

On the Need for Extended Transactional Models@Run.Time

Presented at MRT 2015, Ottawa, Canada

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Agenda

Introduction

Example Issues

Desired Features

Conclusions and Future Work

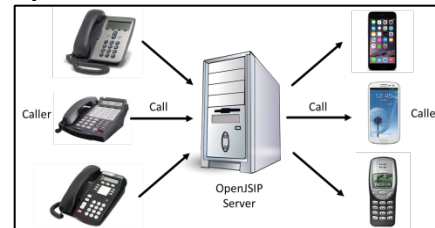
Presentation of the motivation behind this research.

INTRODUCTION

Background: MRT & SAS

Models can be also used at runtime (MRT) to realize adaptive software.

OpenJSIP

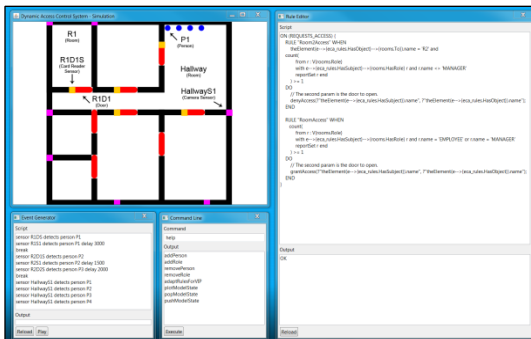


(1) GRAF Project
[Amoui2012ADA]

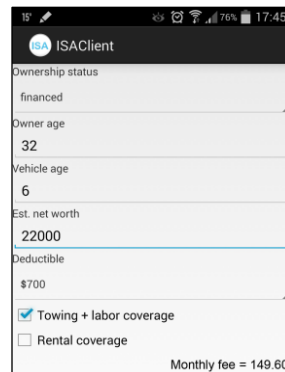
JAKE2



DAC-PL



ISA



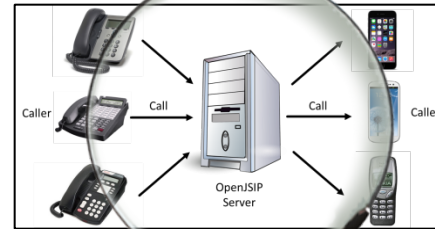
(2) MoSAiC Project

[Derakhshanmanesh2015MSC]

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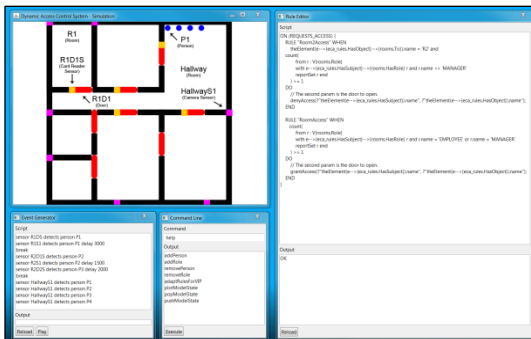
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OpenJSIP



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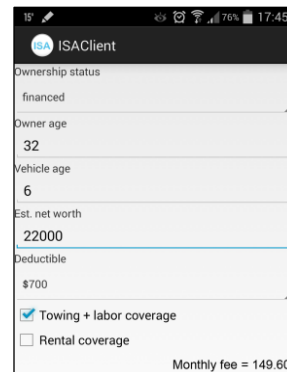
DAC-PL



