



Preventing Performance Violations of Service Compositions using Assumption-based Run-time Verification

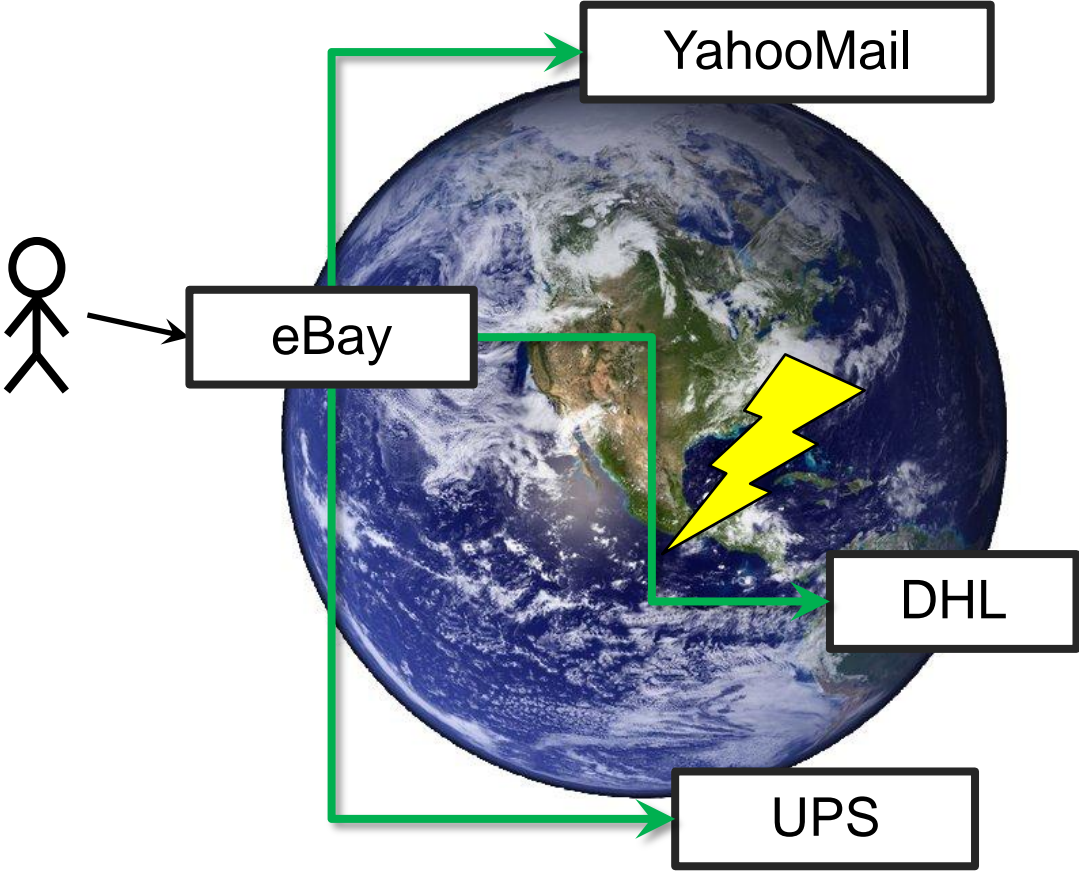
Eric Schmieders and Andreas Metzger
ServiceWave 2011, Poznan



CONTENT

- **Motivation**
- **Proposed Approach**
- **Validation**
- **Conclusion & Outlook**

Motivation

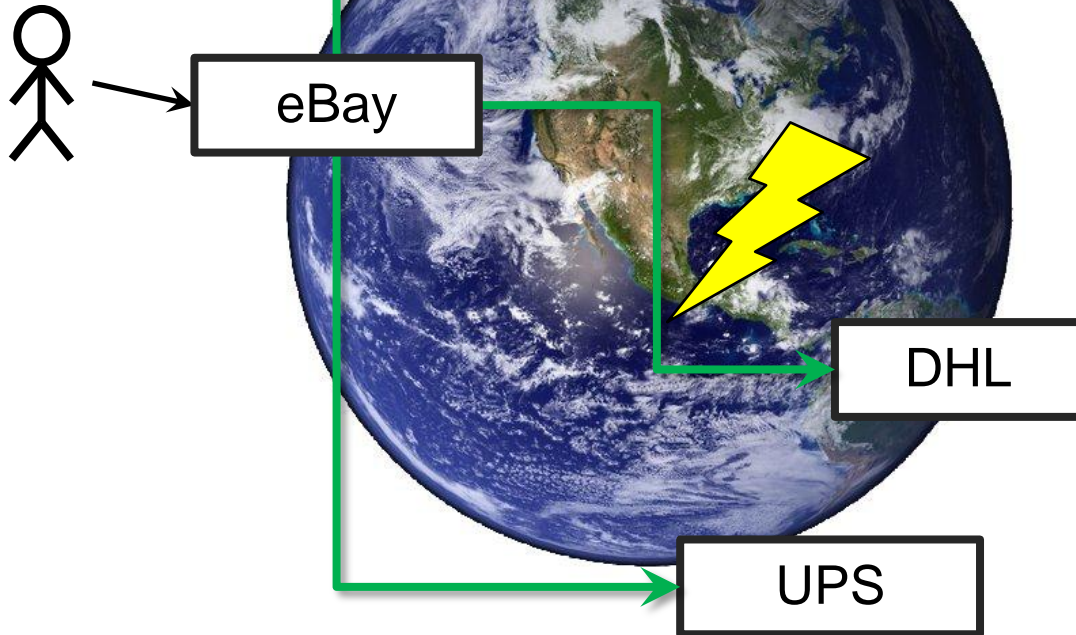


Related Work

[Ghezzi and Tamburrelli 2009]
[Kazhamiakin et al. 2009]



