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Predictability vs. Dynamism: managing dynamic real-time applications

Outline

- Context
- State-of-the-art
- Problem Identification
- Suggested Approach
- Limitations
- Conclusions and perspectives

About

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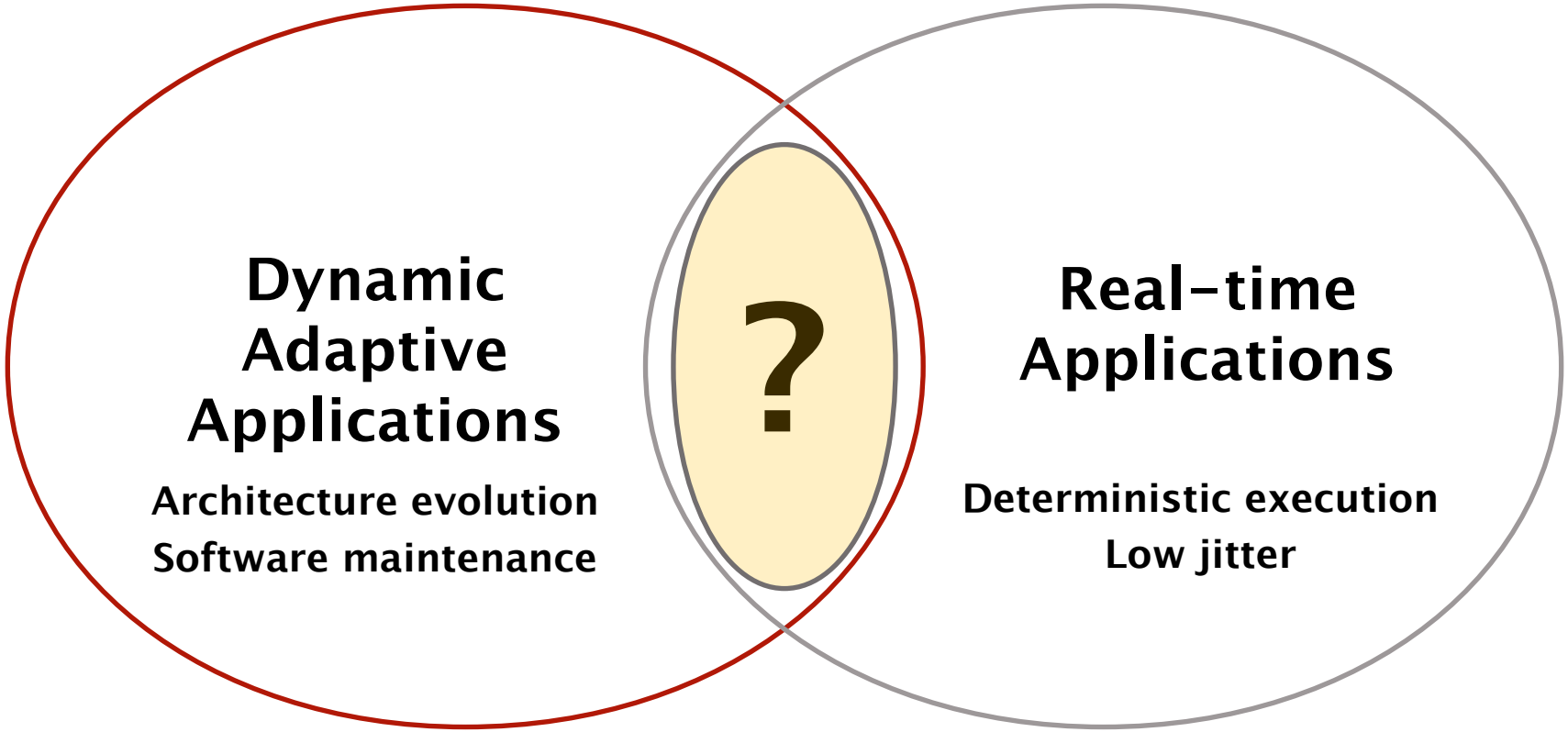
Context


Dynamic
Adaptive
Applications
Architecture evolution
Software maintenance
?
Real-time
Applications
Deterministic execution
Low jitter

State-of-the-art

RTSJ: Real-time Specification for Java

- Issues: garbage collection, dynamic class loading, thread scheduling, etc.

