



nephele

A lightweight software stack and synergetic meta-orchestration framework for the next generation compute continuum

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Main Challenges for the Computing Continuum



- Need for **convergence of IoT technologies** based on novel architectural approaches, able to guarantee continuous and seamless openness and interoperability of the existing and emerging solutions.
- Need for the provision of an **integrated meta-orchestration environment for hyper-distributed applications**, where a **synergy** between cloud and edge computing orchestration platforms takes place

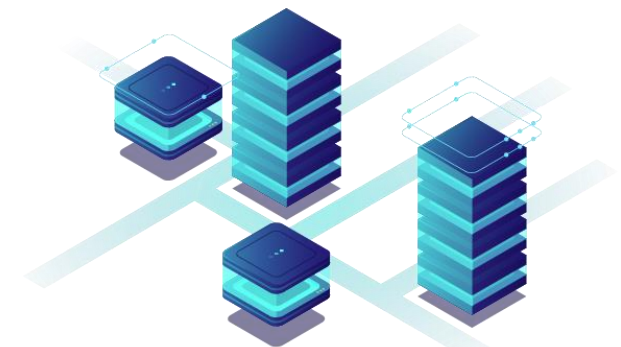


Eclipse Foundation, From DevOps to EdgeOps: A Vision for Edge Computing, White paper, 2021

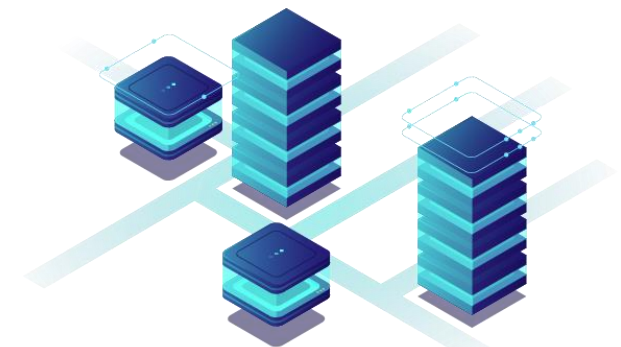
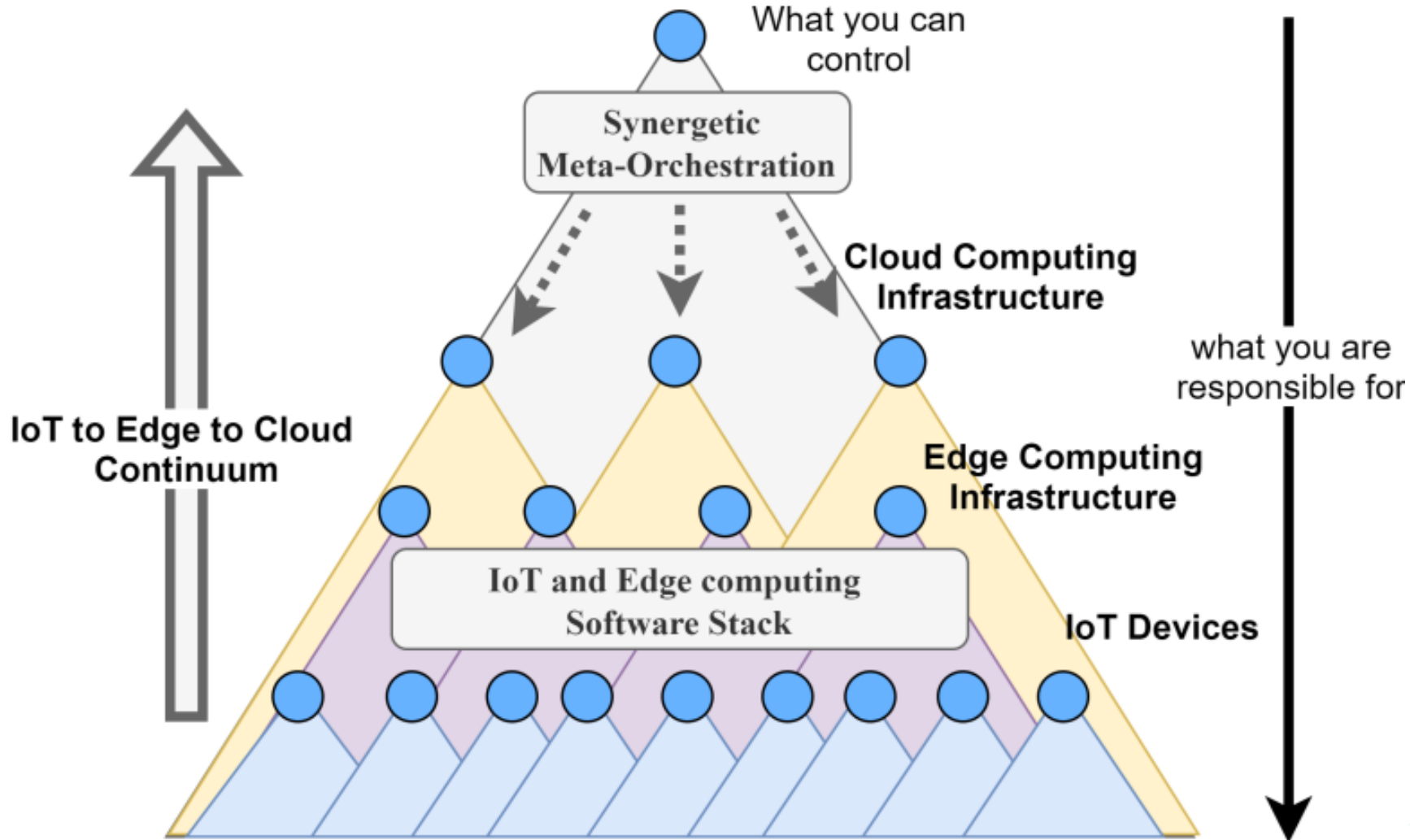
Main Innovations in NEPHELE



- An **IoT and edge computing software stack** for leveraging virtualization of IoT devices at the edge part of the infrastructure and supporting openness and interoperability aspects in a device-independent way.
- A **synergetic meta-orchestration framework** for managing the coordination between cloud and edge computing orchestration platforms, through high-level scheduling supervision and definition, based on the adoption of a “system of systems” approach.



