Melodic

optimized multicloud

MELODIC:

Optimized Hybrid Cloud Application Management for AI and Big-Data

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 731664.

WHY IS A SOLUTION NEEDED?

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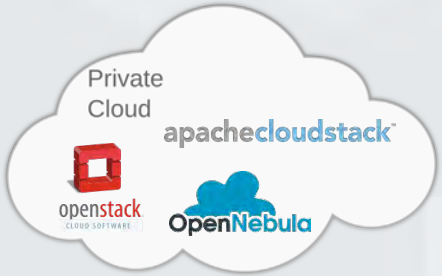
No optimal solution today…

- ✗ Cost Effectiveness
- ✗ Management Flexibility
- ✗ Resource Utilization
- ✓ Privacy and Confidentiality



- ✗ Cost Effectiveness
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- ✓ Cost Effectiveness
- ✓ Management Flexibility
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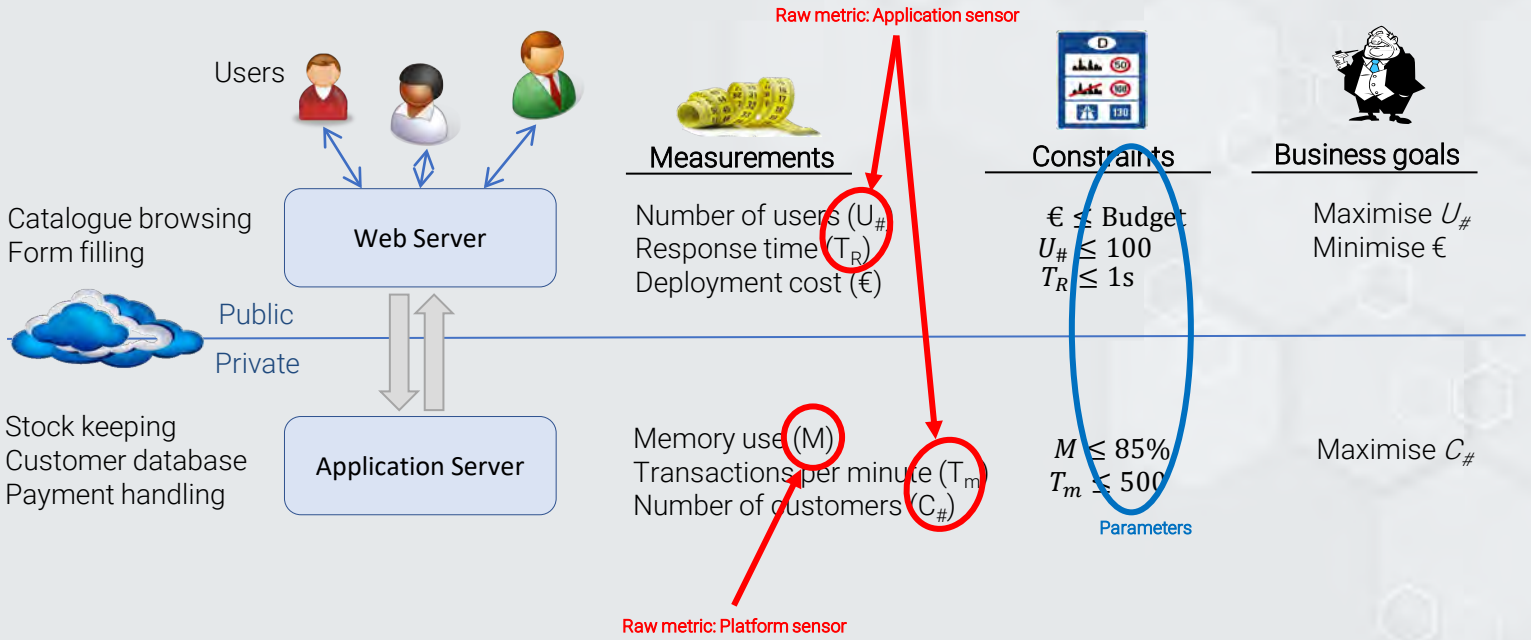
- ✗ Vendor Lock-In

Application requirements

- Variable resource demand
  - Reactive to changing execution context
  - Balance of cost – performance – experience
- Long running
  - Data dependencies
  - Usage dependencies
- Black box
  - No code changes necessary or possible
  - Only architectural knowledge
  - Legacy code possible

Super shop



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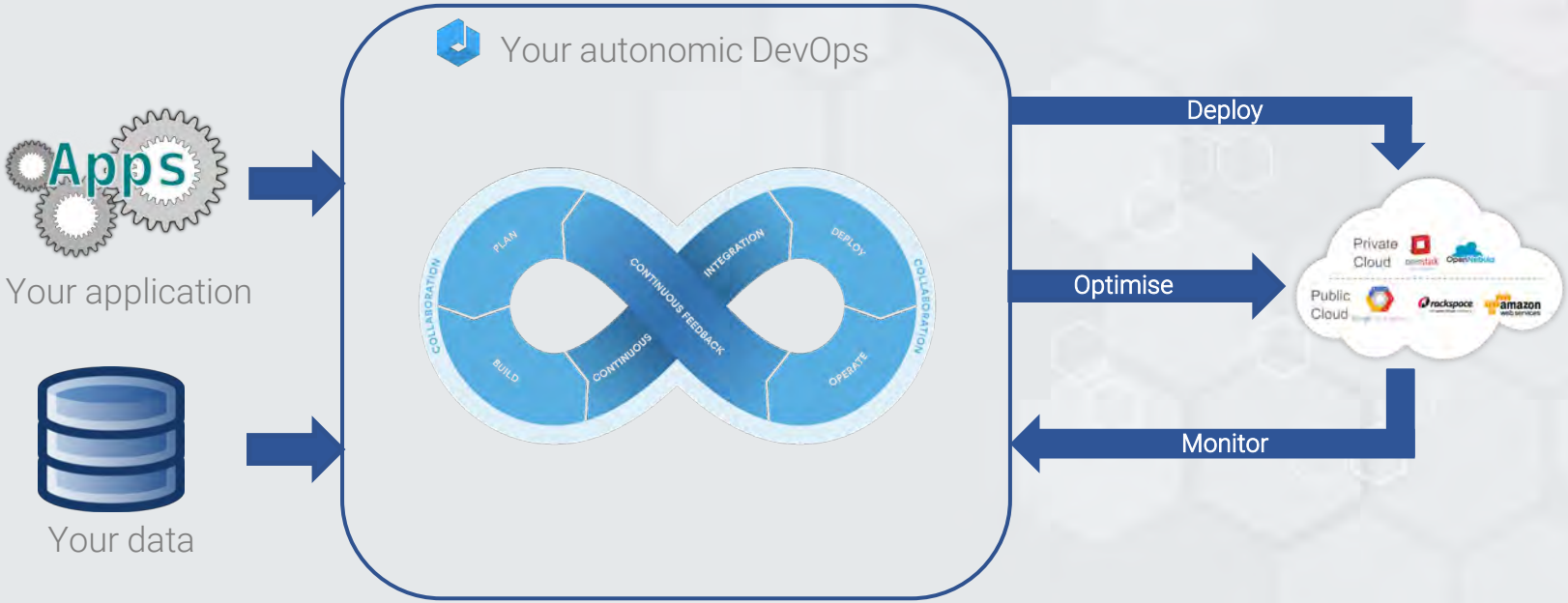
Variability control



