (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?**
Selected entities will enter the Consortium of ASSIST-IoT 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 fixed amount of 60.000€ per awarded proposal will be delivered. The form of financial support to be used will be a pre-defined lump sum.
FAQ#11: **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 **Dec. 20th, 2022**.
FAQ#12: **Could I be eligible if I have been awarded in the 1st Open Call?**
No, a third party can only participate in the project under one of the two rounds of Open Calls.
FAQ#13: **Which are the differences between Open Call #1 and Open Call #2?**
More budget is reserved for round #2, which will haves as the main difference the technical framework and the starting point of the developments in the project (please, consult the Guide for Applicant annexes). Additional challenges per pilot will be have been added as well..
FAQ#14: Who can I contact to get more information about the Open Call?
You can contact the following addresses: opencall-assist-iot-eu@assist-iot.eu, iglaub@upv.es, info@assist-iot.eu

For what regards ASSIST-IoT particularities, the Consortium will maintain a frequently asked questions (FAQ) section available in https://assist-iot.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 three pilots, representing: (i) port automation, (ii) smart safety of workers and (iii) cohesive vehicle monitoring and diagnostics. Each pilot will include different scenarios, in which different technological pillars and enablers will be executed and validated. **Every Open Call applicant must select one of the following pilots** to frame their application within.

Pilot 1: Port automation

Pilot 1 will be driven by the industrial partner and port terminal operator Terminal Link Group (TL) and will be deployed on its premises – in the Malta Freeport Terminal (MFLT). MFLT has experienced remarkable growth since its inception, and currently is one of the largest ports of transhipment in the Mediterranean region with more than 2,000,000 containers/year. MFLT amalgamates activities of container handling and industrial storage, establishing as a critical node of European maritime logistics. Containers are managed by heavy machinery equipment like Rubber Tired Gantry cranes (RTGs), Rail Mounted Gantry Cranes (RMGs), or Ship-To-Shore Cranes (STSs). However, they always require the intervention of on-board operators and on-site clerks, who interact with each other by various means and signals, including information sources required to handle and deliver freight. The pilot aims to demonstrate the benefits of ASSIST-IoT executing several business scenarios to show how the developed technologies can transform complex industrial processes, infrastructure and equipment managed in the maritime industry.

This pilot is divided in three scenarios:

1. Tracking assets in terminal yard.
2. Automated CHE cooperation.
3. RTG remote control with AR support.

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

Code	*Name*	*Description*
P1C1	Low-cost accurate GPS development	Commercial D-GPS are too expensive (10k€), but they are really needed for several industrial assets. However, in principle, their cost can be fairly reduced (1k€) if regular GPS integrate within their hardware L5 lines, or by supporting near-real-time positioning post-processing signal techniques). Hence, a low-cost GPS device that can be leveraged at ASSIST-IoT edge nodes (especially in Port Automation pilot) and interact with ASSIST-IoT enablers should be developed (purchased + integration design + Proof of concept, integration from previous projects...) to empower the localization capabilities of cranes and vehicles inside the port.
P1C2	TOS – IoT data integration	Managing large and time-consuming activities in enormous industrial areas, such as the port facilities, requires software and functionalities developed and supplied by vendors in different data types and architectures, which requires interoperability. In Pilot 1 environment, e.g., in port terminals, the Terminal Operating System (TOS) is the cornerstone of its operational management. However, its access is only allowed through exposed Navis-proprietary XMLRDT messages. Hence, the current cranes telemetry data collected by ASSIST-IoT gateways cannot be easily integrated with the working instructions of the terminal. This challenge aims at providing a resilient real-time software development that enables the integration between cranes telemetry IoT data