JAKE2



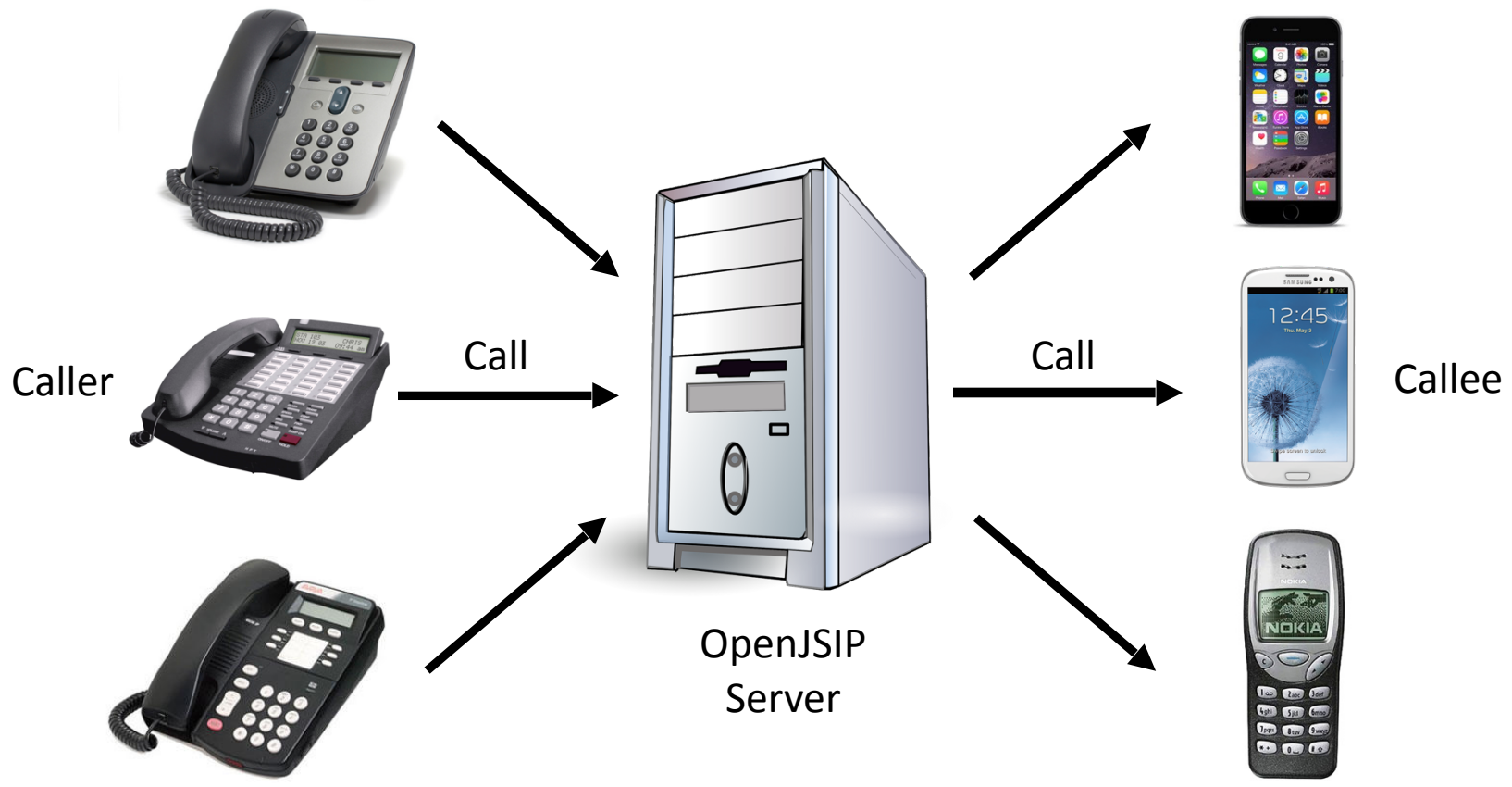
ISA



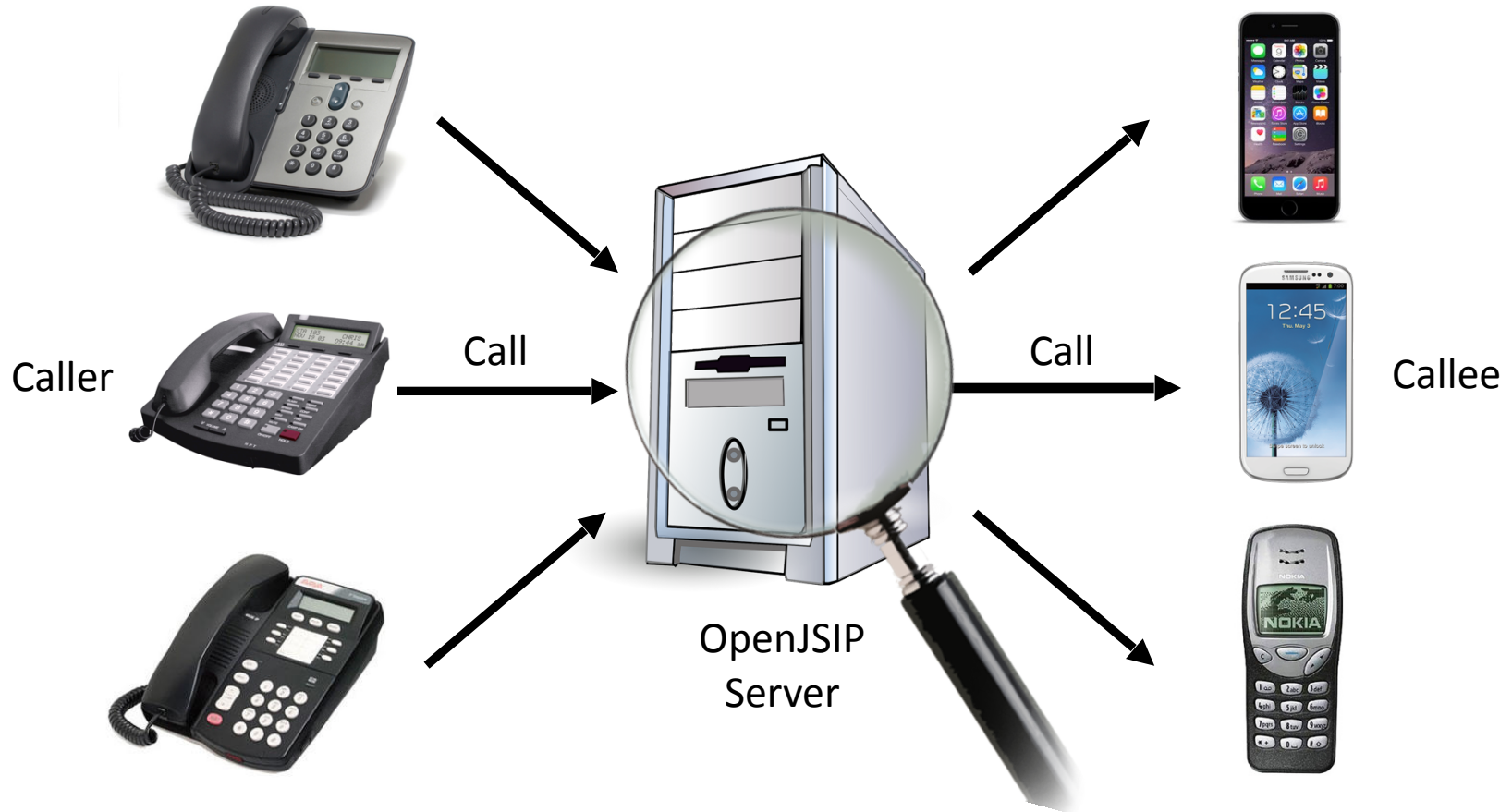
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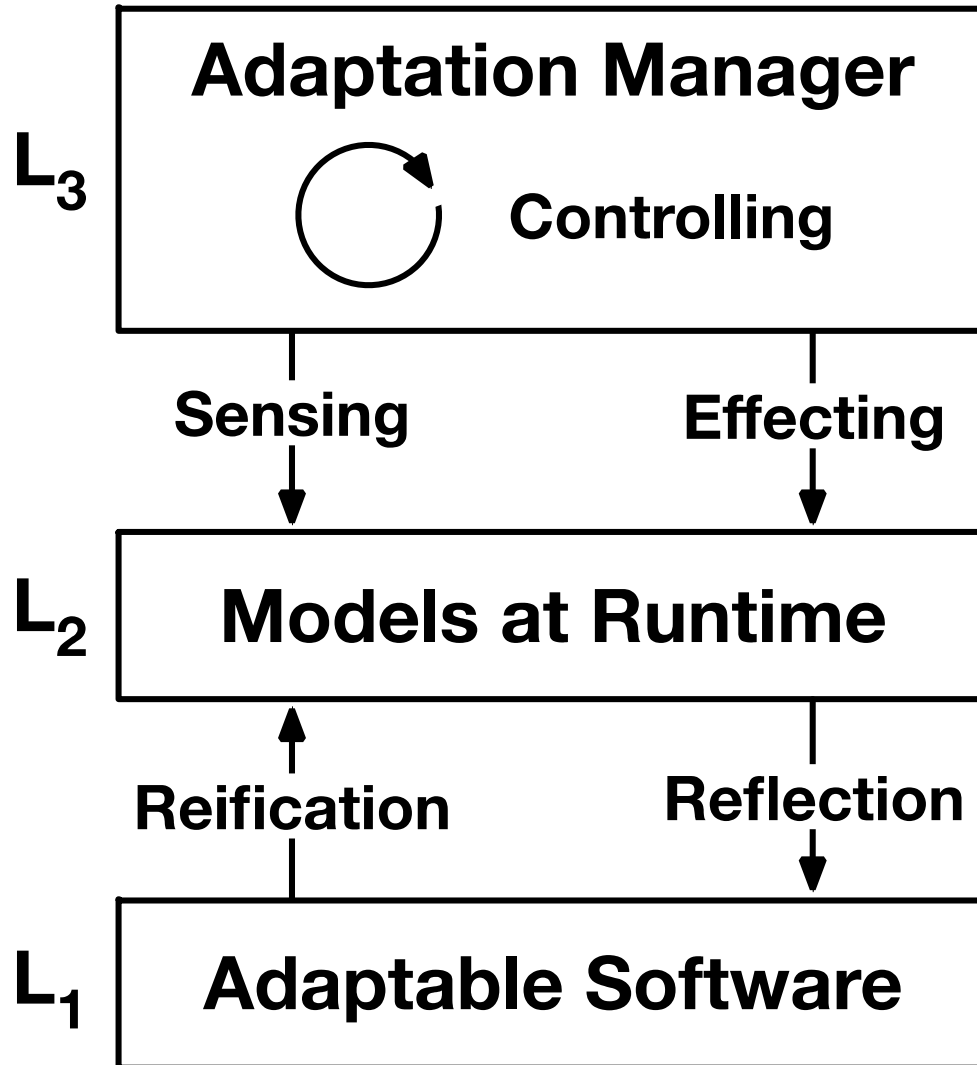
OpenJSIP



