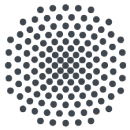


University of Stuttgart
Germany

27.04.2017

# Model-driven Generation of Microservice Architectures for Benchmarking Performance and Resilience Engineering Approaches

Thomas F. Düllmann
André van Hoorn

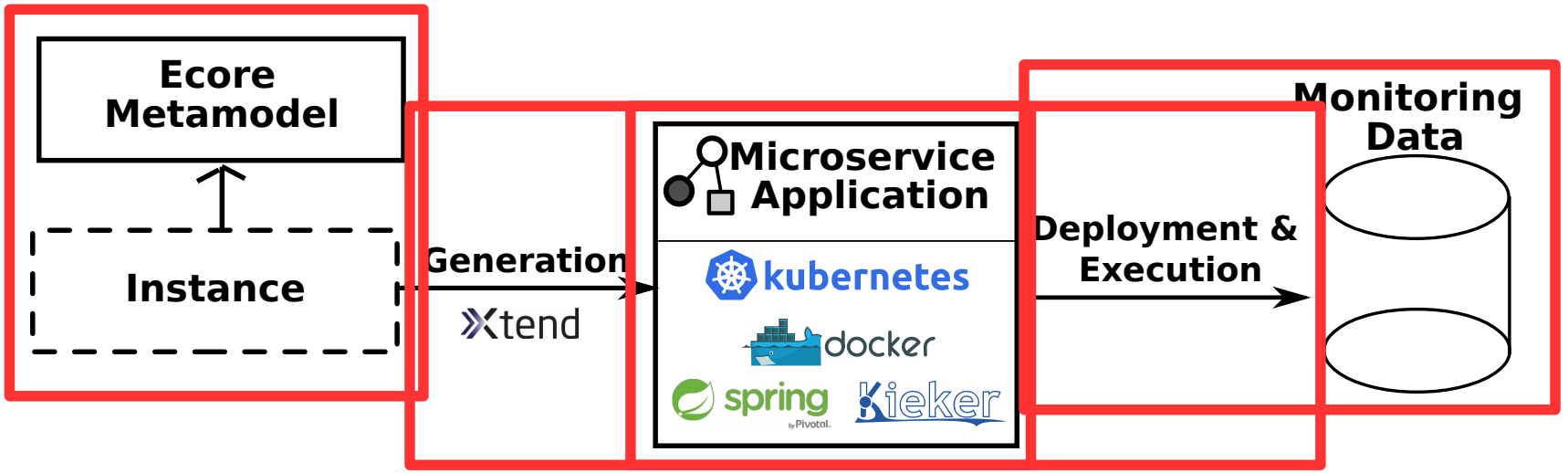
RSS
Reliable Software Systems

Baden-Württemberg Stiftung
WIR STIFTEN ZUKUNFT

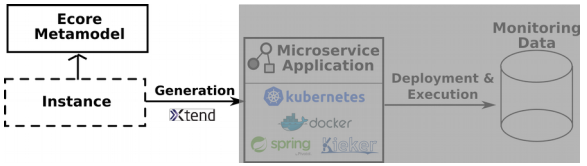
# Motivation

- Microservice architectures are steadily gaining more adopters in practice (e.g., Netflix, Amazon, Zalando, OTTO)
- No known real-world examples for microservice architectures
- No known benchmarking applications for performance and resilience engineering approaches in microservice architectures