System of Systems Approach



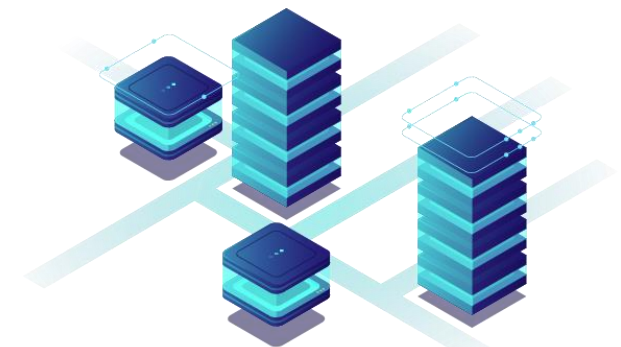
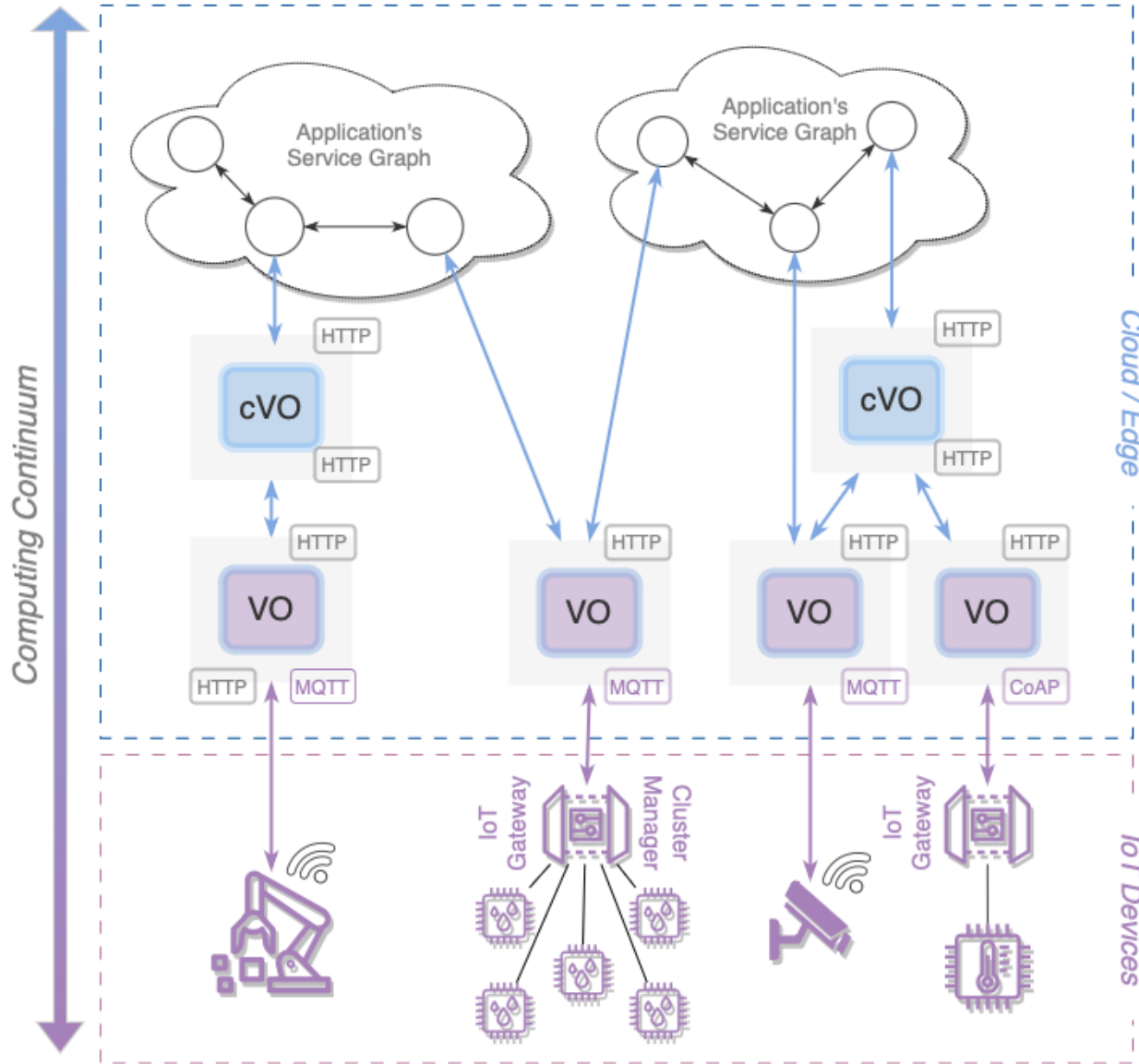
Virtual Object (VO) Definitions



