INFORMATICS EUROPE

SADP Sustainable Application Design for Greener Applications in the Cloud

•••

Monica VITALI
monica.vitali@polimi.it

TEADAL

POLITECNICO MILANO 1863

October 29, 2024

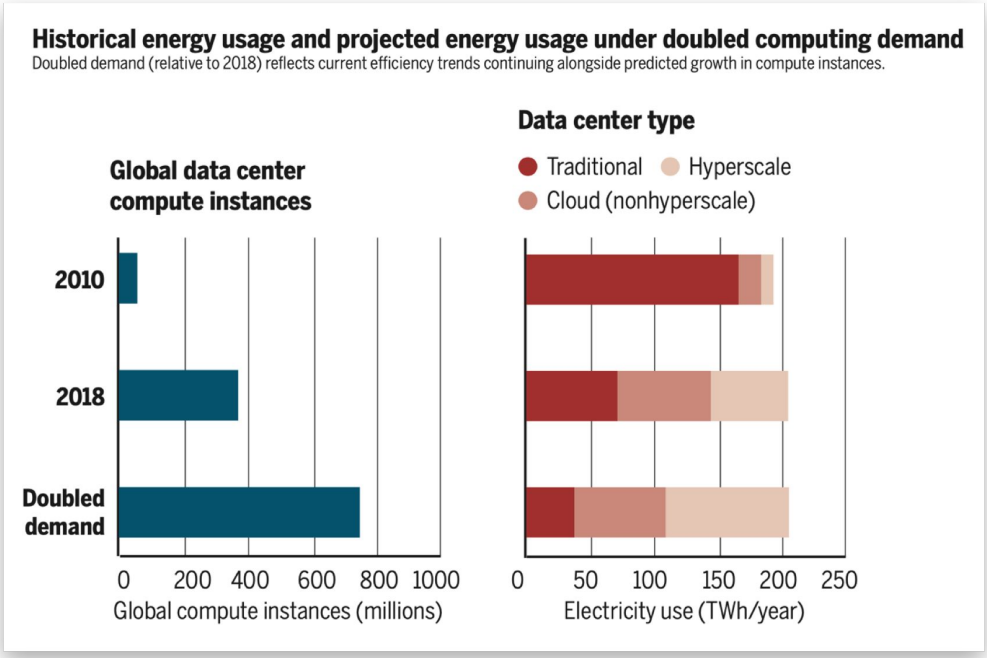
WHO AM I?

Associate Professor at **Politecnico di Milano** in Italy

I research new strategies to improve the efficiency of **data centers** and **clouds** by applying techniques derived from the **Artificial Intelligence** and **Machine Learning** fields.

I am very interested in **adaptation** and **self-adaptation** to discover how a complex system can heal itself when some problems occur.

CONTEXT



*"Data centers are energy-intensive enterprises, estimated to account for around **1% of worldwide electricity use** [and] have clear implications for global energy demand. By 2018, **global data center workloads and compute instances had increased more than sixfold** [compared to 2010]. The **next doubling of global data center compute instances** may occur within the next 3 to 4 years"*

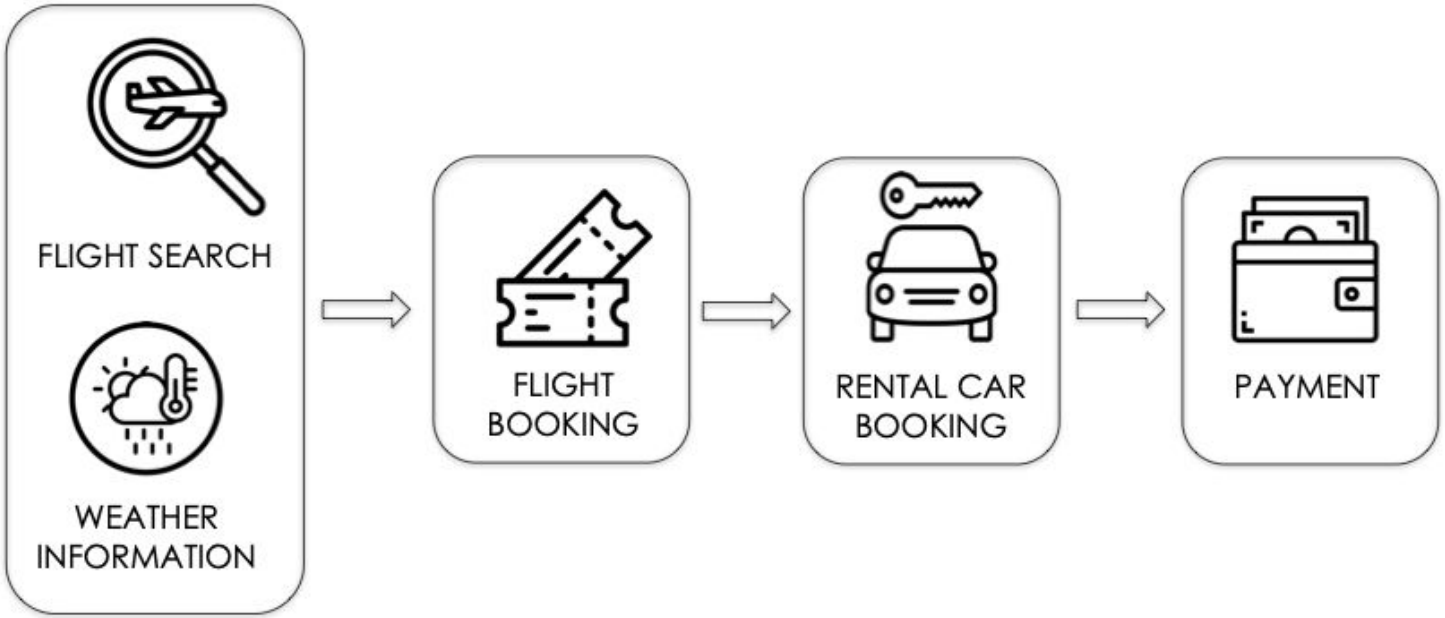
Eric Masanet et. al., Recalibrating global data center energy-use estimates. Science, 2020.