[Leitner et al. 2010,
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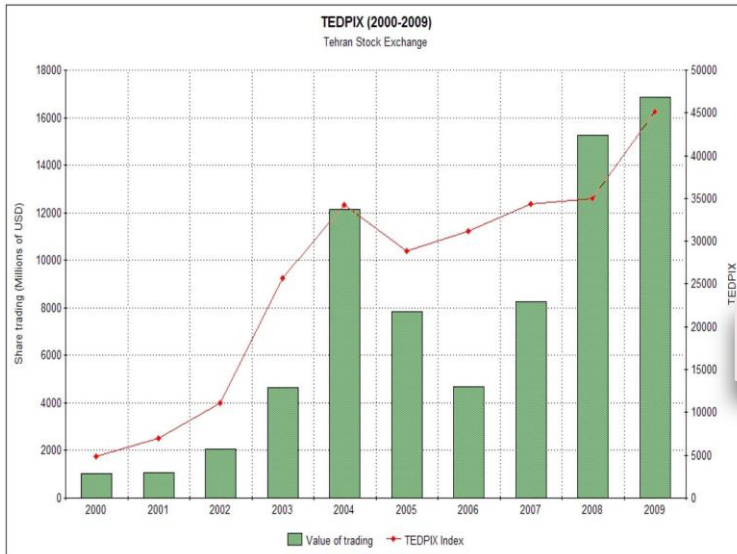
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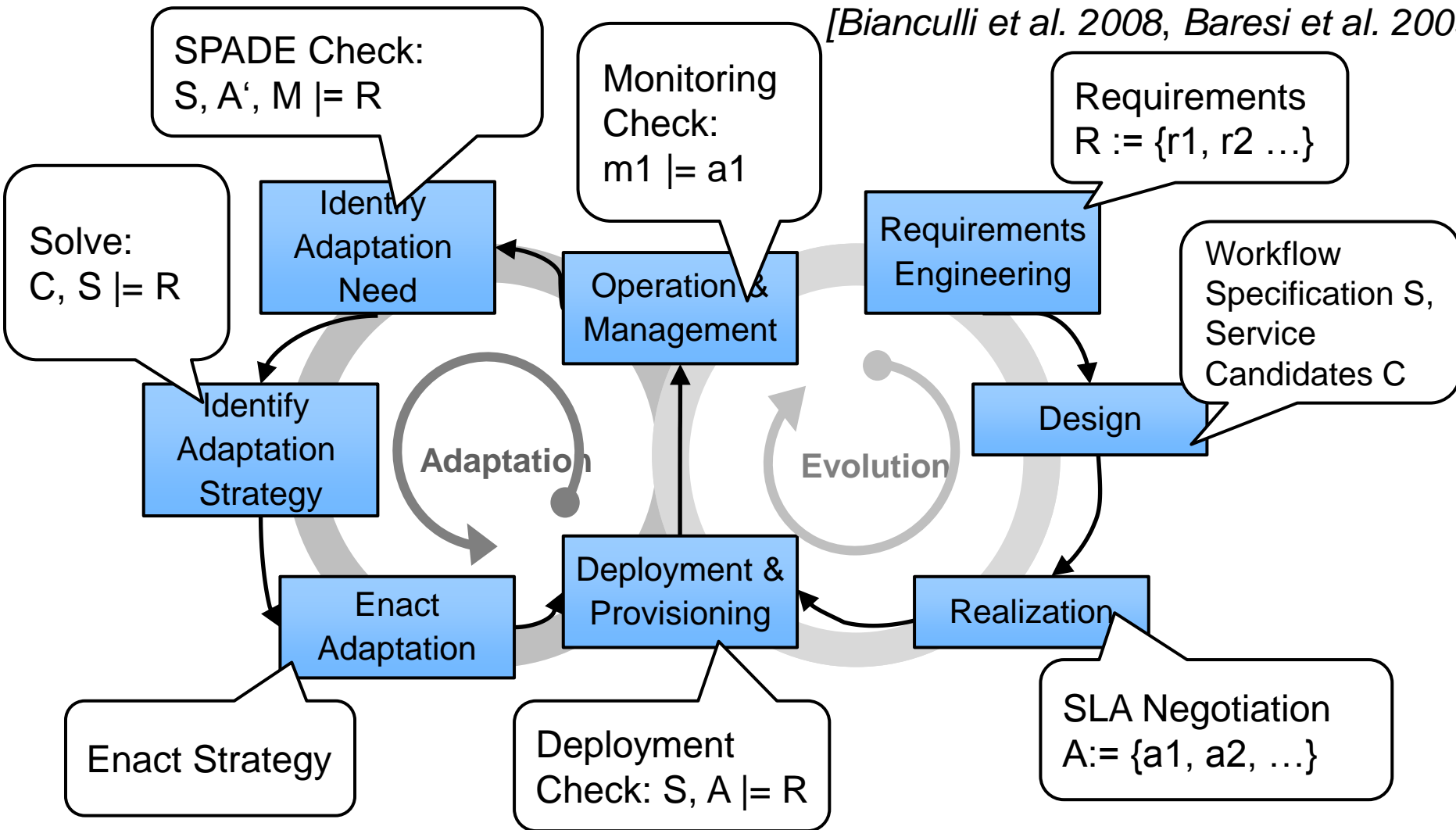
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S-Cube SBA Life-Cycle Model

Design and Runtime Activities of SPADE



[Bianculli et al. 2008, Baresi et al. 2009]

