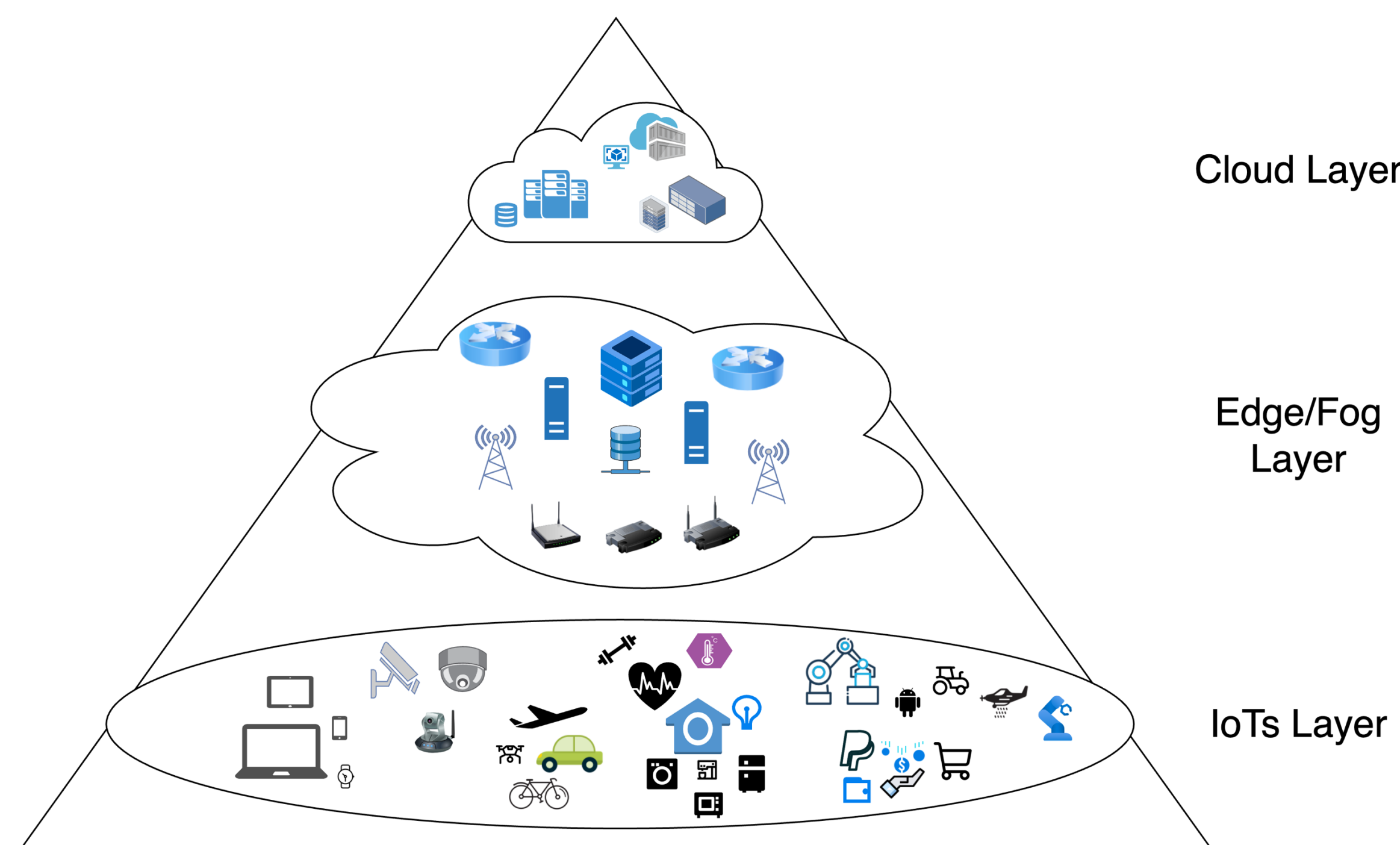


Self-Learning Based Decentralized Resource Management of Cloud Continuum

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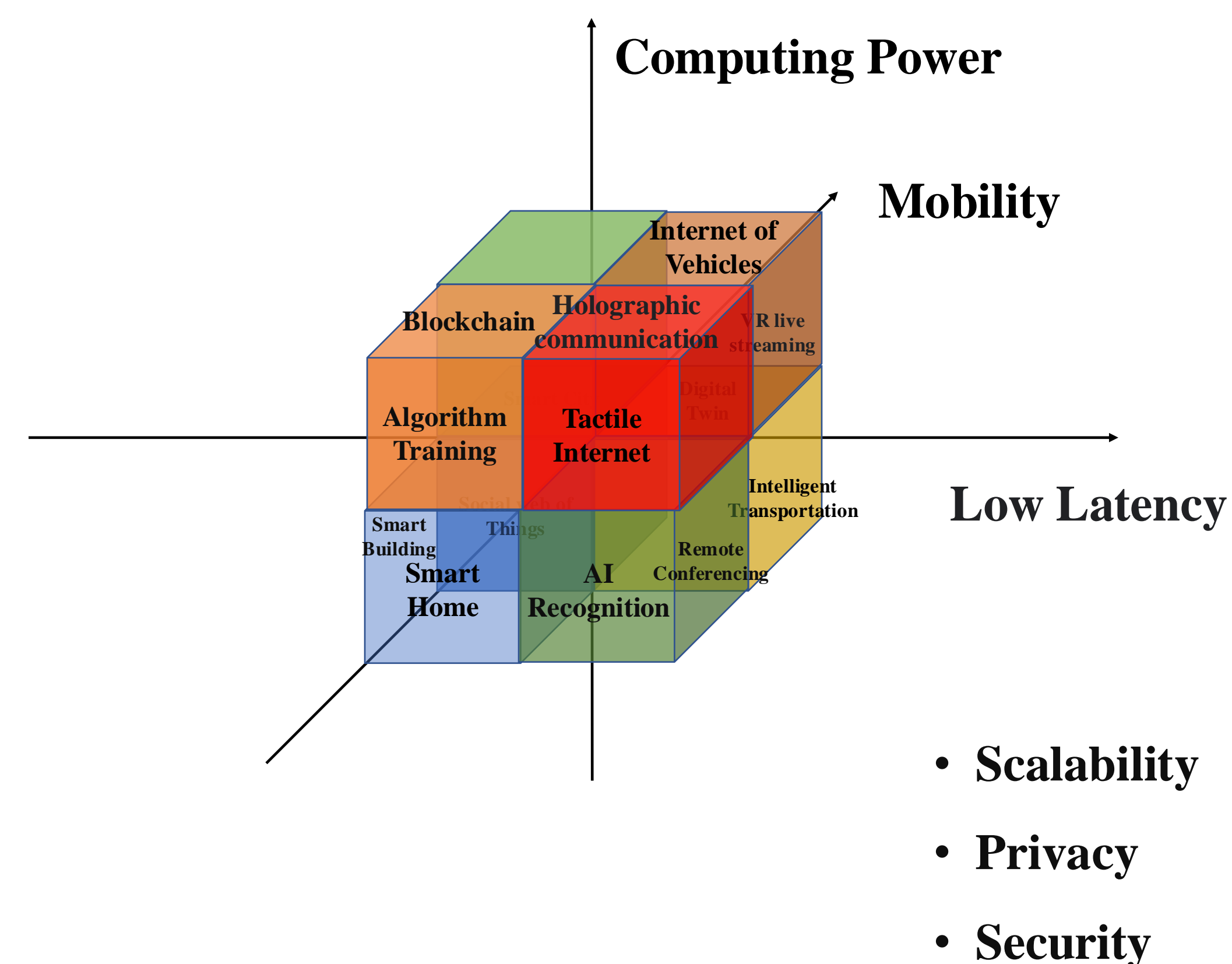
Cloud Continuum

An ecosystem that integrates, organizes, and utilizes computing, storage and network resources across various infrastructures (endpoint devices, edge/fog nodes, cloud data centers, and the networks connecting them) for deploying workloads, rather than relying on a specific infrastructure.



