nephele

Guide for Applicants

2nd Open Call

Use Case Development

Submission starts on **19 August 2024 at 9:00 AM** (Brussels Time)

Deadline is on the **20 October 2024 at 9:00 AM** (Brussels Time)

V1.2, 27/09/2024

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Document version history

Version*	Date	Author	Comments
V1.1 Initial version	August 2024	FBA	-
V1.2	27 September 2024	FBA	1. New change to Chapter 4.2 - "In/Out of Scope screening will be only conducted if we receive more than 150 applications that passed the First Check." 2. Annex 4 added

Terms and abbreviations

EC	European Commission
FSTP	Financial Support to Third Parties
VO	Virtual Object
cVO	Composite Virtual Object
DT	Digital Twin
IoT	Internet of Things
TRL	As per European Commission definition, there are 9 possible levels of technology readiness. • TRL 1 – basic principles observed, • TRL 2 – technology concept formulated, • TRL 3 – experimental proof of concept,

	• TRL 4 – technology validated in a lab, • TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies), • TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies), • TRL 7 – the system prototype demonstration in operational environment, • TRL 8 – system complete and qualified, and • TRL 9 – actual system proven in an operational environment (competitive manufacturing in the case of key enabling technologies; or in space).
FAQ	Frequently Asked Questions

1. Basic info about NEPHELE

NEPHELE is a Research and Innovation Action project funded by the Horizon Europe programme under the topic "Future European platforms for the Edge: Meta Operating Systems". The project's vision is to enable the efficient, reliable and secure end-to-end orchestration of hyper-distributed applications over programmable infrastructure that is spanning across the compute continuum from Cloud-to-Edge-to-IoT, removing existing openness and interoperability barriers in the convergence of IoT technologies against cloud and edge computing orchestration platforms, and introducing automation and decentralized intelligence mechanisms powered by 5G and distributed AI technologies.

The main goal of NEPHELE is to design and build a virtual object software stack (VOStack) that will tackle IoT interoperability and convergence challenges in the compute continuum and develop synergetic orchestration mechanisms that can manage distributed applications in the continuum. See more info about the project here: https://nephele-project.eu/

In order to achieve the project's goals, NEPHELE will distribute up to €1,49M among SMEs/Mid-caps that will be selected through 2 Open Calls:
- **[CLOSED] 1st Open Call** - Extension of the Virtual Object Stack (VOStack) and development of Virtual Objects (VOs), composite Virtual Objects (cVOs) and Digital Twins (DTs) - targeting up to 8 SMEs/Mid-caps to develop Virtual Objects, composite Virtual Objects (including the Digital Twin concept), and generic IoT enablers in accordance with the provided software stack.
- **2nd Open Call** - Use Cases development and NEPHELE approach validation - targeting up to 8 SMEs or Mid-caps to develop use cases and validate the NEPHELE architectural approach & synergetic meta-orchestration framework.

This Guide for Applicants contains relevant information to understand how to successfully take part in the 2nd Open Call.

2. What do we offer?

The 2nd Open Call of NEPHELE will distribute **up to €880,000 among up to 8 SMEs or Mid-caps to** to validate the proposed architectural approach and synergetic meta-orchestration framework implementation, based on the development of intelligent

orchestration mechanisms and a set of use cases provided by partners outside of the NEPHELE Consortium in various vertical industries.

The selected SMEs/Mid-caps will benefit from the 2nd Open Call in a number of ways, namely by:

1. Participating in a 6-month-long support programme;
2. Receiving a fixed lump sum of up to €110,000 per entity;
3. Receiving technical mentoring during the support programme.

Applications are welcome from **the 19st of August 2024 at 9:00 AM (Brussels Time)** until **20th of October at 09:00 AM (Brussels Time)** at https://nephele-2nd-open-call.fundingbox.com/.

3. Eligibility Criteria

We will check the eligibility of all proposals submitted before the deadline (20th of October at 09:00 AM Brussels Time via the online application form). To participate in NEPHELE's Support Programme, you must meet all the criteria described in Section 3 of this guide, successfully pass our evaluation process, and finally sign the Subgrant Agreement with the NEPHELE Consortium.

The projects that do not comply with these criteria will be excluded and marked as ineligible.

We will check the eligibility criteria **during the whole evaluation process**.

3.1 Who are we looking for?

We are looking for single Industrial[1] SMEs[2] (including startups) and Mid-caps[3] registered as legal entities no later than at the end date of the NEPHELE 2nd Open Call (no later than 20th of October 2024) in the following countries:

- [The Member States of the European Union](#)[4] and its Overseas Countries and Territories (OCT) or
- [Horizon Europe Associated Countries](#)[5].

The Industrial SMEs or Mid-caps must demonstrate expertise and experience in at least one of the technical areas described in [Section 3.2.](#)

The applicants who are subject to EU restrictive measures under Article 29 of the Treaty on the European Union (TEU) and Article 215 of the Treaty on the Functioning of the EU (TFEU)[6] are not eligible to participate in this open call.

The NEPHELE Partners are not eligible to act as applicants and CANNOT be involved in the grantees' projects, neither their affiliates nor employees or permanent collaborators.

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[1] An industrial entity is considered to be any type of SME or Mid-cap that covers the expertise and experience criteria described in Section 3.2.

[2] An **SME** will be considered as such if it complies with the European Commission's Recommendation 2003/361/EC.