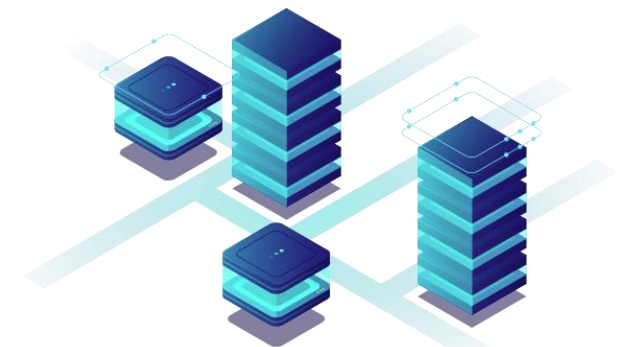
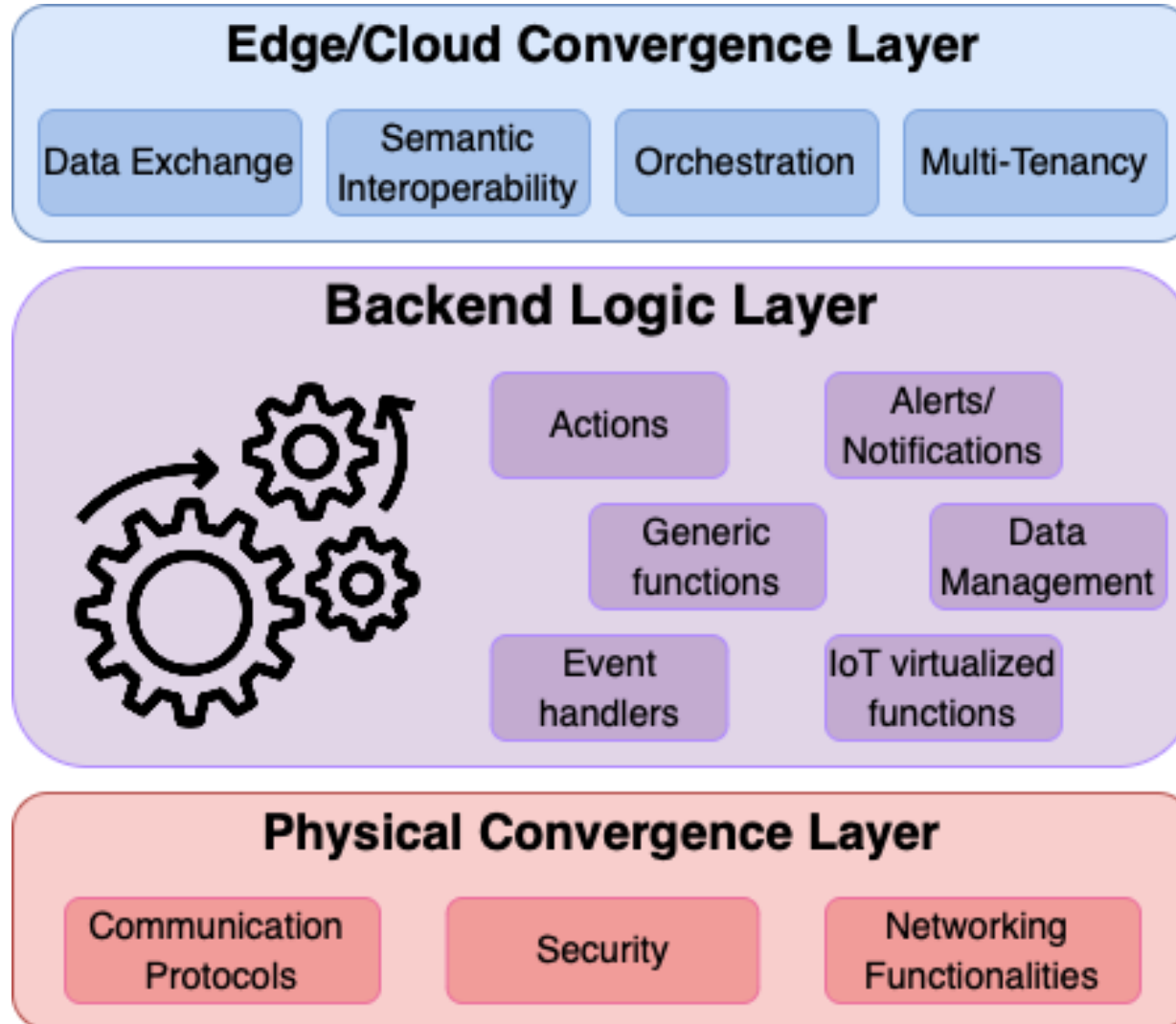
- A Virtual Object (VO) is considered as a virtual counterpart of a physical device on the Internet of Things domain
 - set of abstractions for managing any type of IoT device through a virtualized instance;
 - augments the supported functionalities through the development of a multilayer software stack, called **Virtual Object Stack (VOStack)**.
- A Composite Virtual Object (cVO) is a software entity that can manage the information coming from one or multiple VOs and provide advanced functionalities.
 - a cVO is connected with multiple VOs that manage IoT devices of several types;
 - a cVO enhances the capabilities of the VO through the provision of application-oriented functionalities.



