iObserve

Integrated Observation and Modeling Techniques to Support Adaptation and Evolution of Software Systems

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Project Goals

iObserve

- Future long-living software systems will be engineered using **third-party** software services and infrastructures.
  - Key challenges for such systems will be caused by **dynamic changes** of deployment options on cloud platforms.
  - Third-party services and infrastructures are neither owned nor **controlled** by the users and developers of service-based systems.
  - System users and developers are thus only able to **observe** third-party services and infrastructures via their interface, but are not able to look into the software and infrastructure that provides those services.
- The iObserve project addresses those challenges by following a model-based approach.
  - Develop and validate new models and techniques for runtime observation and anomaly detection of future service-based software systems deployed on third-party platform and infrastructure services,
  - through extending and integrating previous work on **monitoring**, **meta modeling**, and **service-oriented systems**.

Changes in domain assumptions D_a, refer to Carlo's talk

Knowledge Carrying Software

iObserve

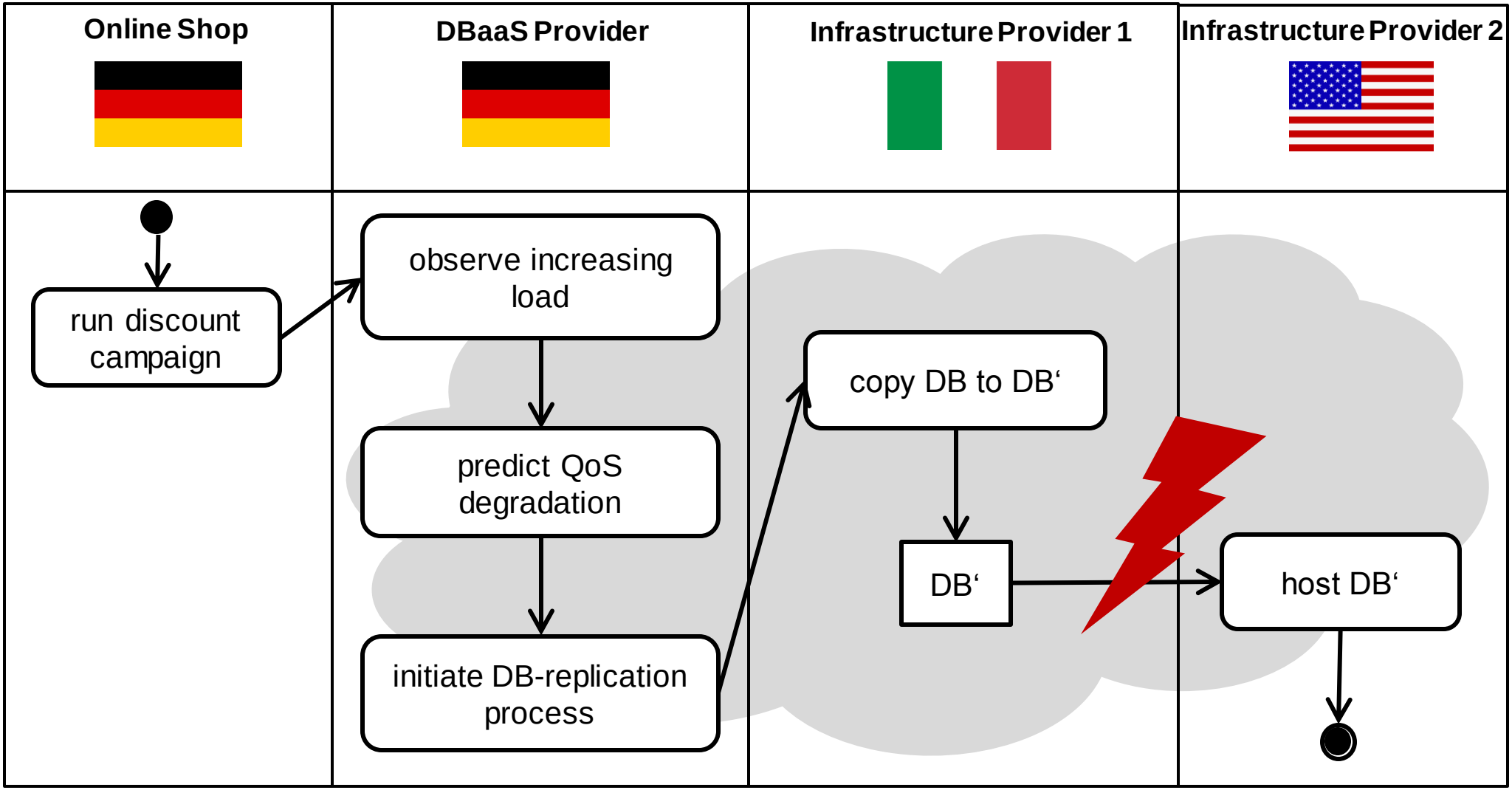
Our Approach:

- Models+Verification@Runtime

Research Questions

- How to keep (design) models consistent with the (adaptive) system?
  - Observe it !
  - Monitoring & analysis of distributed cloud-based applications
- How to conduct continuous modeling and analysis?
  - For quality prediction and forecasting
    - Performance, Cost, Geo-Location, …
    - Evaluation of data-migration-policies, as example adaptation scenario