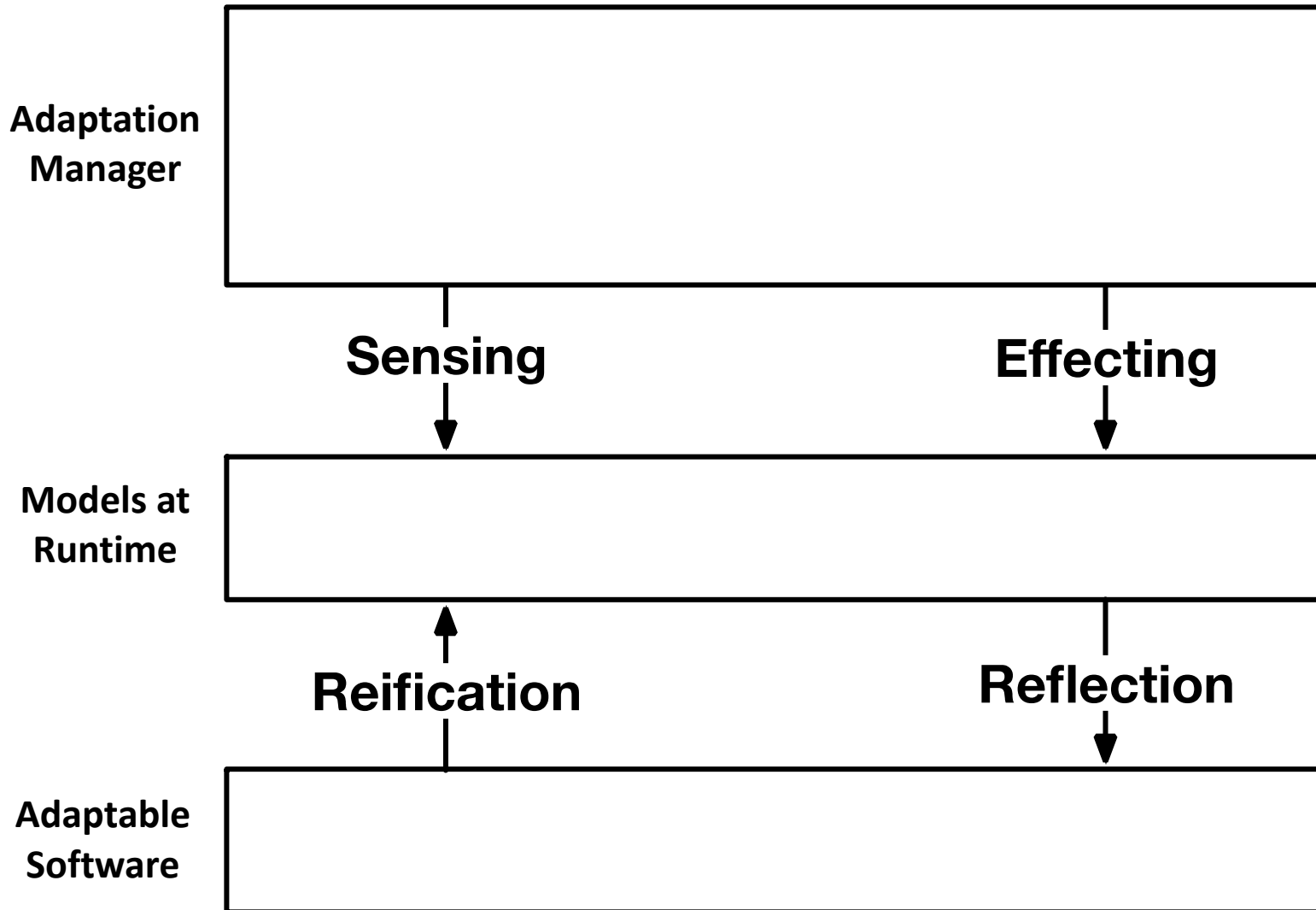
OpenJSIP



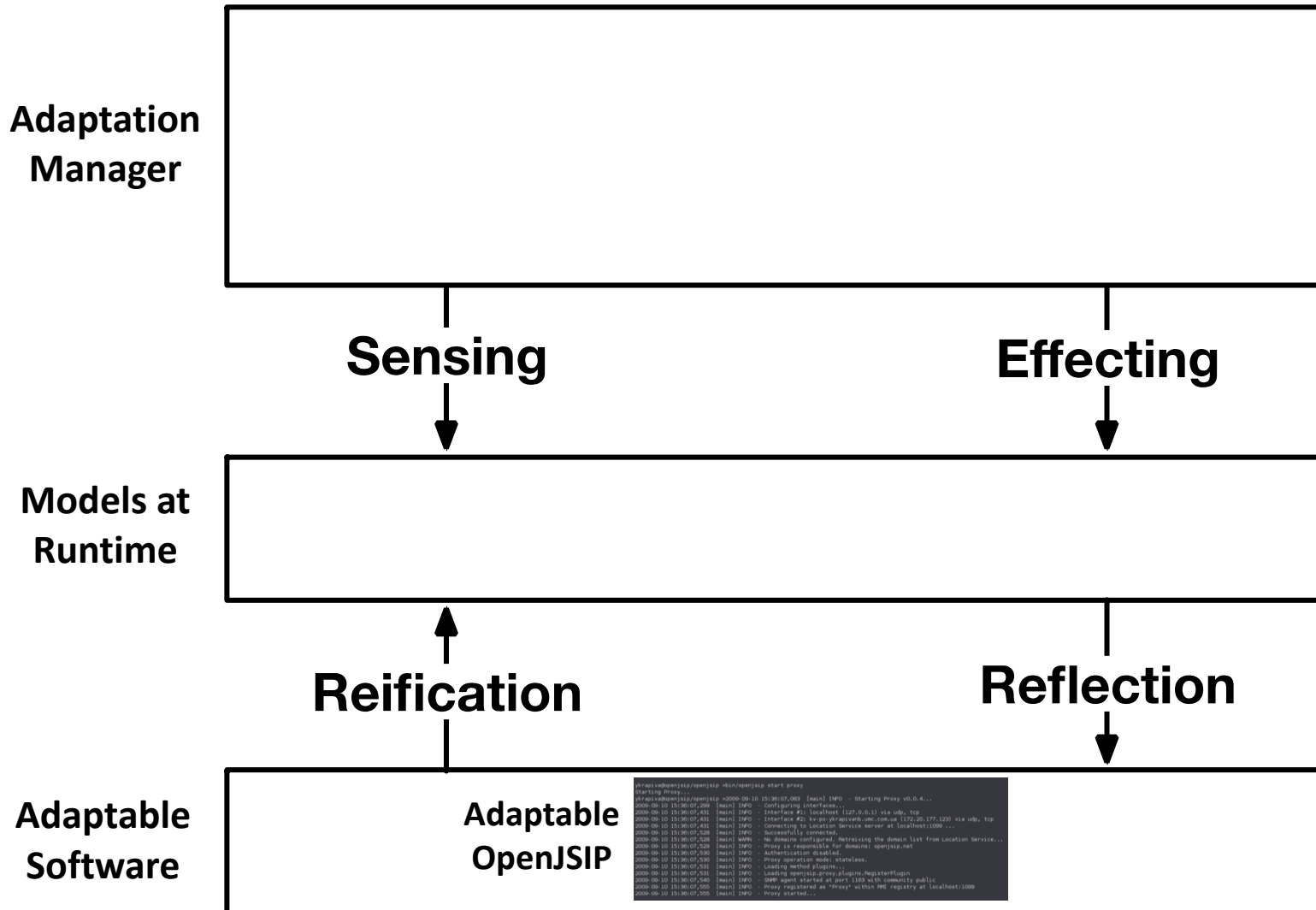
Adaptive OpenJSIP



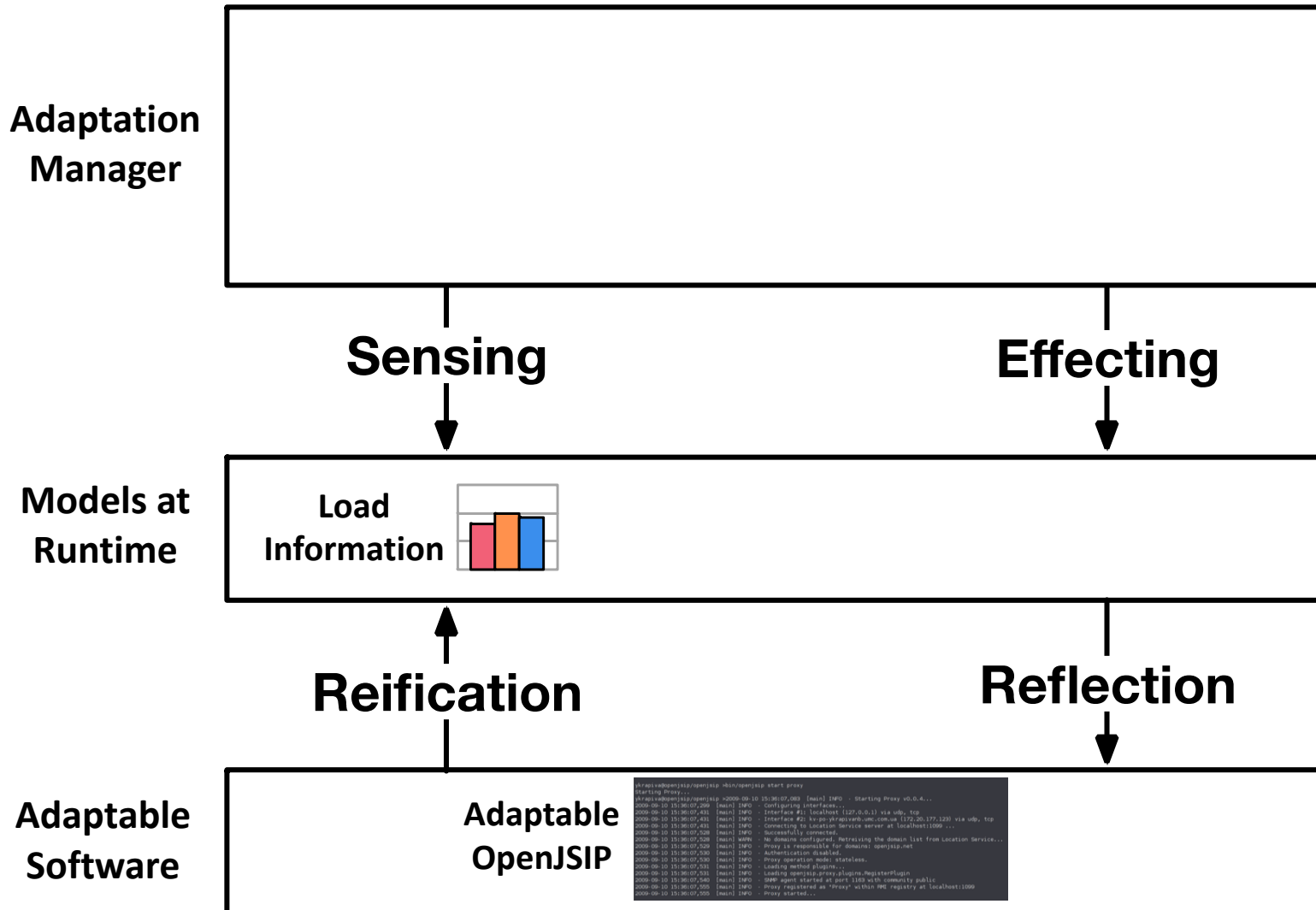
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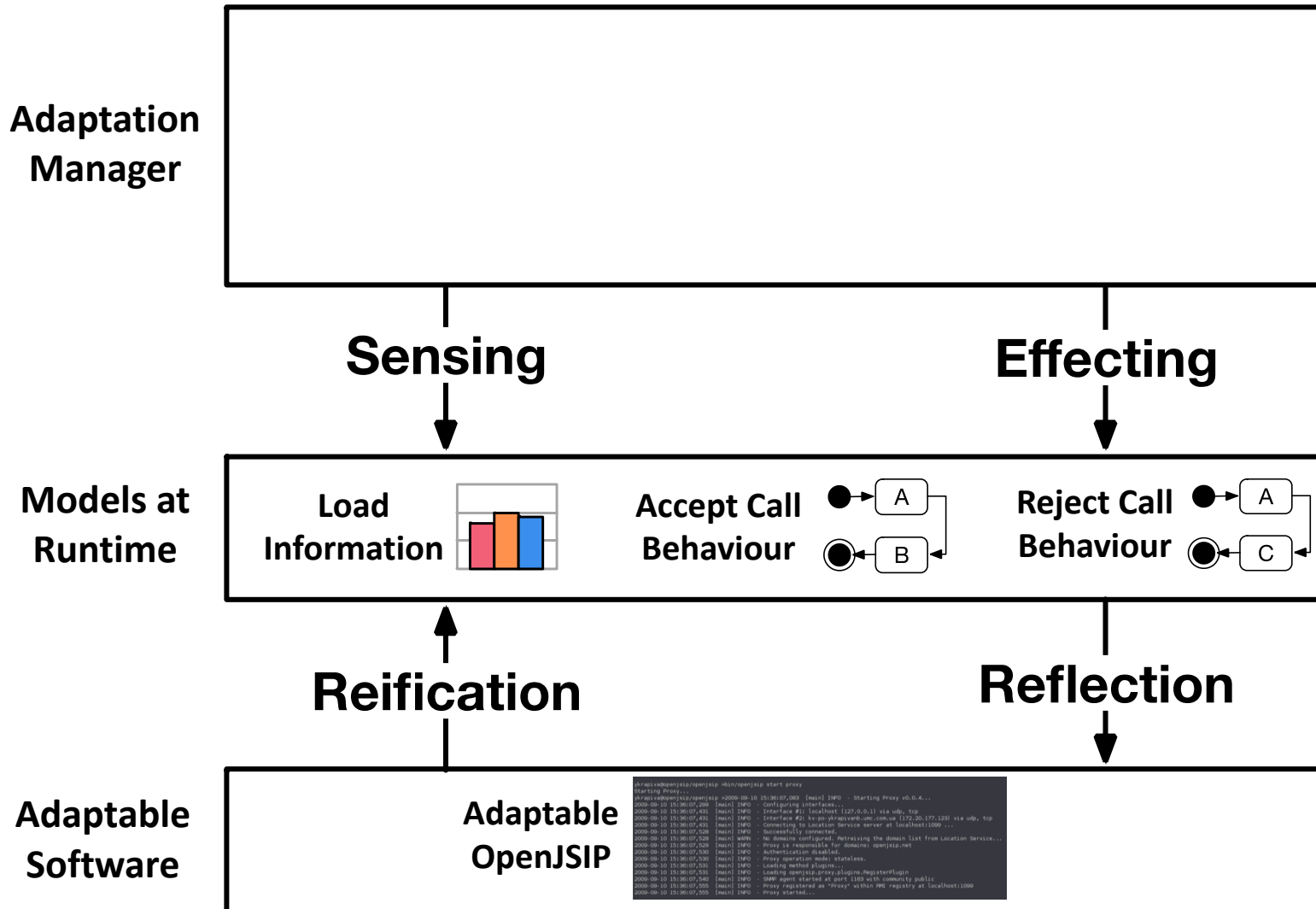
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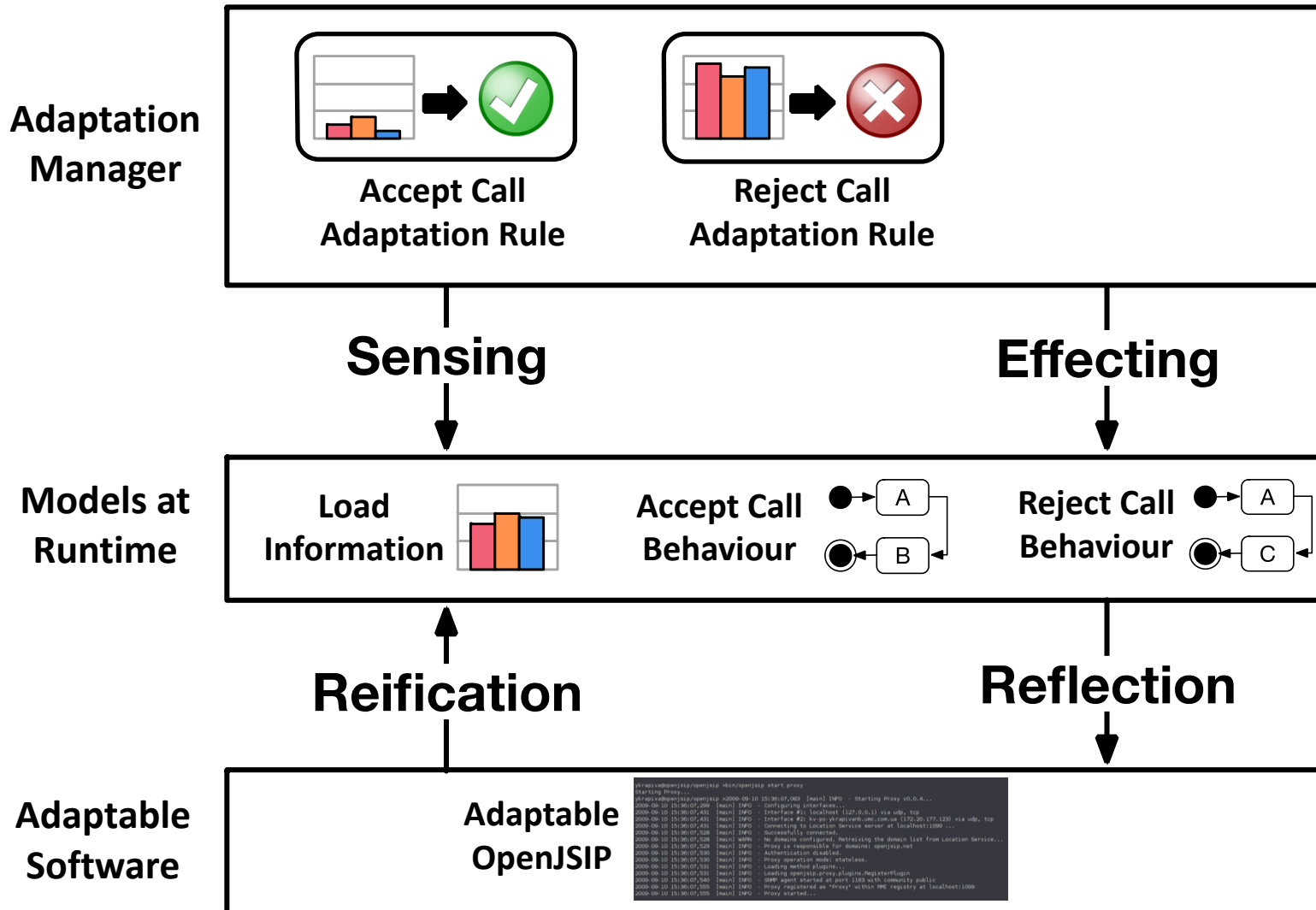