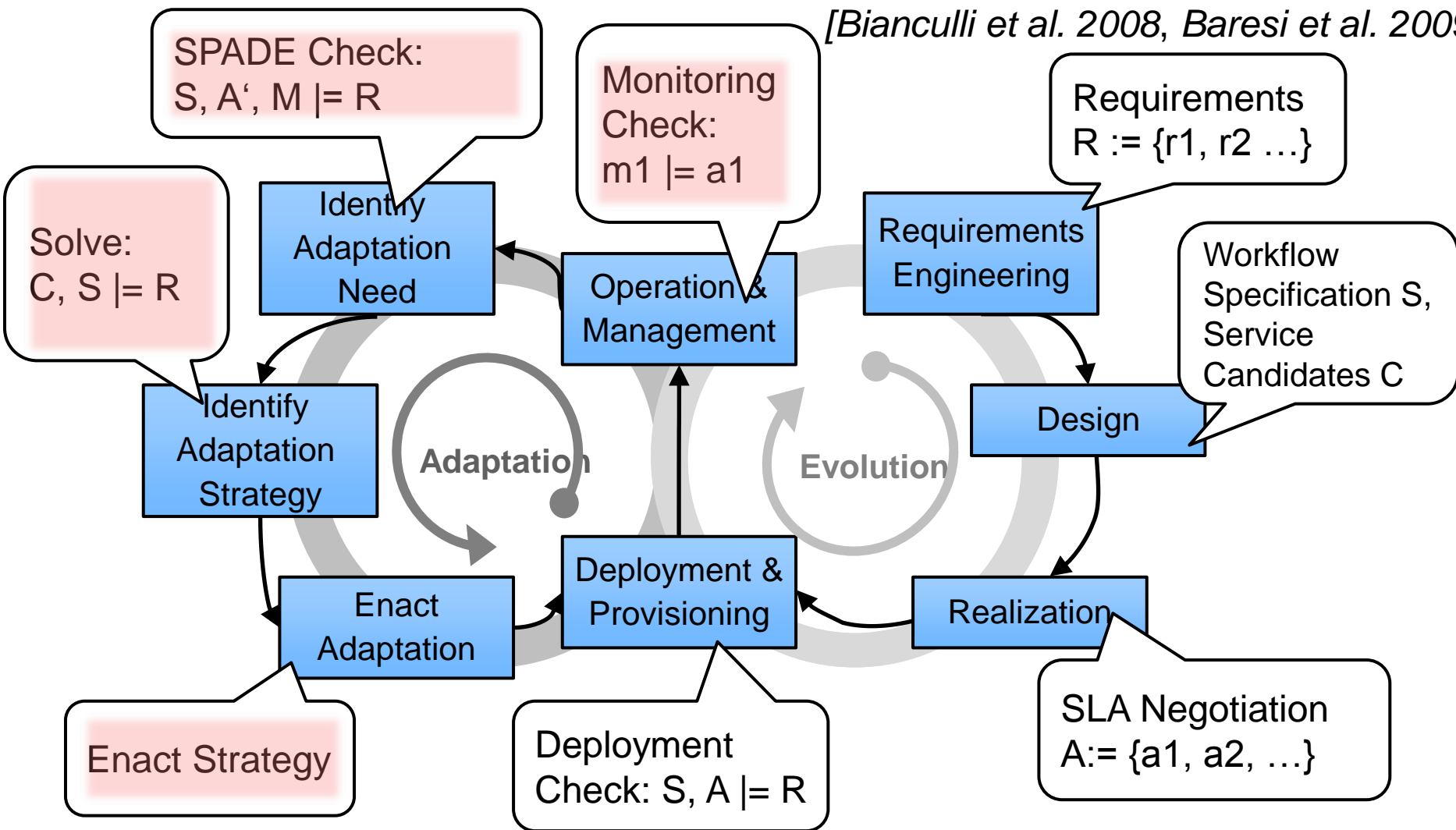


S-Cube SBA Life-Cycle Model

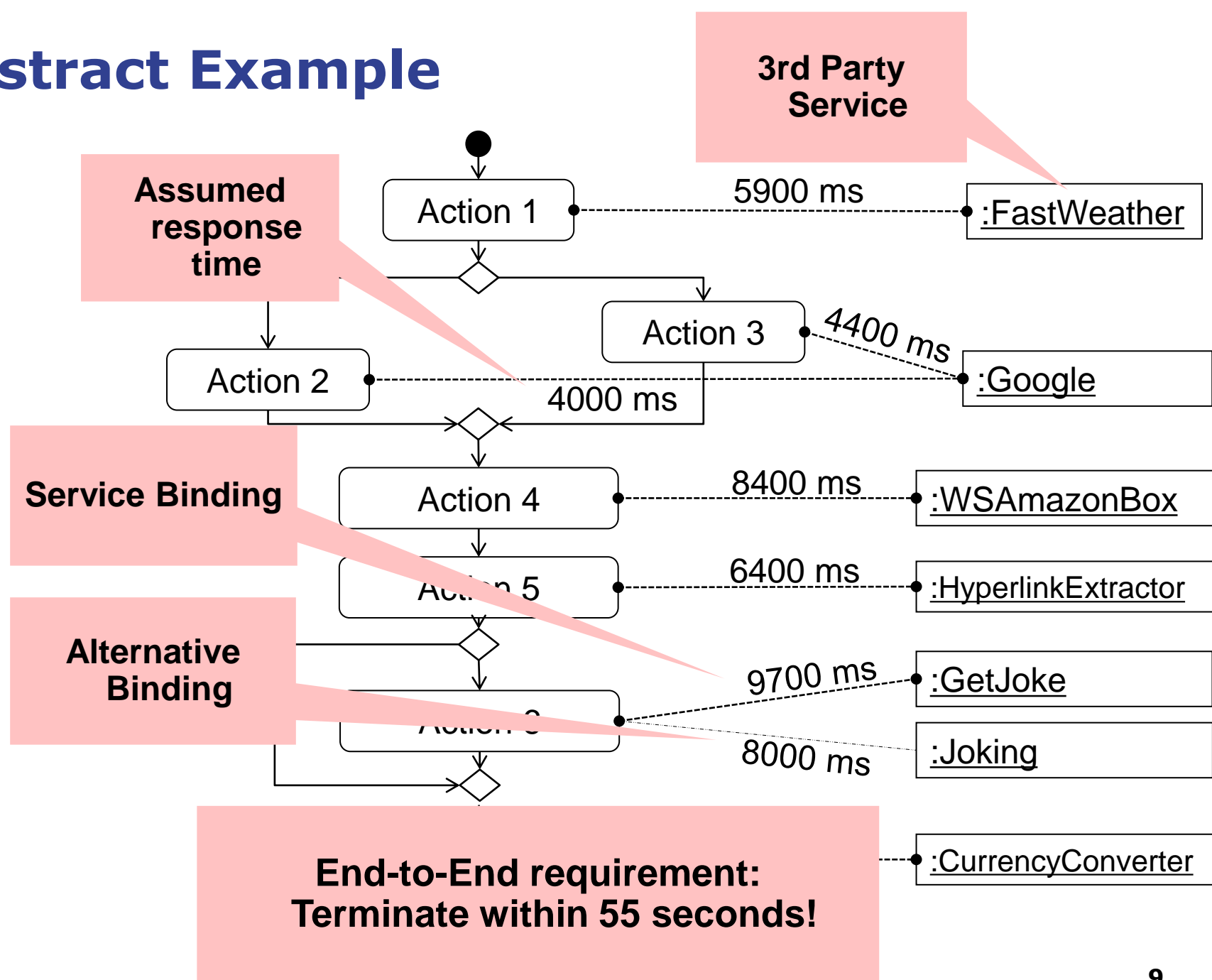
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