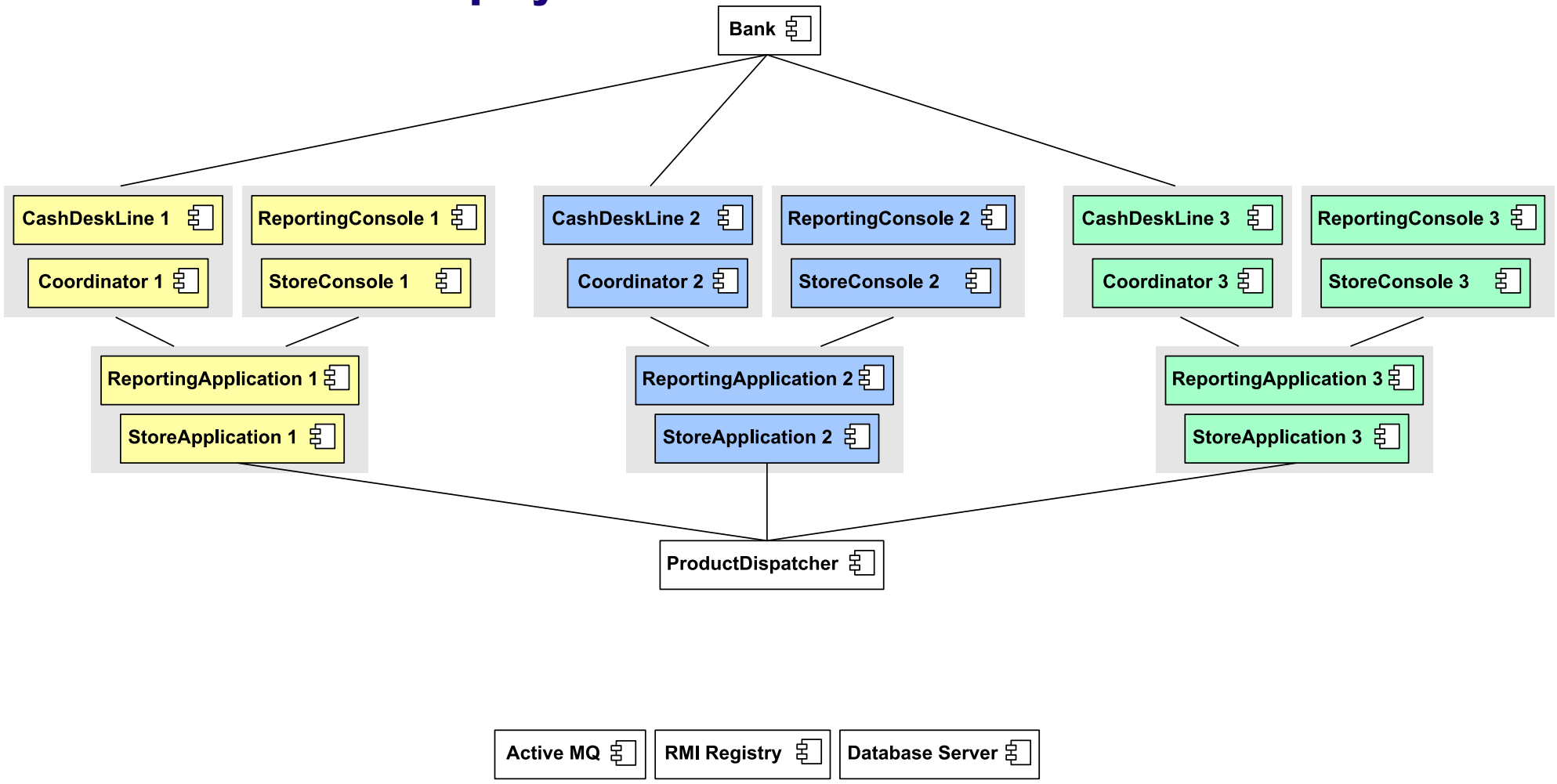
Scenario: Data Management on the Cloud



Agenda

- Project goals
- **Addressed Case Study: CoCoME**
- Results
  - Reverse Engineering of CoCoME
  - Model-driven Instrumentation and Analysis
  - Enforcing Data Geo-Location Policies
- Summary & Outlook

CoCoME Deployment



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Reverse Engineering of CoCoME with Kieker