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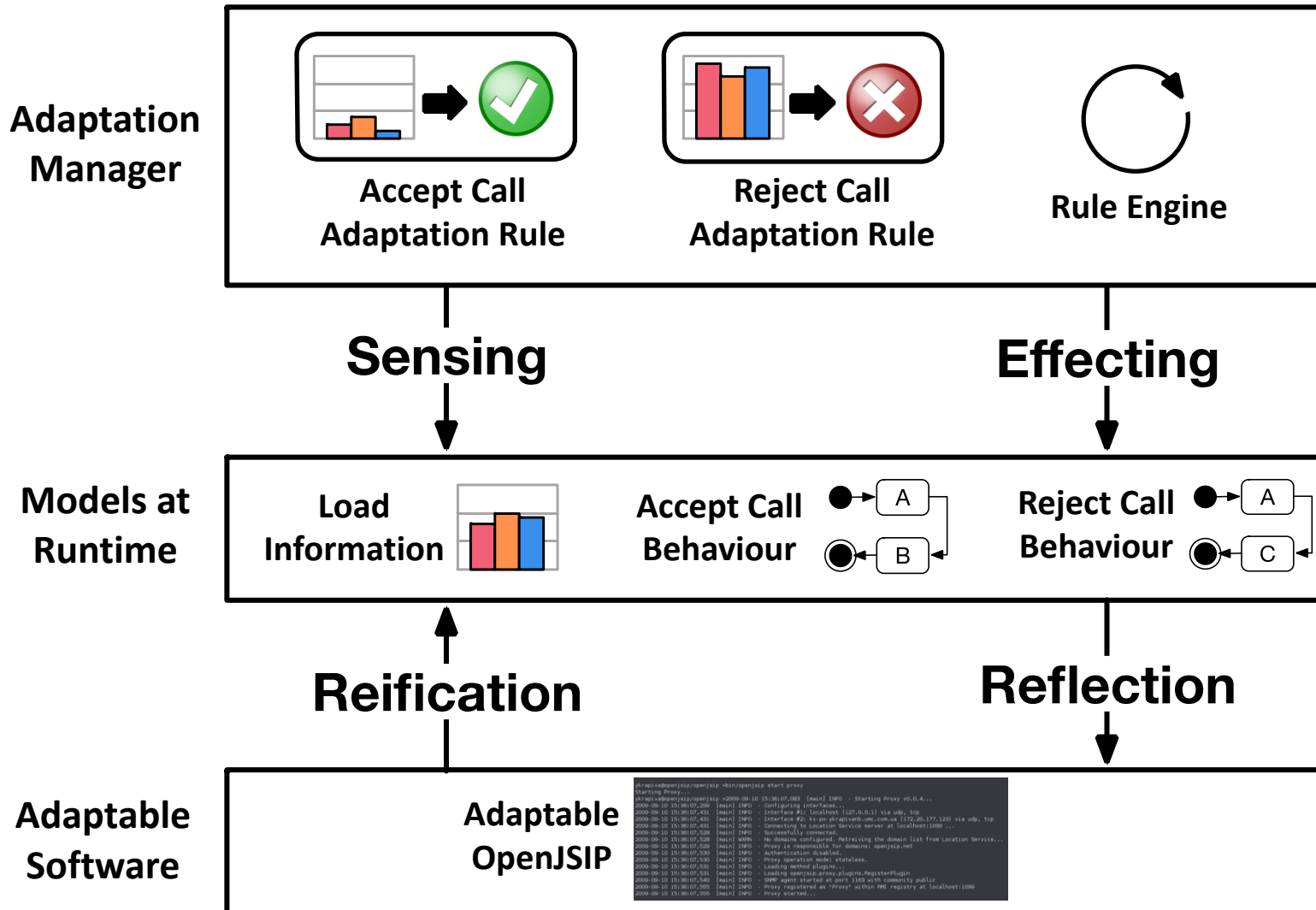
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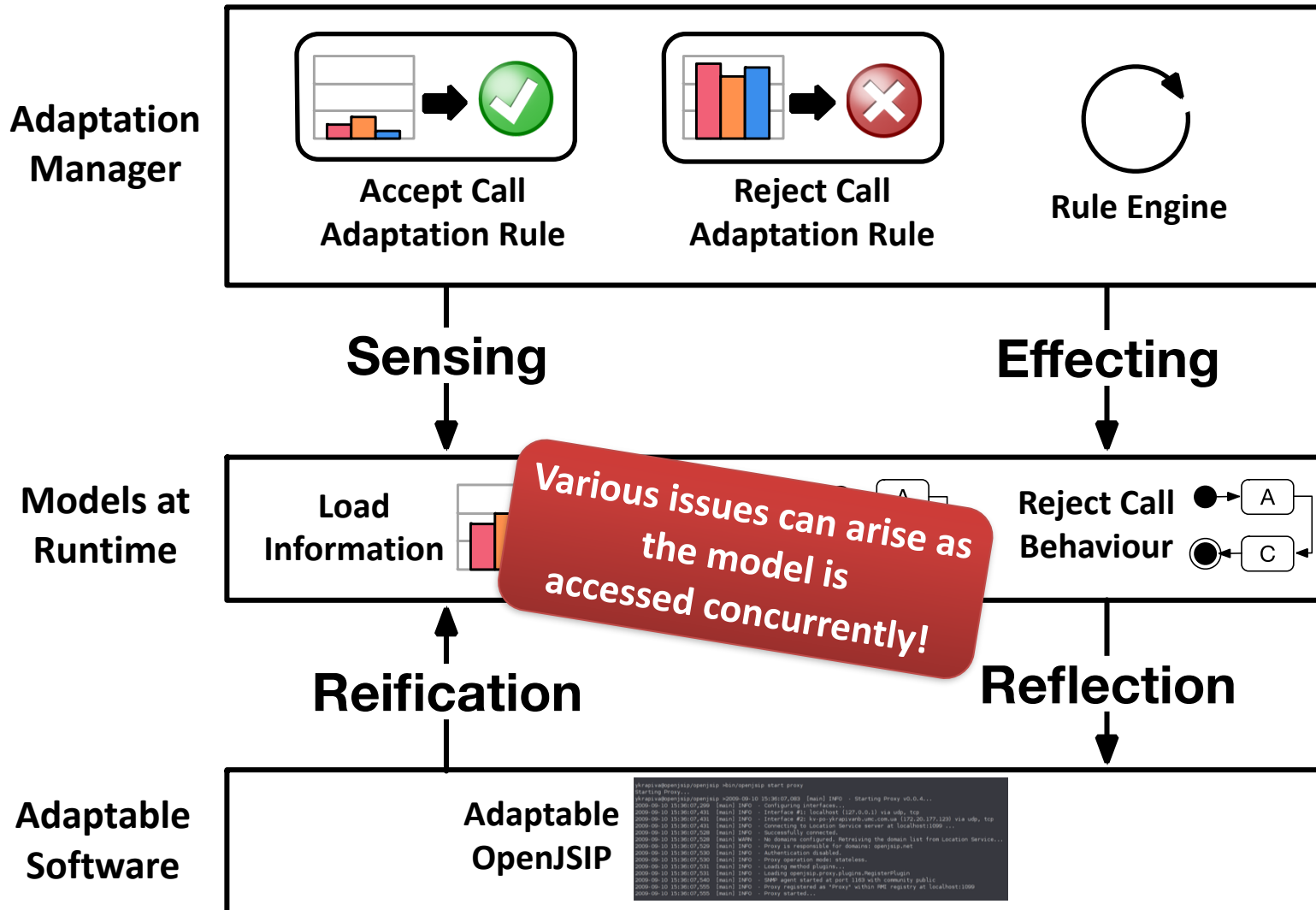
Adaptive OpenJSIP



Adaptive OpenJSIP



Adaptive OpenJSIP



Motivation: Extended Transactions

Execution frameworks (middleware) must **ensure** properties that guarantee a **flawless execution**.