Dynamic Evolution/Adaptation

- Architecture modification at runtime

Real-time dynamic adaptive software

- Based on QoS objects (QoSkets), modes (SOFA-HI/Blue-ArX), and real-time adaptations for CCM (CIAO, Cardamom).

State-of-the-art

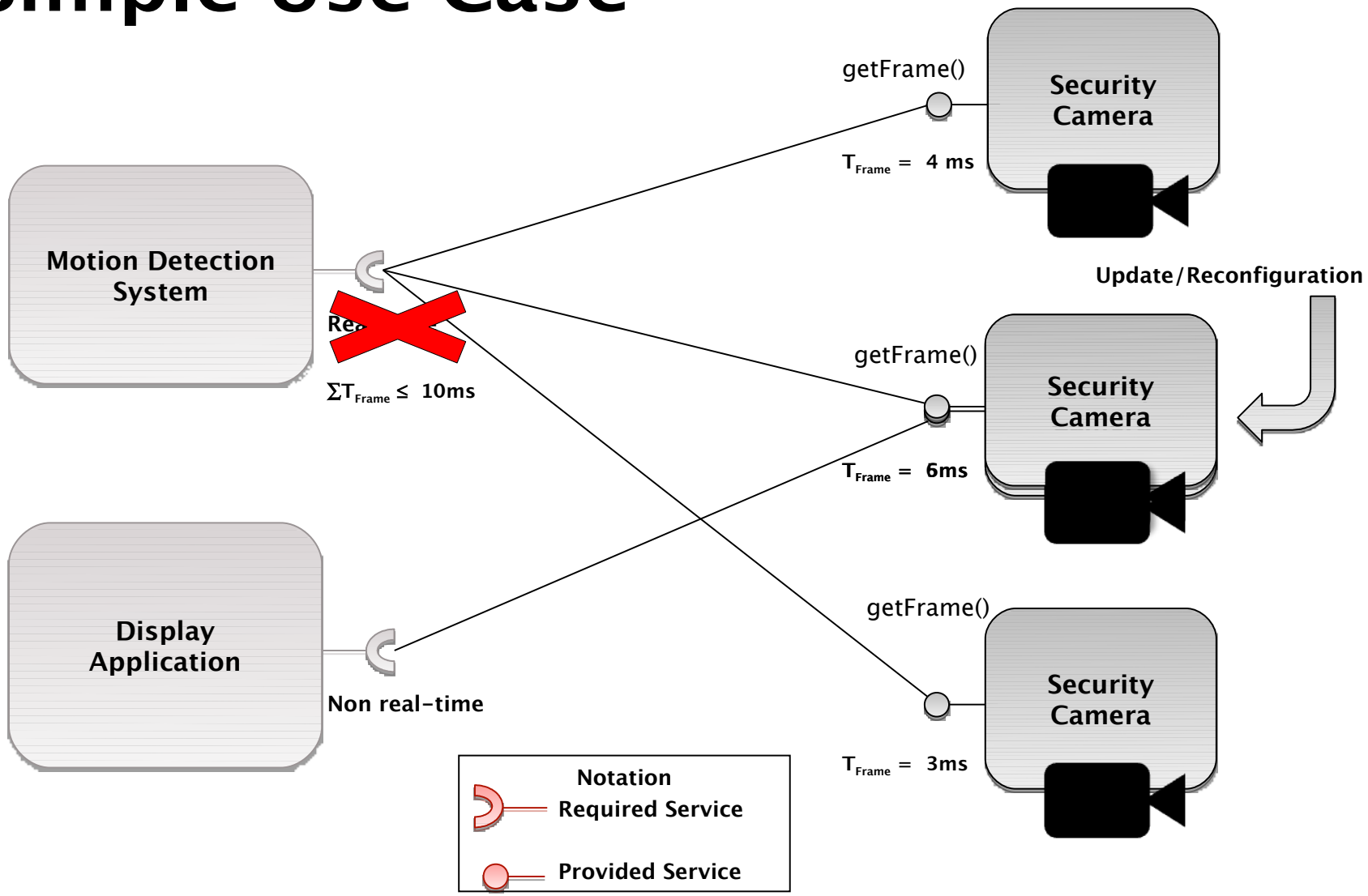
Real-time OSGi

- Works focused mainly on isolation issues: ARFLEX Project, [Richardson, 2009], AONIX's Real-time OSGi model
- Industry initiatives: Oracle/BEA's WebLogic Real-time, Integration between Perc and mBS