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How does MELODIC work for real applications?

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Genome application – Big Data optimization

- Data parallel training of Genome models
- Uses Spark to manage the training
- Least possible cost
- Personalized medicine example application
- Timeliness required

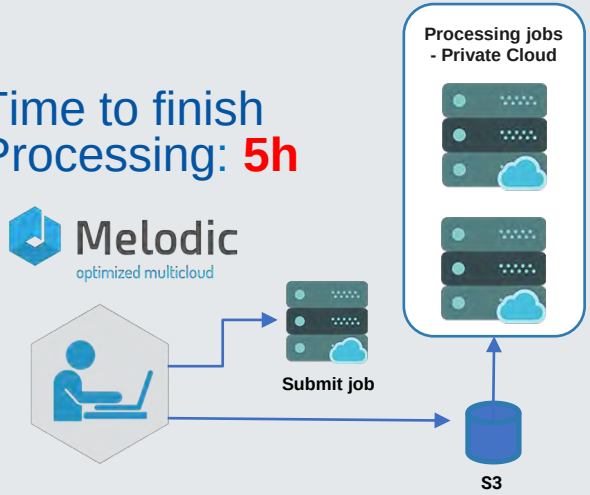
Deployment goal

- Train 50 Genome models
- In about one hour
- Minimal number of resources (cost)

- Two utility dimensions:
  1. Cost
  2. Performance

Genome – Spark Application

Time to finish Processing: **5h**



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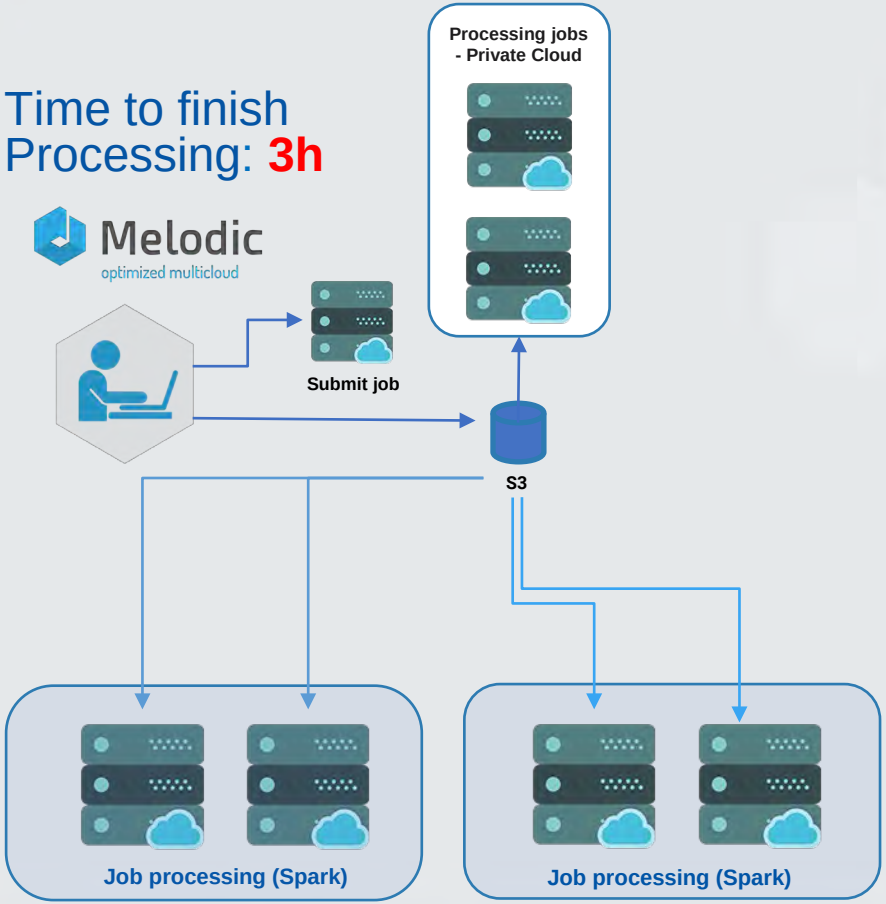
Genome – Spark Application