GOAL engage application designers in the path towards IT and IS sustainability

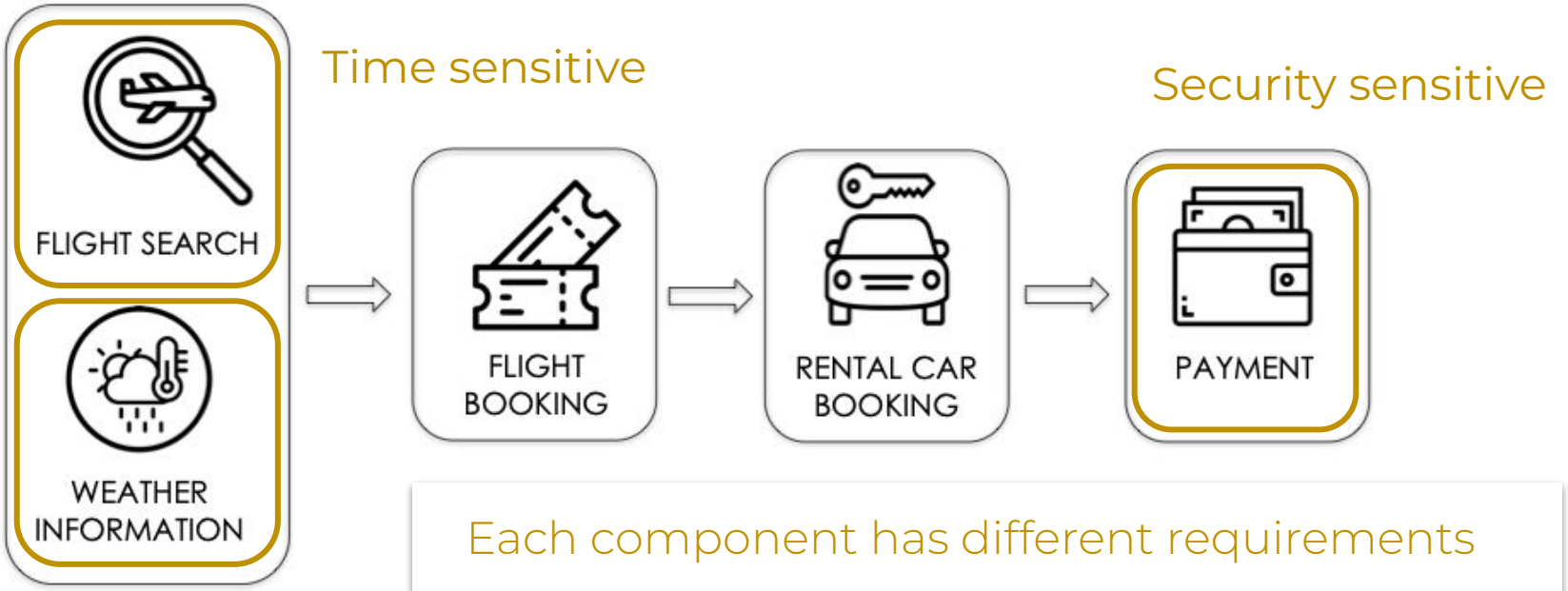
GOAL engage application designers in the path towards IT and IS sustainability

- Increasing sustainability-awareness
- Suggesting best practices
- Providing tools for sustainable-driven (re)design