As a summary, the criteria defining an SME are:

• Headcount in Annual Work Unit (AWU) less than 250;

• Annual turnover less or equal to €50 million OR annual balance sheet total less or equal to €43 million.

Note that the figures of partners and linked enterprises should also be considered as stated in the SME user guide. For detailed information check EU recommendation:

https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en

[3] **Middle-capitalization company' or 'Midcap**' means an enterprise that is not an SME and that has up to 3 000 employees, knowing that the staff headcount is calculated in accordance with Articles 3 to 6 of the Annex to Commission Recommendation 2003/361/EC:

https://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:124:0036:0041:EN:PDF

[4] Following the Council Implementing Decision (EU) 2022/2506, as of 16th December 2022, no legal commitments can be signed with Hungarian public interest trusts established under Hungarian Act IX of 2021 or any entity they maintain. Affected entities may continue to apply to calls for proposals. However, in case the Council measures are not lifted, such entities are not eligible to participate in the NEPHELE 1st open call. In case of consortium, co-applicants will be invited to remove or replace that entity. Tasks and budget may be redistributed accordingly.

[5] AC as of (25.07.2024): Albania, Armenia, Bosnia and Herzegovina, Faroe Islands, Georgia, Iceland, Israel, Kosovo, Moldova, Montenegro, North Macedonia, Norway, Serbia, Türkiye, Tunisia, Ukraine, United Kingdom, Canada. For the most up-to-date list please see the first part of this [document.](#) For the avoidance of doubt, New Zealand is not eligible in this open call.

[6] Please note that the EU Official Journal contains the official list and, in case of conflict, its content prevails over that of the EU Sanctions Map.

3.2 What types of activities can be funded?

Participants have to address the scope of the 2nd Open Call, that is to **validate the proposed architectural approach of the NEPHELE platform and synergetic meta-orchestration framework implementation, based on the development of intelligent orchestration mechanisms and a set of distributed applications (incl. VOs, cVOs)**. The aim is to validate the NEPHELE architectural approach and the NEPHELE platform implementation, considering both the needs of application providers and vertical industries.

The proposals must address one of the two types of projects listed below:

1. **[1st project type] Development and deployment of a distributed application for the computing continuum**, considering the IoT, the edge and -where applicable- the cloud part of the computing infrastructure. The distributed application has to be provided in the form of an application graph, include the usage of IoT infrastructure and consider the interplay between IoT devices, VOs and cVOs. The VOs and cVOs have to be developed based on the VOStack, while the usage and/or extension of existing VOs and cVOs is encouraged (see the list in Annex 2). The distributed application has to be deployed based on the usage of the NEPHELE platform and accompanied by a set of trials, aiming to validate specific related KPIs (e.g., latency between the IoT device and the cVO lower than 30ms, service provision rate greater than 100 requests/second). For the deployment part, two modes can be supported: deployment of the distributed application in the testbed offered by NEPHELE; deployment of the distributed application over an instance of the NEPHELE platform in the premises of the applicant.

2. **[2nd project type] Development, integration and evaluation of an intelligent orchestration mechanism for the NEPHELE Synergetic Meta-Orchestrator**. The proposed mechanisms may regard management of various orchestration actions, such as scaling, compute offloading, live migration, management of ML workflows considering the interplay between the IoT, edge and cloud part of the infrastructure. A set of orchestration KPIs have to be defined and evaluated.

The provided software and its documentation have to be made available **as open source, if possible, and offered as part of the NEPHELE ecosystem**. Especially for the second option (development of intelligent orchestration mechanisms), the release of the software as open-source is mandatory.

The proposals can address any verticals.

To be eligible for funding, the provided solutions and the software development has to be aligned with the provided specifications provided in Annex 1. Furthermore, the TRL levels should be as follows:

1. For the first project type, the Initial TRL should be 4-5 and the proposed solutions should reach TRL 5-6 by the end of the support programme;
2. For the second project type, the Initial TRL should be 3-4 and the proposed solutions should reach TRL 4-5 by the end of the support programme;

Applicants are also required to demonstrate expertise and experience in at least one of the following fields:

- Cloud and edge computing orchestration technologies, especially around Kubernetes-oriented platforms.
- Microservices-based application development. Distributed application development.
- IoT technologies: communication protocols (e.g., HTTP, CoAP, MQTT, Web of Things), semantic interoperability, security mechanisms, digital twin development.
- Artificial Intelligence (AI)/ Machine Learning (ML) techniques for orchestration and workflow management.

See also Annex 4 for NEPHELE's architecture.

3.3 Ground rules

When applying to NEPHELE's 2nd Open Call, please also note the following:

- **Be on time and use our system**: Make sure you submit your proposal through the online form before the deadline . If you submit the form correctly, the system will send you a confirmation of your submission. Get in touch with us if it is not the case. It is important for you to know that we will not be evaluating any proposal sent after the deadline and submitted outside the dedicated form
- **English Language**: your proposal must be written in English in all mandatory parts in order to be eligible. Only parts written in English will be evaluated. If the mandatory parts of the proposal are in any other language, the entire proposal will be rejected
- **Every question deserves your attention**: all mandatory sections - generally marked with an asterisk - of your proposal must be completed . The data provided should be actual, true, and complete and should allow assessment of the proposal. Additional material, not specifically requested in the online application form, will not be considered for the evaluation.
- **European Dimension:** Your project should have a clear European Dimension, meaning: 1) contribute towards the next generation of higher-level (meta) operating systems for the smart Internet of Things with strong computing capacity at the smart device, system and edge-level, embedded in a compute continuum from IoT-to-edge-to-cloud; 2) increase European autonomy in data processing required to support future hyper-distributed applications.
- **Be exhaustive and precise**: You have to verify the completeness of the form, as it won't be possible to add any further information after the deadline. After the proposal is submitted, you will be able to modify the form until the deadline.
- You can submit only **one proposal** in this call. If more than one proposal is identified, only the last proposal which has been submitted in order of time will be evaluated.