Time to finish Processing: **3h**



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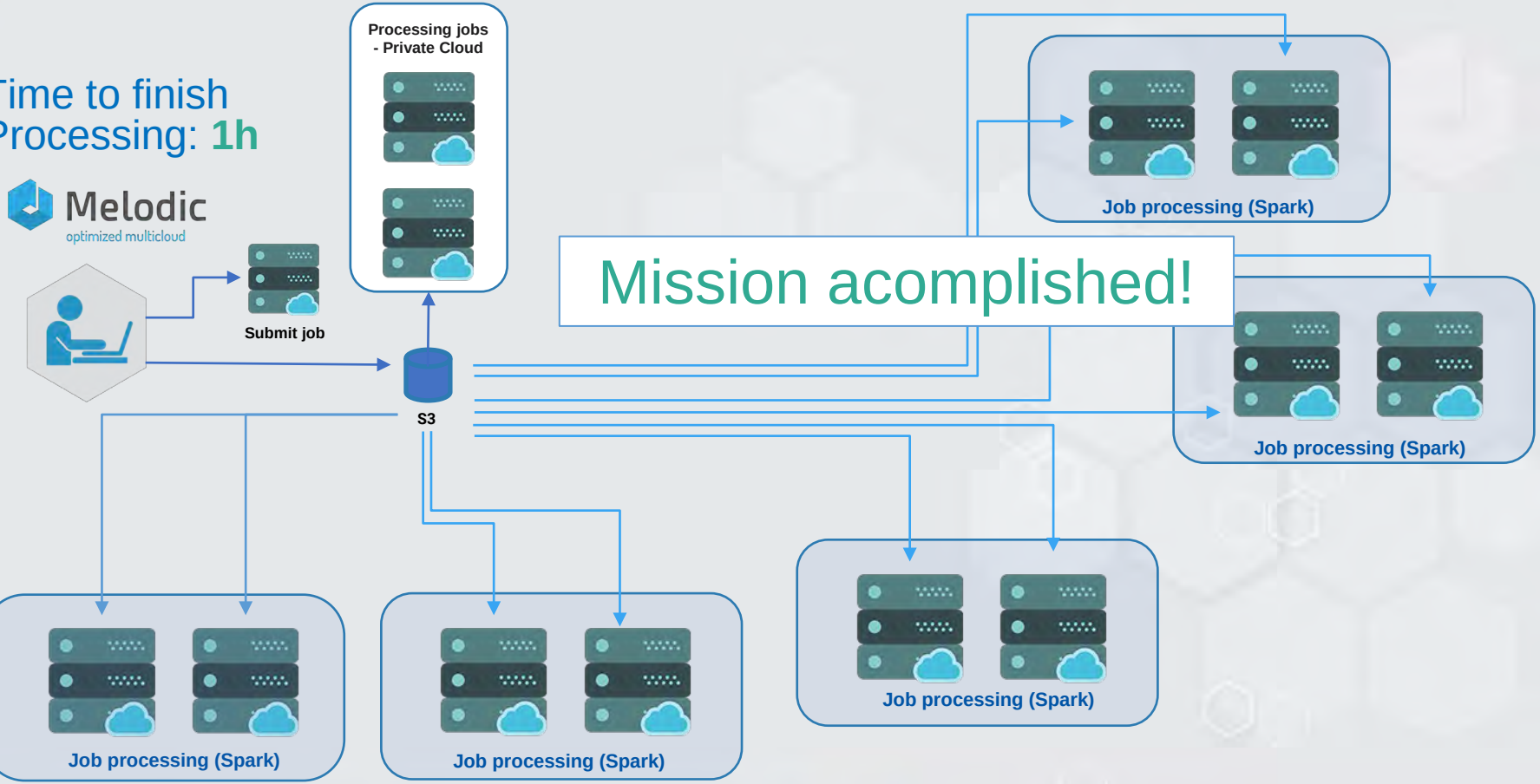
Genome – Spark Application

Time to finish Processing: **1h**



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Download Melodic at

http://www.melodic.cloud/download/

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HOW DOES IT WORK?

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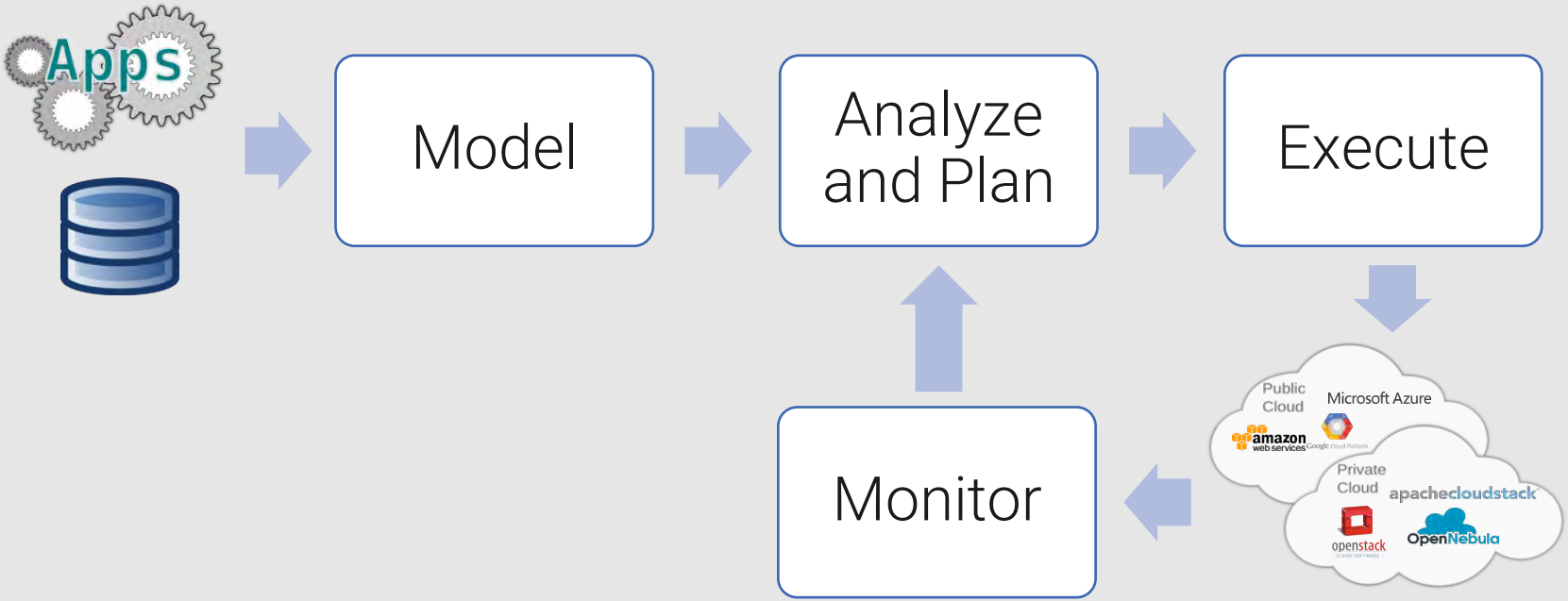
Autonomic Cloud computing loop



An architectural blueprint for autonomic computing, IBM, White Paper on Autonomic Computing, Third Edition, June 2005

