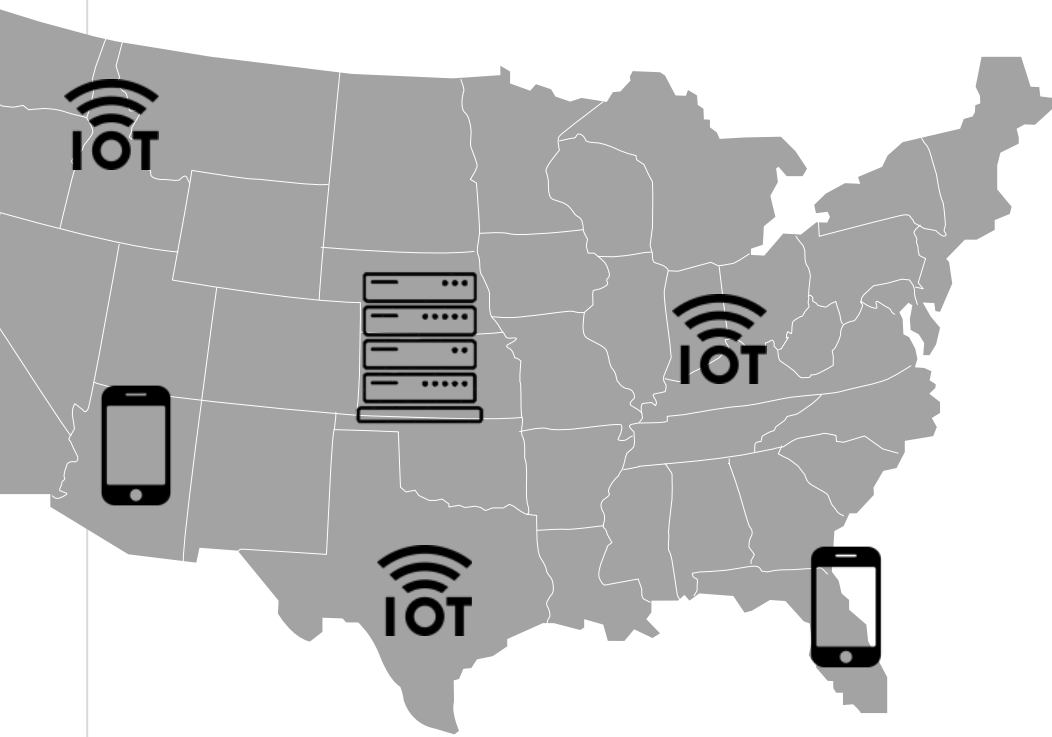


ENS 2024

Building the Cloud Continuum with REAR

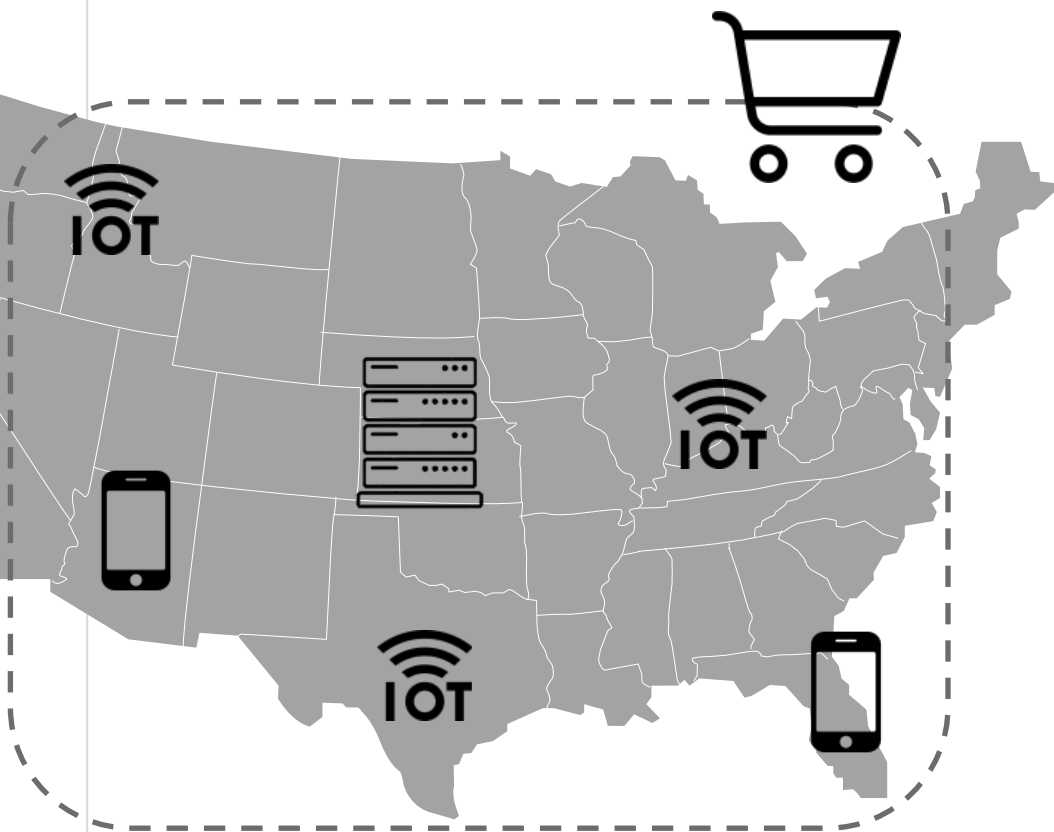
Presenter: Stefano Galantino





THE COMPUTING SCENARIO

The computing continuum allows to create **geographically distributed infrastructures** - from edge devices to central cloud data centers. This spectrum ensures that computation can occur anywhere along this continuum.



THE COMPUTING SCENARIO

The computing continuum allows to create **geographically distributed infrastructures** – from edge devices to central cloud data centers. This spectrum ensures that computation can occur anywhere along this continuum.