- **Conflict of interest**: We will take into consideration the existence of potential **conflict of interest** among you and one or more Consortium partners. Consortium partners, their affiliated entities, employees and permanent collaborators cannot take part in the NEPHELE support programme. All cases of potential conflict of interest will be assessed case by case.
- **Healthy finances and a clean sheet are a must:** We don't accept entities that are under liquidation or are an enterprise under difficulty according to the Commission Regulation No 651/2014, art. 2.18, or that are excluded from the possibility of obtaining EU funding under the provisions of both national and EU law, or by a decision of both national or EU authority. We also don't accept entities that are meeting national regulations regarding bankruptcy.
- **It is your proposal**: Your project should be based on your original work or, if the project is not based on your original work, your right to use the IPR must be clearly defined (you must have a licence agreement or the IPR must be transferred to you from somebody who created the work). In particular, any work related to the implementation of the project described in the application may not violate the IPR of third parties, and the IPR to the application project may not be the subject of a dispute or proceedings for infringement of third party IPR.
- **Funding limits**. The maximum amount of financial support will never exceed €150 000 per entity during the entire NEPHELE project duration.
- The beneficiaries of the NEPHELE 1st open call cannot be selected in the 2nd open call.
- Acceptance of the open call rules: to apply for this open call you have to accept its rules and regulations detailed in this Guide for Applicants.

4.How will we evaluate your proposal?

Our evaluation process is transparent, fair and equal to all our participants with a clearly defined complaint procedure (see section Complaints). We will evaluate your project in four phases as shown below.
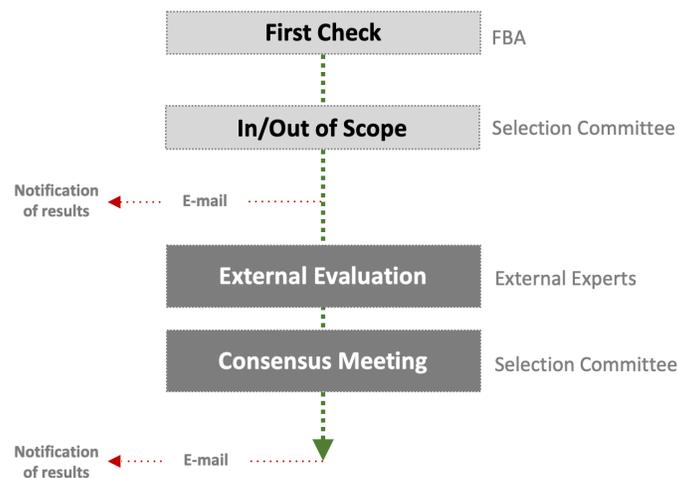

Figure 1 Evaluation process

4.1 First Check

After the closure of the Open Call, we will review the proposal to ensure it meets the conditions outlined in Section 3. This assessment will be based on the statements provided in your proposal.

During this initial stage, the criteria will be cross-referenced against the declaration of honour and self-declarations included in the application form. Subsequently, throughout the evaluation process (including the final formal check), the above criteria will be thoroughly verified.

The proposals that do not comply with the above-mentioned criteria will be excluded.

4.2 In/Out of Scope screening

The Selection Committee will review the following aspects of your proposal:

- The scope - the objectives of the proposal must fit within the scope of the project, as described in this guide in Section 3.2.
- The European Dimension - the project should have a European dimension, as described in this guide in Section 3.3.
- Expertise and experience in the defined technical fields, as per Section 3.2.

The members of the Selection Committee will assess if your proposal matches the criteria mentioned above following a "Yes/No" approach.

Proposals that do not comply with any of the aspects described above will be rejected. Proposals that fully comply with all the specific aspects will proceed to the experts' evaluation phase.

We will inform you about the results of the First Check and the In/Out of Scope screening (if applicable). Please note that the In/Out of Scope screening will be only conducted if we receive more than 150 applications that passed the First Check.

4.3 External Evaluation

In this phase, each project will be evaluated by two external and independent evaluators from the IoT, edge/cloud computing, Artificial Intelligence (AI) and network management fields. Your project will be evaluated within the following awarding criteria:

EXCELLENCE will evaluate:

- **Ambition.** The applicants have to demonstrate to what extent the proposed project contributes to the **project scope**, have a **European dimension** and are beyond the **State of the Art**. Beneficiaries have to describe the innovative approach behind it (e.g. ground-breaking objectives, novel concepts and approaches, new products, services or business and organisational models). Projects have to demonstrate how the Use Cases proposed will contribute to bring an innovative approach to the specific domain addressed.

- **Innovation:** applicants should provide information about the level of innovation within their market and about the degree of **differentiation** that this project will bring.

- **Soundness of the approach** and credibility of the proposed methodology.

IMPACT will analyse:

- **Market opportunity**: The applicants have to demonstrate a clear idea of what they want to do and whether the new/improved product has market potential, e.g. because it solves a problem for a specific target customer. Projects have to demonstrate the wider applicability that the NEPHELE platform can have in the specific domain/vertical.