Basic concepts: Constraints & Variables

Variables

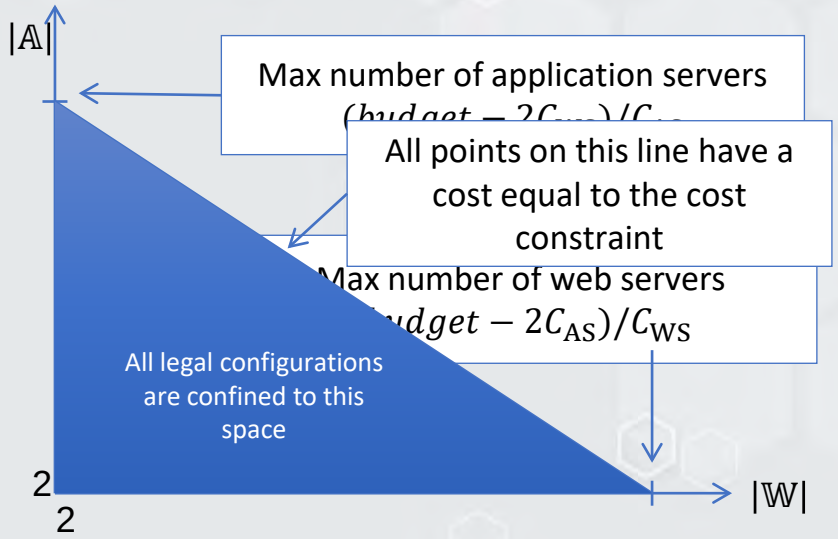
Assume a limited budget, i.e. a cost constraint:

$$C_{\mathrm{WS}} \times |\mathbb{W}| + C_{\mathrm{AS}} \times |\mathbb{A}| \leq budget$$

With

$$\mathbb{W} = \{\mathrm{WS}_1, \mathrm{WS}_2, \cdots, \mathrm{WS}_{|\mathbb{W}|}\} \text{ and } \mathbb{A} = \{\mathrm{AS}_1, \mathrm{AS}_2, \cdots, \mathrm{AS}_{|\mathbb{A}|}\}$$

$\mathbb{W}$ = Set of Web Servers (WS)
$\mathbb{A}$ = Set of Application Servers (AS)
C_{WS} = Cost of a web server
C_{AS} = Cost of an application server
Minimum two servers of each kind must be deployed.



Scalability domain

From the requirements

$$|\mathbb{W}| = [2, |\mathbb{W}|_{\max}]$$

And

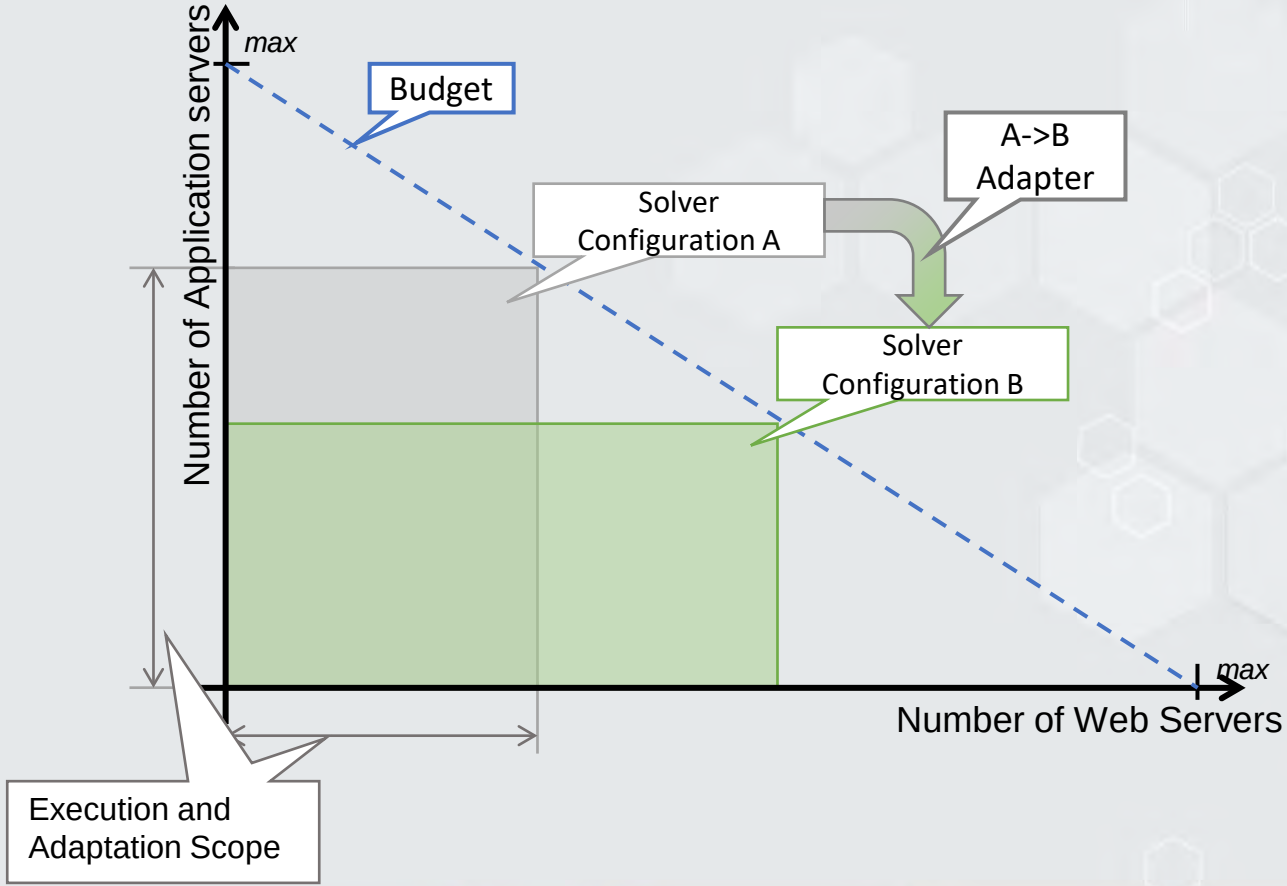
$$|\mathbb{A}| = [2, |\mathbb{A}|_{\max}]$$

Alternative variables to be assigned a value by the optimizer

Subject to

$$C_{\mathrm{WS}} \times |\mathbb{W}|_{\max} + C_{\mathrm{AS}} \times |\mathbb{A}|_{\max} \leq budget$$

Adaptation


Number of Application servers
max
Budget
A->B
Adapter
Solver
Configuration A
Solver
Configuration B
max
Number of Web Servers
Execution and
Adaptation Scope