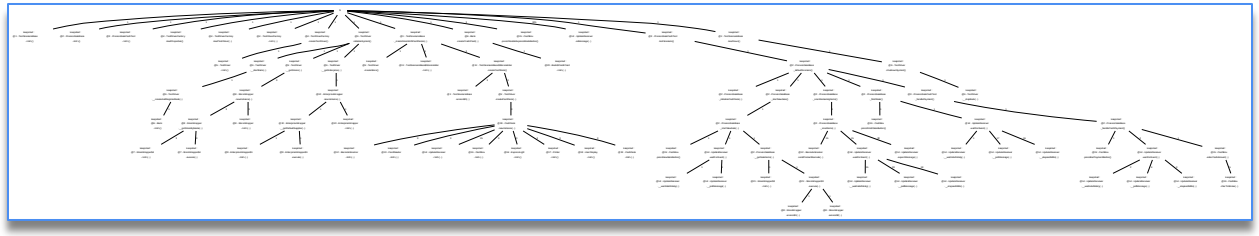
Goals

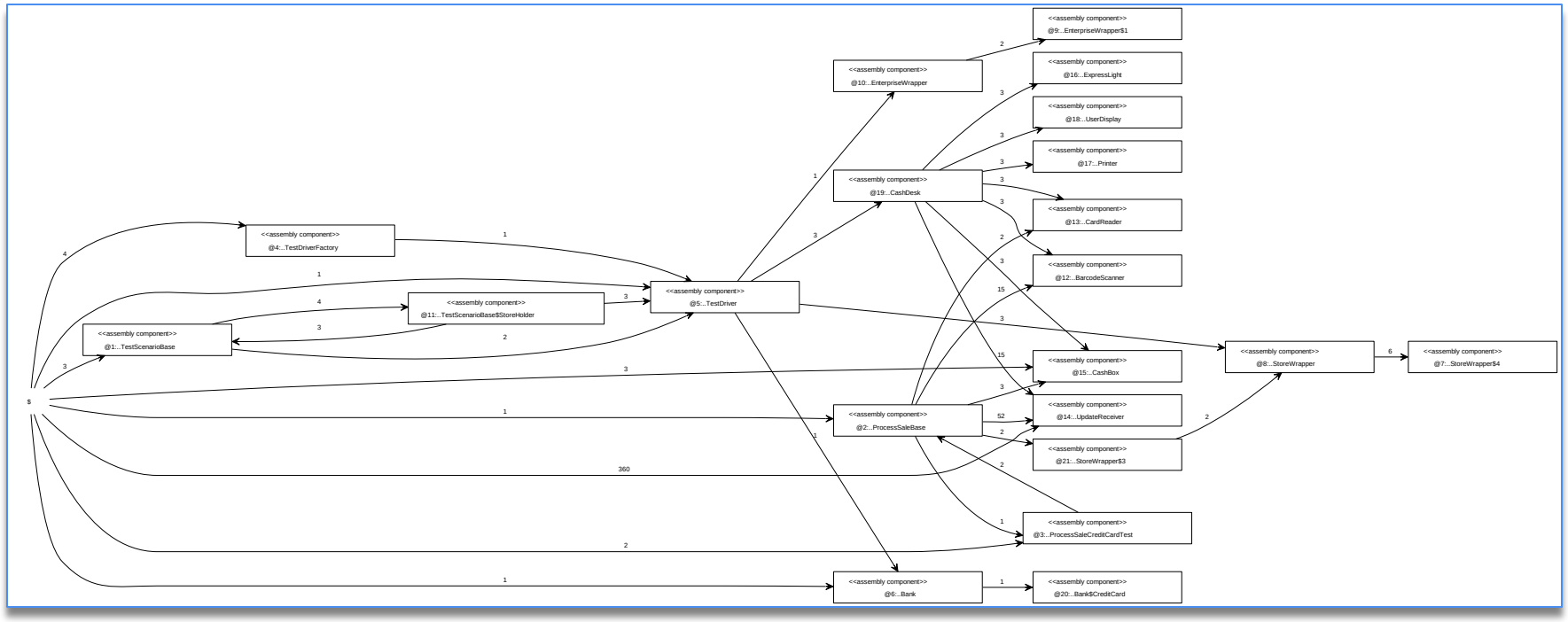
- Better understand the existing CoCoME implementation
- Compare reconstructed models in relation to the original design
- Provide a basis for SOA and cloud migration

Realization

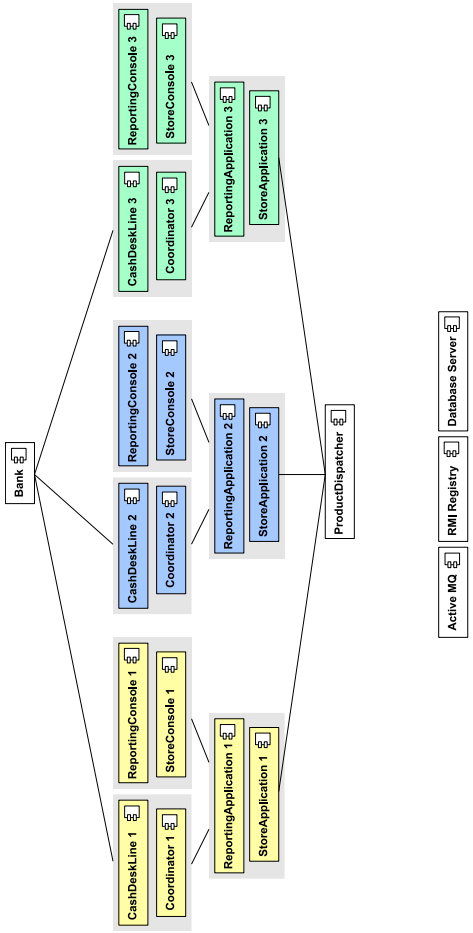
- Static analysis of the deployment architecture
- Dynamic analysis of the application architecture [Hasselbring 2011, van Hoorn 2012]
- Comparison of reconstructed models with the design (software reflexion models [Murphy et al 2001])