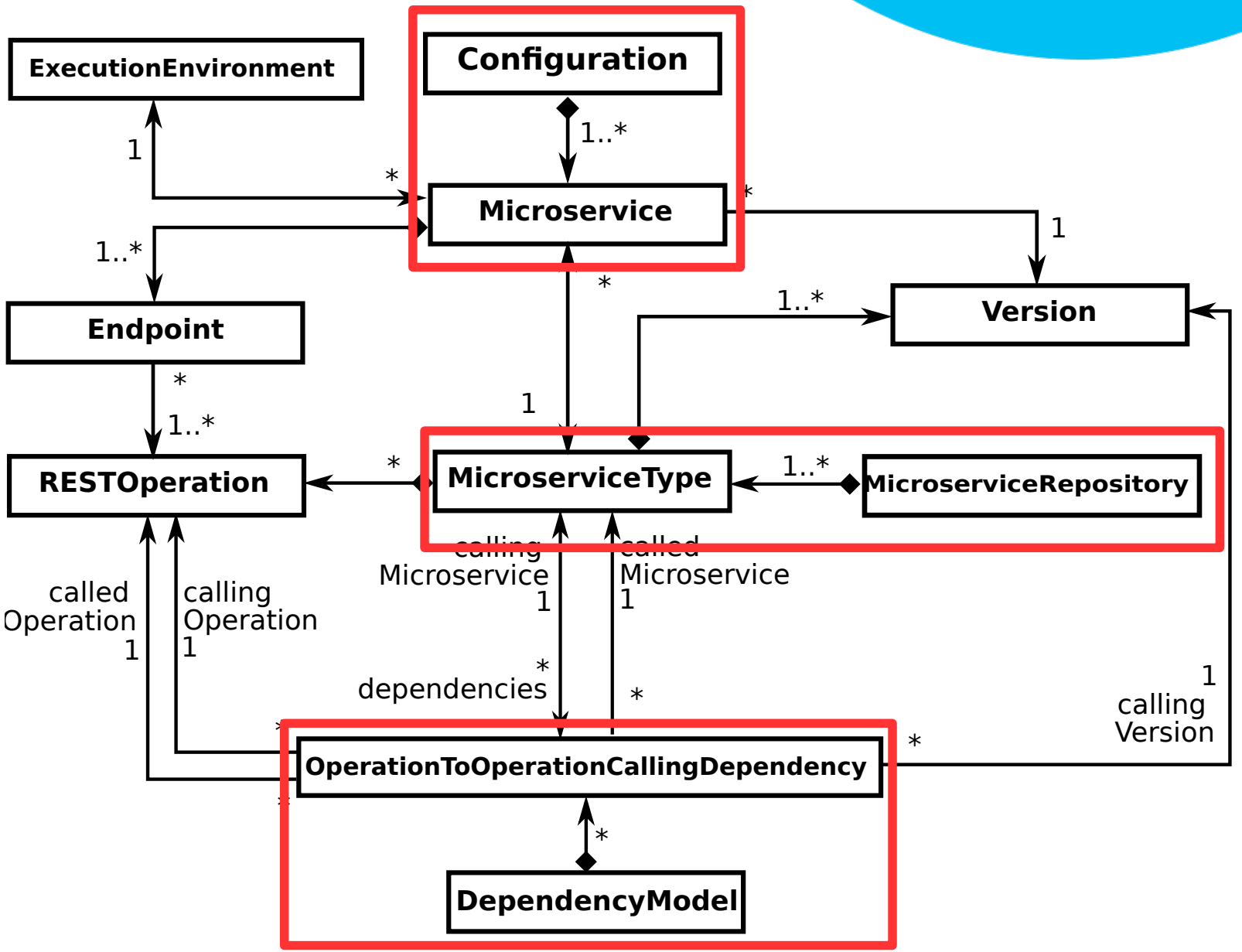
# Approach

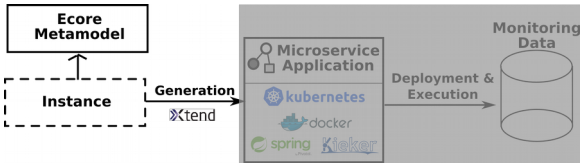



- Define meta model for microservice architecture
- Generate actual microservices based on model instances
- Run instrumented synthetic microservices
- Use monitoring data for benchmarking your approaches