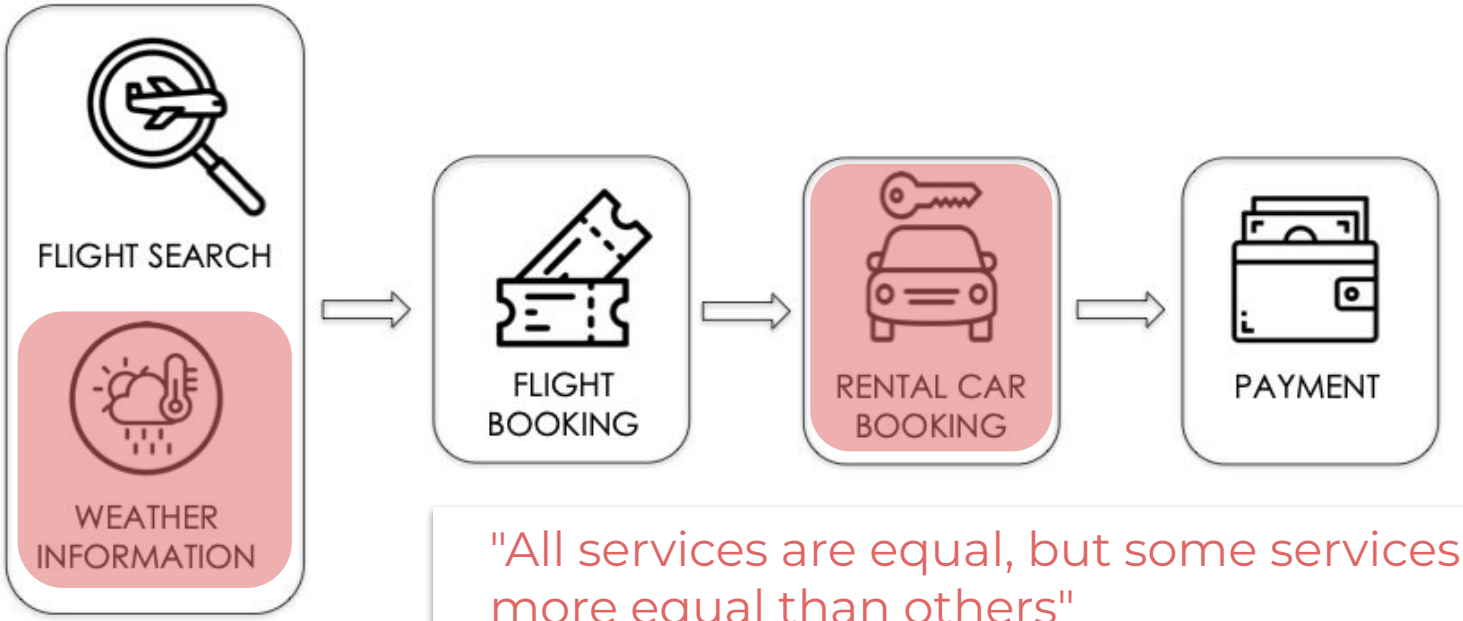
CLOUD NATIVE APPLICATIONS



CLOUD NATIVE APPLICATIONS

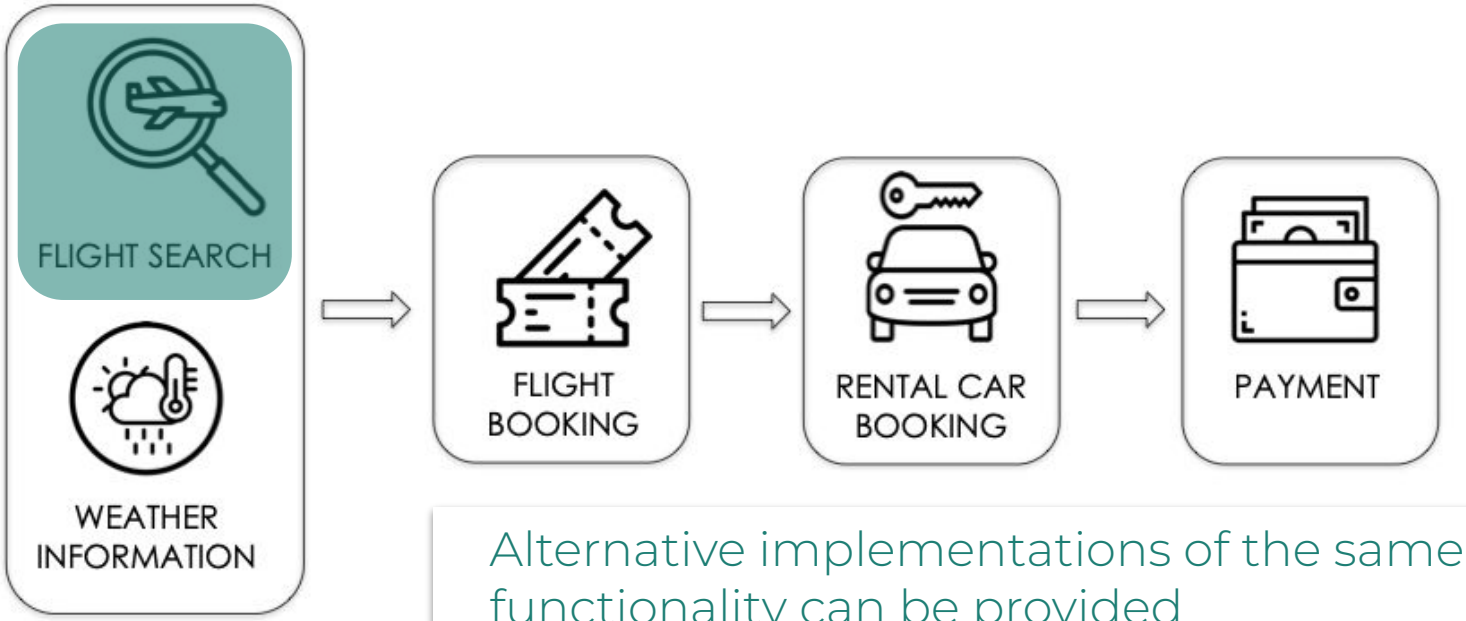


CLOUD NATIVE APPLICATIONS



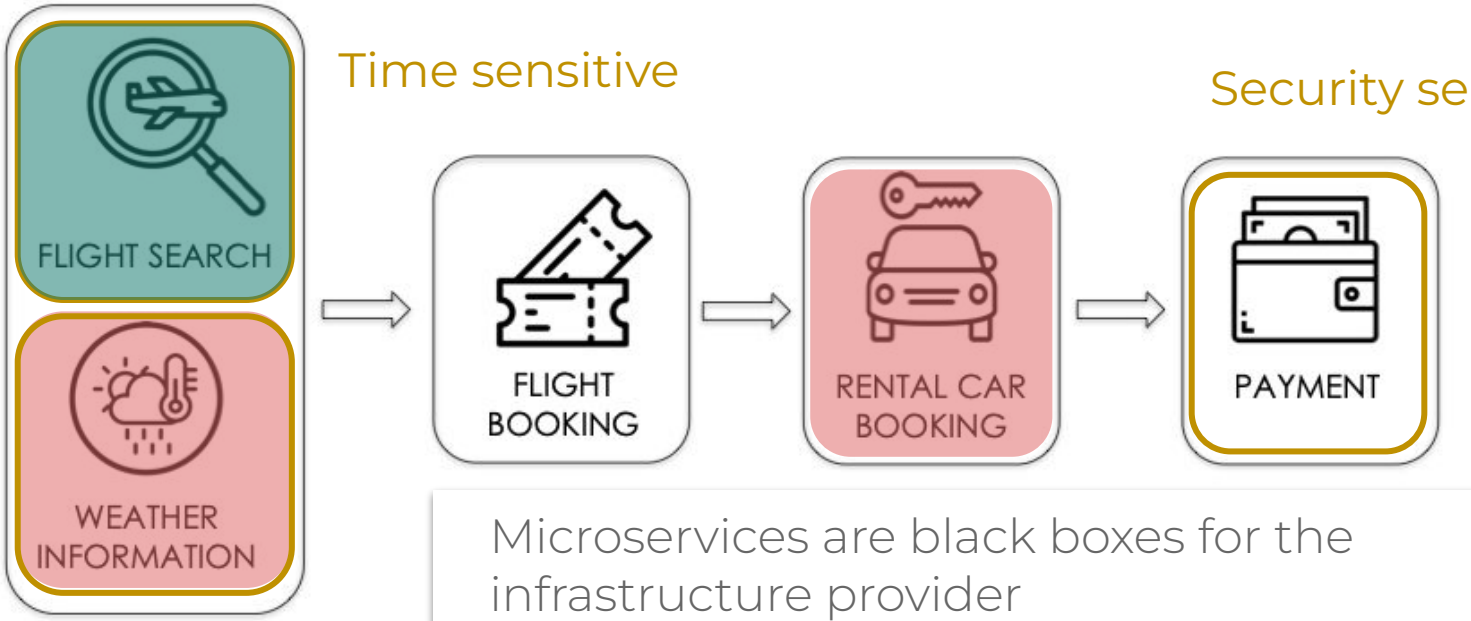
"All services are equal, but some services are more equal than others"

CLOUD NATIVE APPLICATIONS



Alternative implementations of the same functionality can be provided

CLOUD NATIVE APPLICATIONS

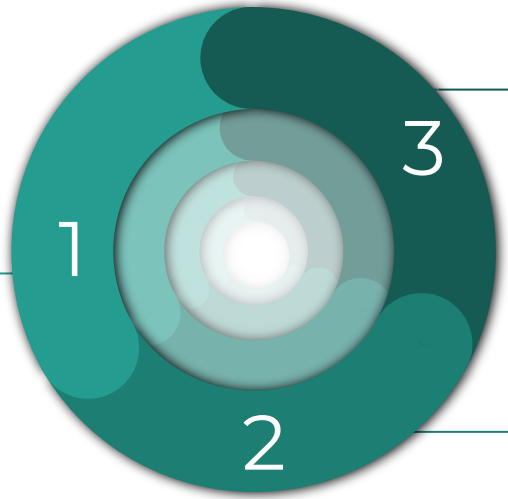


Microservices are black boxes for the infrastructure provider
All these features are hidden and don't adapt with the context of execution

SADP - Sustainable Application Design Process

SUSTAINABILITY AWARENESS

Microservice annotation with computational requirements, QoS constraints, and power consumption metadata