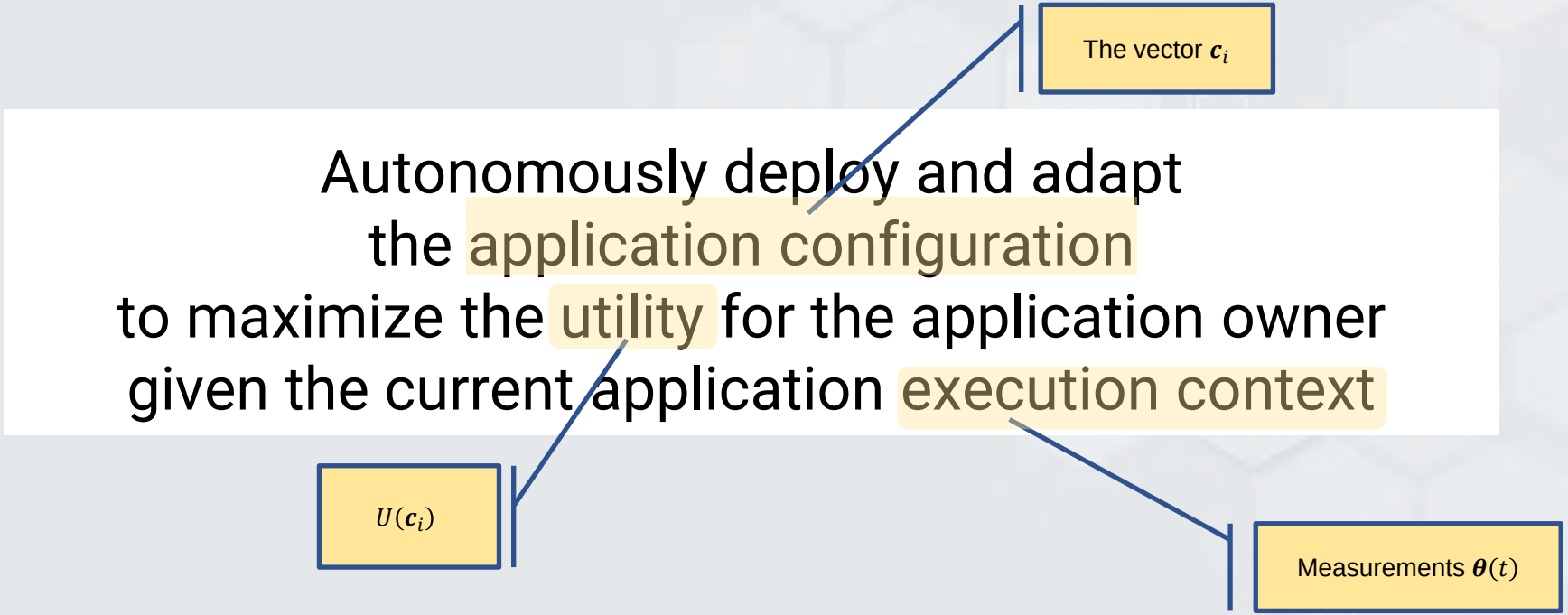
Utility

- Always exists for every *choice*
- Maximizing utility is the rational *decision*
- Normally *multi-dimensional*
- Concept of Economy[1]
- Autonomic computing vision[2]

[1] Peter C. Fishburn (1970): *Utility theory for decision making*, Publications in Operations Research, Vol. 18, ISBN 0-471-26060-6 978-0-471-26060-8, Wiley

[2] Jeffrey O. Kephart and Rajarshi Das (2007): Achieving Self-Management via Utility Functions, *IEEE Internet Computing*, Vol. 11, No. 1, pp. 40-48, January

Autonomic Cross-Cloud Application Management



WHAT IS MELODIC?

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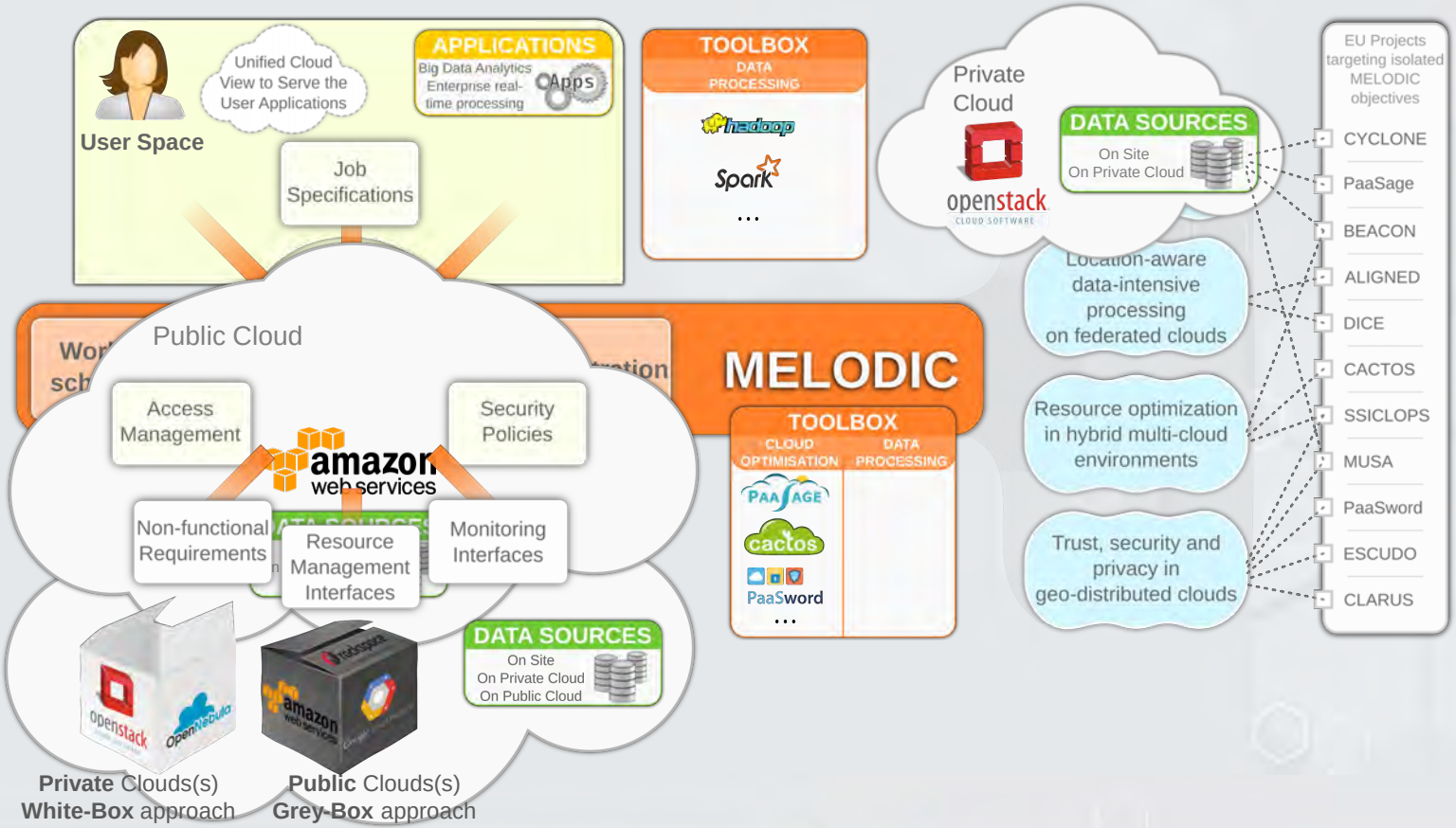
Architecture



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A single universal platform
for optimized deployment and management
of applications in the cloud.