- Geographical Distribution
- Heterogeneity
- Interoperability
- Dynamic Nature

Emerging Applications



- Scalability
- Privacy
- Security

The rapid growth of IoT devices, data explosion, and the critical requirements of emerging applications have made resource management in the Cloud Continuum a complex issue, presenting diverse challenges across multiple dimensions that cannot be addressed as a single, unified problem.

Resource Management

Resource Model

Cloud Continuum:

$$\mathcal{G}_R = (\mathcal{D}, \mathcal{L})$$

Physical devices:

$$\mathcal{D} = \{d_1, d_2, \dots, d_n\}$$

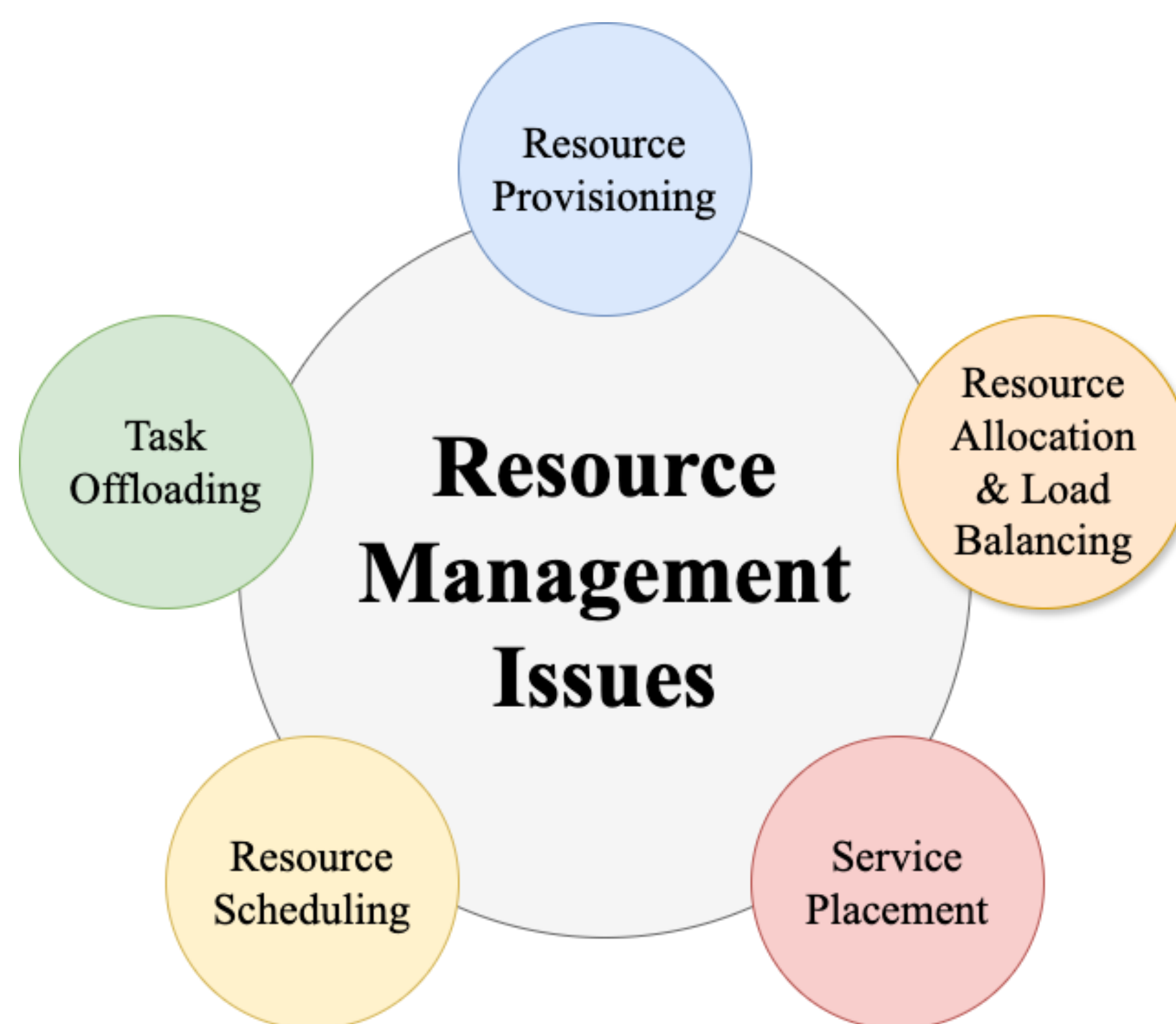
with $d_i =$

$$[CPU(d_i), ACC(d_i), MEM(d_i), STOR(d_i)]$$

Network connections:

$$\mathcal{L} = \{L_{ij} | (d_i, d_j) \in \mathcal{D} \times \mathcal{D}\}$$

with $L_{ij} = (BW_{ij}, LAT_{ij})$



Application Model

Application :

$$\mathcal{G}_A = (\mathcal{W}, \mathcal{E})$$

Application workload:

$$\mathcal{W} = \{w_1, w_2, \dots, w_m\}$$

with QoS Constraints for each $w_i =$

$$[CPU(w_i), ACC(w_i), MEM(w_i), STOR(w_i), DDL(w_i)]$$

with Network edge QoS requirements :