		from IoT Gateways, and yard container status managed by the TOS system through XMLRDT messages.
P1C3	OPC-UA/DA converter	Last port cranes firmware versions have started to make use of OPC-UA/DA communications protocol. Consequently, in order to guarantee their integration with former development, this challenge aims at providing an OPC converter enabler that can be installed in ASSIST-IoT Gateways so that the provided IoT data can still be collected without complex re-programming systems.
P1C4	Stack collision prevention	Enhanced autonomous/remote RTGs via LIDAR/OCR/Computer vision: Stack collision prevention: Crane operator starts driving trolleys towards port terminal container stack. By means of embedded LIDAR/radar-sensors, the profile of the containers stack is measured, so that the crane computer vision system is able to, based on the profile stack, constantly calculate risk areas with current speed and direction in order to prevents collisions with other containers in all directions. To reduce the port accidents, a computer vision system capable to gather LIDAR data, understand the surrounding environment, calculate the risk and inform the crane operator about possible collision should be developed.
P1C5	Path optimising	Crane automatically calculates optimal path for hoist movement by making use of embedded LIDAR/radar-sensors. To support the crane operator, a computer vision system capable to gather LIDAR data, detect the trolley, calculate the hoist height and inform them about possible actions in order to align the crane with the trolley part will be of interest.
P1C6	Low latency IoT buffer	The decoupling of Publishers and Subscribers in MQTT protocol allows for very high scalability options. However, its simple mechanism cannot handle complex environment conditions, such as: (i) the MQTT client loses connection to the MQTT broker, for example because of (mobile) network loss, or (ii) the MQTT client gets overloaded due to too high message frequency on subscribed topics. This challenge aims at providing offline buffering capabilities implemented on the MQTT client side, so the application can send out all messages that were queued while the connection was not present. Furthermore, as this can impact on the optimum exchange of real-time messages, it is expected that the buffer capabilities will not affect the low-latency requirement imposed in the pilot.
P1C#	IoT devices integration	Integration of new IoT devices to bring value to ASSIST-IoT pilot scenarios.
P1C*	Global	Others fitting within the global challenges descriptors.

Pilot 2: Smart safety of workers

All the stakeholders involved in the procurement of small or large, private or public infrastructure works have a vested interest in maintaining a safe construction environment. Compliance with occupational safety and health regulations, and managing the related risk, at the construction site is of outmost priority to construction companies and the relevant administrative bodies, such as the European Agency for Safety and Health at Work (EU-OSHA). Accidents may happen in a matter of seconds without providing any early warnings. In addition, a potentially life-saving timely response to an accident may also not be possible unless adequate monitoring mechanisms are in place. The main objective of ASSIST-IoT in this application area is the prevention and near real-time detection of common OSH hazards such as stress, fatigue, overexposure to heat and UV radiation, slips, trips, falls from height, suspension trauma, immobility due to unconsciousness, collision (forceful impact) with heavy equipment, entrapment (unable to evacuate the worksite during an emergency) and improper use of PPE.

This pilot is divided in four scenarios:

1. Occupation safety and health monitoring
2. Fall arrest monitoring
3. Safe navigation
4. Health and safety inspection support

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

Code	*Name*	*Description*
P2C1	MR support for OSH training	During the training of the Health & Safety officer that happened on or outside of the construction areas, an xR application that inform them about the zones of the construction area or other information needed for training sessions will be of interest. Depending on the case, the open callers should develop an applications that support OSH training phase. This application should be integrated with the BIM model provided by the MOW in IFC format. Either AR application may be provided supporting the newcomer during the OSH training at the real construction site, or VR adaptable application enabling a virtual walk through the construction site indicating crucial from the OSH perspective areas. Together with the application at least of one hardware should be provided. For the purpose of VR application, scans of the construction site will not be available.
P2C2	Vision-based hazard monitoring	In the ASSIST-IoT, techniques are being developed to identify hazardous events from the worker's movement using an IMU sensor, but the monitoring of them with vision-based techniques has not been investigate. For that reason, open callers could develop algorithms to recognize human-related events such as slips, falls etc. or hazardous ones such as explosion, fire etc. in video frames taken from the construction site. Another potential application to be considered for the vision-based system is verification of a use of required PPE (especially protective helmet and high visibility vest) by construction workers, subcontractors and visitors and in the case of irregularities - send notification to the OSH manager. Open Caller should provide both the hardware ensuring monitoring of at least four selected locations, as well as the software.
P2C3	2D/3D localization map user interface	ASSIST-IoT provides the Location Tracking enabler for locating human and assets inside the workplace, and the Location Processing enabler for running complex, streaming geospatial queries on the data. Taking advantage of this, an ASSIST-IoT integrated localisation interface, may be developed by OC applicants to visualise the workers and assets on 2D/3D map based on the BIM model of the worksite. In addition, functionalities such as overcrowding detection and others could also be included in the localisation interface.
P2C4	AR Notifications for Workers	The construction site is an ever-changing environment with a high turnover of workers and subcontractors, which may lead to having people on the site who are unaware of the many potential hazards that may occur. Taking advantage of ASSIST-IoT worker location tracking and danger zone mapping, users should be able to use mobile devices that provide them with up-to-date information on hazards with the help of mixed reality software. The software should also contain information about possible escape routes in case of dangerous situations
P2C5	Creating temporary dangerous zone notifications	New dangers may appear on the construction site at any time and many of them are temporary. Workers responsible for carrying out dangerous tasks should fence off and clearly mark the area where they will be working to prevent harm to themselves or other workers. Using the ASSIST-IoT infrastructure, a mobile application may be created by OC applicants that would allow a worker to easily mark the temporary danger zones, while working in the construction site. The