Actually Cross-Cloud
and Open Source

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Melodic - why?

- Simple and easy way to use multicloud approach.
- Unified way to deploy VMs, containers, serverless and big data to different Cloud Providers.
- Automatic deployment to different Cloud Providers.
- Automatic optimization of cloud resources.

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Melodic - key features

- Automatic deployment of the application in the cloud
- The ability to select optimal deployment option based on application characteristics and defined utility
- Support for Big Data frameworks and data locality awareness
- Security - centralized authentication and authorization of applications
- Enterprise ready - Highly Available and Scalable

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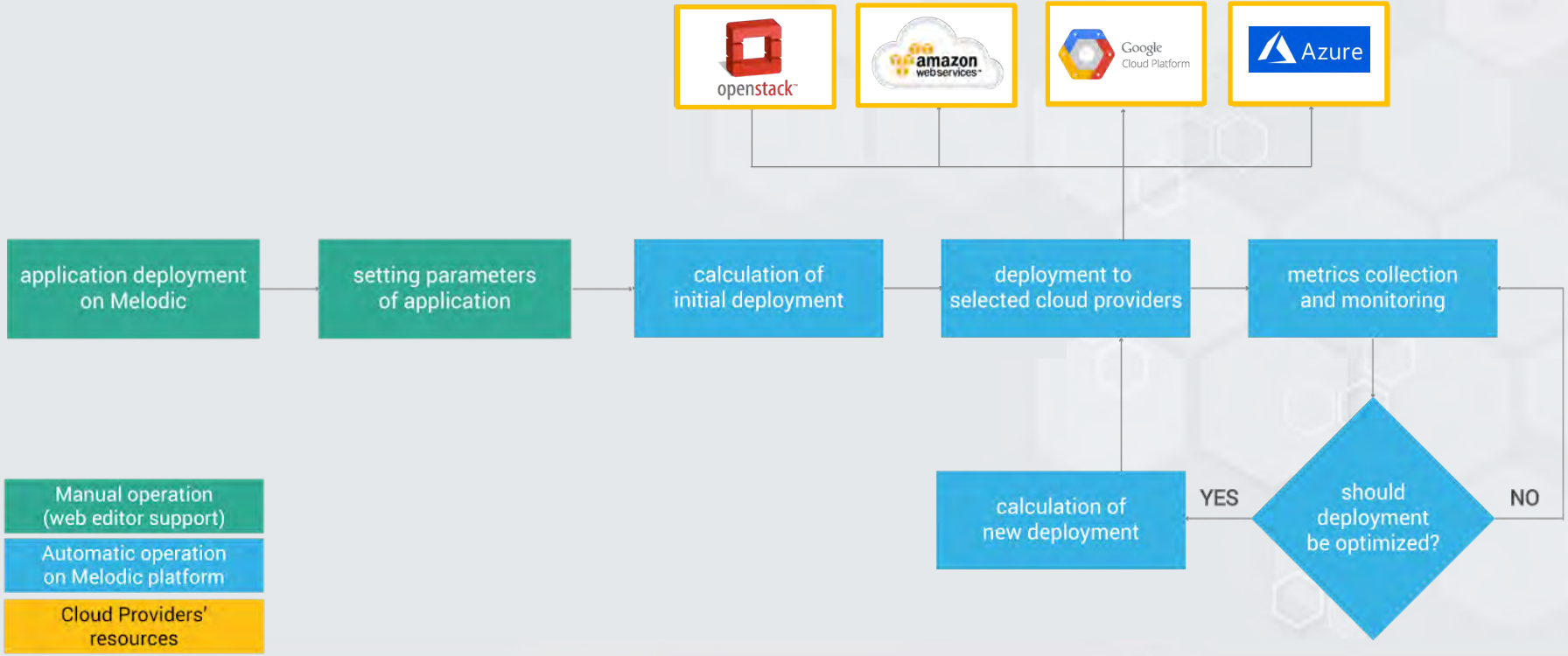
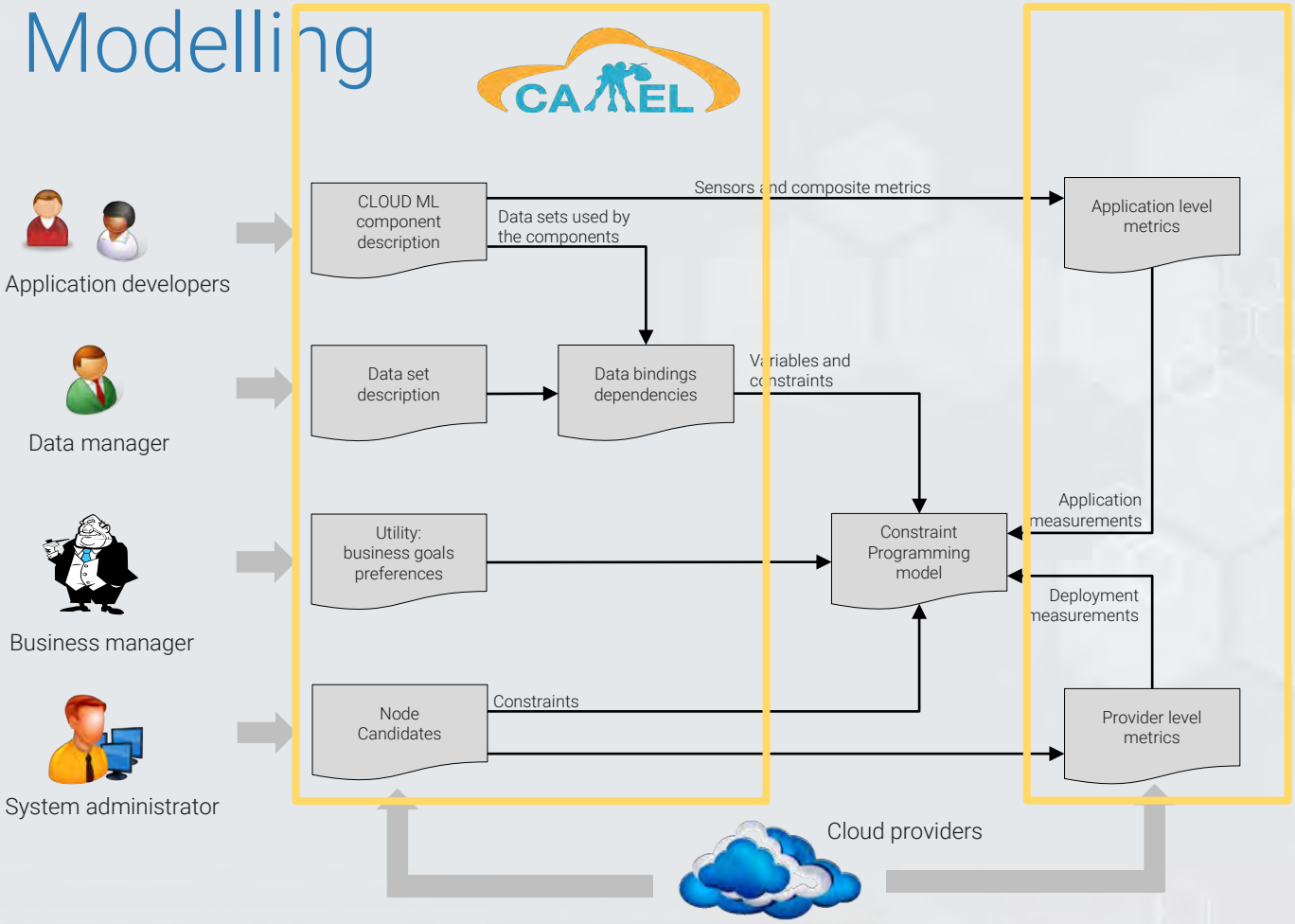
Melodic - optimization and automation