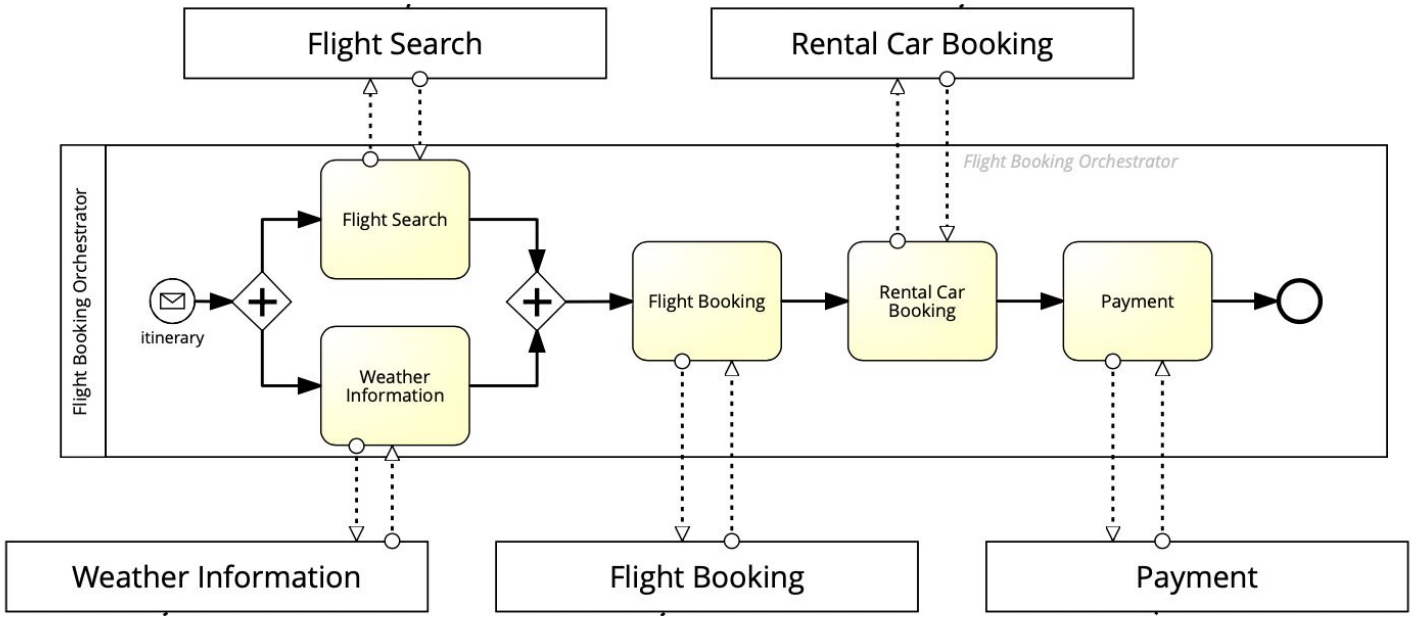
MICROSERVICE ENRICHMENT

Designers provide different execution modalities for the microservices composing the application

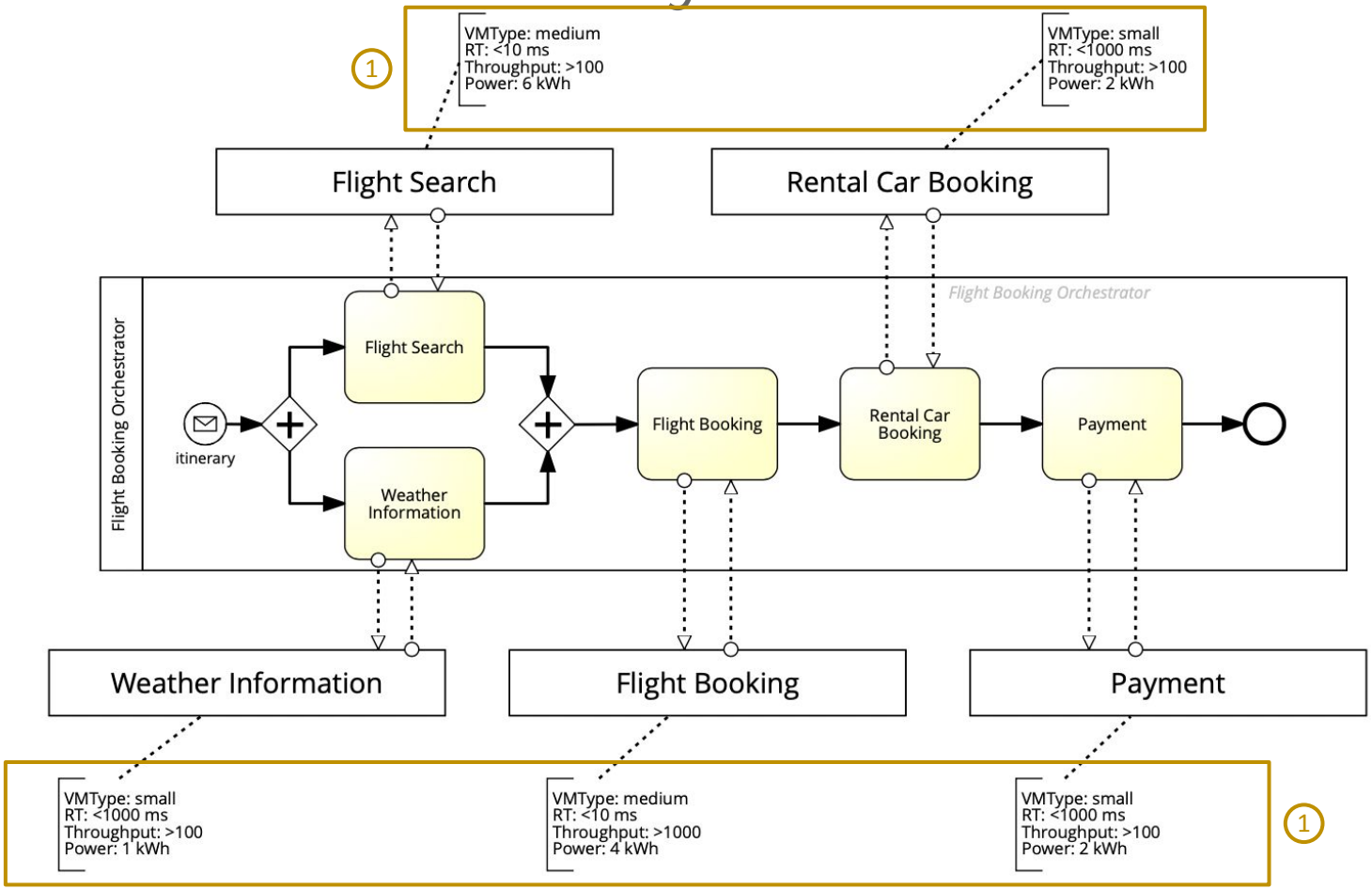
MICROSERVICE CLASSIFICATION

Application components are annotated with their relevance for the overall process