A **transaction approach** assumes that closed execution sequences can be identified (BOT, ..., EOT) such that required **properties can be guaranteed**.

- Database transactions (ACID properties)

Further MRT-issues stem from the MAPE-loop, so we talk about **extended transactions** or **transactions i.t.b.s.**

Research Problems and Contributions

A **standardized solution** for handling models at runtime is needed that guides application development.

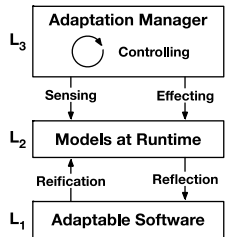
- (1) What are transaction-related issues to be aware of when using models at runtime (e.g., to build SAS)?
- (2) What are the specific needs for a transaction concept for models at runtime in the broader sense?

We (i) describe **concrete examples** for common transaction-related issues with models at runtime from the context of GRAF and (ii) elicit **desired features** of a transaction concept specific to models@run.time.

(Q1) What are transaction-related issues to be aware of when using models at runtime (e.g., to build SAS)?

EXAMPLE ISSUES

Issues - Overview



Unrepeatable
Adaptation



Overeager
Adaptation

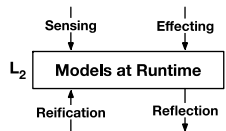


Outdated
Adaptation



Missed
Adaptation

Adaptation-Specific Issues



Lost Model
Update



Dirty Model
Read



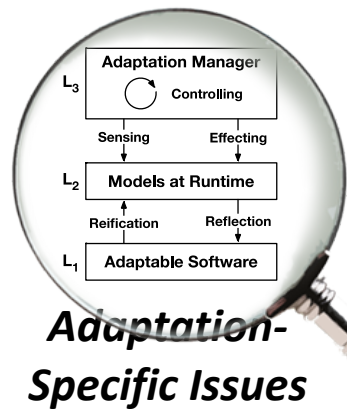
Unrepeatable
Model Read



Conflicting
Model Update

MRT-Specific Issues

Issues - Overview



Unrepeatable Adaptation



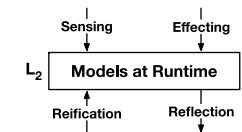
Overeager Adaptation



Outdated Adaptation



Missed Adaptation



MRT-Specific Issues



Lost Model Update



Dirty Model Read



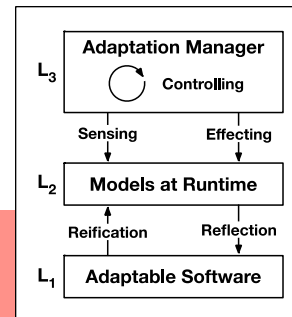
Unrepeatable Model Read



Conflicting Model Update

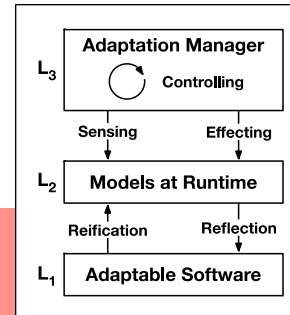
Unrepeatable Adaptation

Problem: The model, based on which the adaptation is triggered, changes during the adaptation.

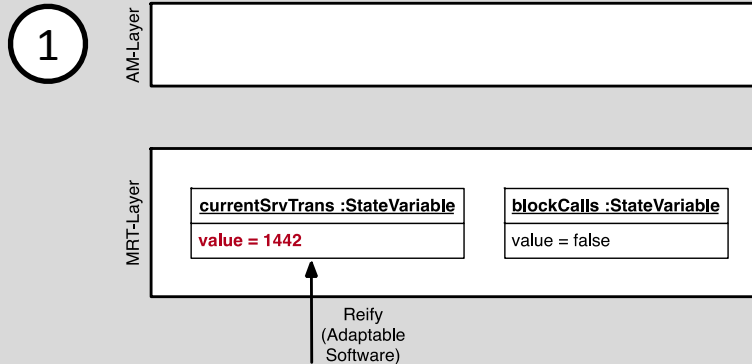


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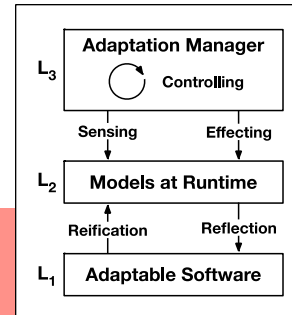


Example:

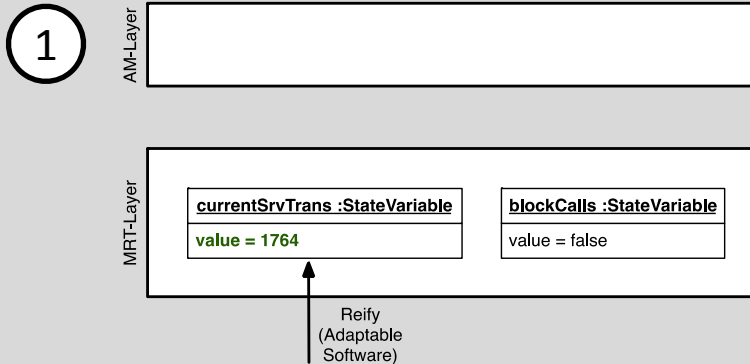


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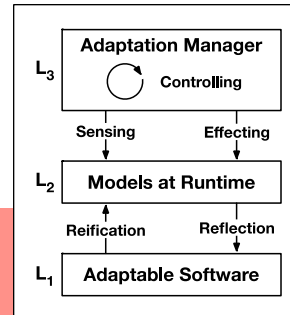
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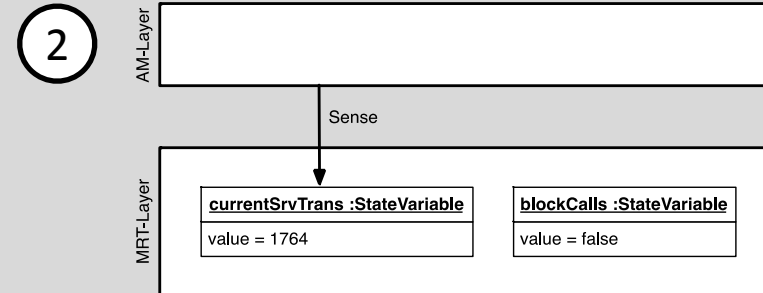
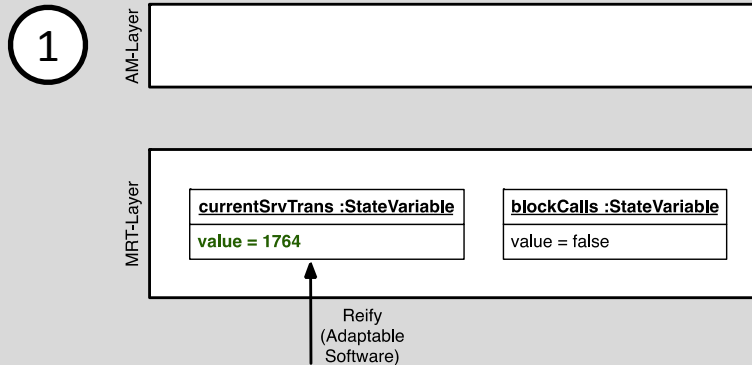


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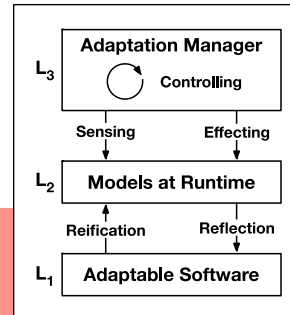


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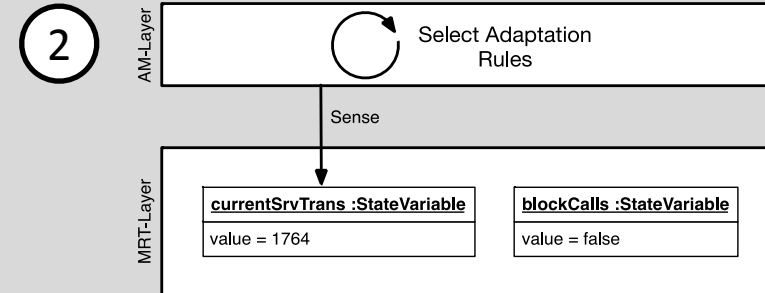
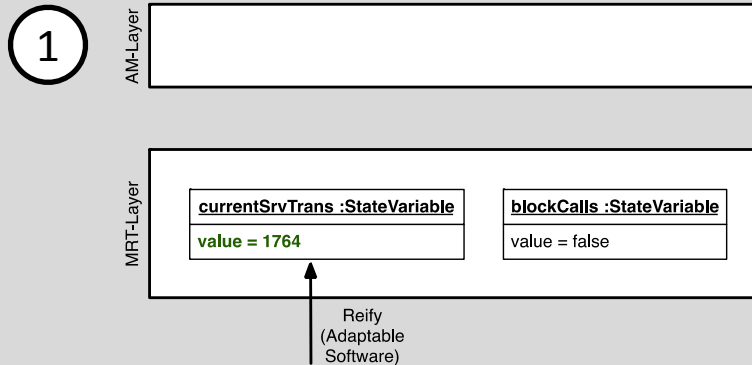