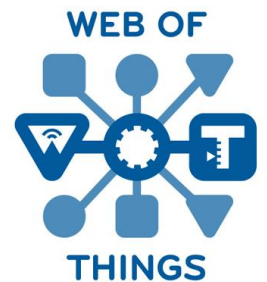
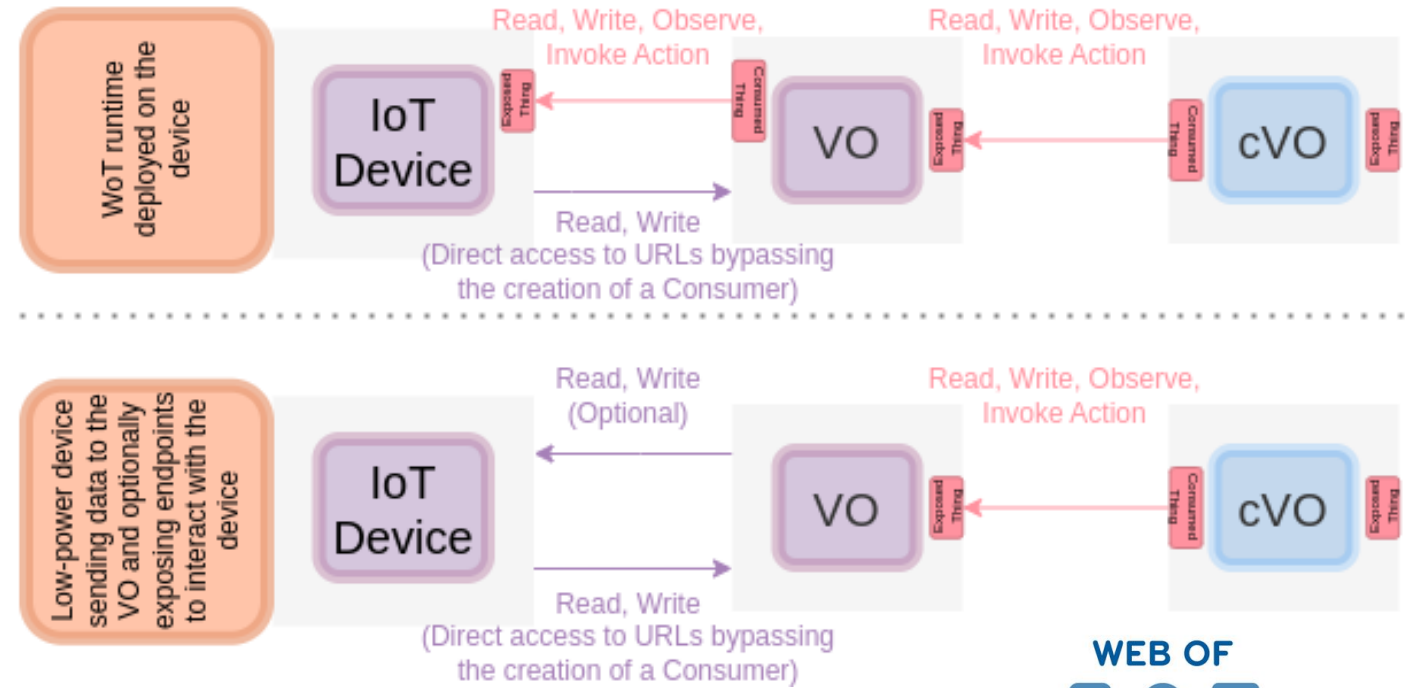
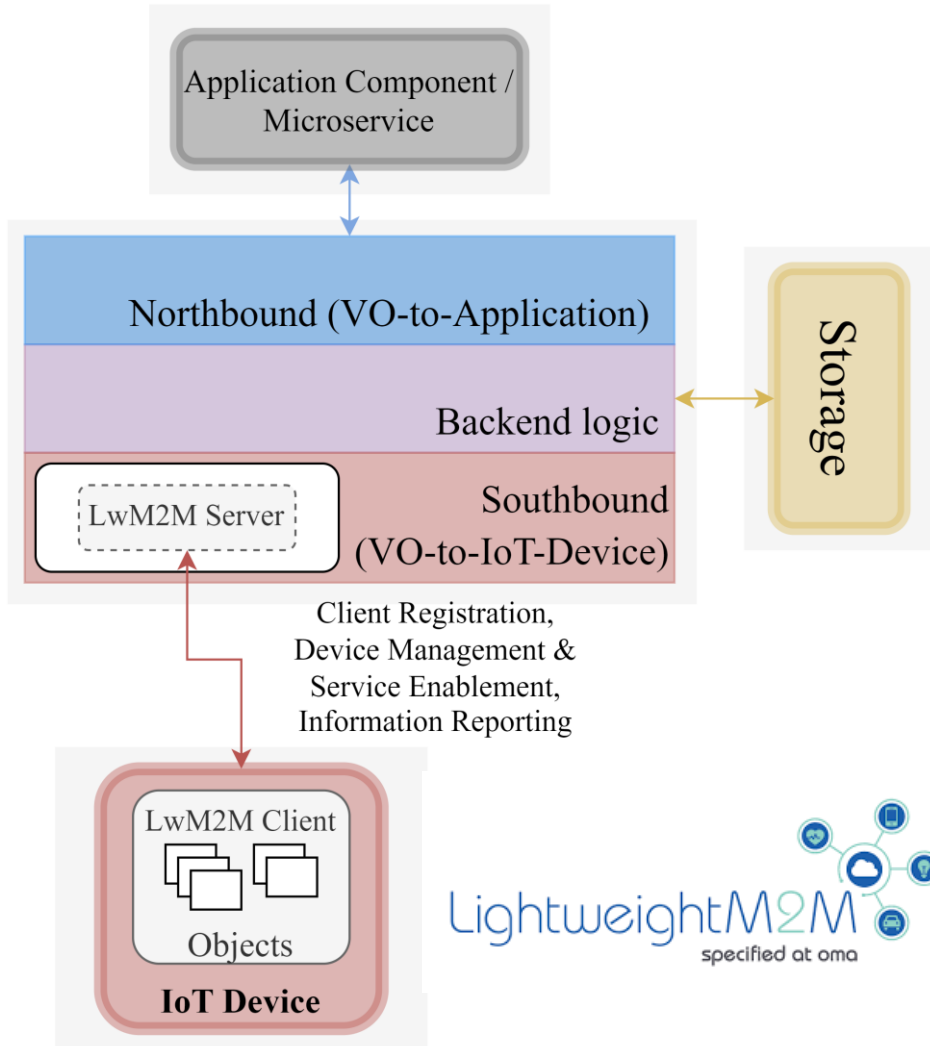
VOs, Composite VOs and Application Graph



Virtual Object Stack (VOStack) Layers



VOSTack implementation



VOStack implementation in W3C WoT Developer Resources



Standards · Participate · Membership 

Groups · Activities · Developers · Documentation · Videos · About ·

Developer Resources

There are various resources available to build Web of Things applications. These are libraries, ready-to-use software, services or SDKs, which can be used in different stages of development or for development needs and are grouped below.