Problem Identification

- OSGi platform is inappropriate for real-time applications
  - Memory issues
  - Scheduling issues
  - Isolation issues
  - **Runtime software evolution**

Simple Use Case

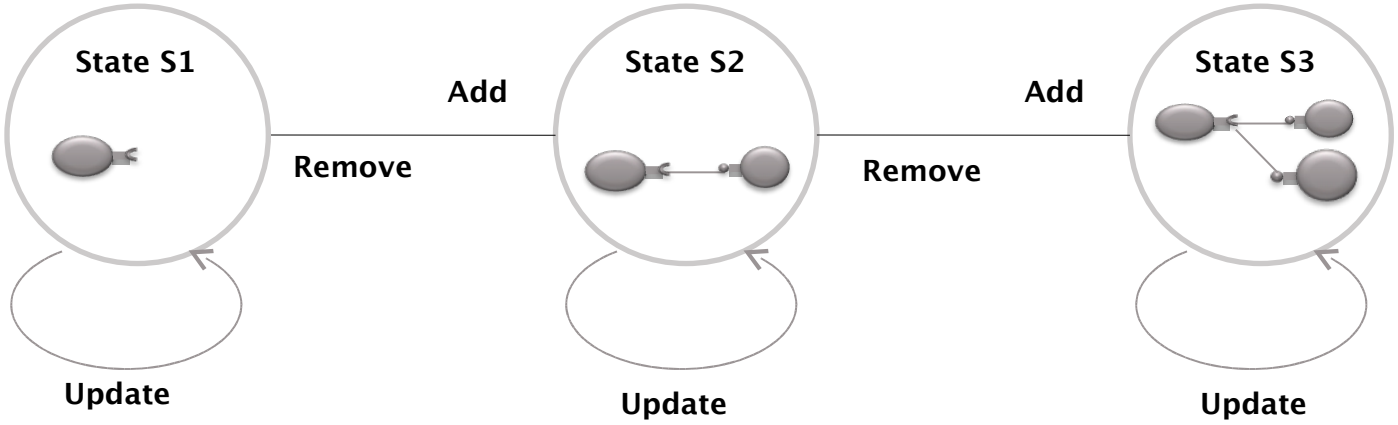


Suggested Approach

- Distinction between critical and non-critical code
  - Architecture freezing policy
  - Dynamic Real-time SLA