As a result, this allows for the creation of a **true market of resources**.

How do we perform the resource negotiation?

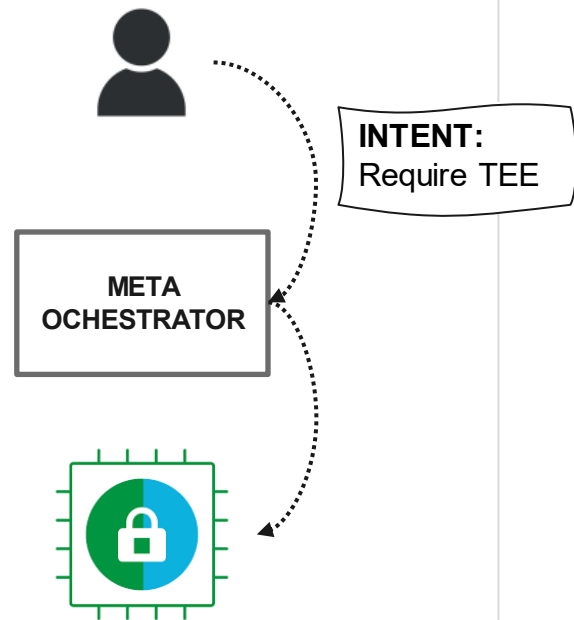
MOTIVATIONS (and requirements) (I)

Support for intent-based allocation

Users to define the desired application architecture using intents, delegating to the infrastructure the task of connecting services to the corresponding data sources.

Support for security features

Security features must be advertised (e.g., hardware-backed Trusted Execution Environments (TEEs)) to give tenants the ability to attest the environment where their workloads run. Furthermore, the dynamic disaggregation of assets across various domains must be supported.