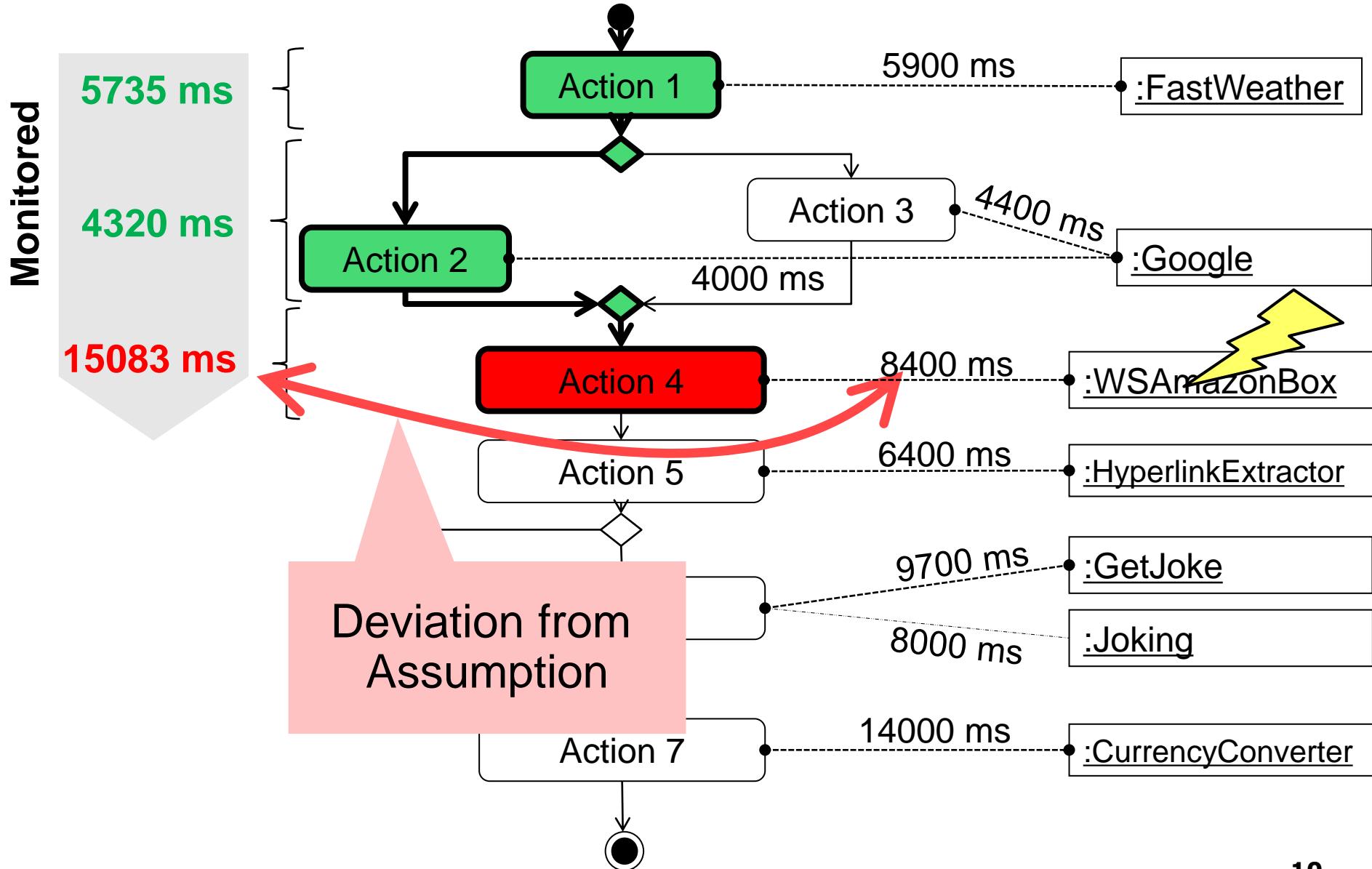
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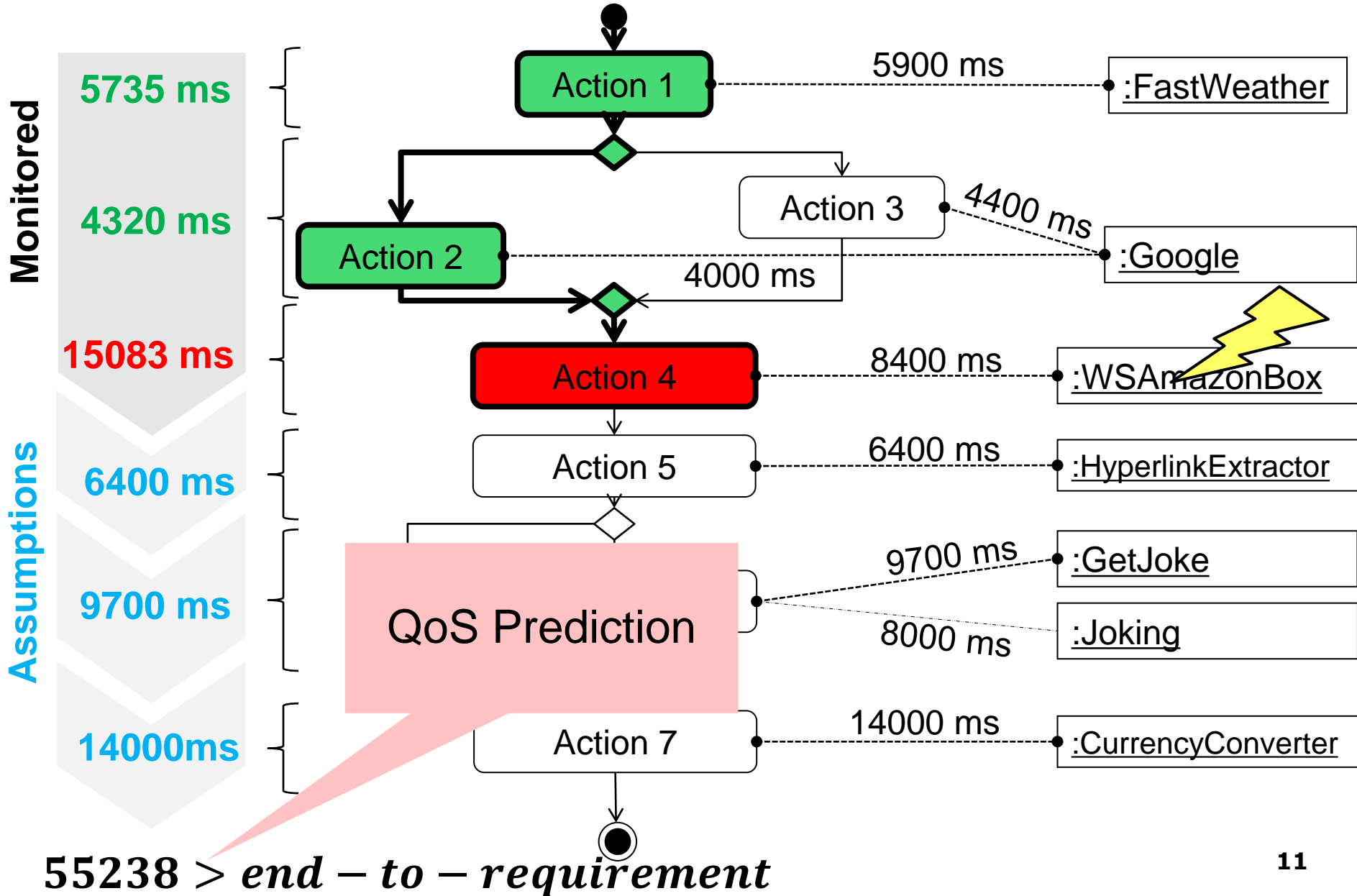
Abstract Example