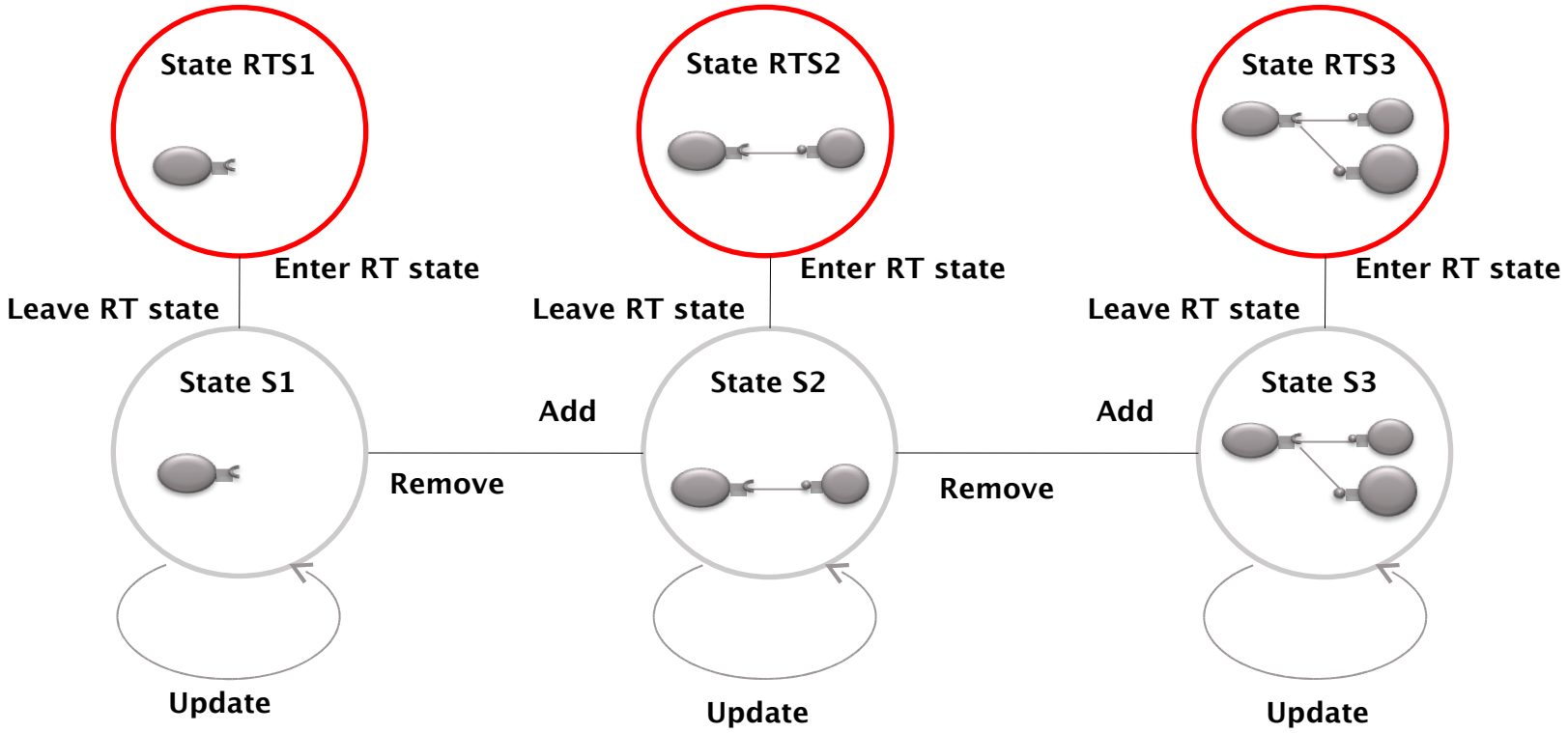
Architecture Freezing

- Application = set of states
  - Each state corresponds to an architecture (service bindings)