TD Tooling



WoT Development Tools



Runtimes for TD Exposers



Runtimes for TD Consumers



TD Directories



WoT Software and Middleware



Other Tooling



Online Things

WoT Software and Middleware

Ready to use software applications that can be deployed in order to provide a certain functionality in a system, such as gateway and proxying, simulation, testing services.

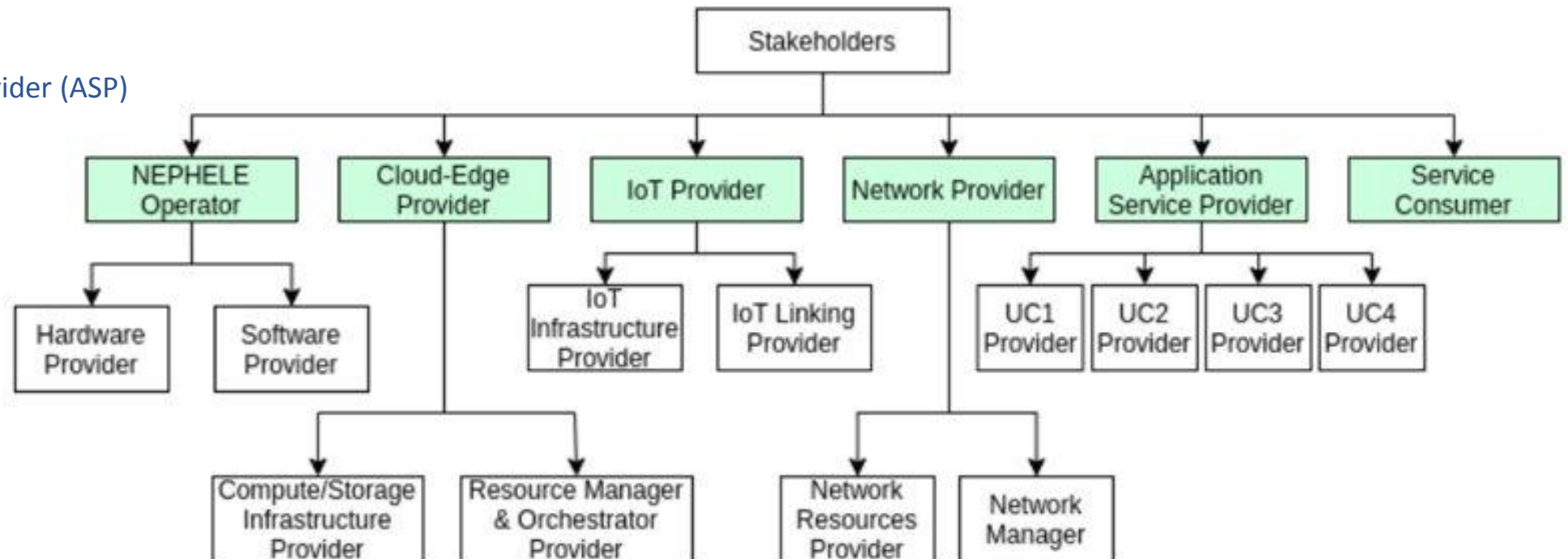
- [sayWoT!](#) - Industrial-grade implementation that allows integration of devices into Siemens software products.
- [Web of Things Test Bench](#) - CLI based tool that tests a WoT Thing by executing interactions automatically, based on its TD.
- [WebThings Gateway](#) - An open source Web of Things gateway for smart buildings, which bridges a wide range of IoT protocols to the Web of Things.
- [UA Edge Translator](#) - An industrial connectivity edge reference application translating from proprietary protocols to OPC UA leveraging the W3C Web of Things (WoT) Thing Descriptions.
- [VO-WoT](#) - A Python-based stack that allows developing WoT Things with additional functionalities, called Virtual Objects (VOs). A documentation website is available [here](#).
- [Shadow Thing](#) - CLI based tool for creating and deploying a Thing based on its TD for simulation, proxy or protocol translation purposes.