		application should integrate with the available BIM model of the building, to provide the user with the necessary context.
P2C#	IoT devices integration	Integration of new IoT devices to bring value to ASSIST-IoT pilot scenarios.
P2C*	Global	Others fitting within the global challenges descriptors (see **A.2** -

Pilot 3: Cohesive vehicle monitoring and diagnostics

Most initiatives covering IoT deployment in vehicles fail to integrate information coming from different sources (e.g., business data, environmental data, data from within the vehicle, historical vehicle maintenance data) and in gaining access to vehicle data due to safety and security reasons. While real-time control of a moving vehicle raises safety concerns, and therefore precludes complete open access to the information and control firmware. There is no current application or deployment that integrates and presents vehicle information to a user in an interactive friendly environment depending on their role and relation to the vehicle. The implementation of the ASSIST-IoT reference architecture in this pilot will enhance the capabilities of automotive OEMs to monitor the emission levels of vehicles which are already in operation (ISE, in-service emissions). Monitoring the fleet emission levels will allow the implementation of timely corrective actions, if needed, in order to restore them to the accepted limits. Ensuring fleet ISE meets the certification limits during their lifetime will imply a *de facto* fulfilment of the EU regulations, which are to be verified through in-service conformity (ISC) mechanism.

This pilot is divided in three scenarios:

1. Fleet in-service emission verification
2. Vehicle diagnostics
3. Vehicle exterior condition inspection and documentation

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

Code	*Name*	*Description*
P3C1	Human factors analysis within power train data	ASSIST-IoT provides a series of relevant information of the power train, including engine parameters configuration, data related to driving periods (drivelets) or high fidelity pollutant emissions. However, there is the willingness to include human information into the mix. Open Call applicants may propose analysis of human (driver) behaviour relying on the usage of dashcams (provided by ASSIST-IoT) or other hardware elements. This information might be correlated with aforementioned power train values to enlarge ASSIST-IoT in-vehicle and fleet analytics.
P3C2	Eco-driving and automotive navigation system as a service	ASSIST-IoT provides intelligent encapsulated digital enablers that can be used in different industrial solutions including automotive driving. To expand ASSIST-IoT platform capabilities, enablers that can be integrated with the current ecosystem and offer navigation and optimal routing planning will be of interest. Growing upon existing navigation systems, signals from the vehicle as the forecasted emission and fuel consumption may be used as inputs to the navigation systems of the open caller, providing fuel and emission optimal routes. The service may also be extended for fleet management.
P3C3	Mapping / registration of 2D-images into 3D image in vehicle coordinates system	The high resolution, colour scanner cameras have no common coordinate system. Thus, all single image-based processing activities are using the local 2D-coordinates of the images. However, correlation between processing results of different images can largely improve the inspection capabilities. This is particularly true for overlapping image