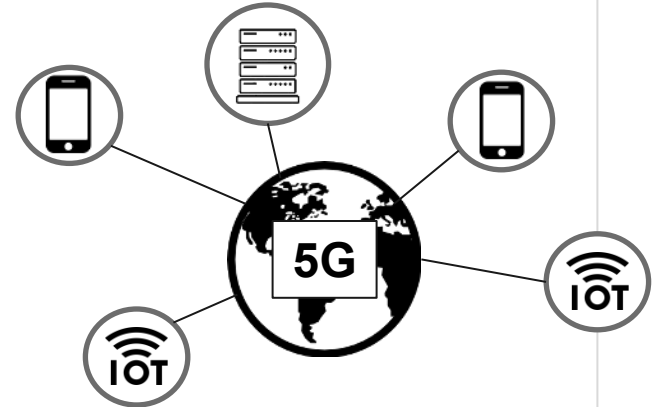
MOTIVATIONS (and requirements) (II)

Support for carbon-aware allocation

Enhance operational efficiency and collaboration across heterogeneous computing resources to pioneer a sustainable approach in such a fluidified continuum.

Use cases

The continuum allows applications to be executed near the data sources to reduce latency, enhance security through on-device data storage, and guarantee functionality even during temporary network isolation, extremely relevant for beyond 5G scenarios.



REAR PROTOCOL

REAR (REsource Advertisement and Reservation) addresses three key objectives:

- *Standardization*, defining common interfaces and messages for resource advertisement and reservation to promote interoperability and compatibility across heterogeneous computing environments.
- *Efficiency*, to optimize resource allocation and utilization by allowing devices to enrich the resource description including internal energy metrics, latency considerations, and cost models.
- *Security and Trust*, incorporating mechanisms for authentication, authorization, and secure communication to ensure the integrity and confidentiality of resource transactions.

Github:

- <https://github.com/fluidos-project/REAR>
- <https://github.com/fluidos-project/REAR-data-models>



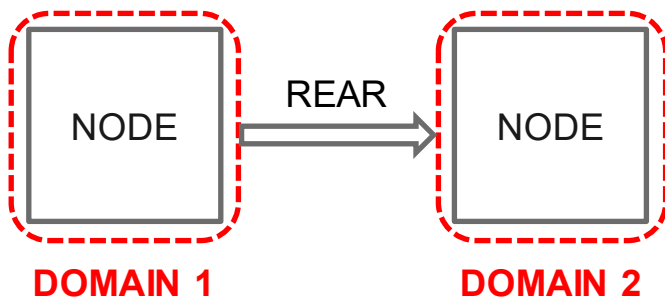
REAR

REAR ARCHITECTURE

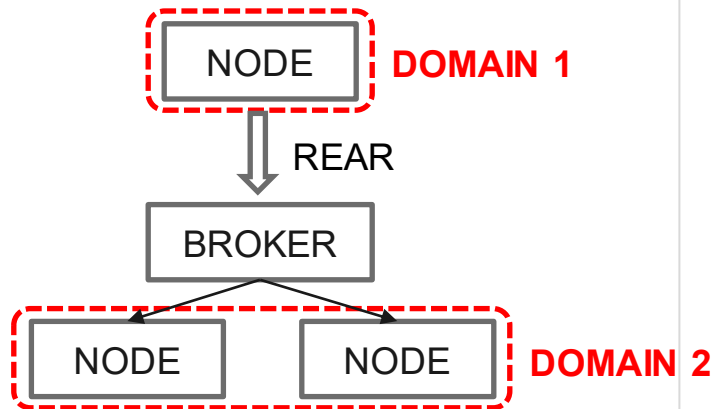
The two main concepts REAR are:

- *Node*, computing environment, under the control of a single administrative entity
- *Domain*, administrative entity logically grouping different compute nodes

HORIZONTAL INTERACTION



VERTICAL INTERACTION



REAR DATA MODELS

The REAR data model outlines the various types of resources advertised in the continuum. This model includes the definition of two terms: **Flavor** and **FlavorType**. The Flavor encompasses the set of information shared among all possible resources, while the FlavorType is a pointer to another dedicated structure that specifies the unique characteristics of each resource.