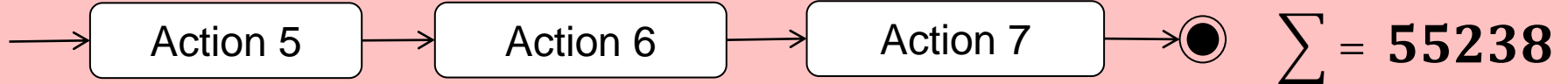
Life-Cycle: Operation & Management



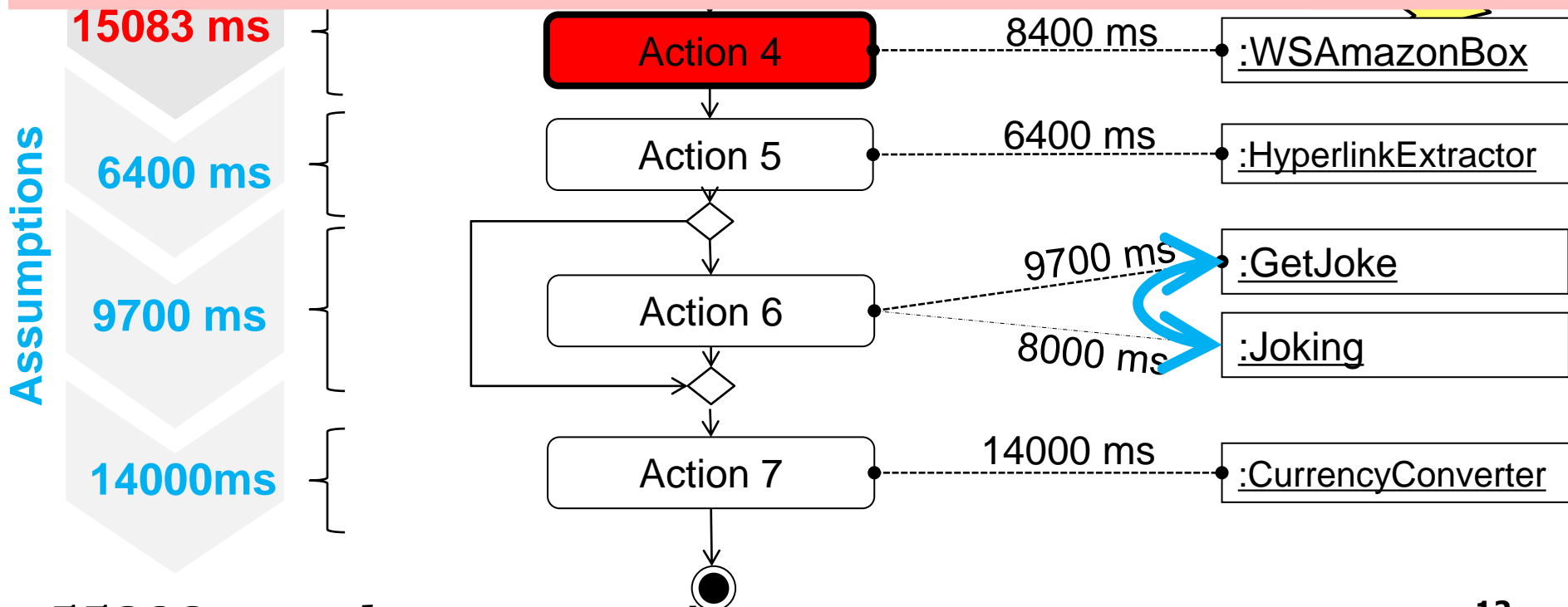
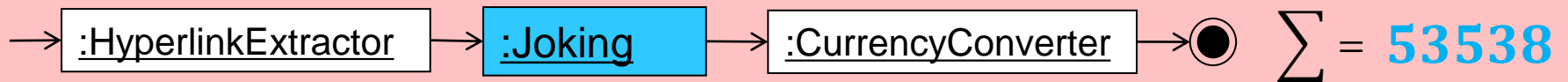
Life-Cycle: Identify Adaptation Need



Identify pathes violating the requirement:

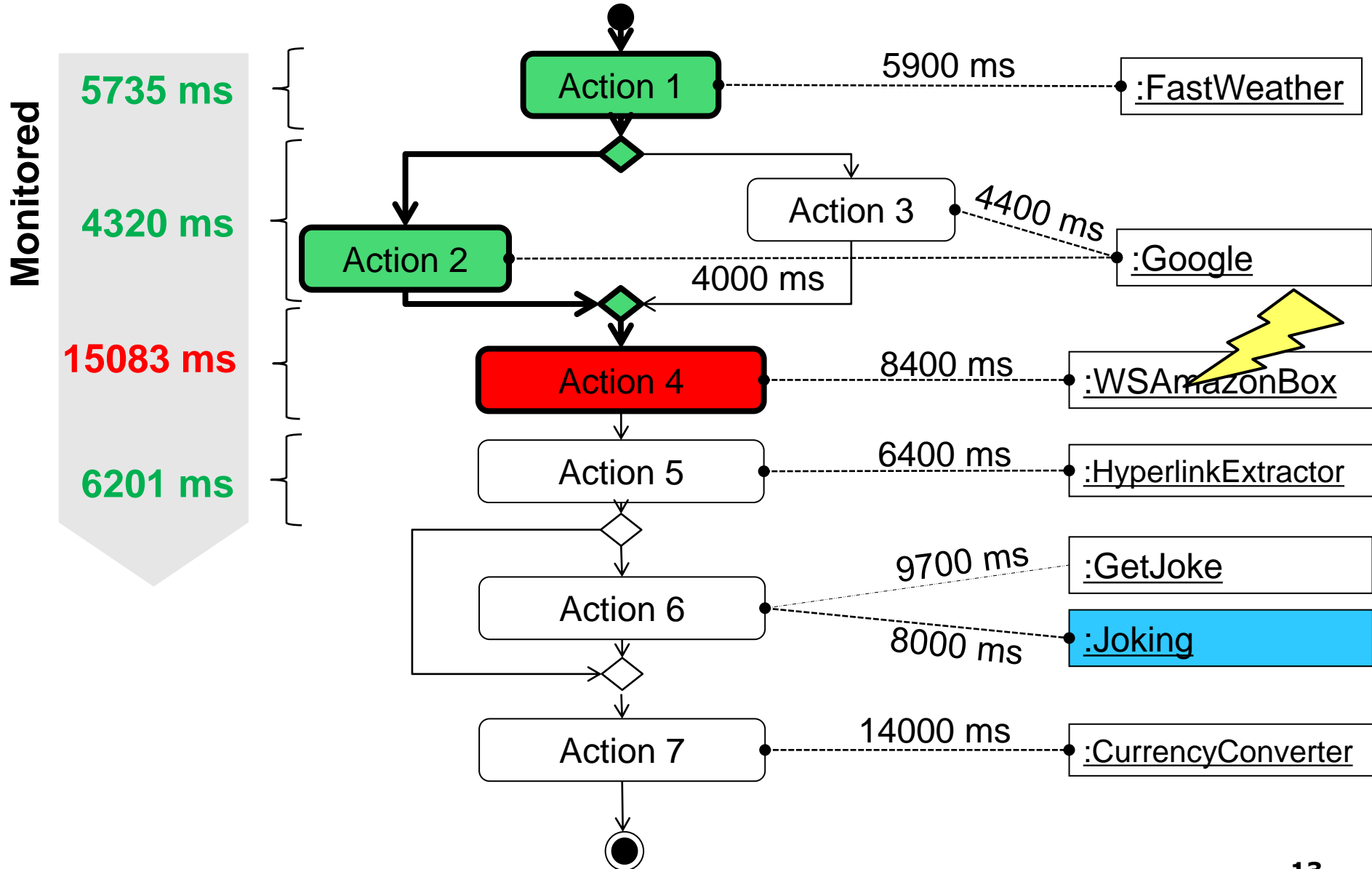


Choose possible Adaptations (using CHOCO):



55238 > end - to - requirement

Life-Cycle: Enact Adaptation and Resume



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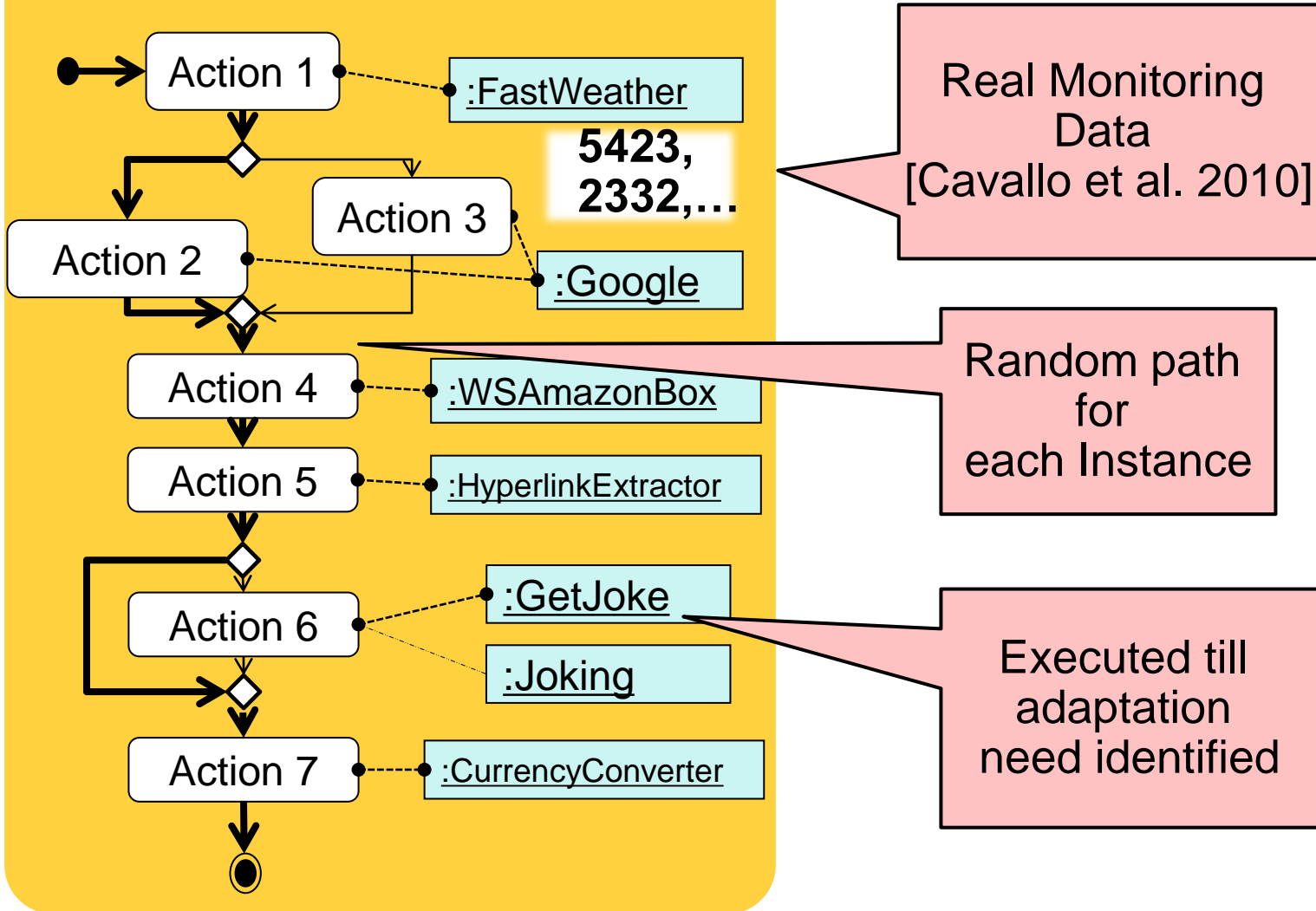
Experimental Validation