		areas. Examples of expected improvements based on such a registration are support for reflexions removal, enhanced inspection possibilities due to multiple views on the same damages from different observation perspectives (different illumination conditions) and support of high-dynamic-range processing for vehicle areas with different intensities like metal, plastic, or ribbon areas (like vehicle fenders, tyres, and rims). Additionally, the capability to move from the 2D-local-images world into the 3D-vehicle-coordinates system also allows the easier correlation of the same vehicle parts acquired in different times with different speed and position conditions. Beyond the processing of image sequences with reasonable overlapping areas, reasonable (with respect to complexity / costs) camera registration methodologies with affordable low-cost 3D sensors could offer a solution to this challenge. Communication bandwidth availability as well as existing network latency times impose an additional challenge for the ergonomic display of the vehicle damages. Open Call applicants are warned not to start from the scratch, but to build atop current solutions.
P3C5	Reflections- and shadows-noise removal on the scanned images of the vehicles	Problem: The typical scanner installation environments include multiple surrounding additional lighting, like parking lights, sunrays arbitrarily coming and going during the day, etc. An efficient handling of the resulting noising reflections in the images (available in raw- or jpeg- format) improves the subsequent input to the AI-based surface examination procedures. The suggested solution will be adopted into the pipeline to expand ASSIST-IoT capabilities. Expected result: Running on the edge node, a significant reduction of the reflections on the complex 3D vehicle exterior as well as better AI classification with respect to the damage classes. Increased overall AI-performance for the automated surface inspection.
P3C6	Image acquisition and processing from user-wear edge nodes	Problem: The vehicle images acquired by the scanner at a given moment (e.g., at the time visiting the garage) show only the current state and provide only images without any concrete user content. This is done by automated AI-based inspection. Allowing the provision of additional images and other relevant meta data, voluntarily generated by the end-users themselves or other relevant actors allows not only a better understanding of the vehicle exterior and a better AI-performance via redundancy and dedication but also provides timely changing information flow to document the vehicle status during the various business case steps. Expected is a trustful, secure transmission using the ASSSIT-IoT networking environment and the smooth merging of these additional images with the scanned ones together with an automated correspondence methodology for the mapping of the smartphone and the scanner images into a common base (ideally on 3D-vehicle coordinates). Expected output: Image acquisition and processing from user-wear edge-nodes (like smartphones), providing additional information supporting better image understanding of the vehicle exterior and timely updated recording of the current vehicle exterior status within the whole application business pipeline (prior or afterwards to the scan event).
P3C7	Advanced visualisation techniques for vehicle images with the found AI-proposals	Problem: A vehicle inspector finds the vehicle images of interesting cases among hundreds of acquired images of a vehicle in very short time. The handling of these many images is very difficult in terms of his energy, time, and costs. Having auto-stitching oriented approaches

		towards a complete vehicle view results in a much easier reviewing process of the user for each vehicle. The short acquisition distance and the strongly 3D-shaped vehicle volumes pose challenges for auto-stitching approaches. The large amount of acquired images poses on the other hand an ergonomic challenge to display them to the end-user in a smart way.
P3C8	Easy and fast integration of application results into existing market IT-ecosystems	Problem: The images and AI-found damage proposals at themselves are not alone providing really added-value to the users. Only the further transmission of these results into their respective, application-specific IT-environment enables the real dimensions of creating value. Needed: A systematic, semantically-enriched, user-friendly methodology to integrate within very short time (a few days) the Pilot 3B generated results (compatible with the proposed ASSIST-IoT architecture) into existing large automotive IT-landscapes without the need of extensive software integration work.
P3C#	IoT devices integration	Integration of new IoT devices to bring value to ASSIST-IoT pilot scenarios.
P3C*	Global	Others fitting within the global challenges descriptors (see **A.2** -

A.2 - Global challenges

- Design, implementation and integration of interoperable device layer components, based on different low-level communication standards or on ad-hoc proprietary device solutions.
- Design, implementation and integration of interoperable networking layer components, based on different standards higher-level communication standards or on ad-hoc proprietary networking solutions to be tested in ASSIST-IoT pilots.
- Design, implementation and integration of interoperable middleware layer components. These need to deal with the different middleware services such as discovery, management, querying, coordination and interaction.
- Design, implementation and integration of interoperable application service components. These should exploit major standards and be integrated with ASSIST-IoT API.
- Design, implementation and integration of interoperable data and semantics components. Specifically, semantics layer components have to deal with heterogeneous IoT ontology matching.
- Design, implementation and integration of virtualization mechanism for smart objects, including context aware mechanisms and transfer of virtual objects between servers and cloud platforms.
- Design, implementation and integration of fog/edge/cloud support mechanisms, including support for different services, inter cloud mechanisms applied to IoT and support for virtualization.
- Design, implementation and integration of AI/ML libraries and tools addressing ASSIST-IoT pilots.