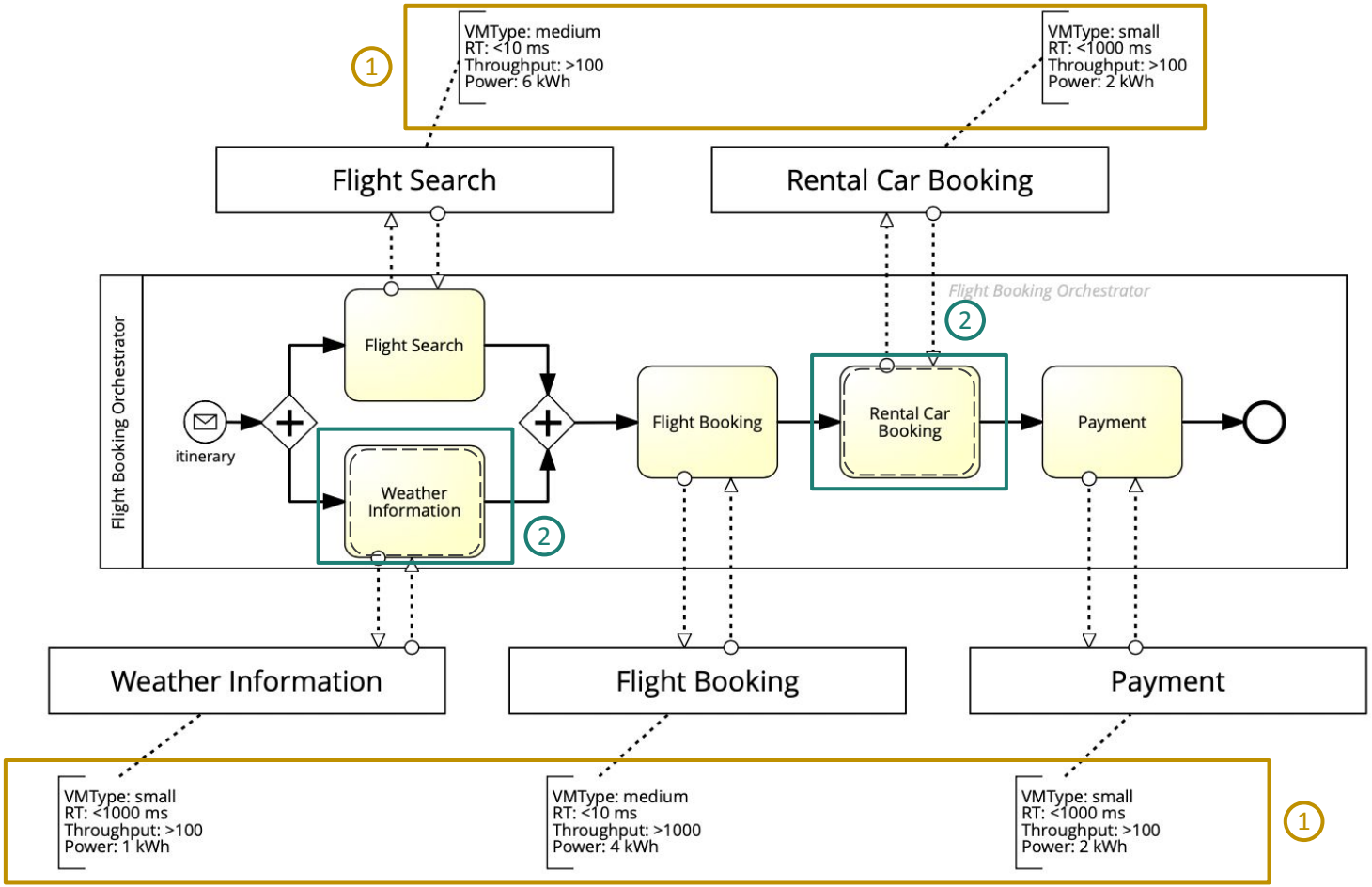
SADP 1 - Sustainability Awareness



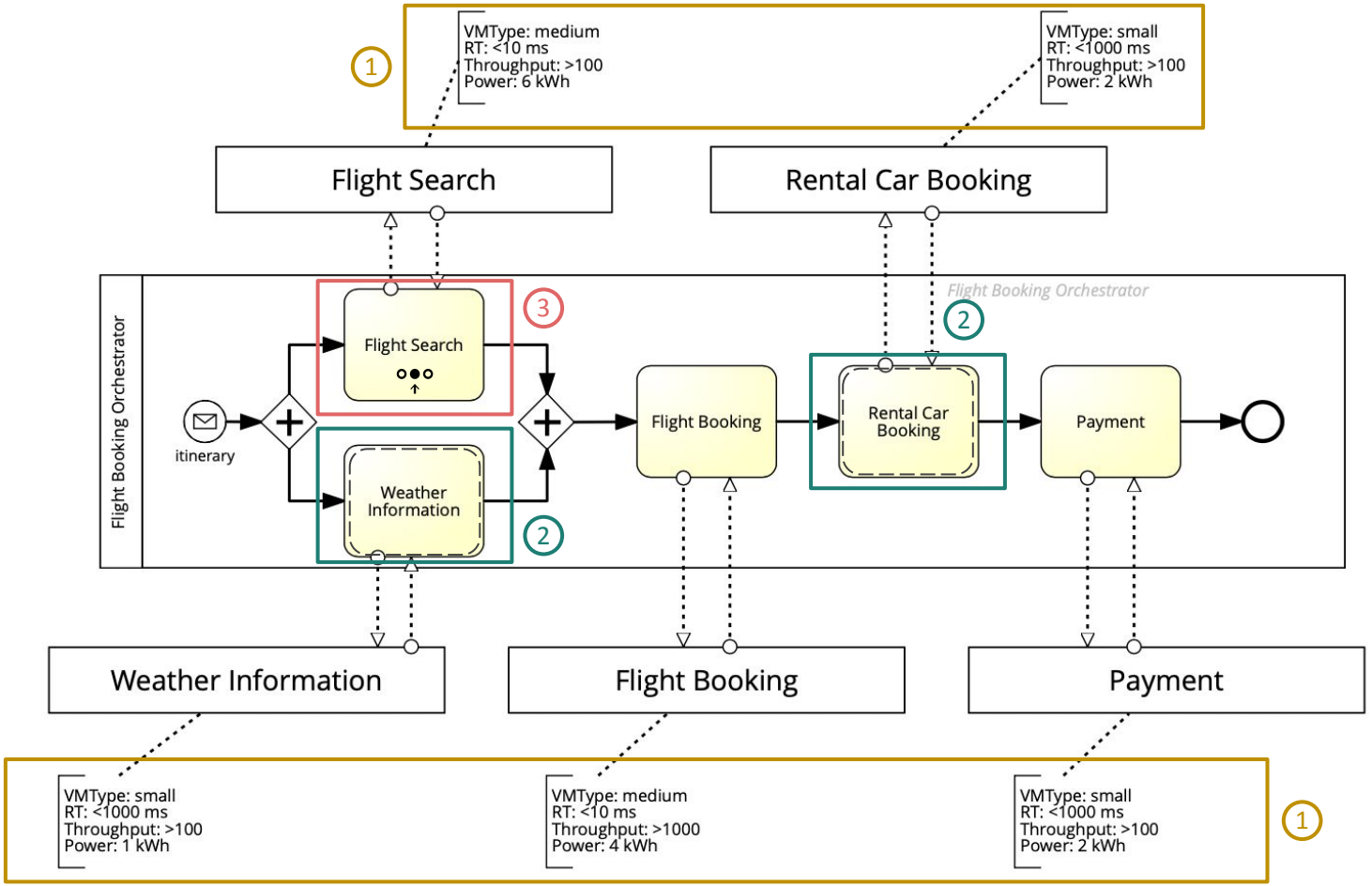
SADP 1 - Sustainability Awareness



