Elasticity Engineering

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What is elasticity?

What is elastic computing?

Views on Elasticity

1. Demand elasticity

   Elastic demands from consumers

2. Output elasticity

   Multiple outputs with different price and quality

3. Input elasticity

   Elastic data inputs, e.g., deal with opportunistic data

4. Elastic pricing and quality models associated resources

Multi-dimensional Elasticity

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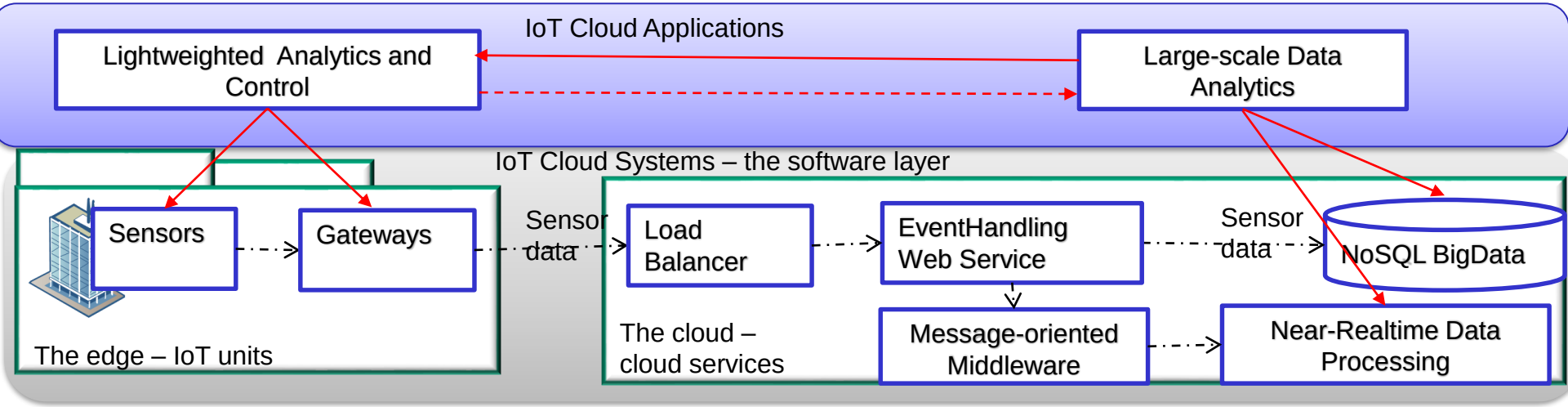
- Multi-dimensional elasticity
  - Resources, quality, and costs
- Elasticity in hybrid systems of human-based, things-based and software-based computing resources
  - Software, things and human capabilities as computing resources in multi clouds
- End-to-end approach
  - the whole system and subsystems
  - Single provider and multiple providers

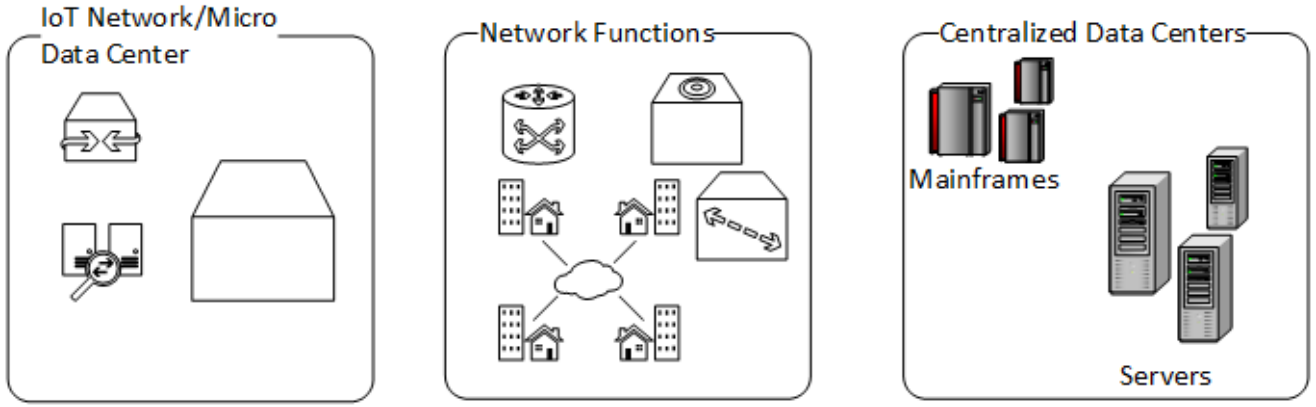
BUT HOW DO WE CARRY OUT ELASTICITY ENGINEERING?