# Ecore Metamodel



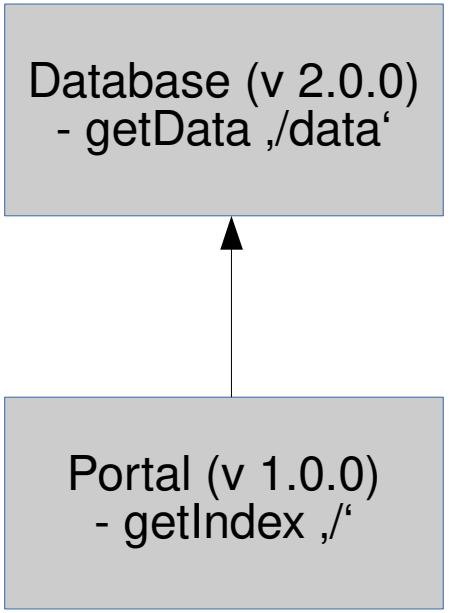


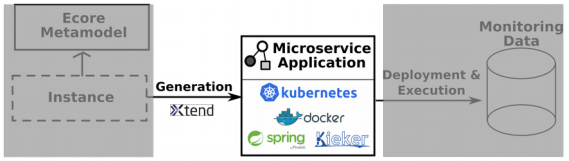

# Ecore Metamodel Instance

- platform:/resource/MicroserviceMetamodel/model/MetaModelStructure.xmi
  - Meta Model Structure
    - Infrastructure Model
    - Configuration
      - Microservice 0000001
      - Microservice 0000002
    - Dependency Model
      - Operation To Operation Calling Dependency
    - Time Series
    - Microservice Repository
      - Microservice Type portal
        - REST Operation getIndex
        - Version 1.0.0
      - Microservice Type database
        - REST Operation getData
        - Version 2.0.0
- platform:/resource/MicroserviceMetamodel/model/anotherMicroserviceMetamodel.ecore

Properties | Problems | Console | ValidityView | Type Hierarchy

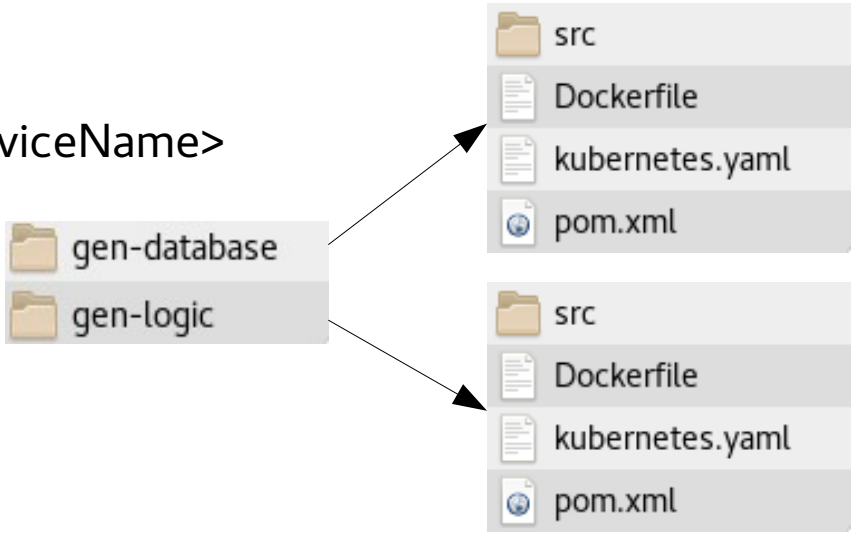
| Property | Value |
|---|---|
| Called Microservice | Microservice Type database |
| Called Operation | REST Operation getData |
| Calling Microservice | Microservice Type portal |
| Calling Operation | REST Operation getIndex |
| Calling Version | Version 1.0.0 |



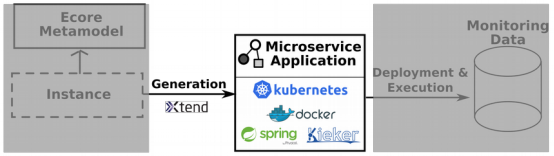



# Generation

- Xtend template feature used for including data from meta model instance
- Generated microservices are based on Spring Boot [1]
- Monitoring is included by default (Kieker)
- Prepared for delay injection
- Further generation artifacts
  - Dockerfile to create Docker [2] container for the microservice
  - Kubernetes [3] kubernetes.yaml file for deployment on a cluster
- Result
  - Folder for each service with gen-<ServiceName>