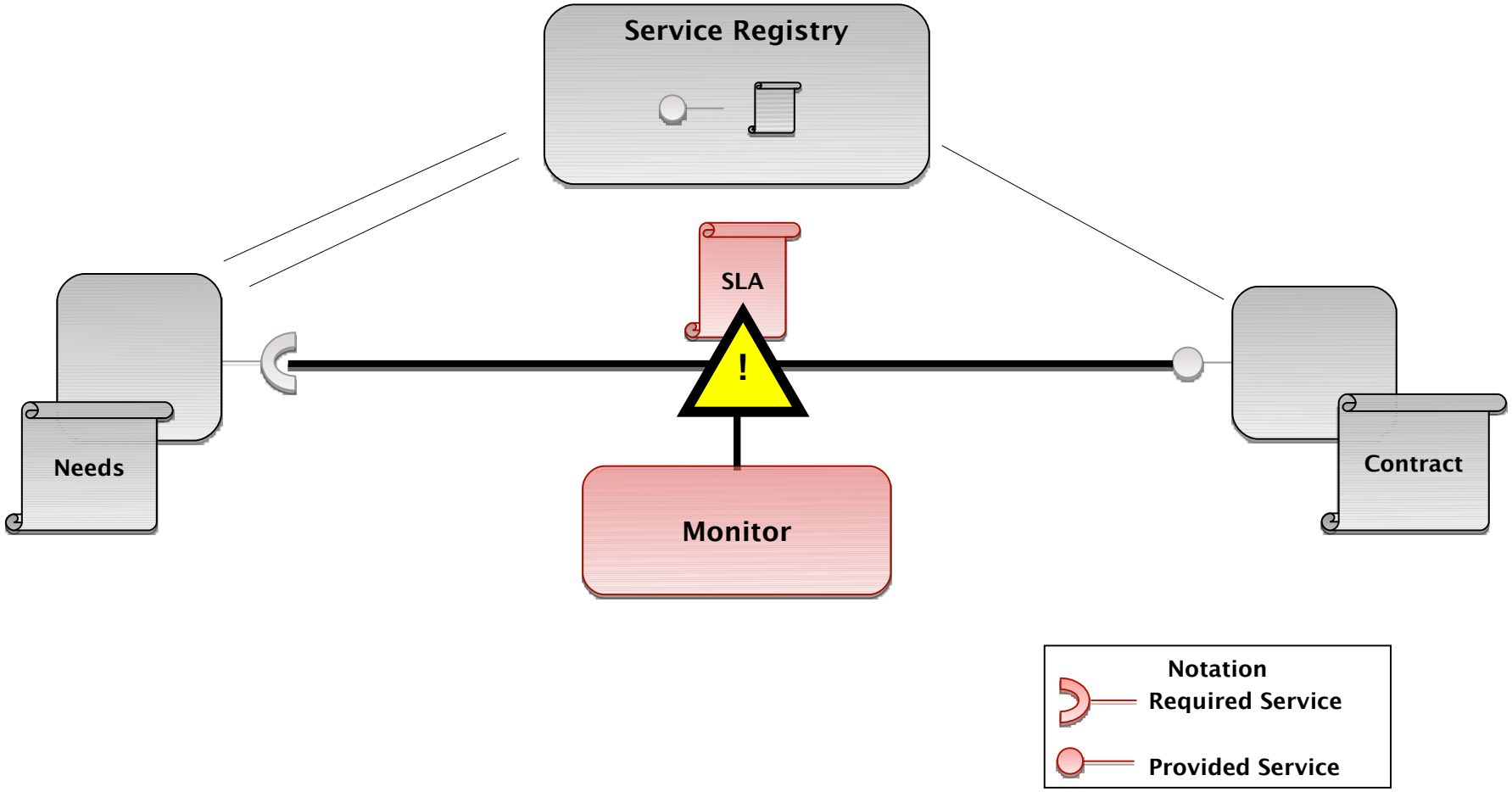


Architecture Freezing

- Real-time processing states
  - Architecture modifications forbidden



Service Level Agreement

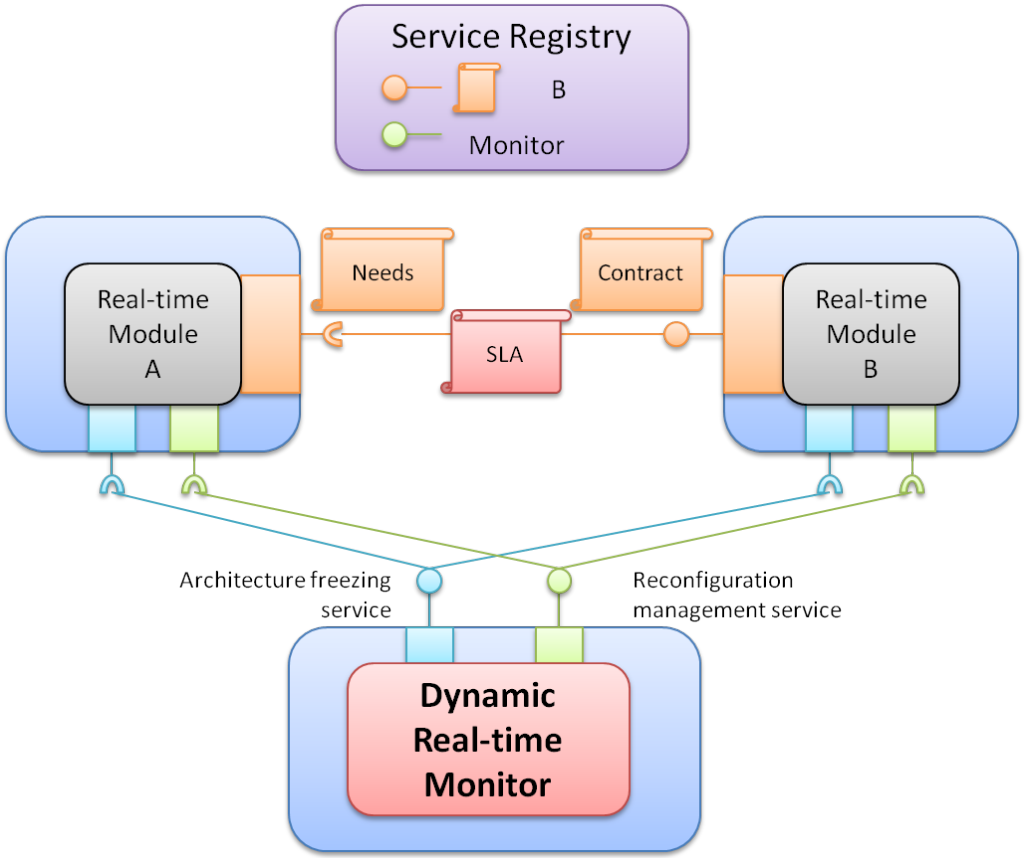


Real-Time Dynamic SLA

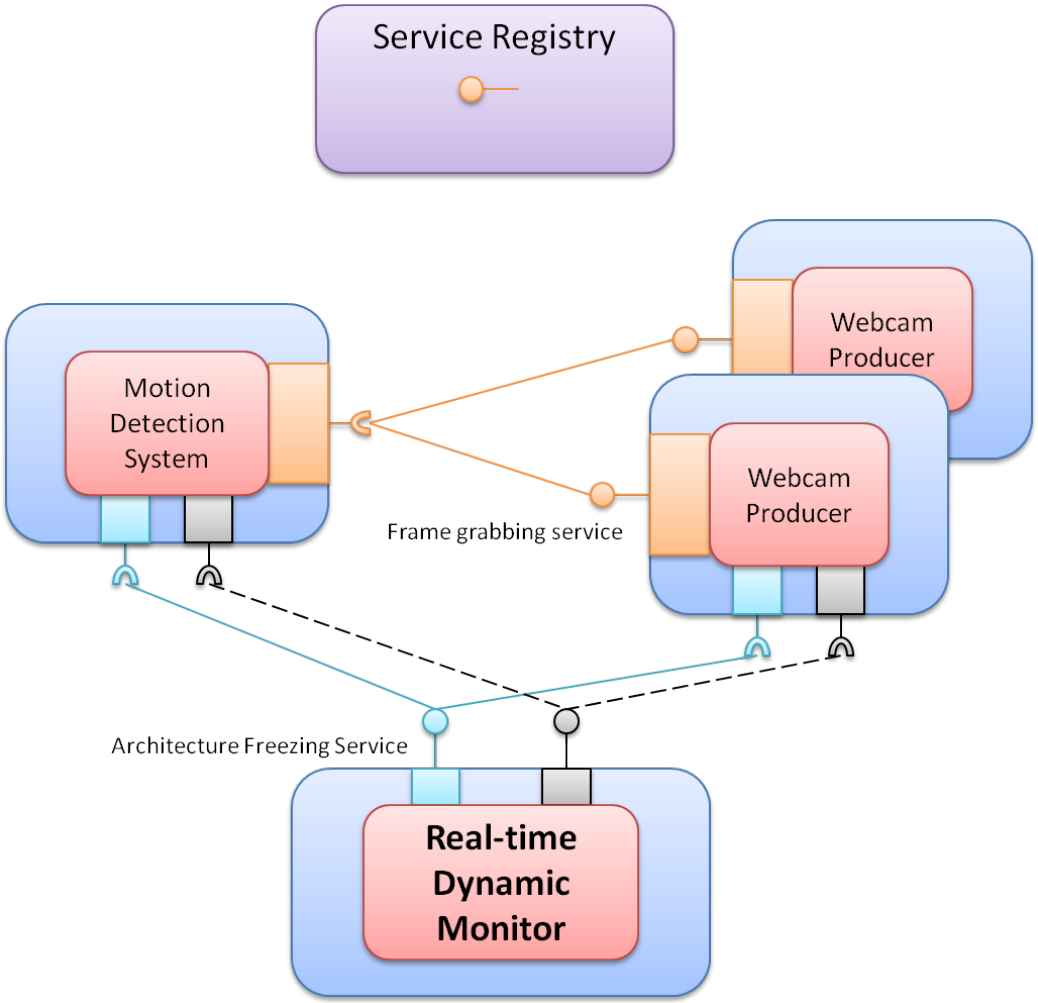
- Extension to the D-SLA model [Touseau, 2010]
  - Task type
  - Period
  - Worst case execution time (WCET)
  - Resource Utilization
  - Priority

Implementation

- iPOJO component model extension



Validation



- **Architectures frozen during real-time processing states**
- **SLM not implemented**

Limitations

- One real-time application at a time
- Unknown update times
- Component characterization
  - Resource utilization measures
- Overhead

Results

- Architectural Freezing solves:
  - Dynamic update
  - Service interruptions
    - but not disappearance of physical devices
- Dynamic RT-SLA solves:
  - Service admission
    - based on resource consumption, deadlines, …
- Both require modifying apps (explicit notifications)

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THANK YOU FOR YOUR ATTENTION!