Elasticity in slices of IoT, Network functions and cloud resources

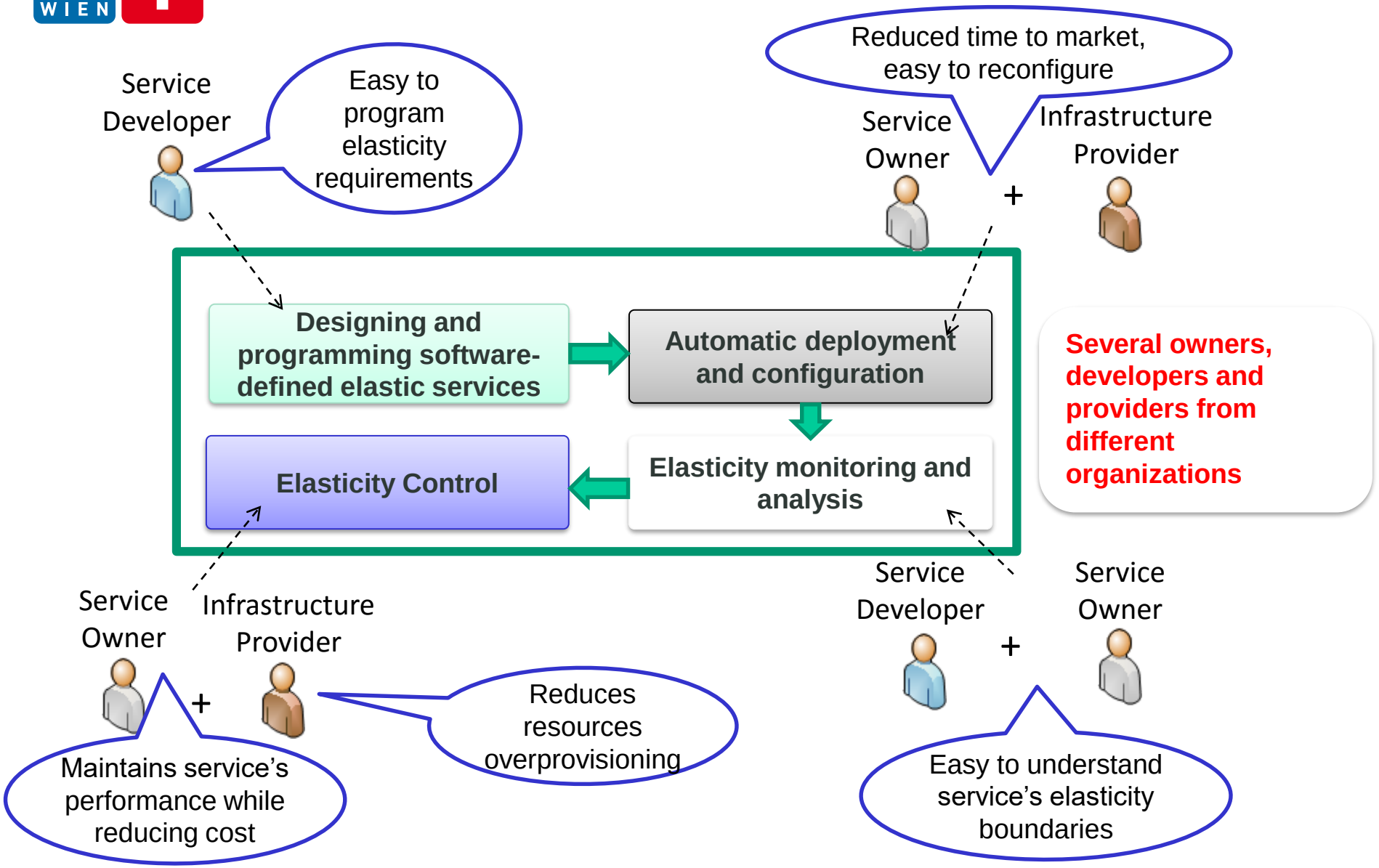
Application example



„IoT + Network functions + Clouds“



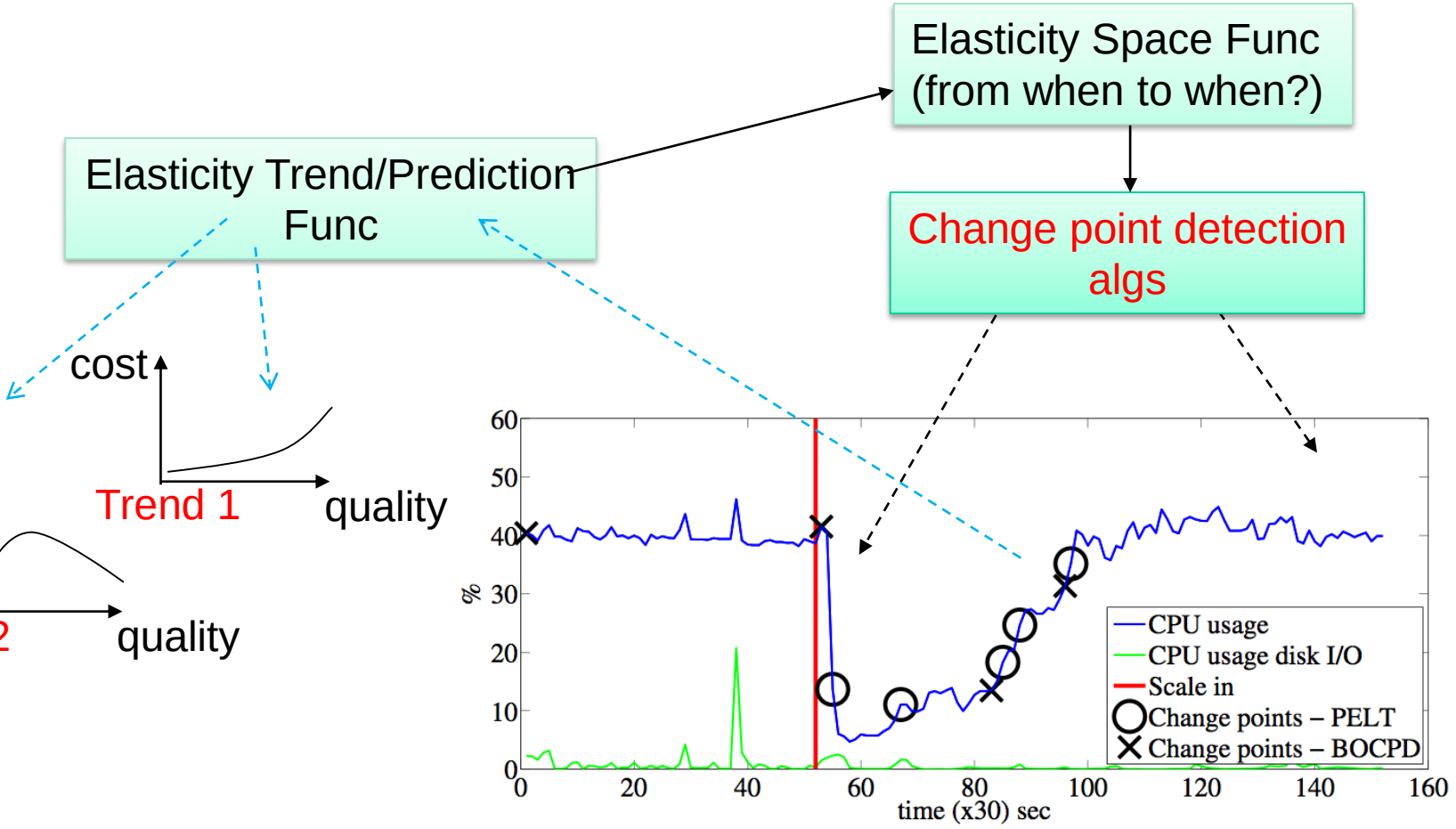
Tasks in Elasticity engineering