- **Commercial Strategy and Scalability**: The applicants have to demonstrate the level of scalability of the new/improved product meaning by not addressing a specific problem but able to be commercialised to solve a structural problem in a specific sector/process/etc. Projects have to demonstrate the scalability of the use case in specific domains.

- **Environmental and social impact**: The applicants have to demonstrate the project contribution towards environmental, social and economic impacts to contribute to sustainable development, Green Deal and other European policies.

IMPLEMENTATION will consider:

- **Team:** The applicants have to demonstrate their management and leadership qualities, their ability to take a concept from ideas to market, their capacity to carry through their ideas and understand the dynamics of the market they are trying to tap into. The team should be a cross-functional team, with a strong background and skills (see required expertise and experience in the defined technical fields in Section 3.2) base and taking into account its gender balance. The implementation in a specific use case has to be clearly explained.

- **Resources:** Demonstrate the quality and effectiveness of the resources assigned in order to get the objectives/deliverables proposed.

The evaluators will score each award criterion on a scale from 0 to 5:

- 0 = Proposal fails to address the criterion or cannot be assessed due to missing or incomplete information
- 1 = Poor – criterion is inadequately addressed or there are serious inherent weaknesses
- 2 = Fair – proposal broadly addresses the criterion, but there are significant weaknesses
- 3 = Good – proposal addresses the criterion well, but a number of shortcomings are present
- 4 = Very good – proposal addresses the criterion very well, but a small number of shortcomings are present
- 5 = Excellent – proposal successfully addresses all relevant aspects of the criterion. Any shortcomings are minor.

Each evaluator will produce an Individual Evaluation Report. The threshold for individual criteria will be 3. The overall threshold, applying to the sum of the three individual scores, will be 10. The final score will be calculated as an average of the individual assessments provided by the Evaluators.

Ties will be solved using the following criteria. The criteria in order of priority are:
1. The highest score in the Excellence section.
2. Gender balance among the personnel responsible for carrying out the activities.
3. The highest score in the Implementation section.

All proposals obtaining a score above the threshold, will pass to the next phase.

In cases where there is significant divergence between the evaluators' scoring, experts will convene to establish a unified position on the evaluated proposals. If no consensus is reached, a third evaluator will be included to provide an extra evaluation.

Please note that we need time to process through all the proposals in this phase, so you probably won't hear back for a while.

4.4 Consensus Meeting

The Selection Committee formed by National Technical University of Athens, Siemens, ATOS, Institut National de Recherche en Informatique et Automatique, GEIE ERCIM and Fundingbox Accelerator sp z o.o. will decide by consensus (minimum ⅔ of the votes) the 'List

of Finalists' and the 'Reserve List'. Two external evaluators will be invited to participate in the Consensus Meeting in an advisory capacity.

The discussion will be based on the ranking obtained as a result of the External Evaluation. Whilst normally the highest ranked proposals will be selected for funding, the Selection Committee might have fair reasons for objecting to a specific third party, like the alignment with NEPHELE's goals and scope, the ability to achieve the highest impact possible, commercial competition, as well as the existence of significant ethical concerns or a potential conflict of interest. In this case, the choice may pass to the next-ranked proposal.[7]

The exact number of proposals approved will be decided based on the overall **quality** of the proposals. Based on the current project's needs, the Consortium may adopt an approximate 70-30 selection ratio for funding the 1st and 2nd project types, respectively.

4.5 Formal check, Subgrant Agreement Preparation and Signature

Before you get started with the NEPHELE Support Programme, you need to sign the Subgrant Agreement with the NEPHELE Consortium.

Prior to signing the Agreement, you should provide documents regarding your formal status. The NEPHELE Consortium will verify them to prove your eligibility (for the details please check our Frequently Asked Questions document that is available on the open call website).

Be extremely vigilant to:

1. **The nature of the documents we request.**
   If the documents you provide us with do not prove your eligibility, your participation will end here.

2. **The deadlines that we will give you to hand us these documents.**
   If you do not deliver the requested documents on time, without a clear and reasonable justification, we will have to exclude you from further formal assessment. Another applicant from the Reserve list will then replace you.

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[7] Please note that this is not a closed list of reasons.

5. Our Support Programme and payment arrangements

Once your eligibility has been confirmed following the formal status check and the Subgrant Agreement signed, you will become an official beneficiary of the NEPHELE Support Programme, which will last up to 6 months. The programme consists of three stages, see Table 1 below.

For the sake of simplicity and transparency, the Financial Support will be paid against specific deliverables/ upon achievement of certain milestones or KPIs (which will be included in the 'Individual Mentoring Plan' annexed to the SGA), and based on the results of Milestone Review.

A delayed payment mechanism will be applied to the payments. The last payment - the delayed payment tranche (22,7% of the total grant amount awarded to each beneficiary (up to €25 000)) will be paid after the whole NEPHELE Project is completed. This should happen approximately 9 months after the end of the NEPHELE Project. The expected end of the NEPHELE Project is 31.08.2025. Relevant provisions will be included in the Subgrant Agreement.