Modelling



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Melodic – Cloud Application Modelling and Execution Language

- Cloud agnostic language, similar to TOSCA
- Application modelling: components, connections, security, etc.
- Infrastructure requirement modelling
- User requirements, constraints, and utility

Unified way of describing application and infrastructure in the Cloud

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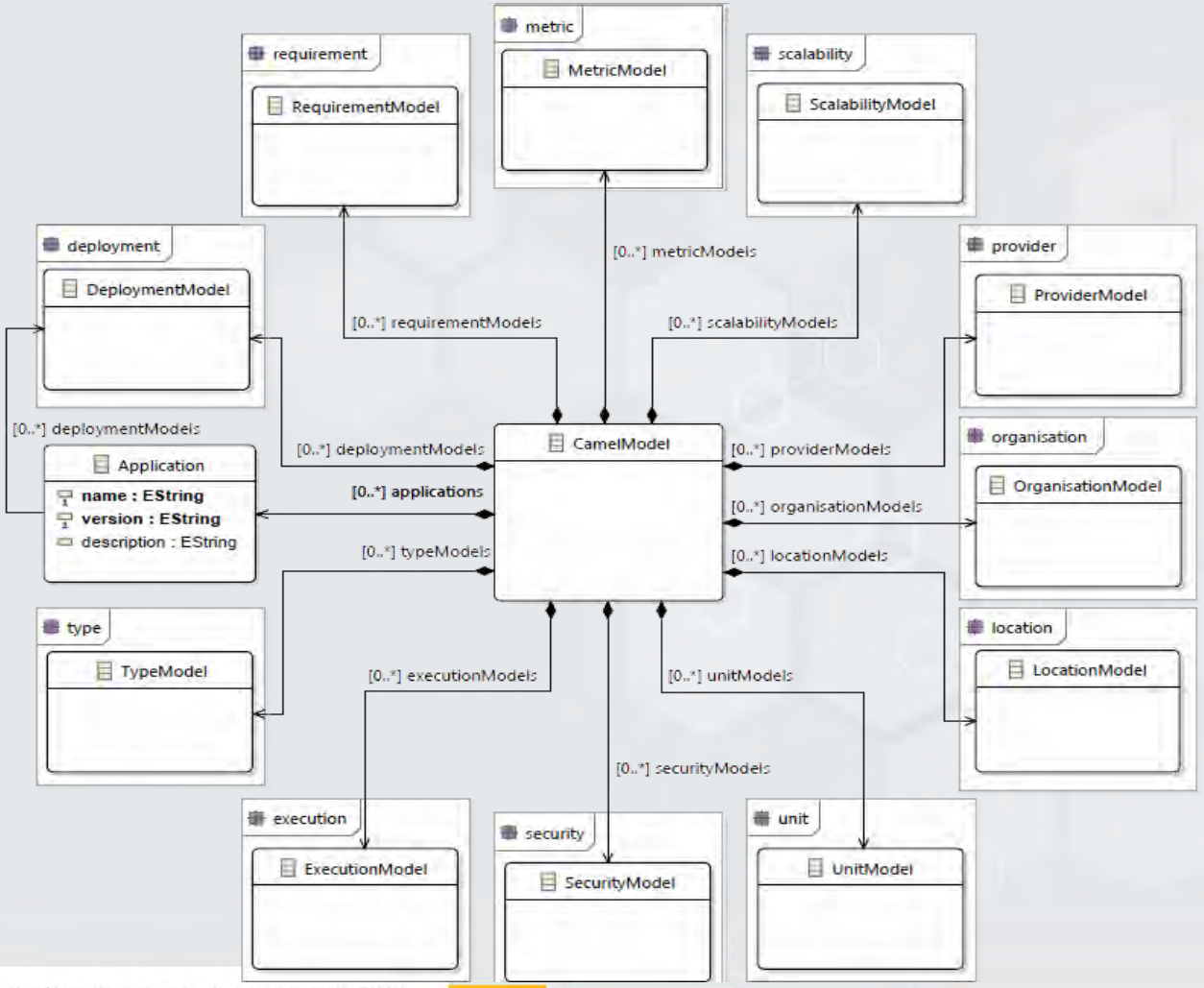
CAMEL

Unified way
of describing
application
and infrastructure
in the Cloud



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Melodic - what is the best deployment?