Stakeholders

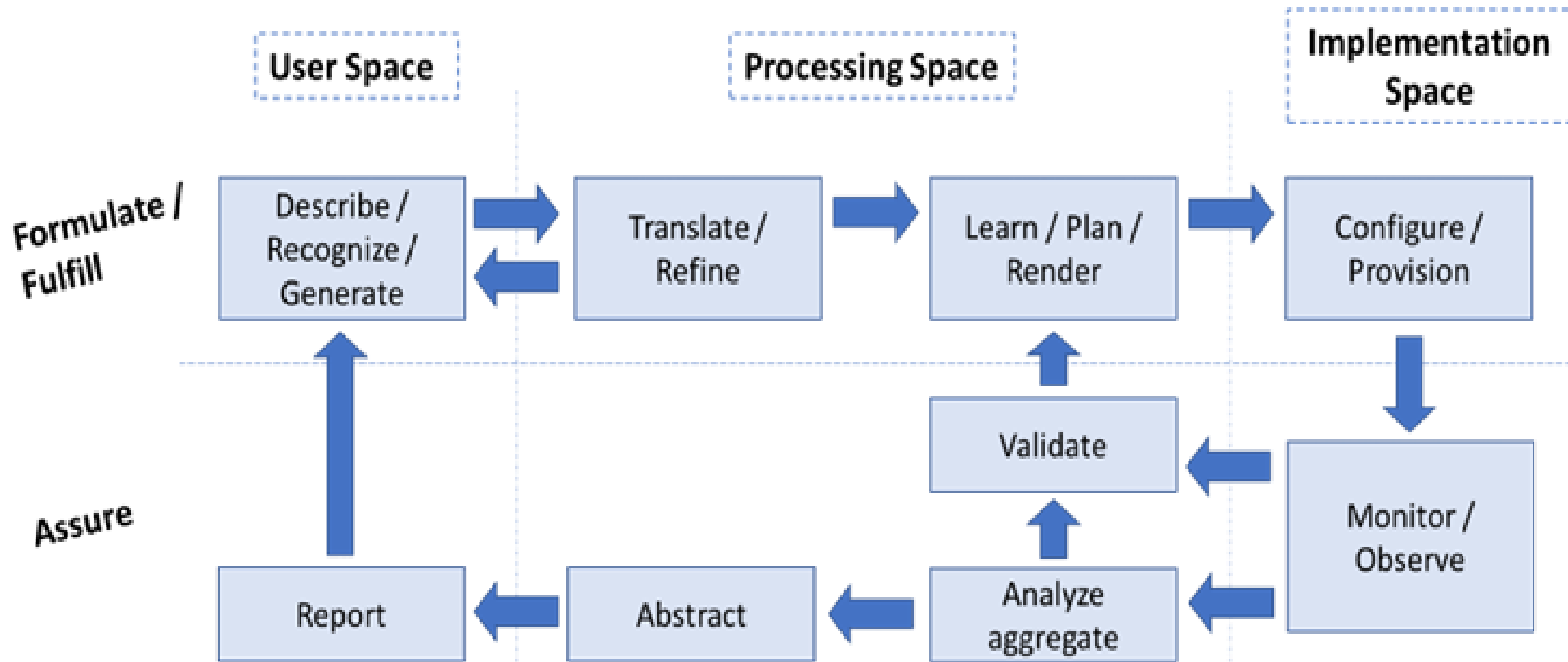
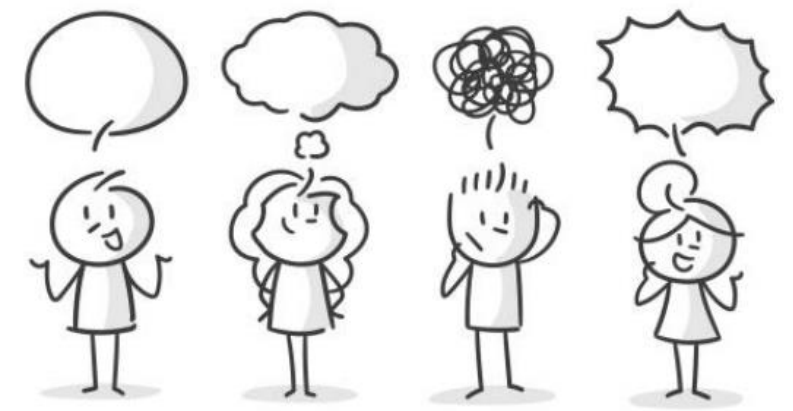


Stakeholders include individual or groups within the system

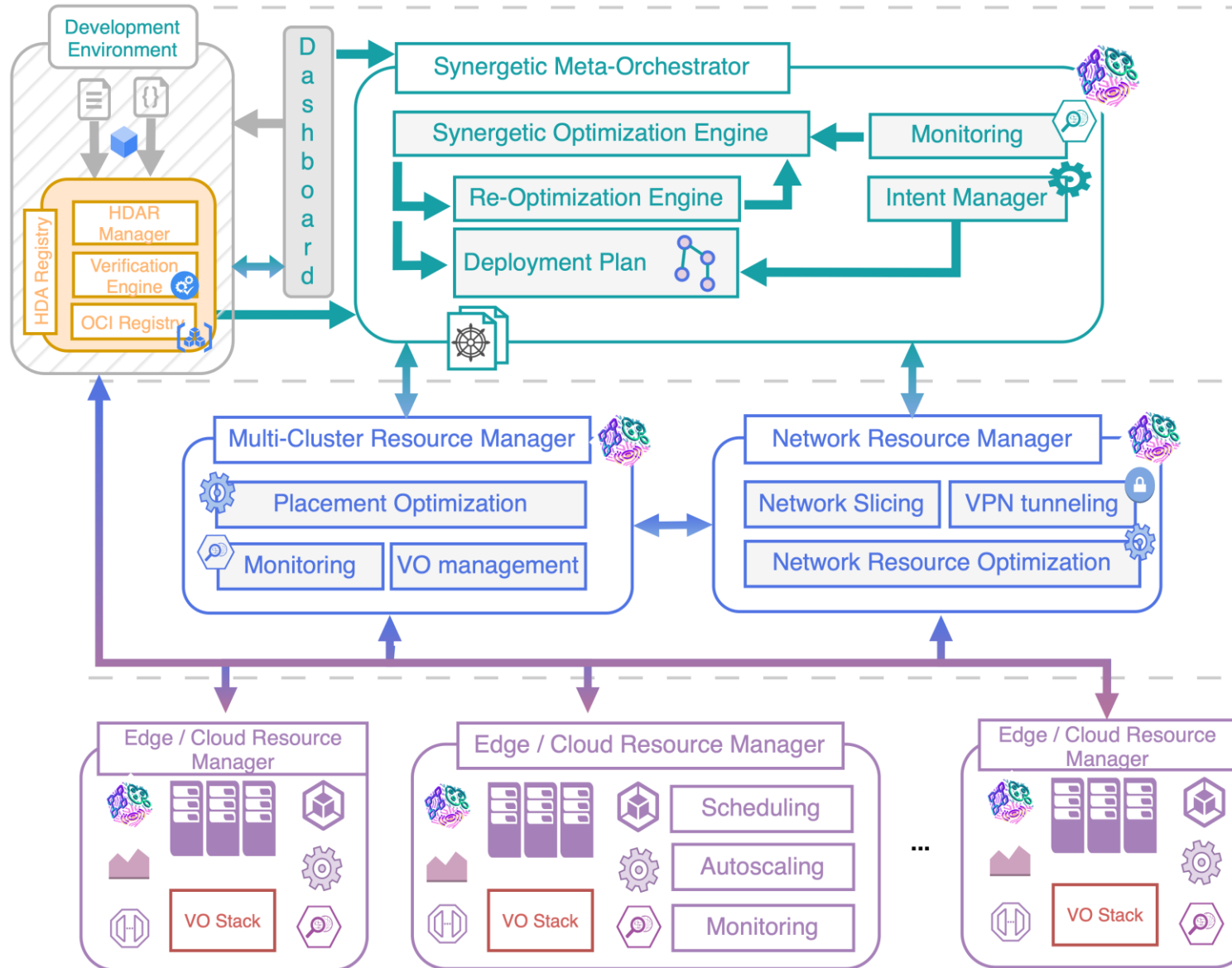
- NEPHELE Operator:
- Cloud-Edge Provider (CEP)
- IoT Provider
- Network Provider
- Application Service Provider (ASP)
- Service Consumer