Fundamental building blocks for the elasticity

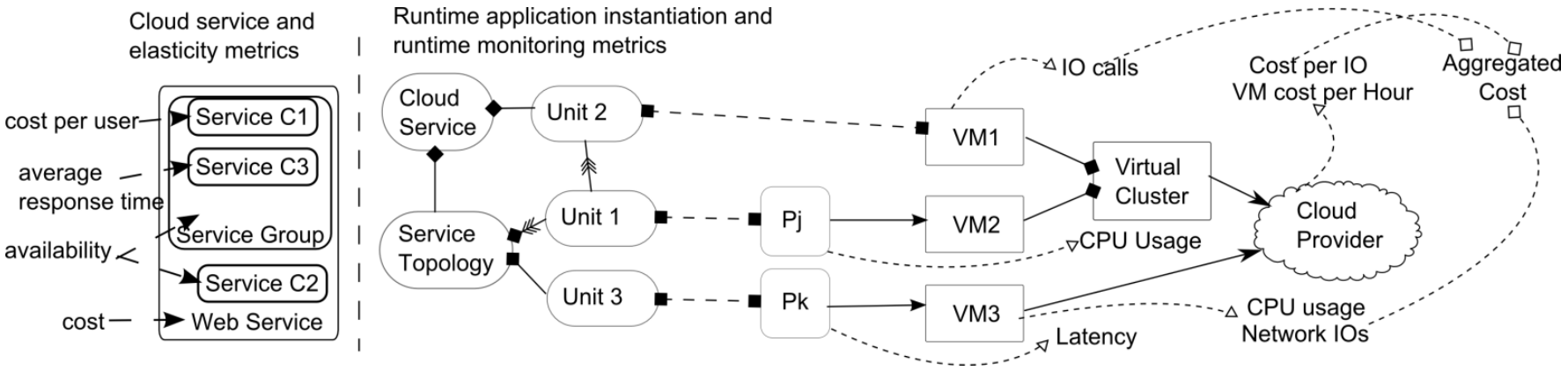
- Conceptualizing and modeling elastic objects (and their instances) and execution environments
  - Diverse types of artifacts and their runtime in a similar manner
- Defining and capturing elasticity primitive operations associated with elastic objects and environments
- Recommending and Programming elastic objects
  - A service system can be built from elastic objects
- Runtime deploying, control, and monitoring techniques for elastic objects