- Metric collection of the running application
- Flexible way to calculate utility for particular application
- Focus on business value of the application
- Optimize the trade-off of cost, performance, availability etc.

Melodic is your smart, autonomic DevOps

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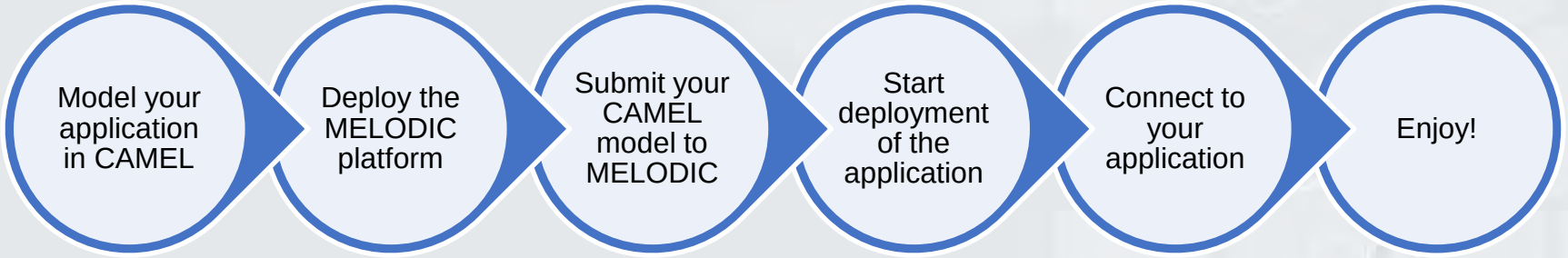
Workflow



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Melodic consortium

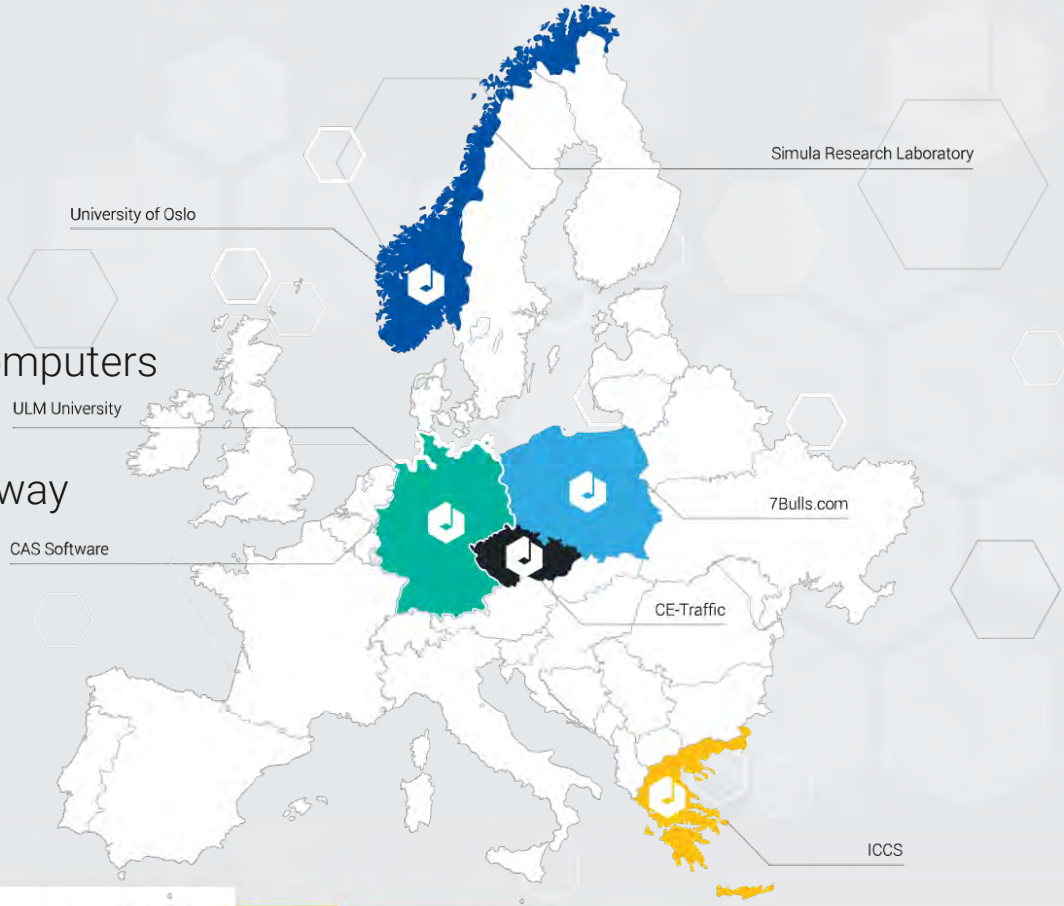
- University of Oslo – Norway
  leader of the consortium

Academic partners:

- University of Ulm – Germany
- Institute of Communication and Computers Systems – Greece
- Simula Research Laboratory – Norway

Business partners:

- CAS Software – Germany
- CE-Traffic – Czech Republic
- 7bulls.com – Poland



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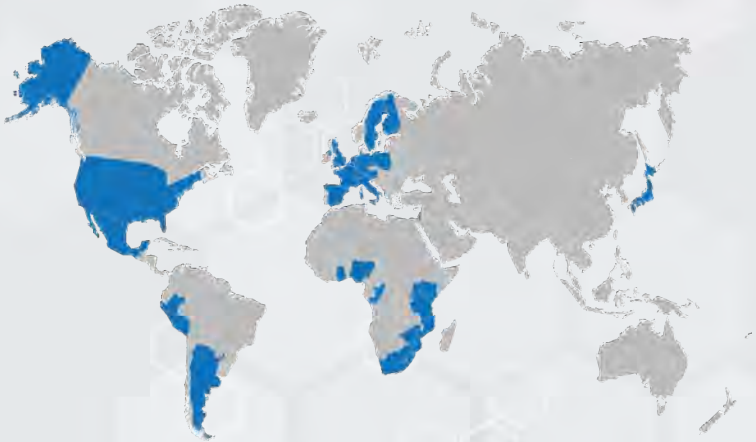
7bulls.com

- IT software development & integration
- Cloud computing, AWS partnership
- Over 150 employees (dev, test, arch, devops)
- 15 years of experience in IT for the industry
- Knowledge of enterprise cloud solutions



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Thank you!

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