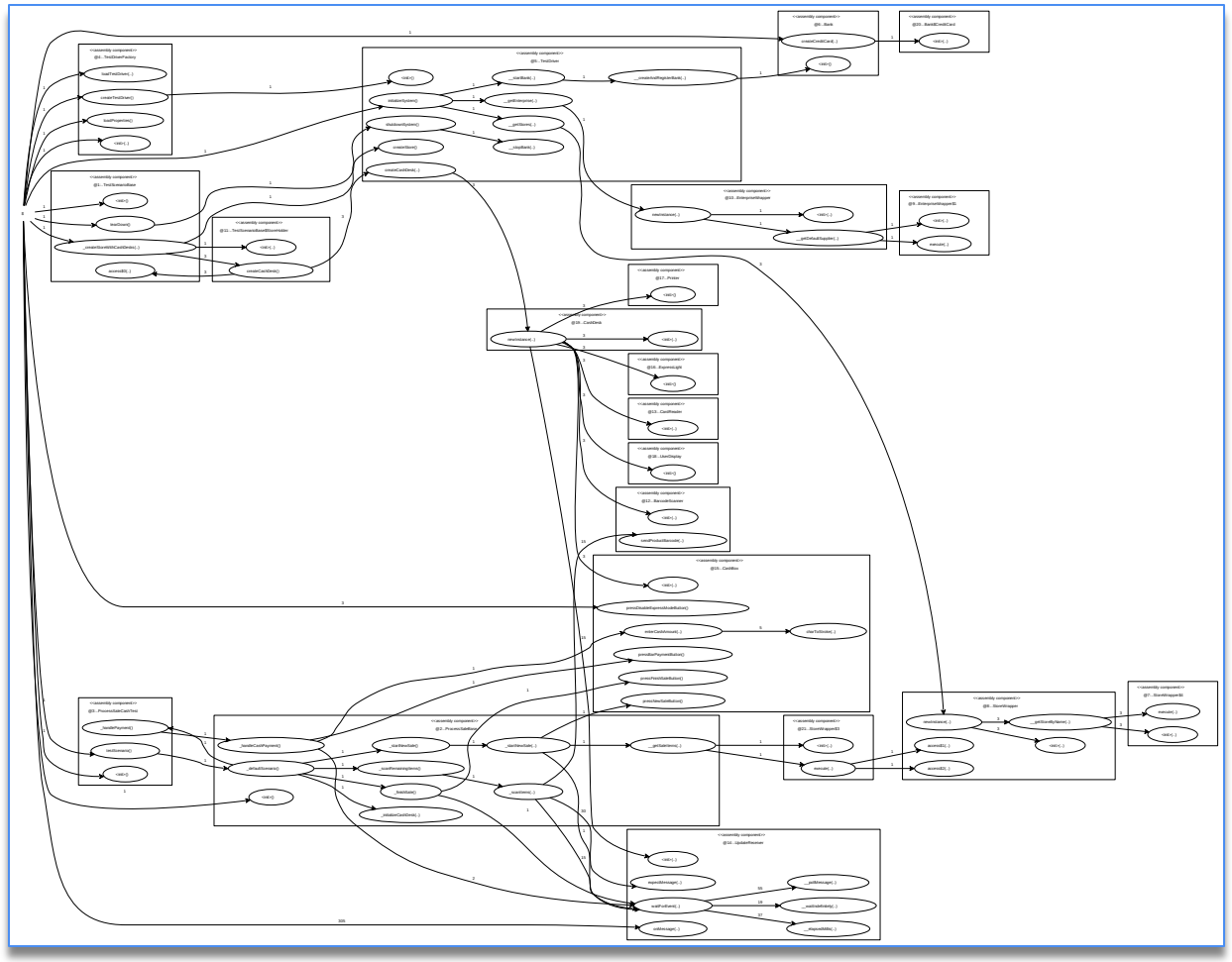
Reverse Engineered Models for CoCoME (via Kieker)