Validation Goal: Assess efficiency of SPADE
in **detecting adaptation needs**

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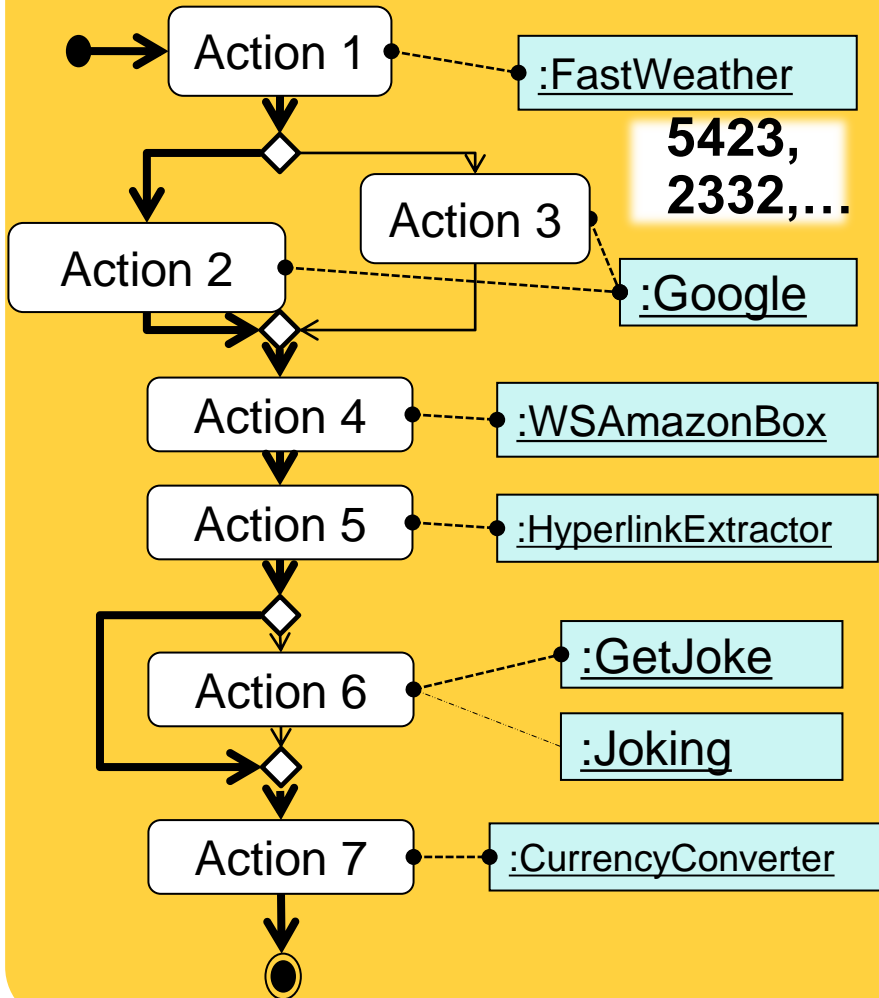
WORKFLOW EXECUTION



Experimental Validation

Validation Goal: Assess efficiency of SPADE
in **detecting adaptation needs**

WORKFLOW EXECUTION



Metrics:

- 1. False Positive = Adaptation Need identified although adaptation unnecessary**
- 2. Impossible Adaptation = response time peak of service invocation leads to requirement violation**

First Experimental Validation

False Positives	
(a) Instance Executed	5884
(b) Instances with Adaptation Needs	604
(c) False Positives	72
Percentage of (c) in relation to (a)	~1.2%

Adaptation Not Possible	
(a) Total Service Executions	30784
(b) Service Executions leading to end-to-end requirement violations	825
Percentage of (b) in relation to (a)	~2.7%

CONTENT

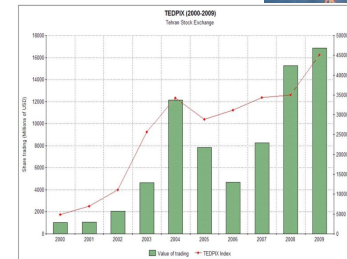
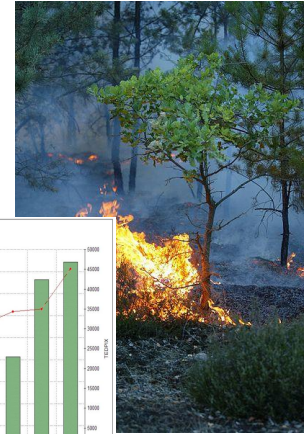
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Conclusion and Outlook

SPADE deals with Situations, in which:
**running instance must be adapted
and no training data exists!**

Outlook:

- Situations in which SPADE cannot perform a preventive adaptation → **further improvement of SPADE using**
 - **Online Testing**
 - **Cross Layer Adaptation**
- Further experiments together with members of the S-Cube Quality Prediction Group to compare efficiency of SPADE in different situations → <http://www.s-cube-network.eu/qp>



THANKS FOR YOUR ATTENTION!