As a beneficiary, you will receive funding as follows:

Stage No and Name	Stage duration	Deliverable	Delivery month	Lump sum
Stage 1: Individual Mentoring Plan (IMP)	1 month	IMP and Use Case Roadmap	End of Stage 1	Up to €12 000
Stage 2: Use Case Implementation	3 months	Report on the deployment of NEPHELE	End of Stage 2	Up to €73 000
Stage 3: Use Case Evaluation	2 months	NEPHELE Feedback Report	End of Stage 3	Up to €25 000 paid after the end of the NEPHELE project as a delayed payment tranche
Total:	**6 months**	**-**	**-**	**Up to €110 000**

Table 1 Stages and payment schedule

Milestone review process

At the end of each stage, an exhaustive review process will be implemented consisting of the following evaluation criteria:

- Deliverables' quality;
- Technical performance indicators;
- Deadline Compliance.

Each criterion will be scored by Technical Mentors from 0 to 10 and the weight of each of these criteria, in the final score, will be as follows:

- Deliverable quality (30%).
- Technical performance indicators (60%).
- Deadline Compliance (10%).

The threshold to receive payments and to pass on to the next stage is **7 points**:

- **Beneficiaries over threshold** will successfully receive the next payment and continue in the programme.
- **Beneficiaries under threshold** will be invited to leave the programme by their Technical Mentor. If this decision is ratified by the Selection Committee, then they will have to leave the programme and will not receive the payment.

The function of the Selection Committee is to review and validate each Technical Mentor's evaluation proposal, with a special focus on cases where beneficiaries have not met the threshold. The Committee will take into account all possible objective reasons for underperformance, such as external factors that may have influenced the beneficiaries' performance. The Selection Committee will then make the final decision and approve the payments.

Payment schedule

As a selected grantee, you will receive a fixed lump sum of up to €110 000. The lump sum funding is a simplified method of settling expenses in projects financed by Horizon Europe funds. As a grantee, you will not be required to present strictly defined accounting documents (e.g. invoices) to prove the costs incurred. However, you will need to demonstrate that the project implementation is in line with the set milestones (i.e. KPIs/Deliverables) see

FAQ, Section 4), which will be defined in the Individual Mentoring Plan at the beginning of the programme. We will carefully assess your progress and the quality of your work during the review process , not your accounting. The lump sum method does not exempt you from collecting documentation to confirm the costs under fiscal regulations.

For a more detailed payment schedule please check the FAQ.

6.Contact us

How can we help you?

If you have any questions regarding the application process, please feel free to email us at nephelehelpdesk@fundingbox.com, or post your questions in our Discord helpdesk space. Responses to any questions are provided on an individual basis, and do not constitute a change to this Guide for Applicants; they are provided for informational purposes.

In case of any technical issues or problems, please include the following information in your message:
- Your username, telephone number and your email address;
- Details of the specific problem (error messages you encountered, bugs descriptions, i.e. if a dropdown list isn't working, etc.);
- Screenshots of the problem.

Complaints

If you believe that a mistake has been made after receiving the results of one of the evaluation phases (when foreseen), you may submit a complaint. To do so please email us your complaint in English at nephelehelpdesk@fundingbox.com and include the following information:
- Your contact details, including email address,
- The subject of the complaint,
- Information and evidence regarding the alleged breach.

You have **3 calendar days** to submit your complaint, starting from the day after the communication was sent. We will review your complaint within seven calendar days of its

receipt. If we need more time to assess your complaint, we will notify you by email of the extension. Please note that we will not review anonymous complaints or complaints with incomplete information.

Please be aware that the evaluation is conducted by experts in the relevant field, and we do not interfere with their assessment. Therefore, we will not evaluate complaints related to the results of the evaluation other than those related to procedural or technical mistakes.

7. Last but not least - final provisions

Any matters not covered by this guide will be governed by Polish law and rules related to the Horizon Europe Programme and general rules of EU grants.

Please take into account that we make our best effort to keep all provided data confidential. However, for the avoidance of doubt, you are solely responsible for indicating your confidential or sensitive information as such.

Your IPR will remain your property.

For the selected grantees, the Subgrant agreement will include a set of obligations towards the European Commission (for example: promoting the project and giving visibility to the EU funding, maintaining confidentiality, understanding potential controls by the EC/ECA, EPPO and OLAF).

The NEPHELE Consortium might cancel the call at any time, change its provisions or extend it. In such a case we will inform all applicants about such change. The signature of the Subgrant agreement is an initial condition to establish any obligations among applicants and any Consortium partners (with respect to the obligation of confidentiality of the application).

Did not find what you were looking for? You may want to check our Frequently Asked Questions (available on the open call website).

8. Extra hints before you submit your proposal

A proposal takes time and effort and we know it. Here are some few crucial points you should read before submitting your proposal.

- Is your project in line with what NEPHELE is looking for? You are not sure? You can consult this [section](#) and this [one](#).
- Did you present your project in a way that will convince evaluators? Not sure if you did? Go back to this [section](#).
- Is your project fulfilling all eligibility requirements described in the guide? Check again this [section](#).
- Are you sure you are able to cope with our process of the Subgrant agreement signature and payment arrangements for selected proposals? You may want to go over this [section](#).
- Do you need extra help? [Contact us](#)

Annex 1: Software repository and documentation

The software release of the NEPHELE platform is made available at https://gitlab.eclipse.org/eclipse-research-labs/nephele-project. It includes access to:

- the NEPHELE Development environment (https://gitlab.eclipse.org/eclipse-research-labs/nephele-project/nephele-hdar),
- the NEPHELE Synergetic Meta-Orchestrator (https://gitlab.eclipse.org/eclipse-research-labs/nephele-project/smo)
- and the NEPHELE Dashboard (https://gitlab.eclipse.org/eclipse-research-labs/nephele-project/nephele-dashboard)

Each repository includes documentation for the usage of the provided software artifacts.