Software reflexion models





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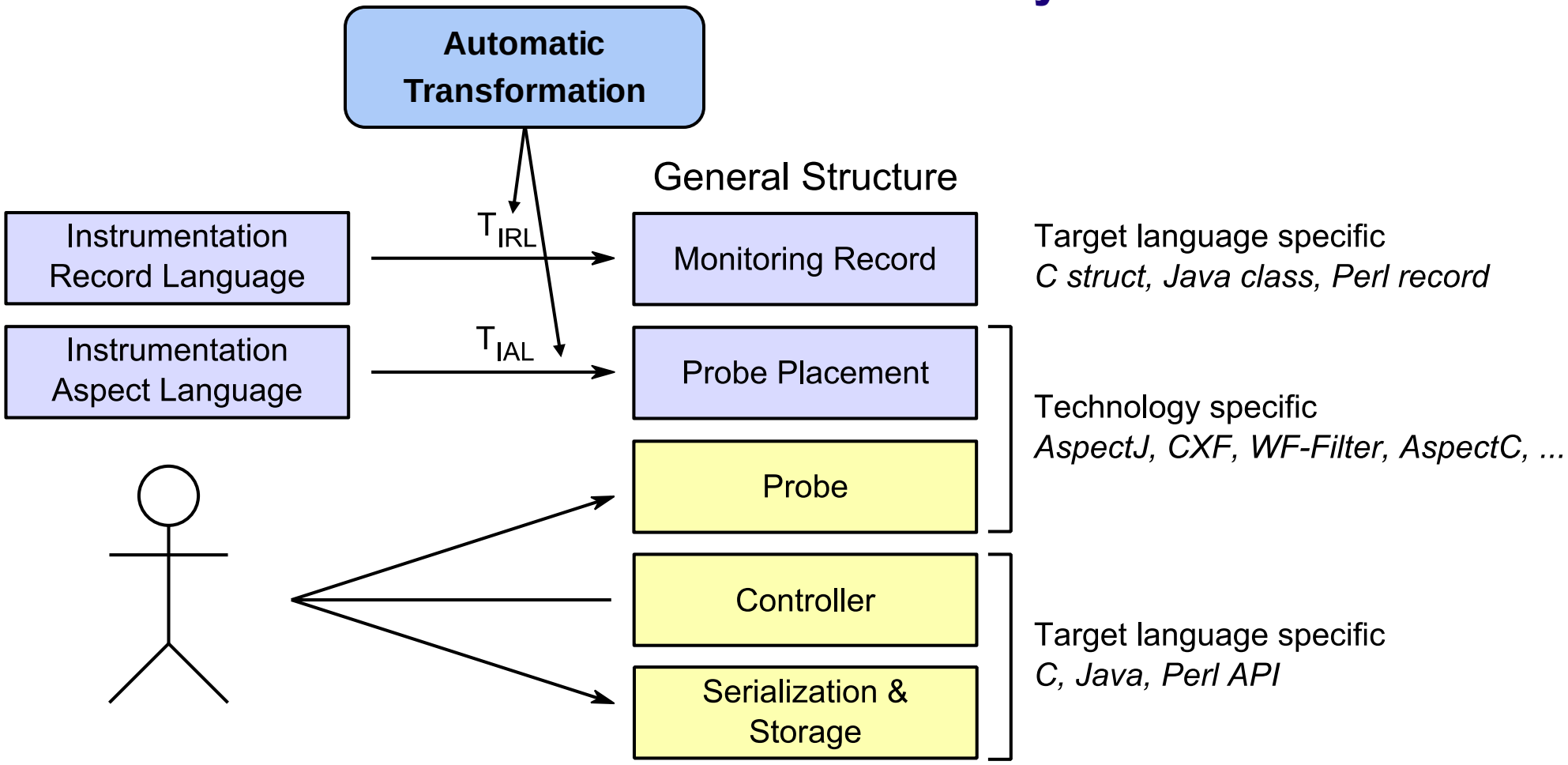
Model-driven Instrumentation and Analysis



Model-driven Instrumentation and Analysis

```
package org.spp.kieker.instrumentation

probe /TradingSystem/**/* *(*) : * {
   before collect BeforeOperationEvent(
         time, id, index,
         ./name,../name)
   after collect AfterOperationEvent(
         time, id, index,
         ./name, ../name)
}
```

Instrumentation Aspect Language

- Queries to determine application model nodes
- Target language support
- Support for different probe technologies
- Support for probe configuration

```
collect AverageMethodResponseTime ( String methodName )
    average AfterOperationEvent - BeforeOperationEvent
    scope ( pcm.repository.Operationsignature.entityName == methodName )
measure BeforeOperationEvent
measure AfterOperationEvent
```

Evaluation metrics based on **MAMBA** [Frey 2012].