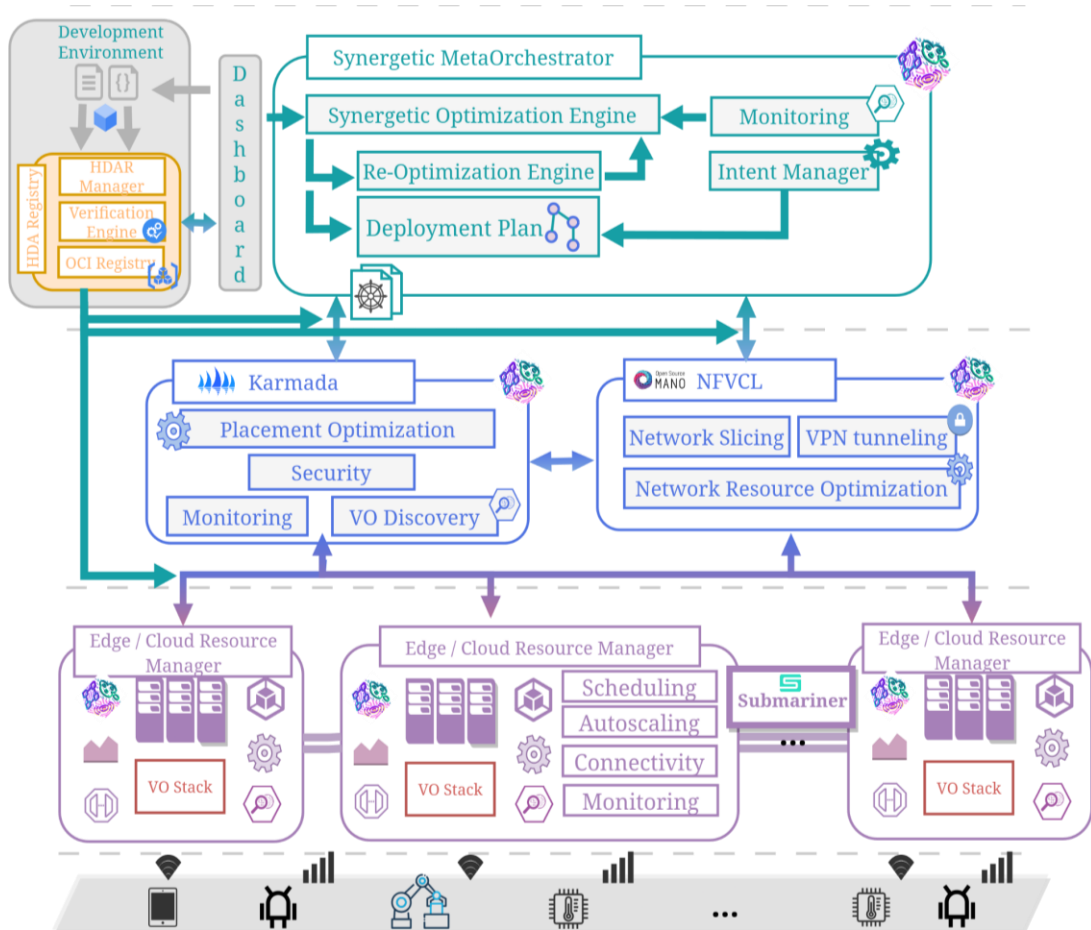
Intent-based Orchestration



Reference Architecture



NEPHELE Platform Development



Nephele Cluster Information

Cluster Name	Availability	Location	Available CPU	Available RAM	Grafana Link
Netmode	Yes	NTUA	72 vCPUs	234 GiB	GRAFANA
CNIT	Yes	Italy	50 vCPUs	150 GiB	GRAFANA

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Nephele Registered IoT Devices

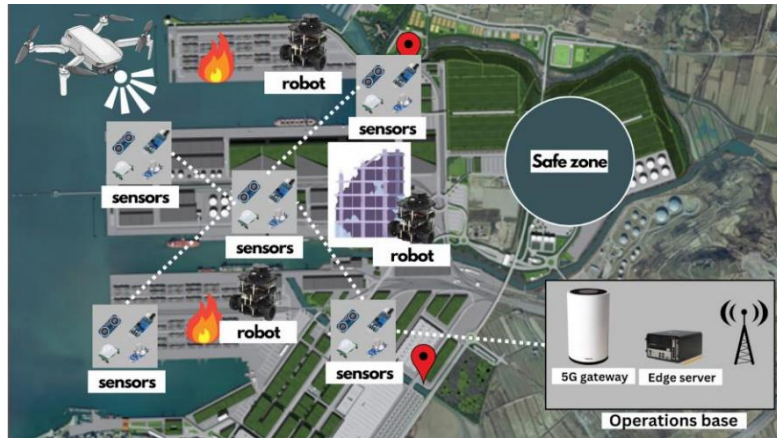
Title	Device Type	IP	Location	Descriptor
vo	Raspberry Pi	147.102.13.100	Netmode	VIEW DESCRIPTOR