Elasticity Detection

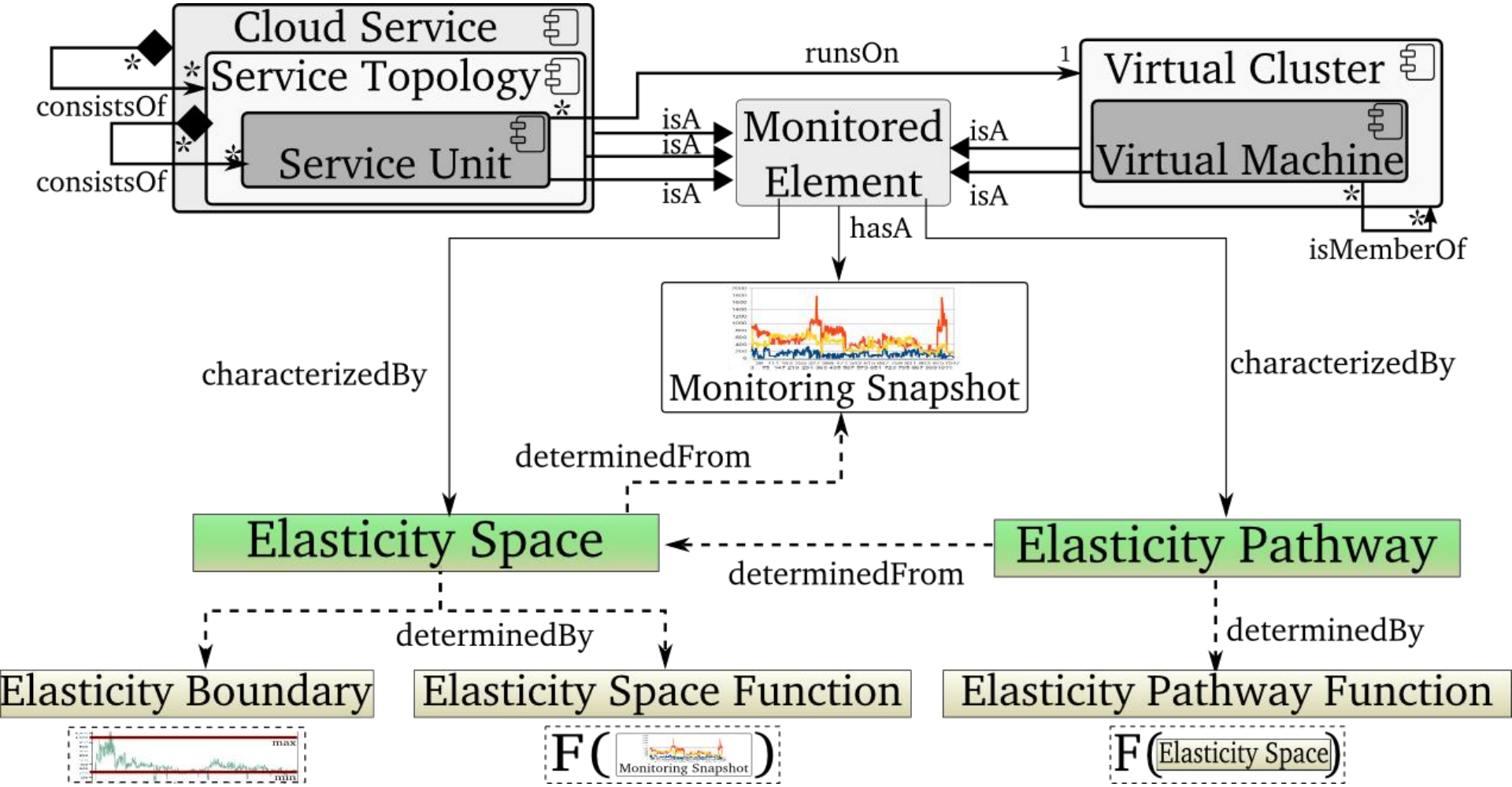


Alessio Gambi, Daniel Moldovan, Georgiana Copil, Hong Linh Truong, Schahram Dustdar: On estimating actuation delays in elastic computing systems. SEAMS 2013: 33-42