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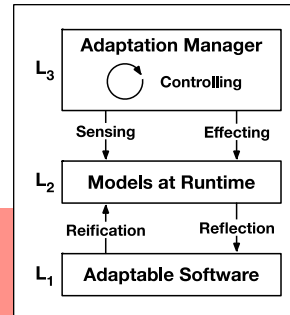


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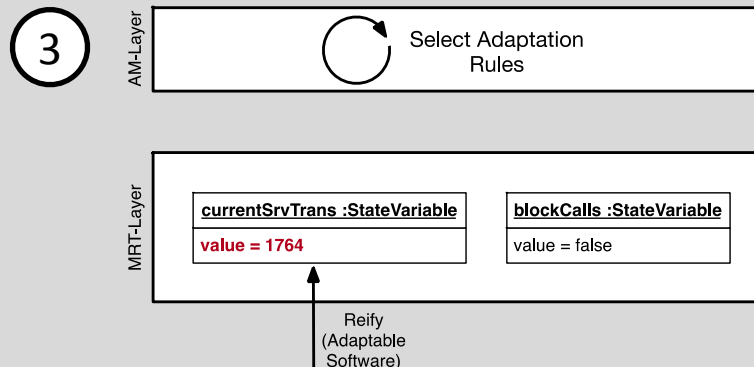
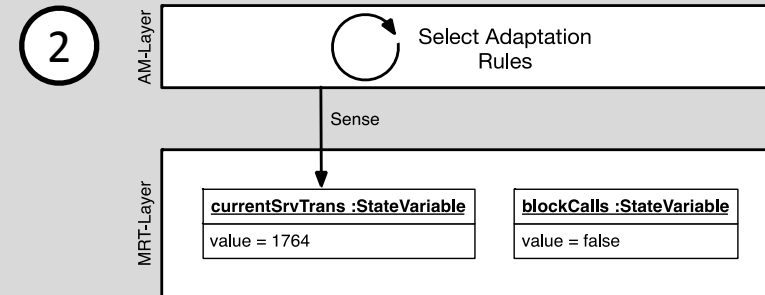
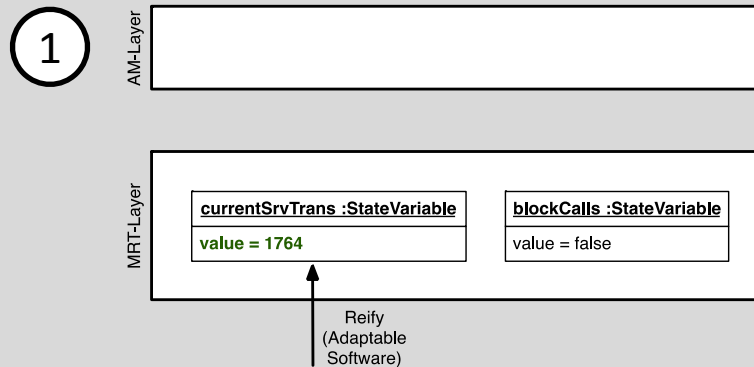


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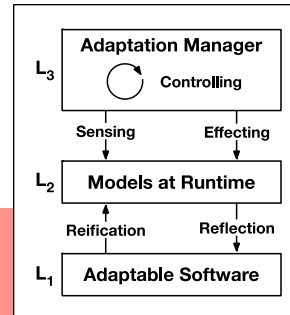


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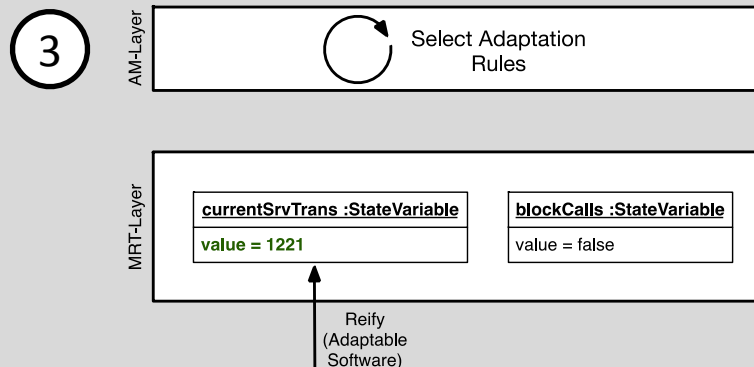
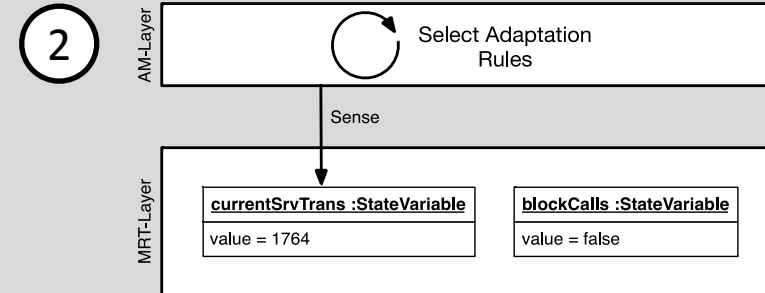
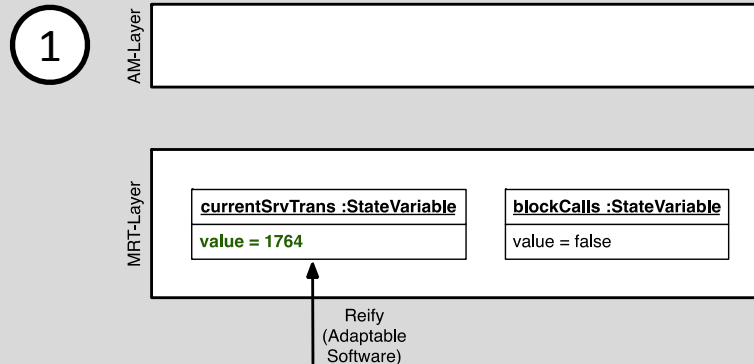


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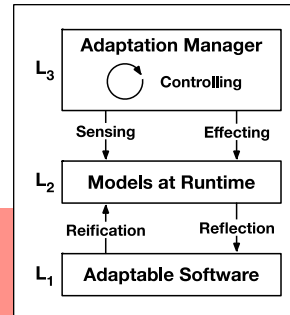


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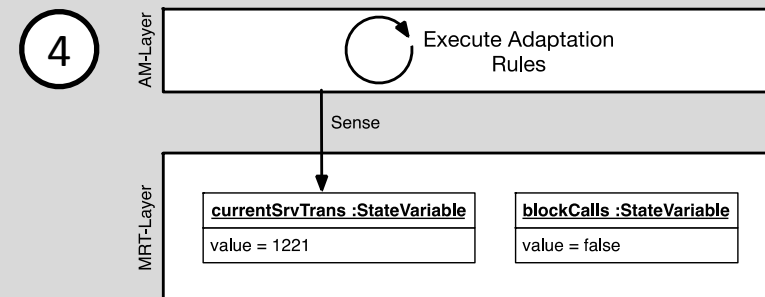
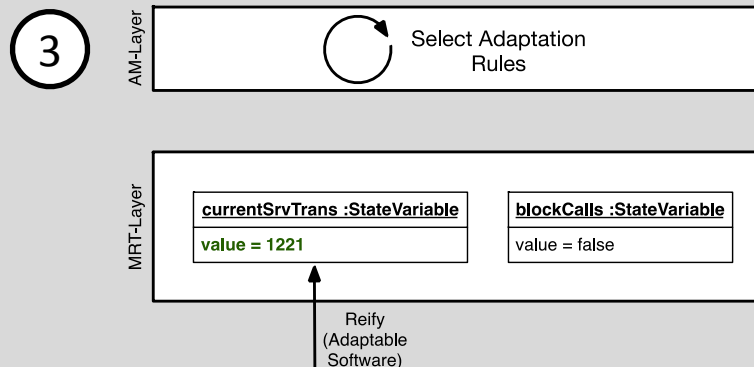
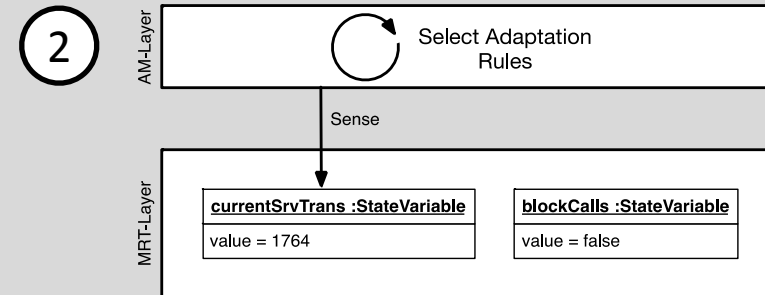
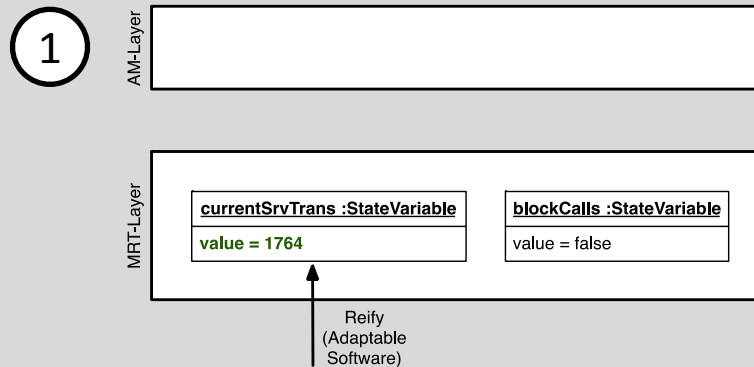


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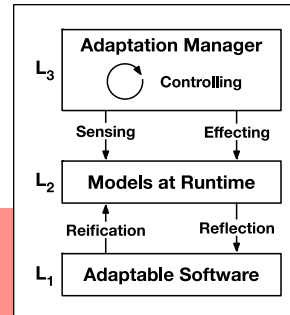