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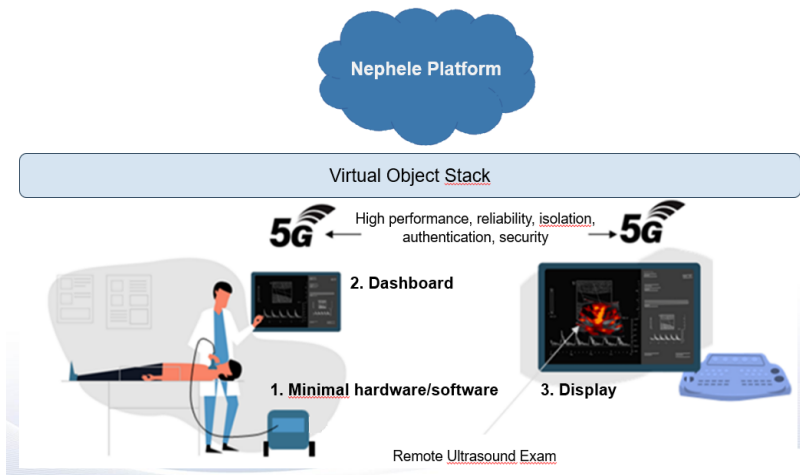
NEPHELE Use cases



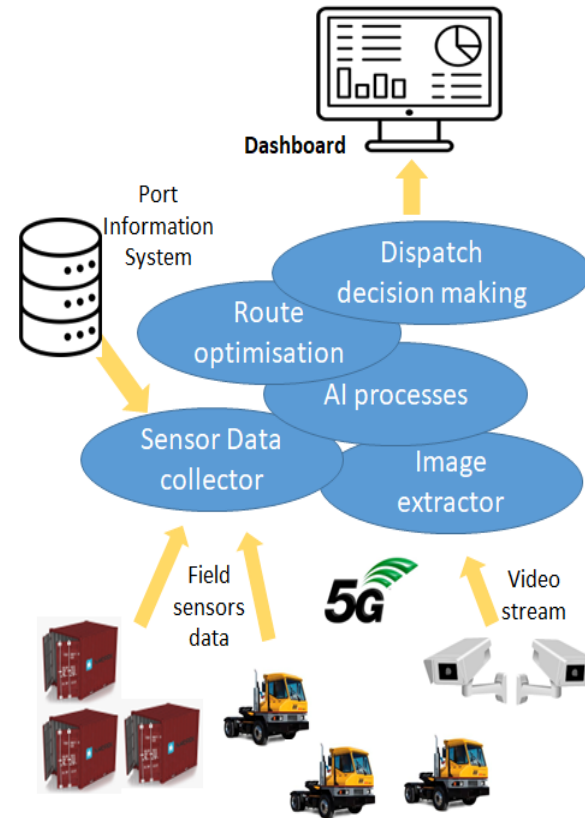
Emergency/Disaster Recovery



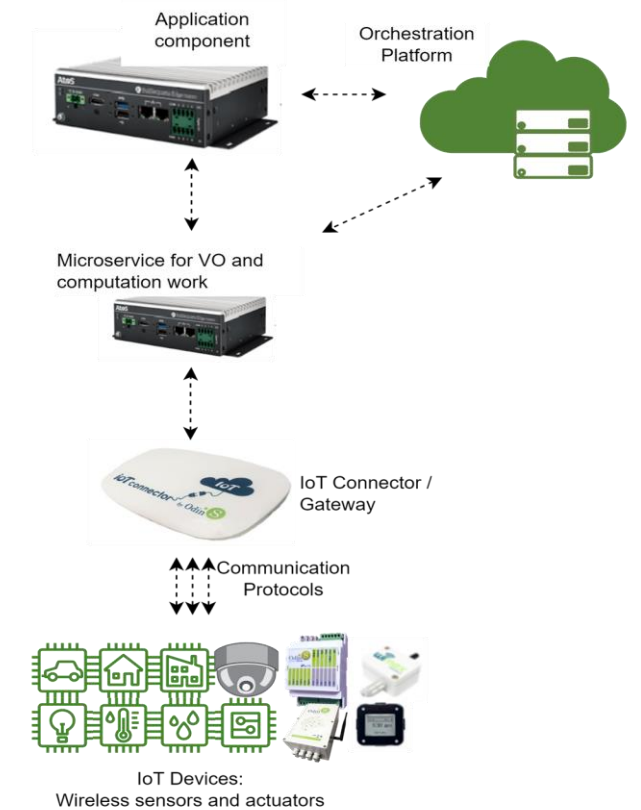
Remote Healthcare



Smart Port



Energy Management in Smart Buildings



NEPHELE Open Source Ecosystem



Goal: Prepare NEPHELE open-source results for up-take by developers (open calls, OS communities, Meta-OS cluster, etc.) by implementing open-source best practices.



Eclipse Research Labs / NEPHELE Project

NEPHELE Project

A lightweight software stack and synergetic meta-orchestration framework for the next generation compute continuum.

Recent activity Last 30 days: Merge requests created: 6, Issues created: 0, Members added: 0

Subgroups and projects

Subgroup	Star	Time ago
Nephele-Dashboard	0	14 hours ago
nephele-HDAR	0	2 weeks ago
Nephele-Integration	0	3 months ago
SMO	0	1 day ago
VO-Discovery-Server	0	1 month ago
VO-LwM2M	0	3 weeks ago
VO-SDN	0	2 weeks ago
VO-Security	0	5 days ago
VO-TSN	0	2 weeks ago
VO-WoT	1	4 days ago

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<https://gitlab.eclipse.org/eclipse-research-labs/nephele-project>



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Thank you!