Mapping Services Structures to Elasticity Metrics



Multi-level monitoring and analysis

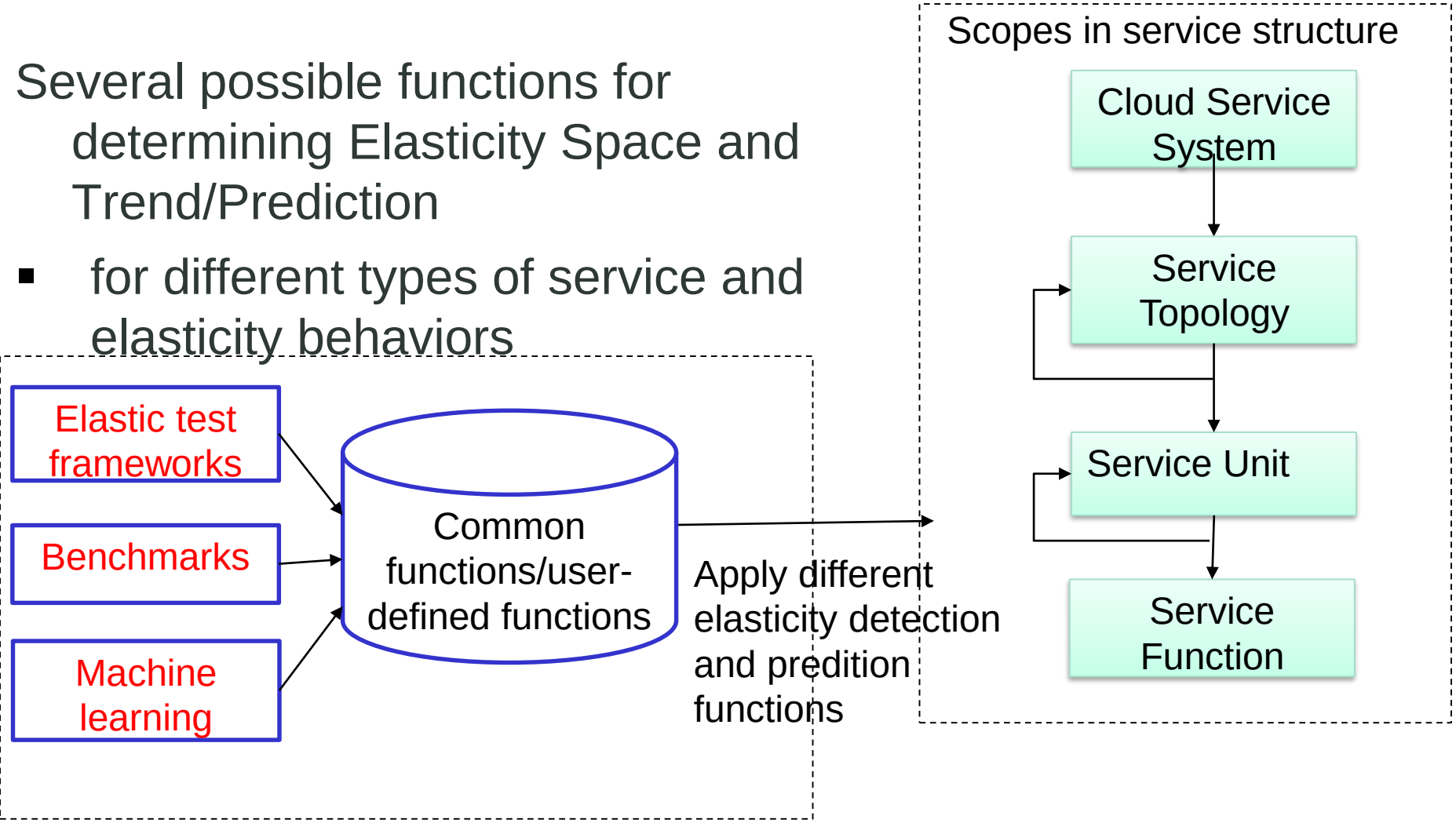


Note: Pathway=Trend

Multi-level cross platforms monitoring and analysis

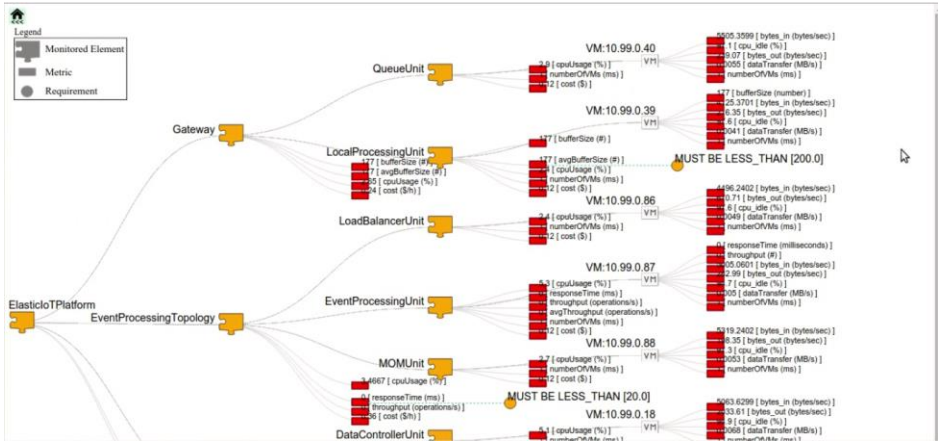
Several possible functions for determining Elasticity Space and Trend/Prediction