$$\mathcal{E} = \{Q_1, Q_2, \dots, Q_m\}$$

Resource Orchestration

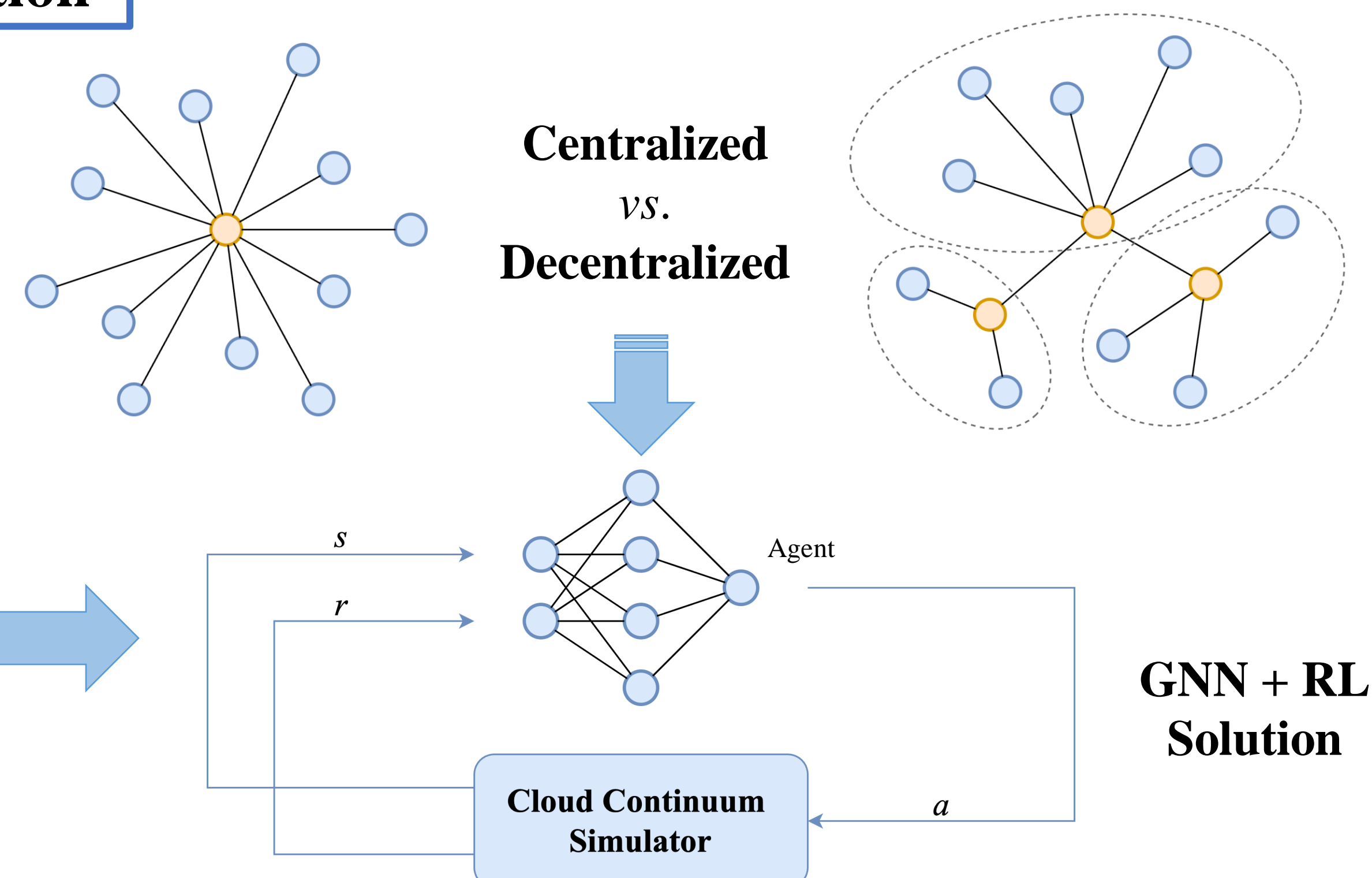
Objective

- Completion Time
- Energy Consumption
- Economic Cost
- Resource Utilization
- Load Balancing
- Quality of Service(QoS)
- Others

Multi-Objective
Optimization

Solution

- Linear Optimization
- Non-Linear Optimization
- Heuristic Algorithm
- Meta-Heuristic Algorithm
- Genetic Algorithm
- Learning-based Algorithm
- Others

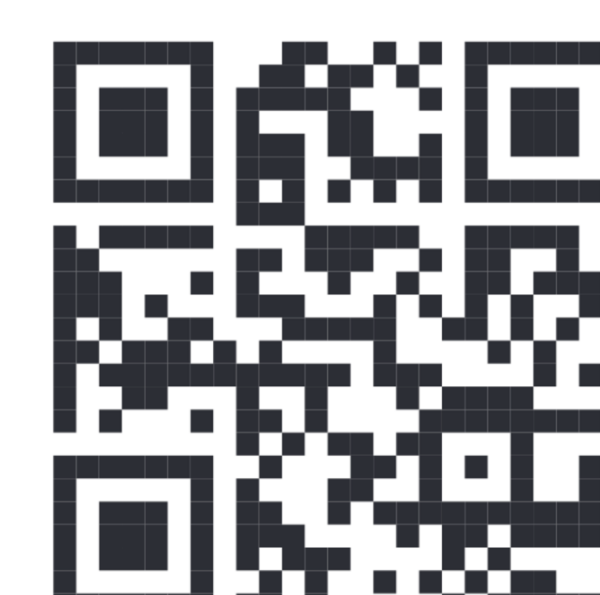


PUBLICATIONS

L. Li, E. Piccoli, A. Cossu, D. Bacciu and V. Lomonaco, "Calibration of Continual Learning Models," 2024 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), Seattle, WA, USA, 2024, pp. 4160-4169, doi: 10.1109/CVPRW63382.2024.00419.

L. Li, E. Donatot, V. Lomonaco and E. Falotico, "Continual Policy Distillation of Reinforcement Learning-based Controllers for Soft Robotic In-Hand Manipulation," 2024 IEEE 7th International Conference on Soft Robotics (RoboSoft), San Diego, CA, USA, 2024, pp. 1026-1033, doi: 10.1109/RoboSoft60065.2024.10522027.

MORE INFORMATION



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