The software release of VOStack is made available at the URL: https://gitlab.eclipse.org/eclipse-research-labs/nephele-project. Details regarding the basic definitions of the VOs and cVOs and the architectural approach followed in VOStack are

available at the URL: https://netmode.gitlab.io/vo-wot/index.html. It should be noted that in accordance with the VOStack specifications, we have made available two software implementations. Both implementations adhere to the same principles and core Application Programming Interfaces (APIs), however being aligned with specifications coming from different standardisation groups. These groups regard the W3C Web of Things (WoT) (https://www.w3.org/WoT/) and the Open Mobile Alliance (OMA) Lightweight M2M (LWM2M) (https://omaspecworks.org/what-is-oma-specworks/iot/lightweight-m2m-lwm2m/) specifications.

Specifically, for the implementation that is aligned with the W3C WoT:

- The software repository is available at the URL:
  https://gitlab.eclipse.org/eclipse-research-labs/nephele-project/vo-wot
- The documentation is available at the URL:
  https://netmode.gitlab.io/vo-wot/index.html#

For the implementation that is aligned with the OMA LWM2M:

- The software repository and the documentation is available at the URL:
  https://gitlab.eclipse.org/eclipse-research-labs/nephele-project/vo-lwm2m

In your application, you may select to work based on any of the two provided implementations.

Annex 2: List of VOs and cVOs

Type of IoT Device	Domain	Description	Type	Status	Available Repository
VOs and cVOs from the NEPHELE Consortium					
Camera	Image manipulation for an image detection Application graph	A VO that receives images and implements compression to the image	WoT	Implemented	link
Temperatur, Humidity, Smoke Sensors	Agriculture	VO consumes IoT sensors and triggers alerts and actions regarding temperature level, humidity and smoke alarm	WoT	Implemented	link

Coffee Machine-Quickstart example	IoT	VO acts as a smart coffee machine that acts as a scheduler for the maintenance and automatic control of a coffee machine	WoT	Implemented	link
Video Streaming	Video Surveillance	VO that propagates an RTSP video stream	WoT	Implemented	link
Database VO	Storage Information	VO that acts as an example of how to use the database with a VO	WoT	Implemented	link
VOs and cVOs from the 1st Open Call					
Magos Haptic Glove	Haptic	VO that gathers data from a haptic glove device implements data transformation and a tracking algorithm	WoT	To be delivered by October 2024	link
EVPS Electric Vehicle Parking Stack	Transportation/ Parking	VO Smart Data Model for EV Charging Station	WoT	To be delivered by October 2024	link
VAIMEE	Agriculture	VO that measures soil moisture	WoT	To be delivered by October 2024	link
Wise Cool	Environmental/ Smart Building	VO that detects and controls windows operating system in a smart building, A/C actuator	WoT	To be delivered by October 2024	link
SIREN	Surveillance	VOs for door alarm, robotic agent and live camera feed	WoT	To be delivered by October 2024	link
HELLE	Wearables	VO that captures the biometrics for gesture and stress level to implement a human Digital Twin	WoT	To be delivered by October 2024	link
ASTERISK	Healthcare Services	VO for Semantic Interoperability between different semantic models and managing	OMA-LwM2M	To be delivered by October 2024	link

		video streams and images			
VOFactory	Data collection	VO that stores information from a temperature sensor and will have to be accessible from the Eclipse sensiNact instance and integrated into the platform as an Eclipse sensiNact provider.	WoT	To be delivered by October 2024	link

Annex 3: Project's use cases

NEPHELE will launch four internal use cases in various vertical industries (logistics, smart buildings, emergency, healthcare) to validate, evaluate and demonstrate the innovative characteristics of the proposed architectural approach.

More info on these use cases is available on the project's main website: https://nephele-project.eu/use-cases.