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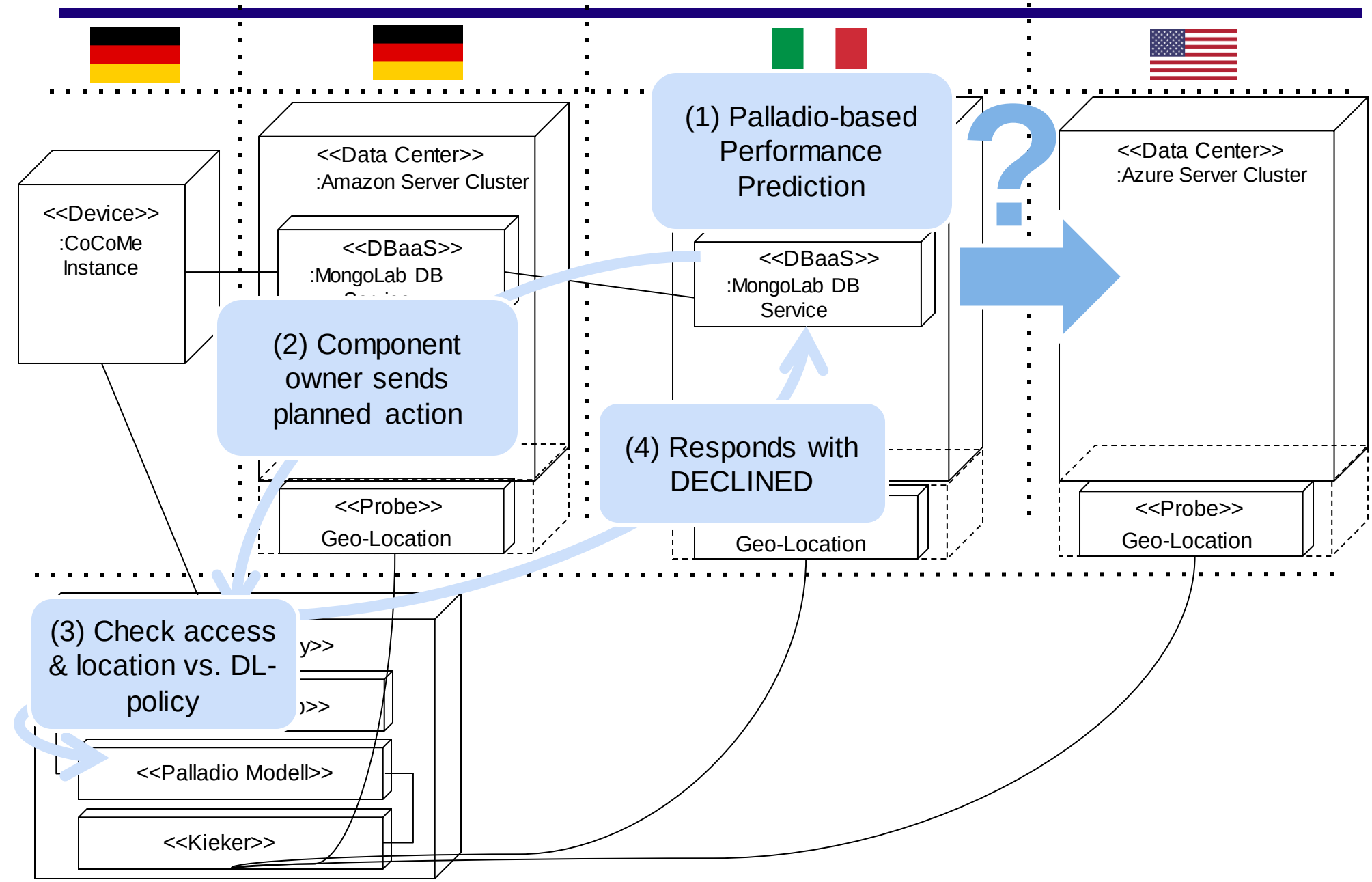
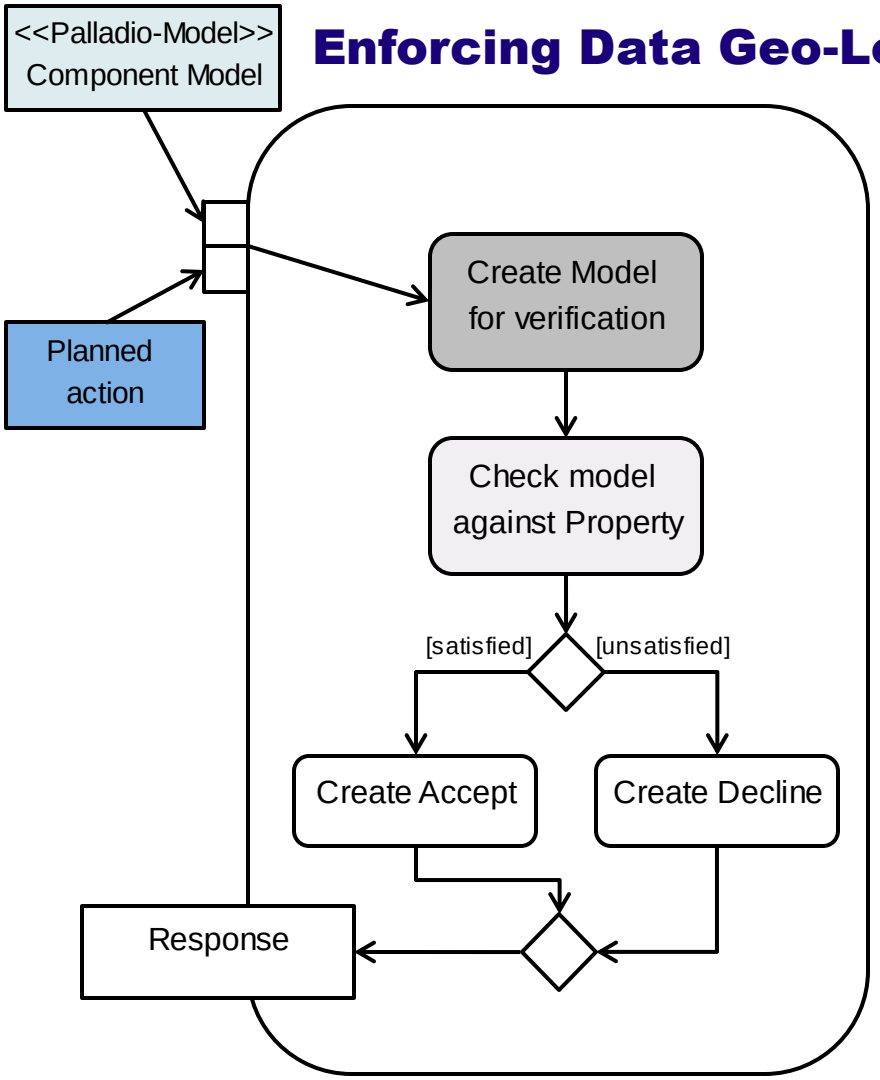
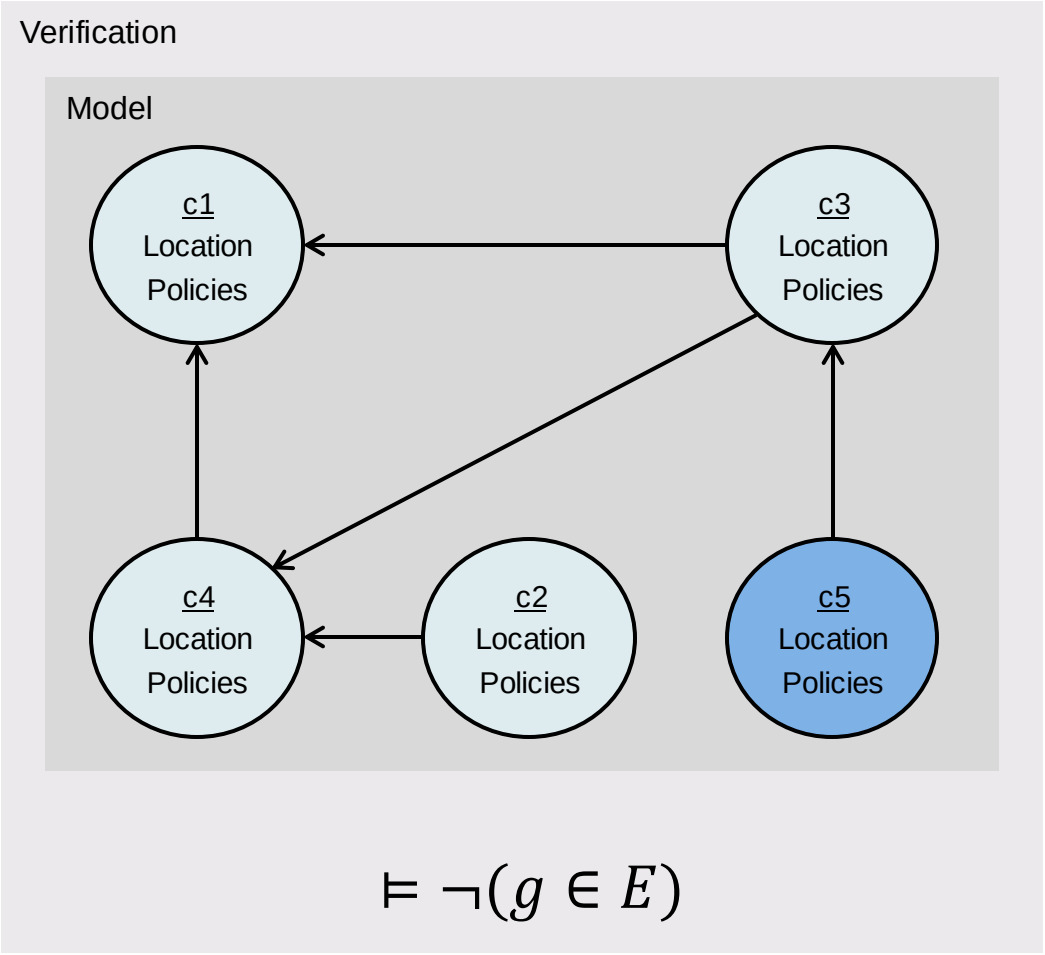