Appendix B - Technical framework

B.1 - Overall integration perspective

For a proper writing of the Proposal, applicants must consider the following depending on the type of solution proposed:

- If they are planning to deliver an **AI/ML scripts/services to be integrated** into the current infrastructure of the pilot:
  - For training the model, external components will need to interact with specific ASSIST-IoT enablers, therefore the applicant must use the provided OpenAPI (see **B.2 - OpenAPI enabler**).
  - The final script will be of the nature of one of the following:
    a) Living within an external software (e.g., applicant's own server). In this case, such external components will need to interact with specific ASSIST-IoT enablers, therefore the applicant must use the provided OpenAPI (see **B.3 - OpenAPI enabler**).
    b) Becoming an actual ASSIST-IoT enabler (developed on-purpose for the project and living within the pilot's premises and infrastructure). In this case, the design principles for delivering an encapsulated enabler must be bear in mind for the proposal (see **C.1.2 - Design principles**).
- If they are planning to **create a new software application to be executed in pilot's infrastructure and to use data** from ASSIST-IoT pilots **and store the results** in the ASSIST-IoT infrastructure:
  - The proposal must consider delivering an actual ASSIST-IoT enabler. the design principles for delivering an encapsulated enabler must be bear in mind for the proposal (see **B.2.2 - Design principles**).
  - If the application will have an associated UI, this might be of the nature of one of the following:
    a) Included within global ASSIST-IoT UI (management interface). In this case, the requirement is that it must be developed using Vue.js.
    b) In a separated environment. In this case, the external application will need to query for the proper data to the long-term storage enabler of ASSIST-IoT through proper OpenAPI (see **B.3 - OpenAPI enabler**).
- If they are planning to **integrate an existing external s/w component** (e.g., a mobile app) **to use data** from ASSIST-IoT pilots **and store the results outside** the ASSIST-IoT infrastructure:
  - External components will need to interact with specific ASSIST-IoT enablers, therefore the applicant must use the provided OpenAPI (see **B.2 - OpenAPI enabler**).
- If they are planning to **deploy new IoT sensors and associated equipment** into the infrastructure of one pilot:
  - Those should be able to support connection from external machines (e.g., Linux-based) under Pub/sub schemas or other standard protocols. Plug-and-play connectivity will be appreciated.
- If they are planning to **deploy and integrate** own **gateways or smart network equipment** into the infrastructure of one pilot:
  - The equipment must be prepared to act as a master/node in a cluster of K3s/K8s/K0s.
- If they are planning to **generate datasets and/or data models/ontologies** to support/enhance the deployments of ASSIST-IoT pilots:
  - Publication of the datasets into ASSIST-IoT storage system will require passing through proper OpenAPI (see **B.2 - OpenAPI enabler**).
  - Querying datasets/data modes from ASSIST-IoT storage will also going through OpenAPI.

Independently of the specific type of contribution, all Proposals must be written in a way that compliance with ASSIST-IoT architecture blocks is contemplated since the very beginning. The diagram of the architecture is

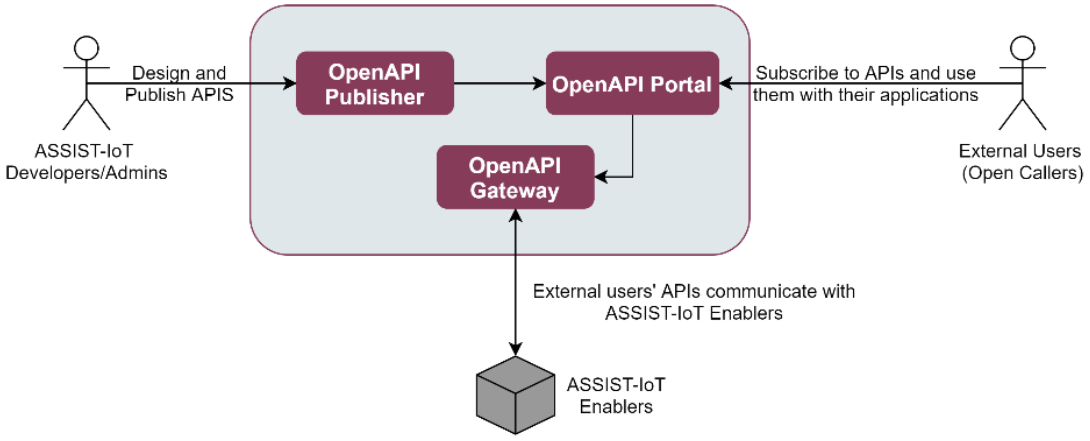
attached in **B.2.1 -Summary of** ASSIST-IoT architecture **- Diagram** and more specific details can be consulted in D3.5.