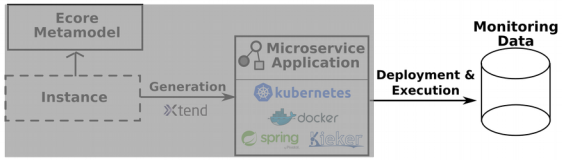



[1]http://projects.spring.io/spring-boot/
[2]https://www.docker.com
[3]https://kubernetes.io

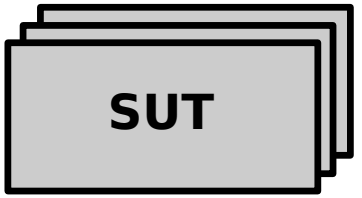



# Generation

- Based on the artifacts, the following steps lead to runnable microservices (example for the generated portal microservice)
  - Pull dependencies for Spring Boot and build JAR file
    - **`mvn clean package`**
  - Create Docker image
    - **`docker build -t my/portal .`**
  - Deploy on Kubernetes cluster
    - **`kubectl create -f kubernetes.yaml`**

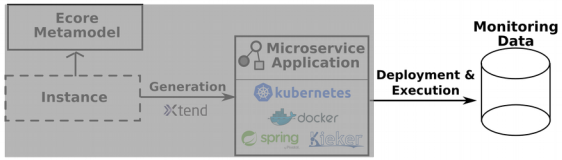



# Execution

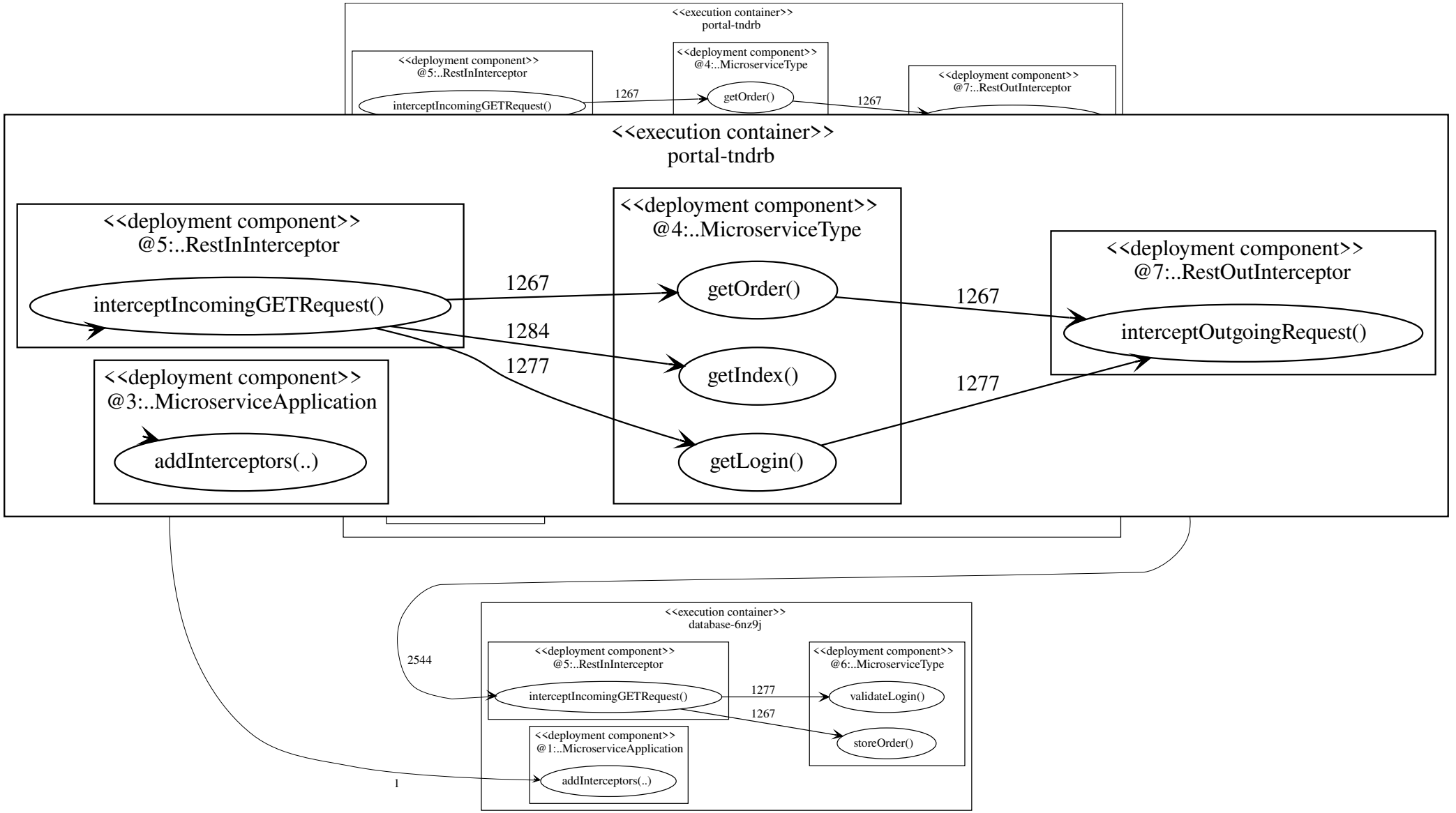



- Artifacts can be used to deploy generated microservices to Kubernetes cluster
- Supplemental microservices for evaluating the system under test (SUT)
  - Load generation (JMeter)
  - Monitoring data collection (JMS Server) and storing (Monitoring Server)
  - Delay injection (Registry, Injector)

University of Stuttgart
Germany