<<Device>>
:CoCoMe
Instance
<<Data Center>>
:Amazon Server Cluster
<<DBaaS>>
:MongoLab DB
<<Probe>>
Geo-Location
(1) Palladio-based Performance Prediction
<<DBaaS>>
:MongoLab DB
Service
Geo-Location
?
<<Data Center>>
:Azure Server Cluster
<<Probe>>
Geo-Location
(2) Component owner sends planned action
(4) Responds with DECLINED
(3) Check access & location vs. DL-policy
<<Palladio Modell>>
<<Kieker>>

Enforcing Data Geo-Location Policies



Policy decision process



Idea: Runtime verification, e.g., via model checking

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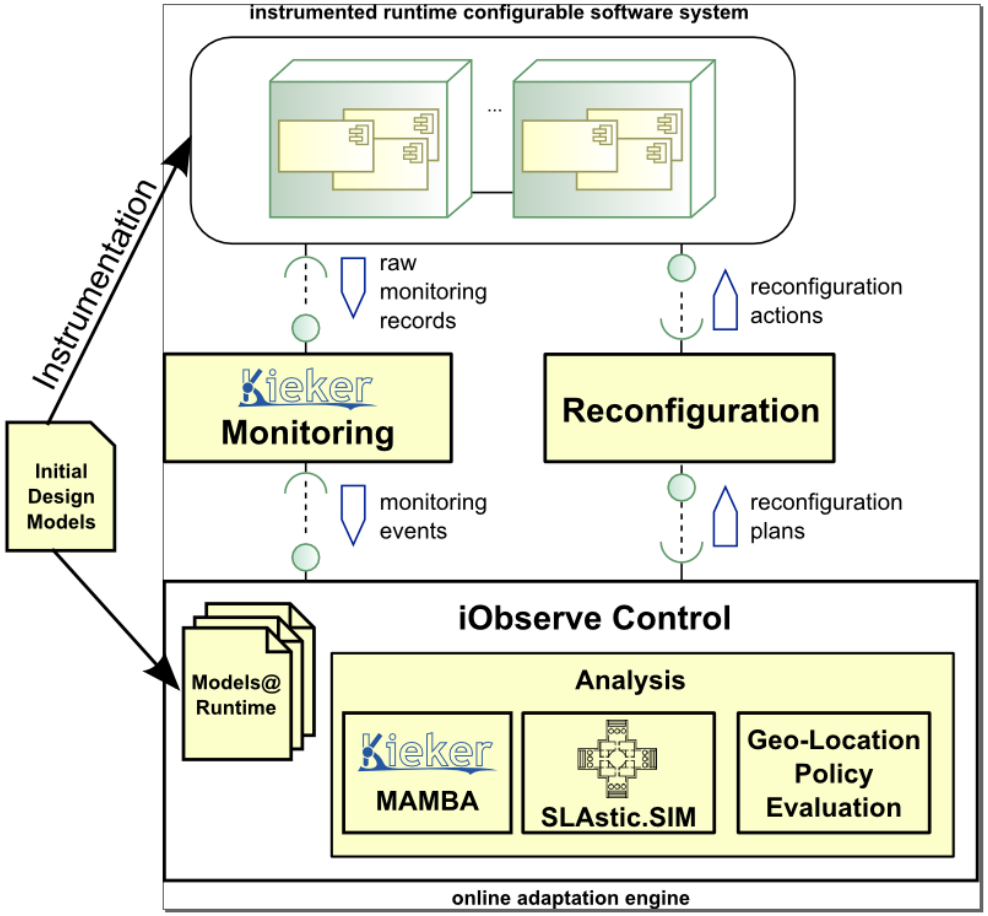
iObserve Integrated Approach