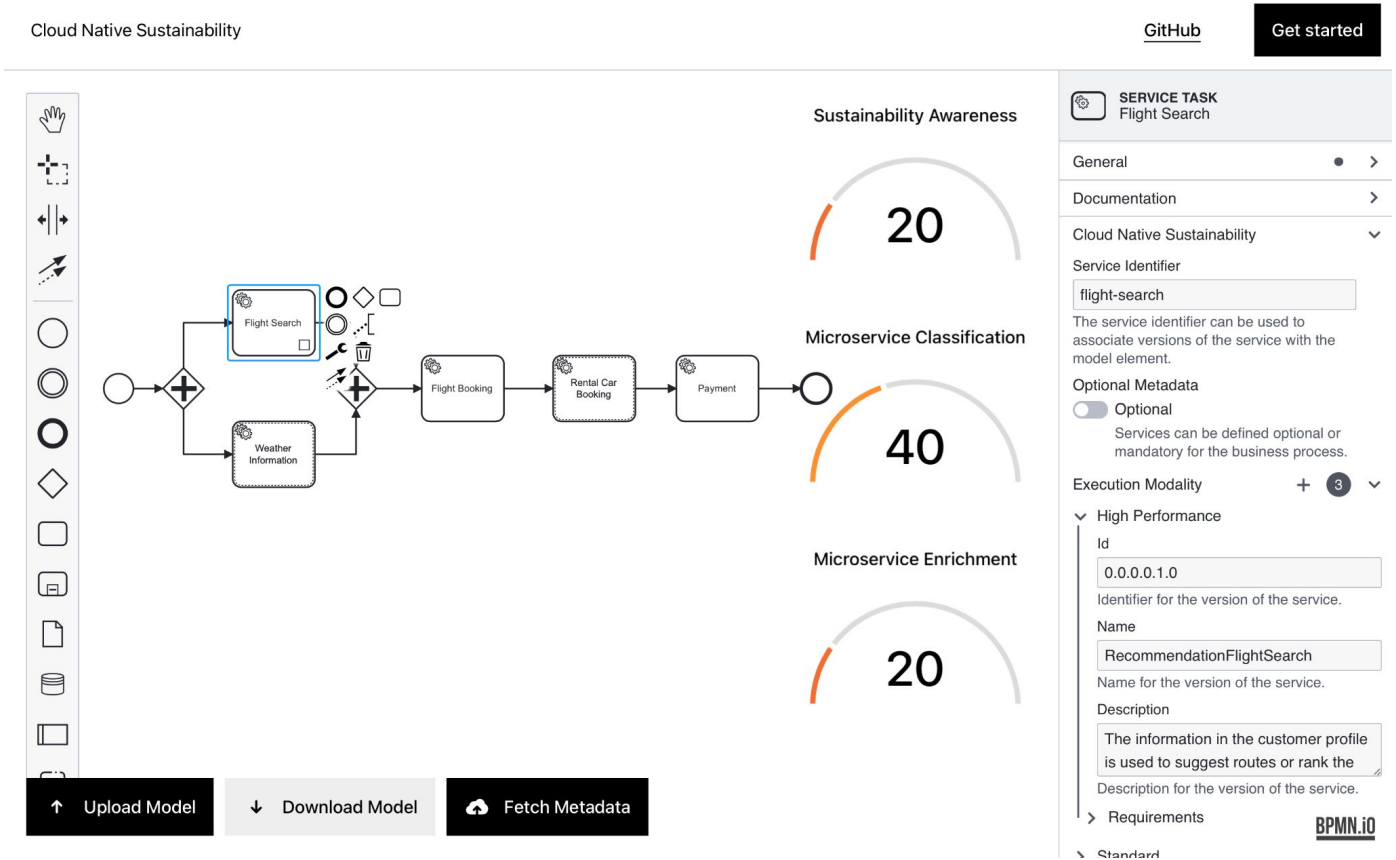
SADP 2 - Microservice Classification



SADP 3 - Microservice Enrichment

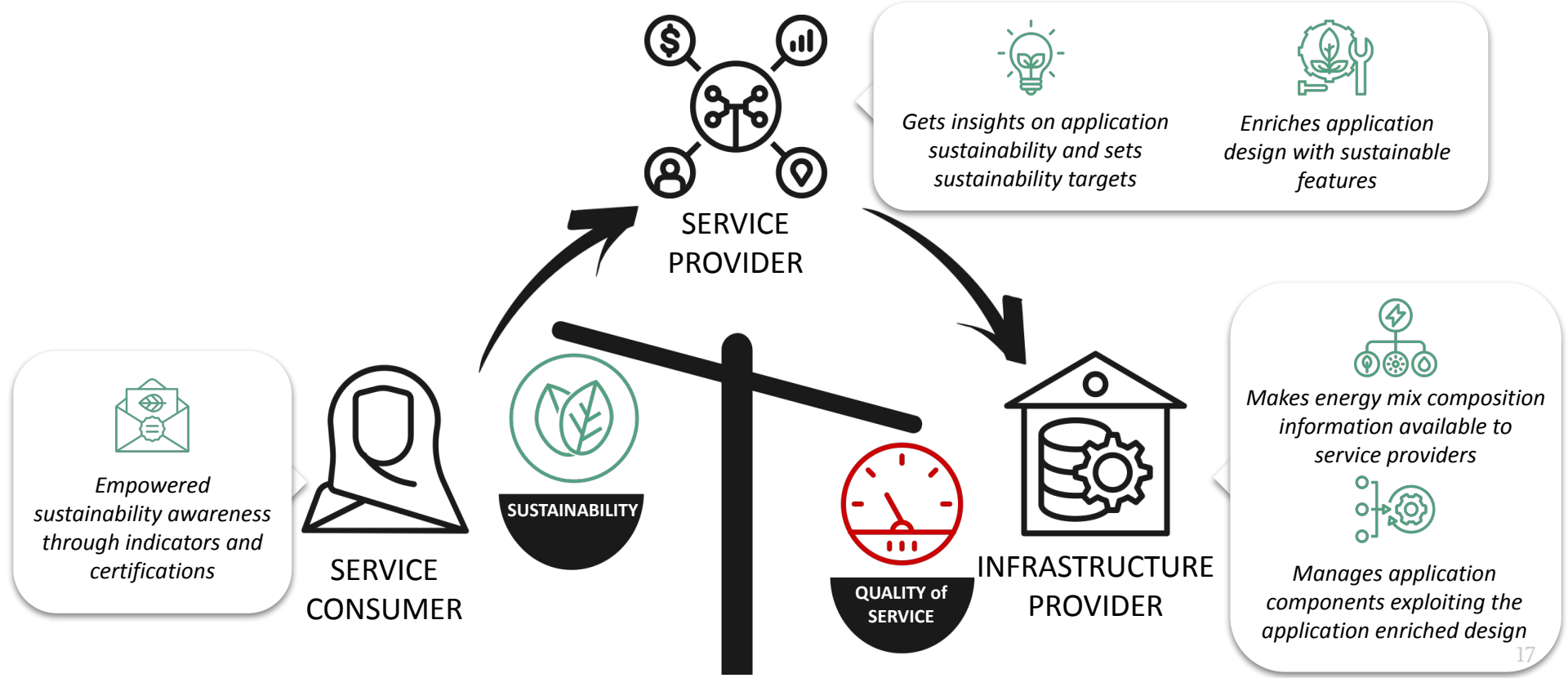