- for different types of service and elasticity behaviors

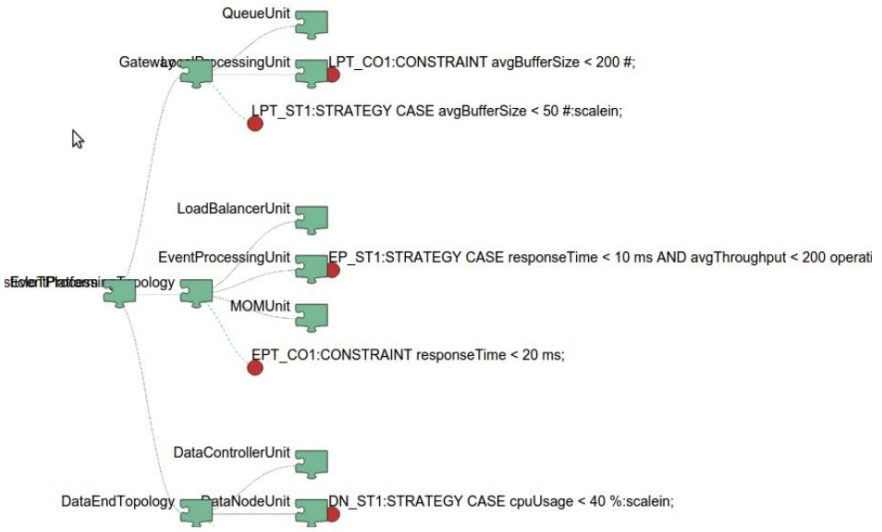


Elasticity reconfiguration/adjustment

Analysis detects problems but predefined strategies do not always work!

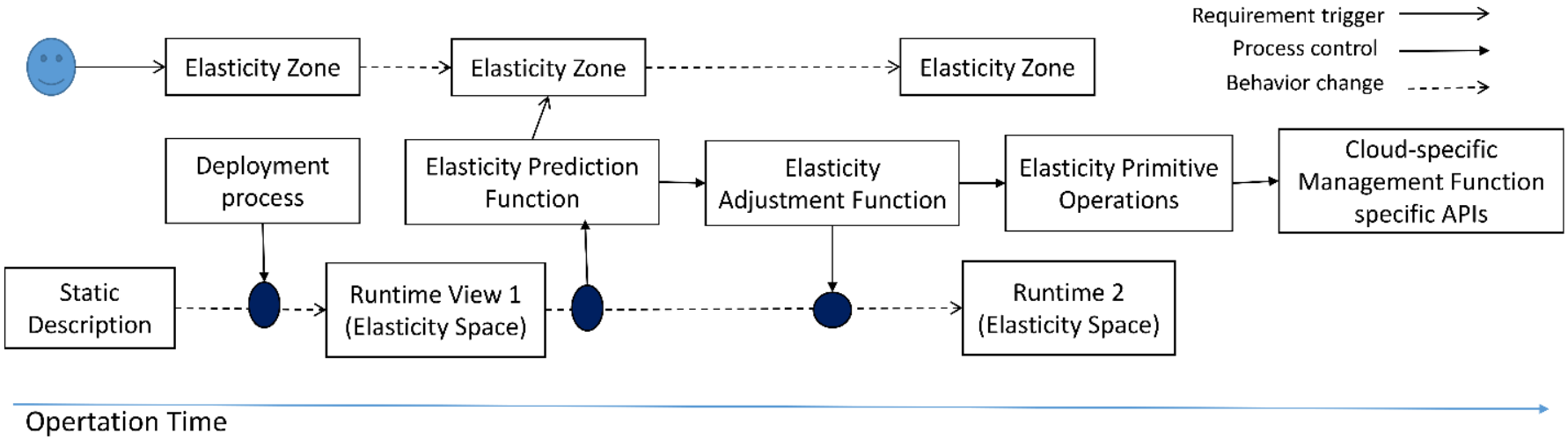


Changing elasticity specifications at runtime without stoping services



Put things together – Flows

„High-level but complete view“



Hong-Linh Truong, Schahram Dustdar, Frank Leymann, Towards the Realization of Multi-dimensional Elasticity for Distributed Cloud Systems (Submitted version), Cloud Forward Conference 2016, Elsevier Science Procedia Computer Science, 18-20 October 2016, Madrid, Spain

Summary

- **Multi-dimensional elasticity**
  - Key concepts atop IoT, edge systems and clouds
- **Elasticity engineering across platforms**
  - Complex problems need software, things and people in a single system (but composed from multiple subsystems)
  - coordinating elasticity across platforms
- **End-to-end elasticity toolsets**
  - Detection, monitoring, analysis and control
  - runtime elasticity techniques for dealing with diverse types of services
  - There will be no single one

Thanks for your attention

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