Annex 4: NEPHELE's architecture
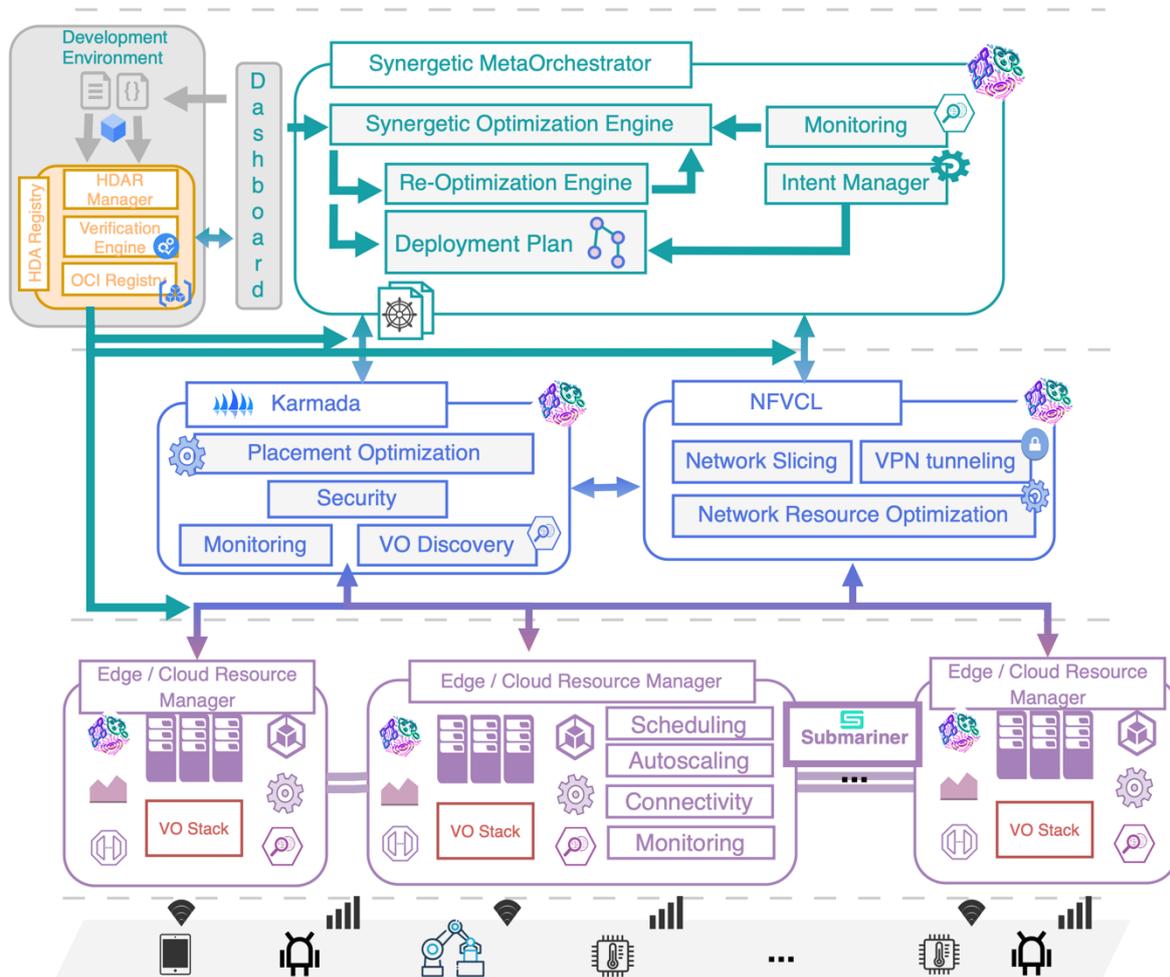
See the next page.

NEPHELE Architecture

Figure 1: NEPHELE Architecture

HDAR

The HDA Registry (HDAR) system is the common storage, distribution and verification system for all the artifacts involved in the deployment of Hyper Distributed Application (HDA) within the NEPHELE Platform.

NEPHELE Dashboard

The NEPHELE Dashboard is the core frontend of the NEPHELE project allowing the interaction with the underlying infrastructure and the deployment of HDAs. The Dashboard is developed using Vue.js as frontend and Python Flask as backend. In practice, the developer can create Hyper Distributed Application Graphs (HDAG) by combining various application components that use already created artifacts hosted on the HDAR. Afterward, the developer can request the deployment of the created HDAG which forwards the request to the SMO constructing and enforcing a deployment plan. Moreover, the dashboard can be used to monitor the deployment of the graph and view metrics related to its performance. Grafana dashboards are also utilized to present metrics and real-time information both for the deployed HDAGs of the users and for the NEPHELE infrastructure itself.

SMO

The SMO is built using a combination of technologies to provide seamless orchestration and efficient deployment of HDAGs. The development of the SMO is based on the Python programming language.

Also, the SMO employs Flask[1], a lightweight WSGI web application framework, to build REST APIs that facilitate communication and integration among its various components., which include:

- **Intent Manager/Translation:** Mapping to resoruces of the user defined intent through the Dashboard
- **Deployment Planner:** Helm Chart creation that contains all necessary information for the deployement of the application nodes in Kubernetes ecosystem.
- **Re-optimization Engine:** Interacts with NFVCL layer to optimize and manage the infrastructure's topology.
- **AI-assisted Synergetic Optimization Engine:** Event-based mechanism that triggers the respective componenet of the NEPHELE architecture to perform optimization operations.
- **Centralised Monitoring Engine:** Collects all application and infrastructure related data.

Multi-Cluster Resource Manager - [Karmada](#)

The Multi-Cluster Manager oversees the management of computational resources across multiple Edge/Cloud clusters. This component operates under the assumption that various clusters are integrated into a unified continuum. These clusters may encompass a spectrum from IoT devices to edge computing to the cloud infrastructure. Therefore, the Multi-Cluster Resource Manager/Orchestrator manages multiple (Kubernetes-based) clusters across diverse environments and providers, offering a centralized and unified interface for administration and operation. The basic functionalities are:

- Placement Optimization: Optimization Problem that coordinates the decision regarding the placement of applications to the available Kubernetes Clusters.
- Virtual Object (VO) Discovery: Stores the information of available (c)VOs and allows automatic discovery of (c)VOs for the applications.
- Multi-Cluster Connectivity: NEPHELE utilizes Submariner that enables direct networking between pods and services in different K8s clusters.