Currently, five **FlavorTypes** are defined in REAR:

K8SSLICE

VM

SERVICE

SENSOR

DATA



REAR WORKFLOW

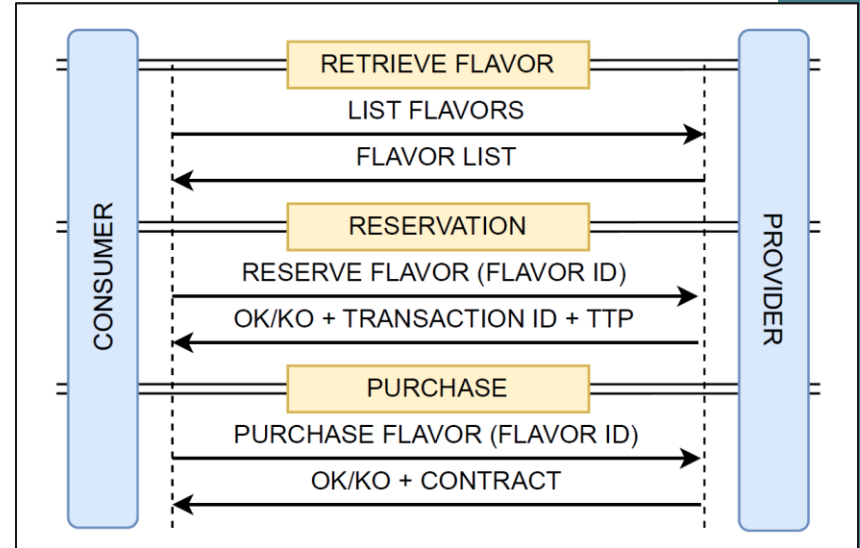
REAR defines several messages for the advertisement/reservation of resources in the continuum. The messages can be classified as either required or optional:

REQUIRED

- LIST_FLAVORS
- RESERVE_FLAVOR
- PURCHASE_FLAVOR

OPTIONAL

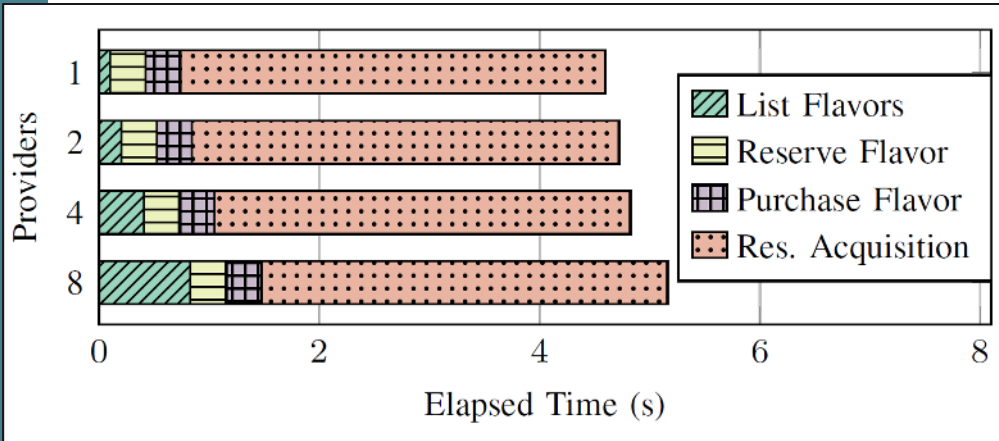
- SUBSCRIBE_FLAVOR
- WITHDRAW_FLAVOR



EVALUATION

We collect metrics from the **three different stages of the REAR protocol** to provide a breakdown of the overhead, varying the number of providers offering flavors of type K8Slice.

The Resource Acquisition phase represents the reference time required to extend the pool of locally available resources in Kubernetes using the Liqo framework.



- the Reserve Flavor and Purchase Flavor messages maintain stability through the different scenarios.
- the List Flavor message is influenced by the number of available providers
- the REAR protocol's overhead remains minimal (approximately 30% of the total time in the worst case)

CONCLUSIONS

- **Novel Protocol:** Introduces REAR, a new protocol for resource advertisement and reservation.
 - **Standardized Interface:** Provides a standardized interface for messages and data models.
 - **Interoperability:** Promotes interoperability and compatibility across different computing environments.
 - **Enhanced Allocation Policies:** Supports enhanced allocation policies, enabling devices to provide richer resource descriptions.
 - **Security Support:** Ensures the integrity and confidentiality of resource transactions through security measures.
- 

THANKS!

stefano.galantino@polito.it
stegala.github.com