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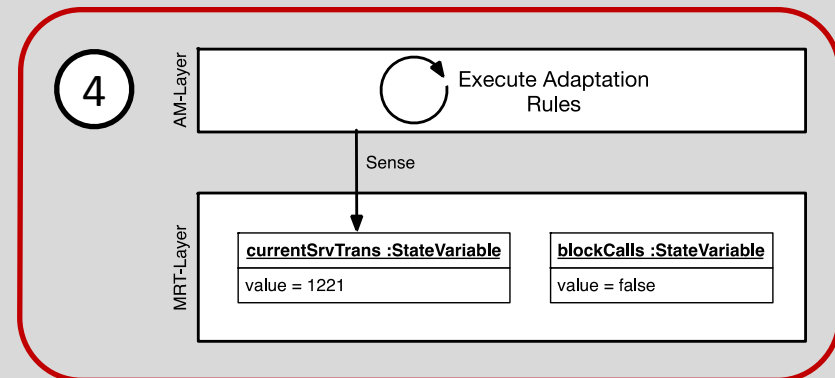
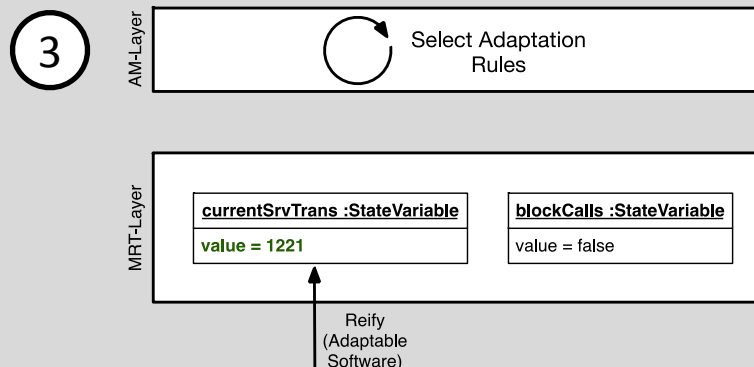
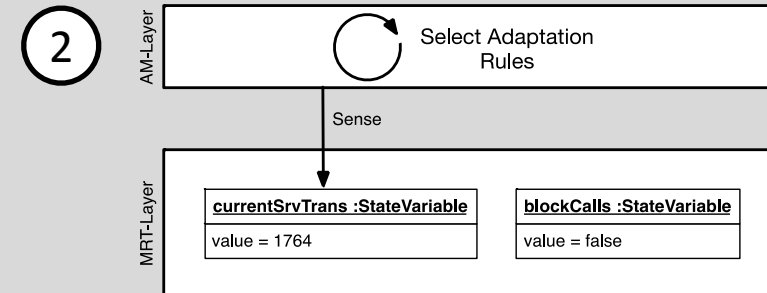
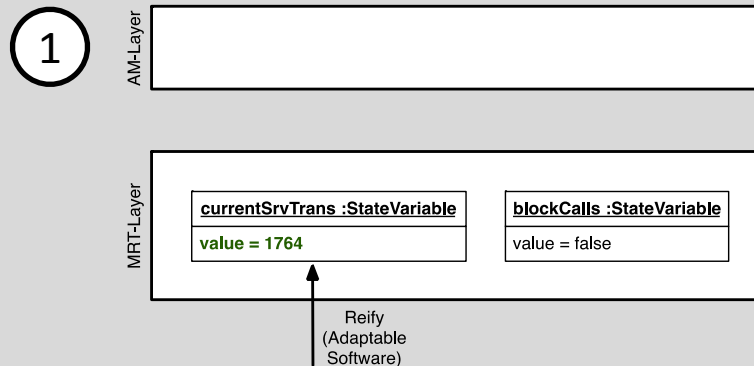


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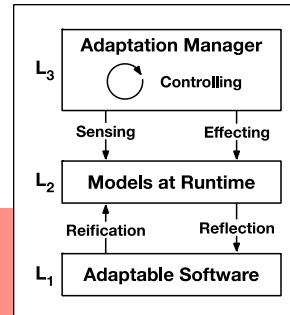


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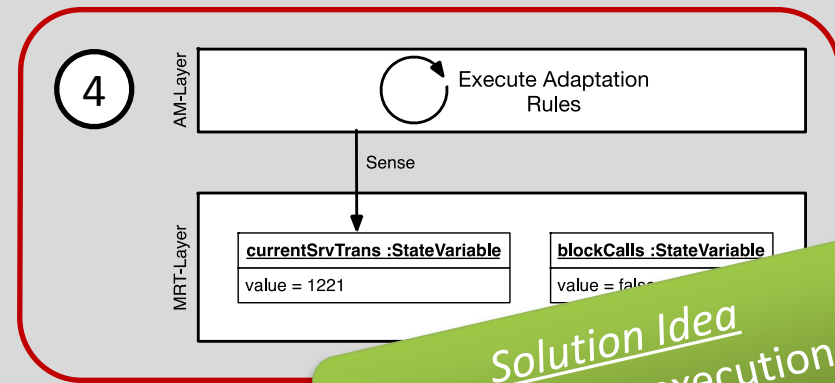
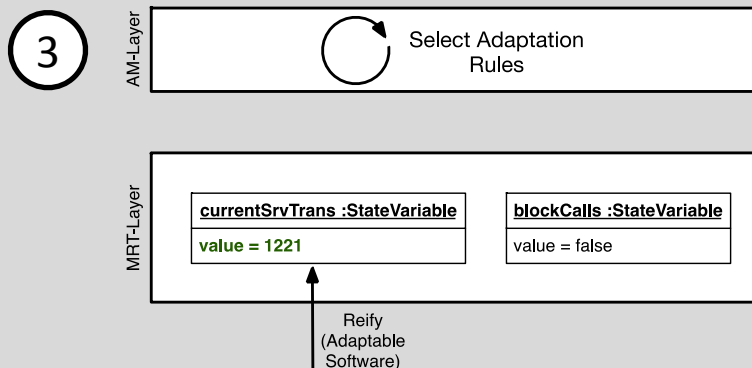
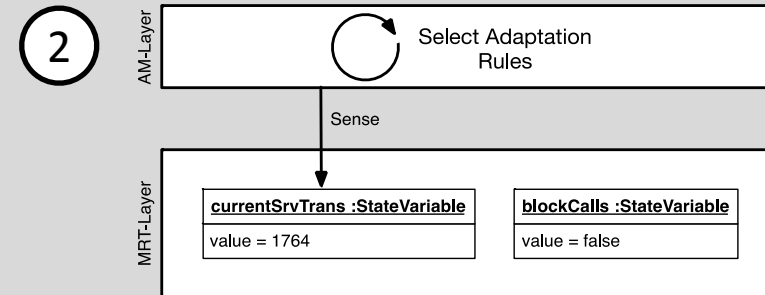
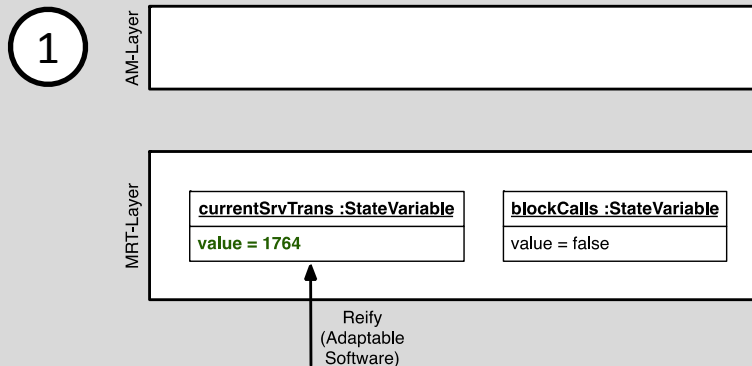


Unrepeatable Adaptation



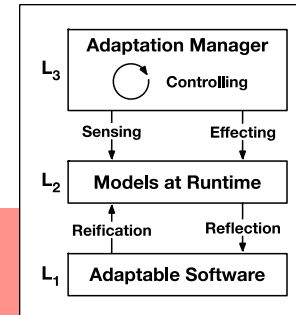
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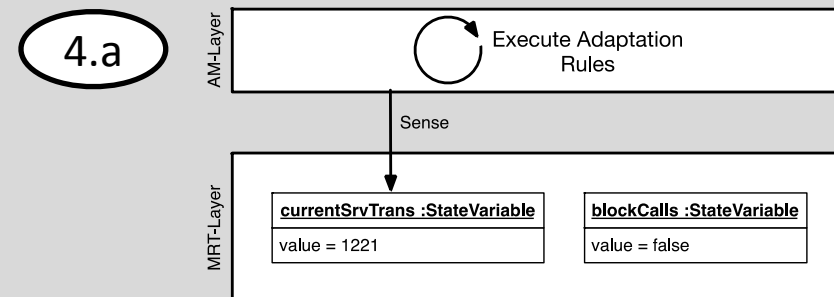
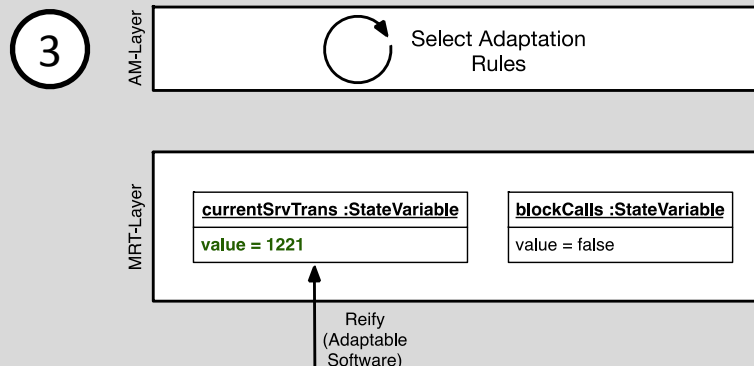
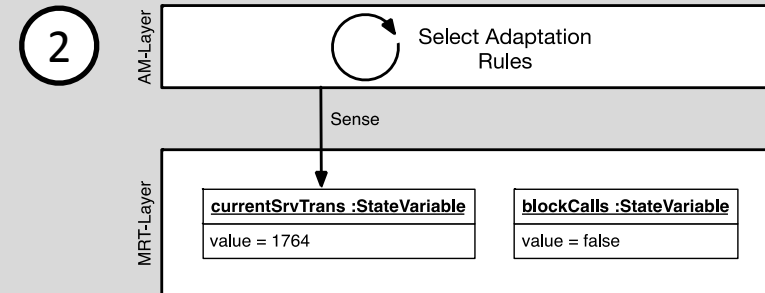
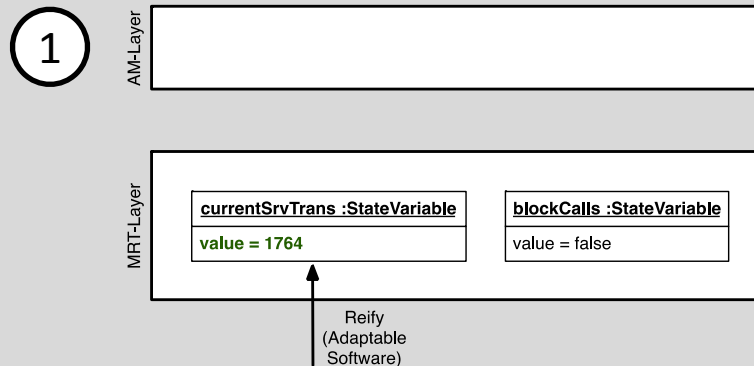
Solution Idea
Atomic rule execution