B.2 - OpenAPI enabler

The OpenAPI management enabler is an endpoint feature included in all (necessary) enablers of an ASSIST-IoT deployment to allow external entities (e.g., granted open callers) access and interact with them. It is an API Manager that will expose a Swagger UI to which external software components can automatedly interface so that ASSIST-IoT internal enablers can be queried/managed (in Swagger-JSON format).

To use this API, the user must subscribe to the API subscription (via Swagger GUI) as "ASSIST-IoT External Users". Thereafter, every enabler will decide the methods to be exposed to the user (to be analysed and decided at the beginning of the collaboration Open Call third party – Consortium). The OpenAPI is also thought to be a door for accessing documentation, tutorials, sample code, software development kits, etc. It can also allow to manage subscription keys and obtain support from the API provider if needed.

The schema of the OpenAPI enabler of ASSIST-IoT (just for applicants' information) is as follows:



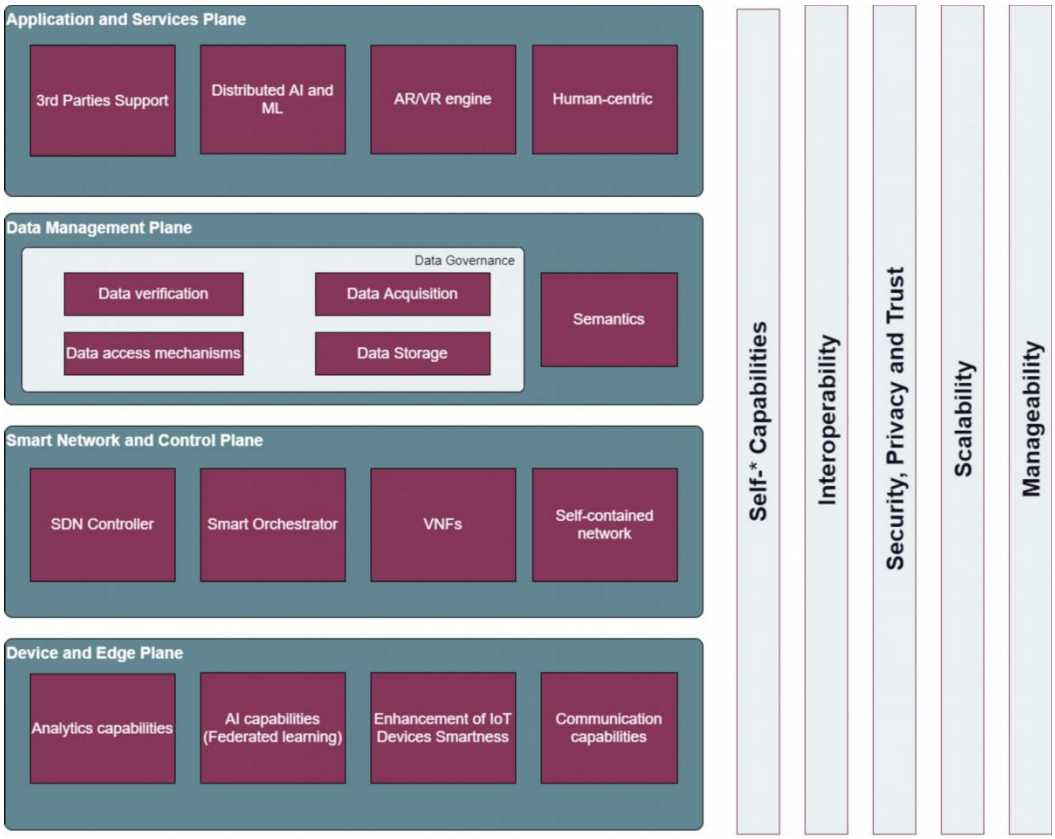
Appendix C - Summary of ASSIST-IoT architecture

DISCLAIMER:

This summary will be properly updated by July 31st, 2022. Thanks for understanding and apologies for any inconveniences caused.

C.1.1 - Diagram

The horizontal Planes represent collections of functions that can be logically layered on top of one another. For example, observation data originating from a sensor must pass through the Smart Network and Control plane and be processed on the Data Management plane, before being presented to an end-user in a GUI application on the Applications and Services plane. Verticals, on the other hand, represent functions targeting NGIoT properties that exist either independently on different planes or require the cooperation of elements from multiple planes.