# Execution

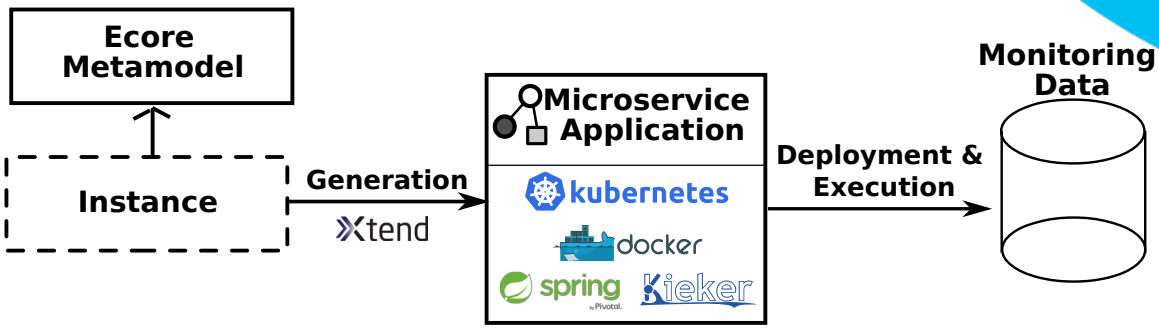


# Future Work / Limitations

Feature set still limited but may be a base for **future work**:

- Improve the generator to use more properties of the model instance
- Use generated microservice architectures in the CASPA approach
- Dashboard for injections and status of microservices in SUT
- Extraction of meta model instance based on monitoring data
- More kinds of injections for different (performance) problems
  - Delay patterns (e.g., the ramp)
  - Resource demands (e.g., CPU, memory)

# Conclusion




- Microservice generation based on Ecore meta model instance
- Actual microservices that are prepared to be deployed on a Kubernetes cluster
- Enables to run and monitor pre-defined microservice architectures
- Possible base for extensions in the area of performance and resilience engineering benchmarking
- Available on GitHub:

  **github.com/orcas-elite/arch-gen**

- **Questions/Discussion**

  Contact: **duellmann@informatik.uni-stuttgart.de**