SADP - Supporting green applications design



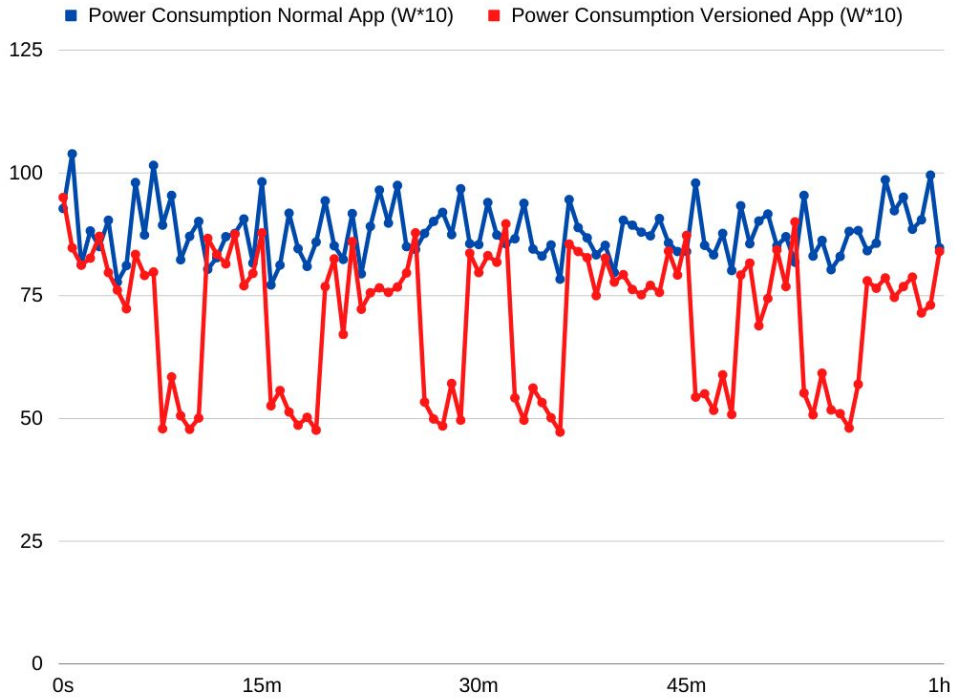
https://github.com/valentinbootz/app-cloud-native-sustainability