C.1.2 - Design principles

In this section are detailed the design principles that govern ASSIST-IoT components, namely (i) the use of microservices, (ii) their instantiation in containers, (iii) their grouping into "enablers (iv) and their further orchestration using Kubernetes technology.

Microservices

To cope with these anticipated challenges, ASSIST-IoT architecture proposes to **follow a microservice software architecture**, which pursues building applications as suites of services. Following this approach, it

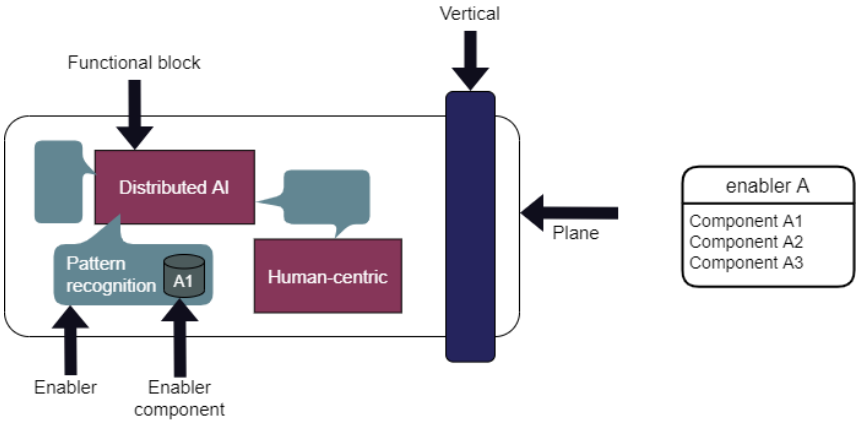
will allow beyond the fact that microservices can be independently deployable and scalable, to also provide a firm module boundary, allowing for different services being written in different programming languages, and being managed by different project partners. The goal of the microservice architecture of ASSIST-IoT is to allow the inclusion of small applications (called **enablers)** that are each responsible for executing one function (as opposed to the monolithic way of building one application that executes everything), and to let each microservice be autonomous, independent, and self-contained.

Enablers encapsulation

Since ASSIST-IoT targets software products for covering many different functional domains, the project introduces the abstraction term "enablers", which will consist of a group of microservices, each of them served over a container, acting towards a single goal (i.e., to provide a specific functionality). Each enabler provides a single point of entry (interface) to communicate with it, without exposing the internal communication mechanisms between its components, thus having an **"encapsulation"** of microservices. In essence, an enabler is a collection of software (and possibly hardware) components - running on nodes - that work together to deliver a specific functionality of a system.

Open Call applicants are (in some cases – see sub-section above) expected to deliver concrete enablers that will be deployed in specific pilot implementations

Enablers are not atomic but presented as a set of interconnected components. An enabler component is a software or hardware artifact that can be viewed as an internal part of an enabler, and that performs some action necessary to deliver the functionality of an enabler as a whole.



Each enabler must define and control communication between its components. ASSIST-IoT does not mandate any particular interface of communication between enabler components in order to allow for flexible implementations, depending on the needs for performance and throughput of the communication.

Containerisation, Kubernetes and Helm charts

ASSIST-IoT proposes to employ a *containerised* approach that will allow developers to create each microservice over the most fitting OS and language. As all components on the edge appliance will be containerised, it will allow to search and infer which equipment can handle which containers, and enables applications to be dynamically deployed and moved, and their resource utilisation to be monitored.

In ASSIST-IoT, **Kubernetes**[1] (k8s) has been selected as the main technology for containers orchestration, and, therefore, for enablers orchestration. In addition, the modified distributions of Kubernetes that target constrain devices must be used in specific cases: microk8s2, k3s3 and k0s4.

In particular, deployment of enablers in ASSIST-IoT are expected to be as follows:

[1] https://kubernetes.io/
[2] https://microk8s.io/
[3] https://k3s.io/
[4] https://k0sproject.io/

- Enabler components must be put together and be containerised as pieces of software – enablers (using Docker)
- Enablers will be "pods" in K8s terminology.
- Enablers must have "standardised" interfaces following ASSIST-IoT guidelines (to be provided whenever joining the project).
- Enablers -to be deployed- must include enough networking features and other specifications, needing to be annotated as Helm charts[5].

Open Call applicants must consider the previous if they are delivering a specific enabler solutions according to the cases described in **B.1 - Overall integration perspective**.

[5] https://helm.sh/