Network Resource Manager - [NFVCL](#)

The NRM is responsible for managing network resources and functionalities across the edge-cloud compute continuum, ensuring network performance guarantees for distributed application deployments. This encompasses identifying computing and network resources, setting up related cluster topologies, and instantiating blueprints according to application requirements. It also involves managing the lifecycle of these resources and continuously optimising network resource utilisation. Given the geographically distributed nature of resources across multiple clusters and the dynamic characteristics of distributed application deployments, the NRM must establish robust and secure communication channels between clusters and adapt topology configurations to accommodate changing traffic patterns and workload dynamics. The main functionalities are:

- Network Slicing: Creation, deployment, monitoring, and termination of network slices, known as Blueprints.
- VPN tunelling: Provides secure communication between the clusters with OpenVPN.
- Network Resources Optimization: By leveraging real-time monitoring data regarding application performance and infrastructure utilisation, this optimization engine orchestrates the efficient allocation and management of network resources by dynamically adjusting network configurations, routing policies, and bandwidth allocation to enhance performance, reliability, and efficiency.
- Infrastructure Scaling: The NRM seamlessly integrates with orchestration frameworks like OpenStack[2] and K8s, to facilitate expansion or contraction of the utilised resources.

Edge/Cloud Resource Manager

The Edge/Cloud Resource Manager integrates essential technologies for the Edge/Cloud compute and network resources in the final clouds where the HDAs are deployed. Specifically, K8s and lightweight

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[1] https://flask.palletsprojects.com/en/3.0.x/

[2] https://www.openstack.org/

versions of K8s i.e., K3s[3], are used for the management and orchestration of application does in the Edge and Cloud clusters of the NEPHELE infrastructure. The main functionalities are:

- Cluster Scheduler: Custom scheduler for placement of applications inside a specific cluster depending on various metrics
- Cluster Autoscaler: AI-driven custom autoscaler for dynamic scalong of applications.
- Cluster Monitoring: Exposure of Kubernetes and application-related metrics (can also be customed through the HDAG Descriptor) to a Prometheus instance.

(c)VO Stack

The Virtual Object (VO), is the virtual counterpart/extension of IoT devices deployed on the premises of Edge/Cloud Clusters. The VO is a lightweight software stack[4], based on two different specifications, W3C Web of Things[5] and Open Mobile Alliance (OMA) Lightweight Machine-to-Machine (LwM2M)[6], that stores the necessary information produced by IoT devices and therefore acts as a broker between the devices and an application graph.
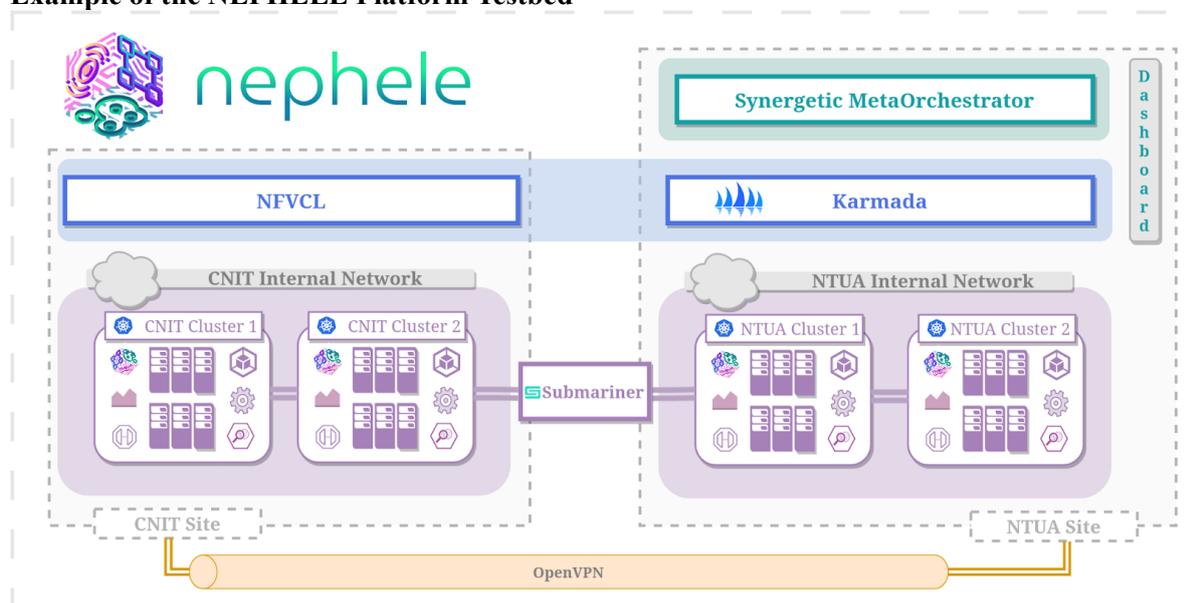
Example of the NEPHELE Platform Testbed

Figure 2: NEPHELE infrastructure Setup, the network overlay between partners provided infrastructures is connected through Submariner

Useful Links:
(c)VO examples
VO descriptor
VO Example Helm
Application Graph Descriptor Example
Example Application with Helm Chart

Desired Functionalities (non exclussive list): The desired extensions and functionalities consider solutions for: scaling, application scheduling, task scheduling, computation offloading, live migration, management of ML workflows considering the interplay between the IoT the edge and cloud part of the infrastructure, enablers for accelerator's management (e.g., GPU), security and trust management.

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[3] https://k3s.io/

[4] https://netmode.gitlab.io/vo-wot/

[5] https://www.w3.org/WoT/

[6] https://technical.openmobilealliance.org/index.html

Dependeny Technology Stack: All extensions should be easily adopted from the NEPHELE technology stack. NEPHELE seeks for open-source solutions than can be easily integrated e.g., Kubernetes CRDs, Kubernetes/KARMADA APIs extension, integration of CNCF projects to NEPHELE.