Integrate expertise of three groups

- CAU:
  - Kieker [van Hoorn 2012]
  - SLAstic [van Hoorn 2009]
  - MAMBA [Frey 2012]
- KIT:
  - Palladio [Becker 2009]
- UDE:
  - Runtime verification (S-Cube) [Metzger 2010, Schmieders 2001]

Summary & Outlook

Invitation:

Joint Kieker/Palladio Days 2013

Symposium on Software Performance

27 - 29 November 2013, Karlsruhe

Deadlines: Oct. 19, 2013 (abstracts)

http://www.kieker-palladio-days.org/

Summary

- Integration of Palladio and Kieker
- Elaboration of the CoCoME case study
- Scenario and approach for data privacy policies

Outlook

- Multi-objective optimization [Frey 2013]
  - Performance / Cost / Data policies
- Anomaly detection, Analysis [Ehlers 2011]
- Model-driven CoCoME (co-operation with other SPP projects)
  - iObserve DSL to augment Palladio
  - Generator for complete CoCoME system

iObserve URES EnSure ADVERT SW EVOLUTION SecVolution

(Technical report on this presentation is available at **http://eprints.uni-kiel.de/22077/**)

Publications

- [Becker 2009] Becker, S., Koziolek, H., Reussner, R., “The Palladio component model for model-driven performance prediction,” Journal of Systems and Software, 82(1): 3-22, 2009.
- [Ehlers 2011] Ehlers, J., van Hoorn, A., Waller, J., Hasselbring, W., “Self-Adaptive Software System Monitoring for Performance Anomaly Localization,” in: 8th IEEE/ACM International Conference on Autonomic Computing (ICAC '11), June 14-18, 2011, Karlsruhe, Germany.
- [Frey 2012] Frey, S., van Hoorn, A., Jung, R., Kiel, B. und Hasselbring, W., “MAMBA: Model-Based Software Analysis Utilizing OMG's SMM,” in: 14th Workshop Software-Reengineering (WSR '12)
- [Frey 2013] Frey, S., Fittkau, F., Hasselbring, W., “Search-Based Genetic Optimization for Deployment and Reconfiguration of Software in the Cloud,” in: 35th International Conference on Software Engineering (ICSE 2013), 18.-26. May 2013, San Francisco, CA, USA.
- [Metzger 2010] Metzger, A., Schmieders, E., Cappiello, C., Di Nitto, E., Kazhamiakin, R., Pernici, B., Pistore, M., “Towards Proactive Adaptation: A Journey along the S-Cube Service Life-Cycle,” in 'MESOA: 4th International Workshop on Maintenance and Evolution of Service-Oriented Systems‘, 2010
- [Murphy et al 2001] Murphy, G.C.; Notkin, D.; Sullivan, K.J., "Software reflexion models: bridging the gap between design and implementation," IEEE Transactions on Software Engineering, 27(4): 364-380, Apr 2001
- [Pearson 2011] Pearson, S., Casassa Mont, M, “Sticky policies: An approach for managing privacy across multiple parties,” Computer, 44(9): 60-68, 2011
- [Schmieders 2001] Schmieders, E., Metzger, A., “Preventing Performance Violations of Service Compositions using Assumption-based Run-time Verification,” in 'ServiceWave‘, 2011
- [van Hoorn 2009] van Hoorn, A., Rohr, M., Gul, A., Hasselbring, W., “An adaptation framework enabling resource-efficient operation of software systems,” in: Proceedings of the 2nd Warm-Up Workshop for ACM/IEEE ICSE 2010 (WUP '09), 2009.
- [van Hoorn 2012] van Hoorn, A., Waller, J., Hasselbring, W., “Kieker: A Framework for Application Performance Monitoring and Dynamic Software Analysis,” in: 3rd joint ACM/SPEC International Conference on Performance Engineering (ICPE'12), April 22-25, 2012, Boston, Massachusetts, USA.