DESIGN IS ONLY A PIECE OF THE PUZZLE

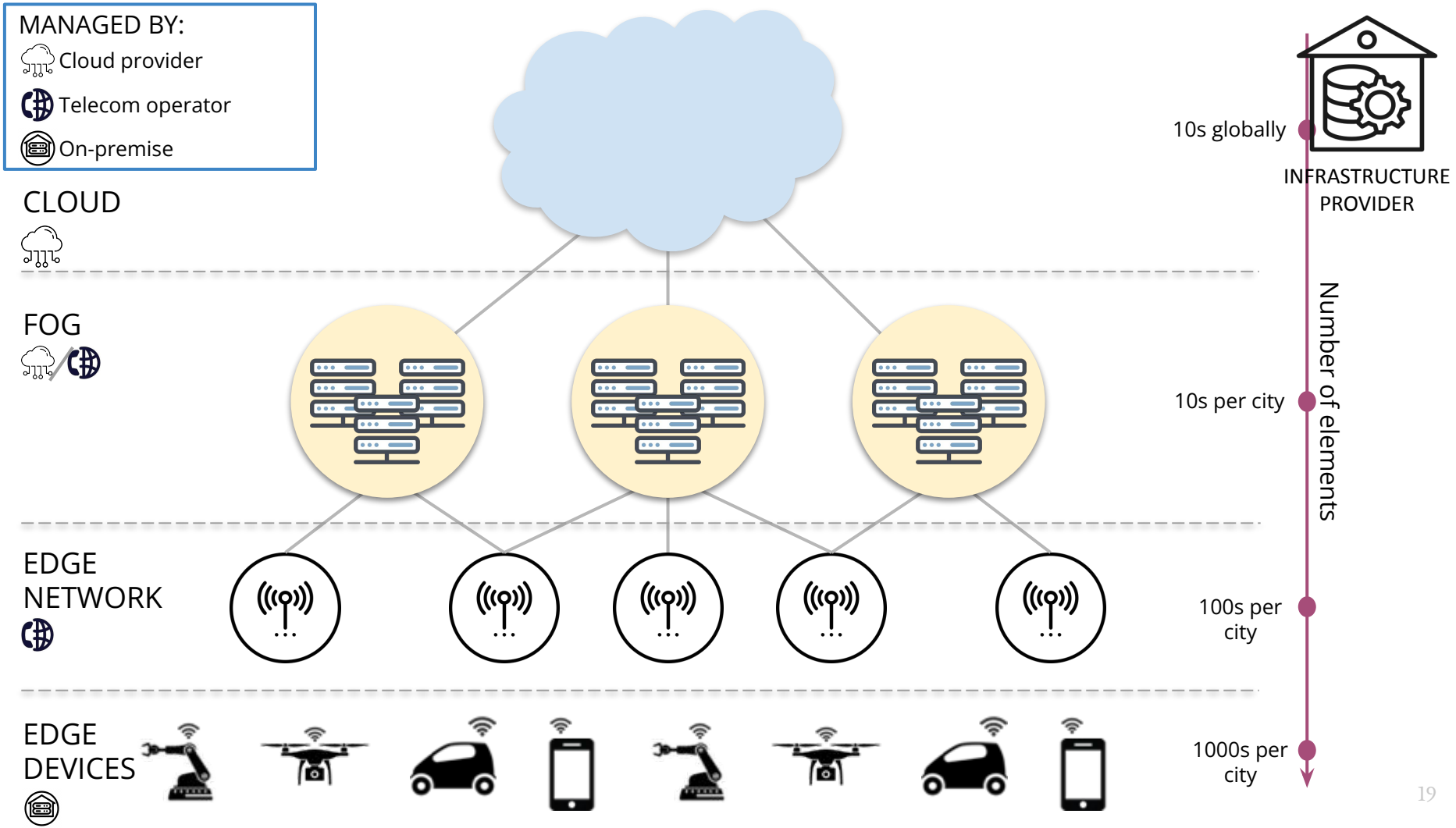


CONTEXT-AWARE DEPLOYMENT

INFRASTRUCTURE PROVIDER

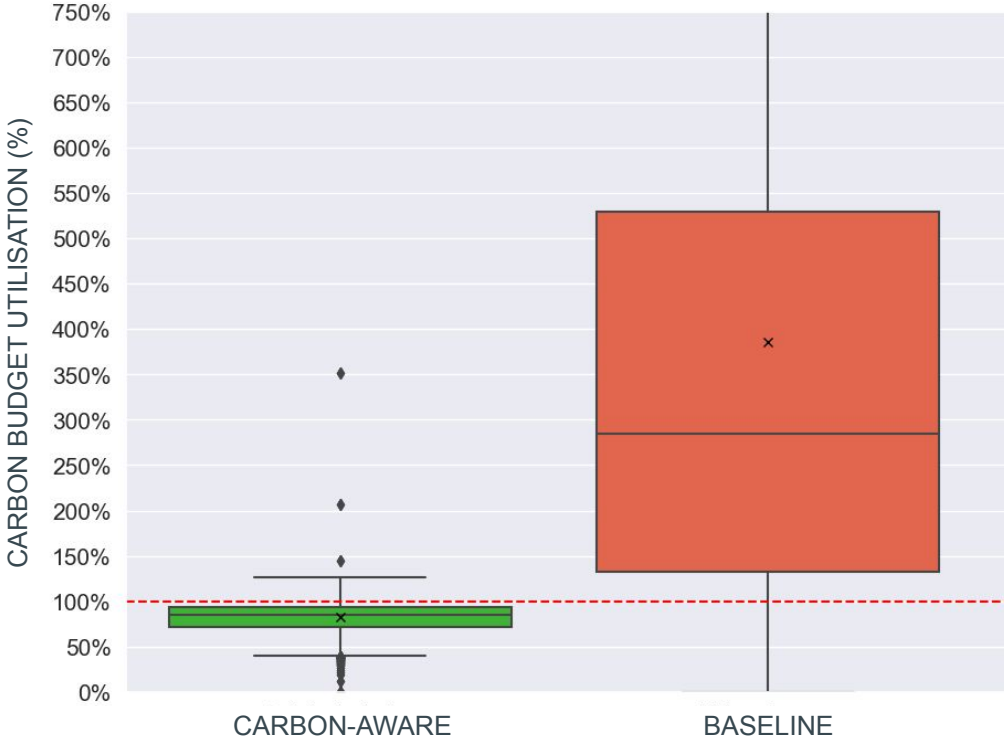


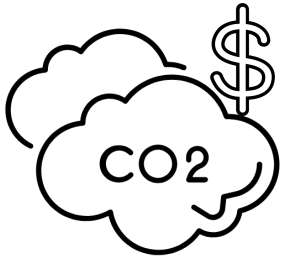
- 20% energy


MANAGED BY:
Cloud provider
Telecom operator
On-premise
CLOUD
FOG
EDGE NETWORK
EDGE DEVICES
10s globally
INFRASTRUCTURE PROVIDER
10s per city
100s per city
1000s per city
Number of elements

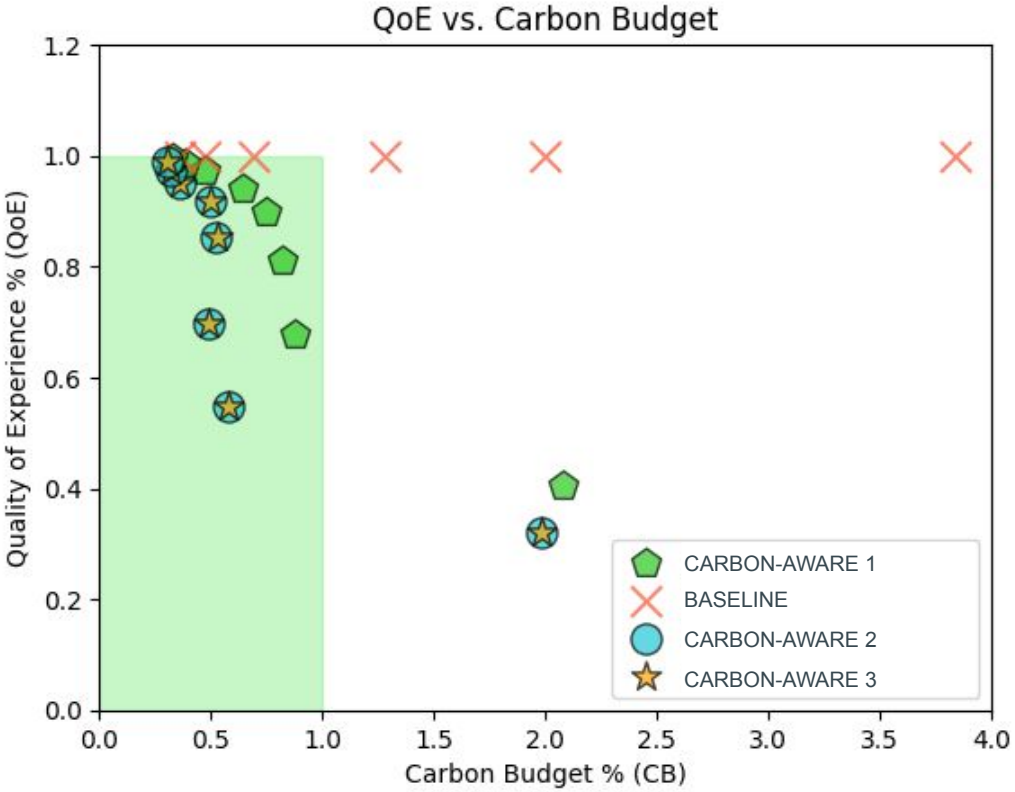
CONTEXT-AWARE DEPLOYMENT

INFRASTRUCTURE PROVIDER





CONTEXT-AWARE DEPLOYMENT



INFRASTRUCTURE PROVIDER

CONCLUSIONS

IS sustainability requires the involvement of all the stakeholders

A sustainability-aware design enables a **greener application management**

Preliminary results shown feasibility and energy reduction

The tradeoff between sustainability and QoE/revenue need to be explored

THANK YOU FOR YOUR ATTENTION

INFORMATICS EUROPE

SADP Sustainable Application Design for Greener Applications in the Cloud

•••

Monica VITALI
monica.vitali@polimi.it

TEADAL

POLITECNICO MILANO 1863

October 29, 2024