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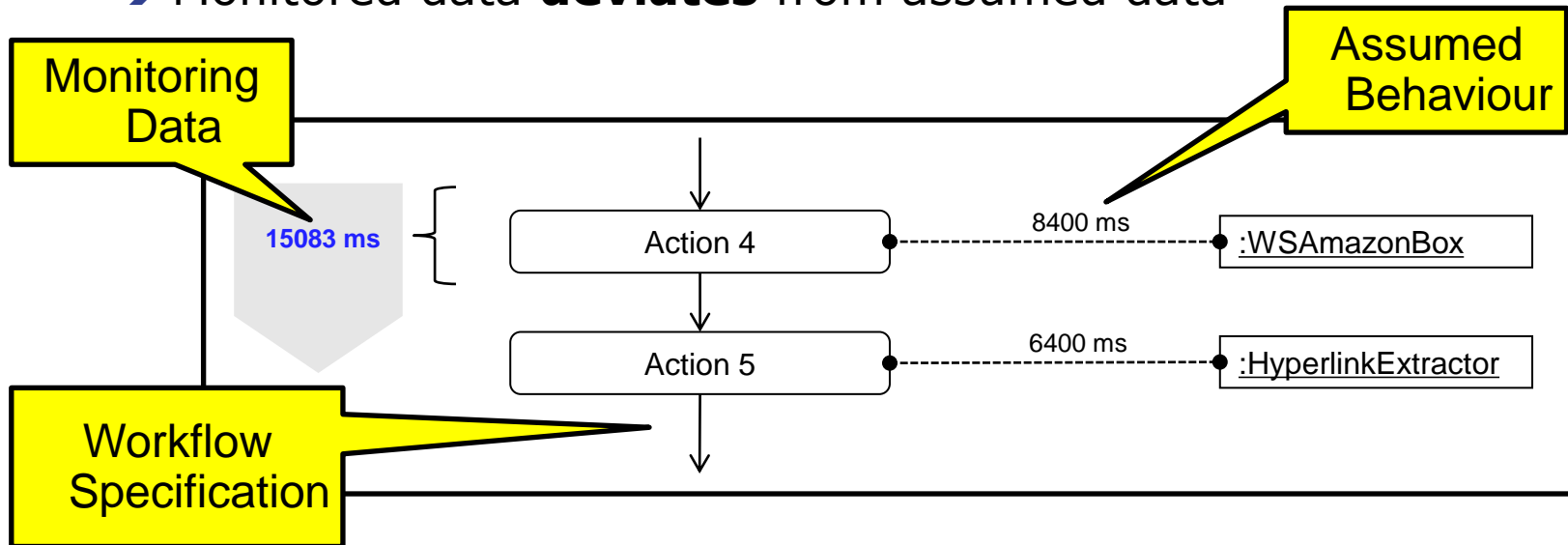
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MOTIVATION & HYPOTHESE

Sketching the Solution

- **SPADE in a Nutshell:**

→ Monitored data **deviates** from assumed data



→ Monitoring Data & Assumed data together with Workflow Specification: **checked against** requirements

→ If adaptation required: Adaptation based on Constraint Solving

S-Cube Life-Cycle Phases

Design Time (1)

- **Requirements Engineering:**

- ALBERT: $r := \text{onEvent}(\text{start}, \text{"Action1"}) \rightarrow \text{Within}(\text{onEvent}(\text{end}, \text{"Action7"}), 55000)$

- **Design:**

- Formalization of Workflow Spec in BIR:

```
function init() {
  identifyParkingTicket :=
  createAction("DeptATicketHandler", 100);
  makePayment := createAction("ePay", 400);
  updateParkingTicketRecord :=
    createAction("DeptCTicketHandler", 500);
  sign := createAction("eSign", 100);
  sendEmail := createAction("Yahoo", 100);
}
```

- **Realization:**

- Formalization of Assumptions in ALBERT:

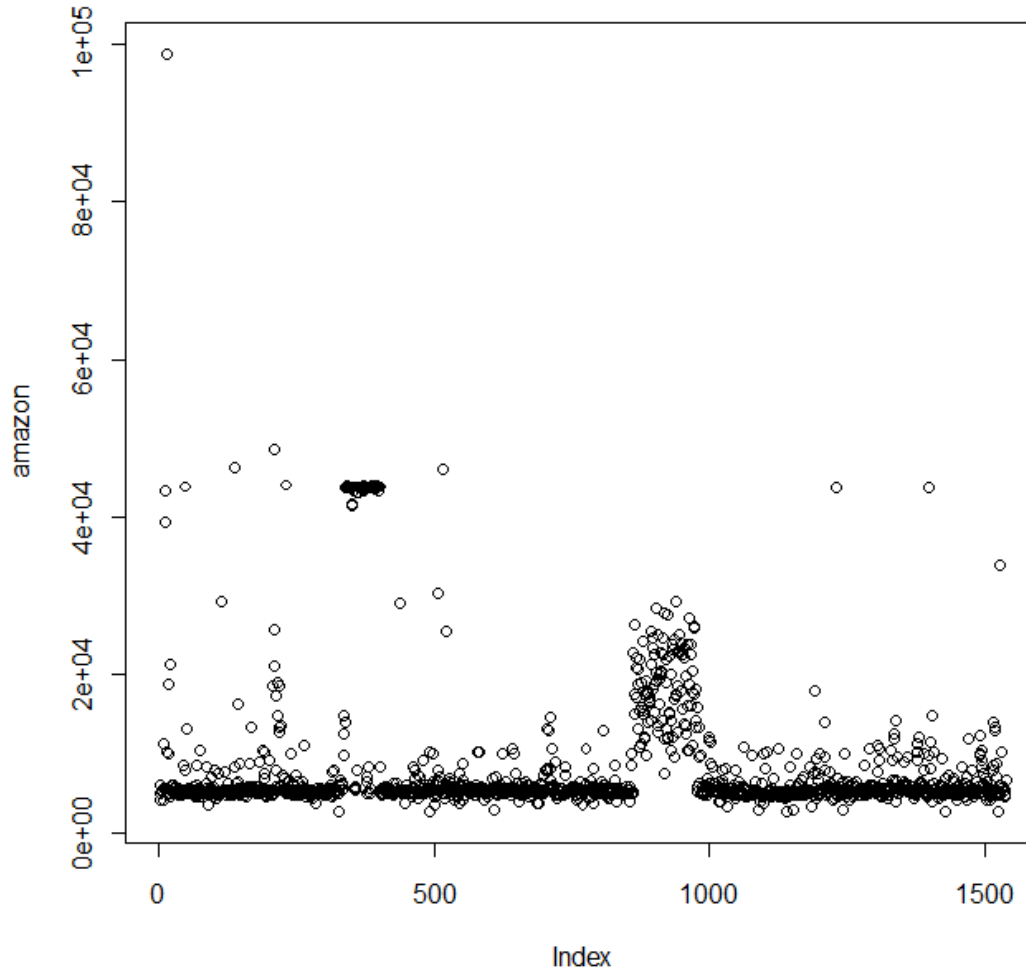
$a_{\text{FastWeather}} := \text{onEvent}(\text{start}, \text{"Action 1"}) \rightarrow \text{Within}(\text{onEvent}(\text{end}, \text{"Action 1"}), 5900)$

- **Deployment:**

- check whether the workflow specification (S), under the given assumptions (A), satisfies the requirements (R), i.e. whether:
 $S, A \models R$

Amazon

1540 Monitoring Daten für Amazon



Threats to Validity

External Validity:

- Using real monitoring data, but not tested with real workflows and requirements → Realistic data from Case Study needed
- Example does not cover all possible Workflow constructs; no loops and forks

Internal Validity:

- Influence factors like workflow structure might bias the outcome → Experiments have to be conducted with several different workflows