Overeager Adaptation

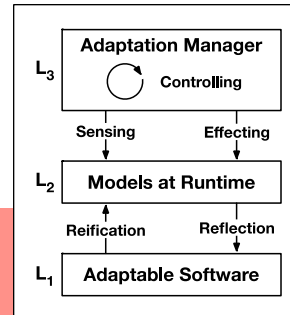


Problem: The adaptation might rarely or never occur.

Example:

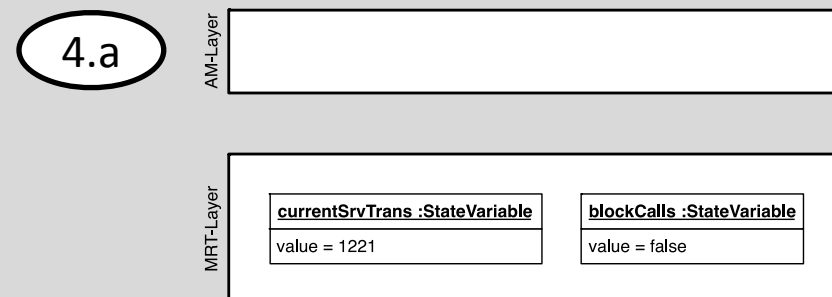
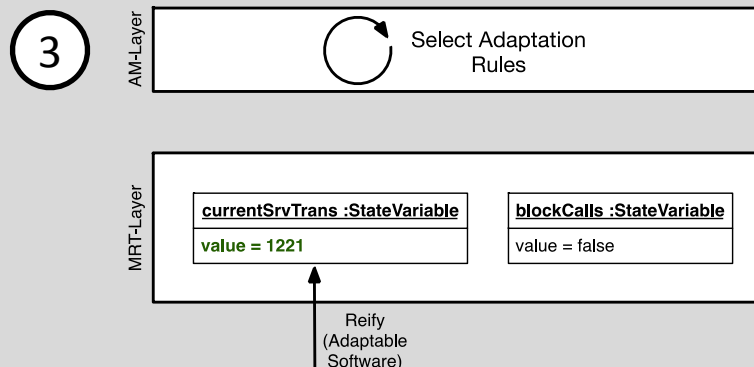
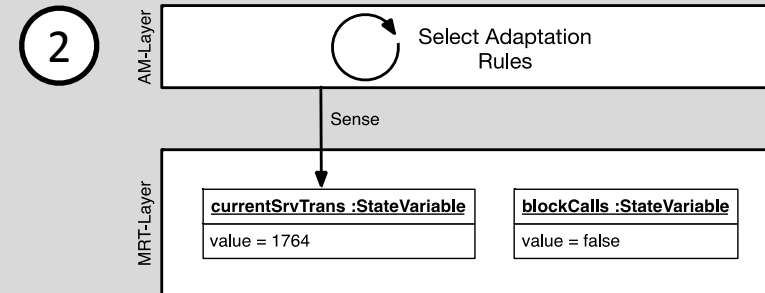
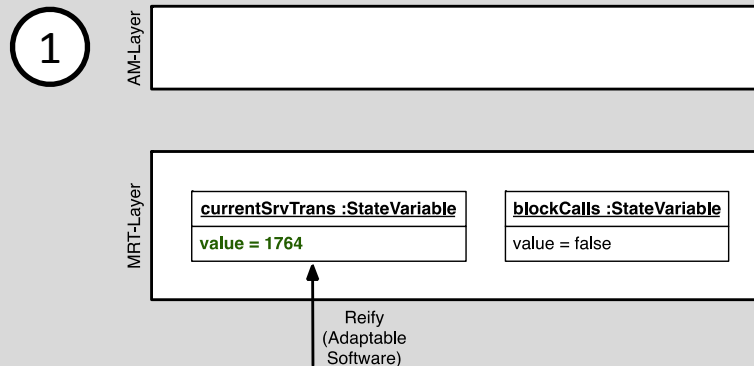


Overeager Adaptation

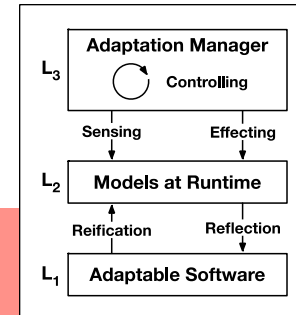


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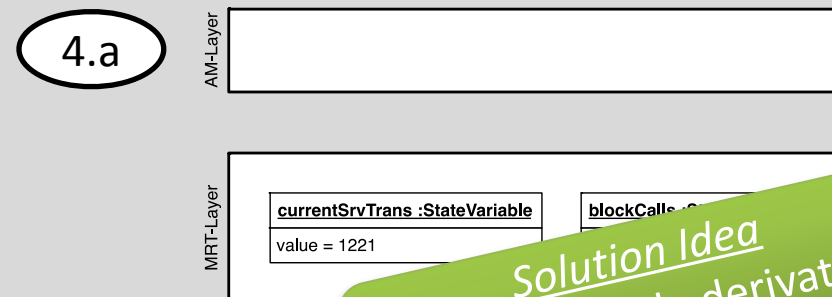
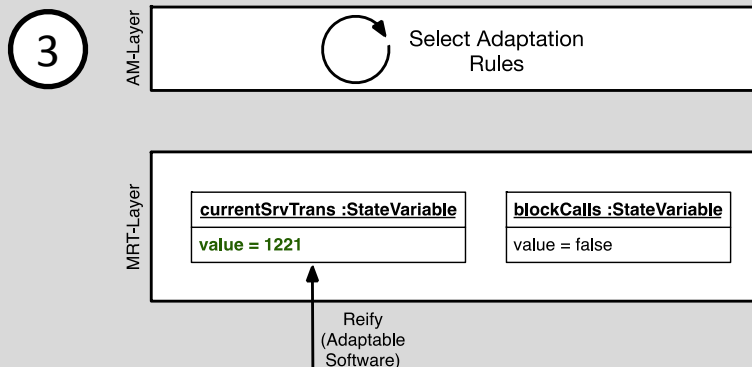
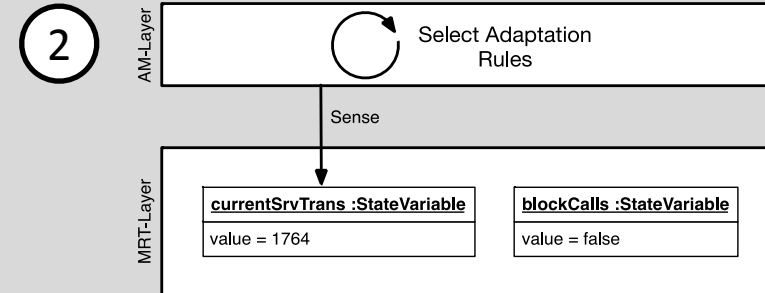
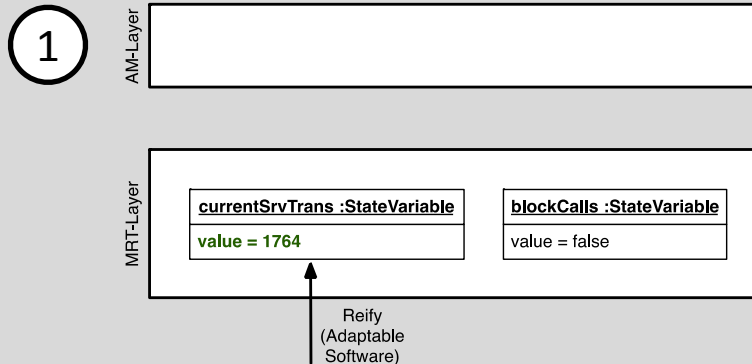


Overeager Adaptation



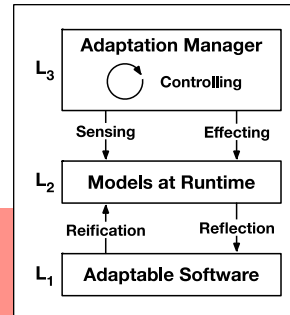
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Example:



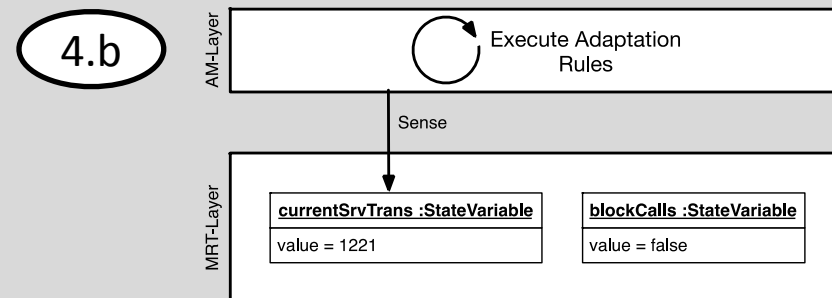
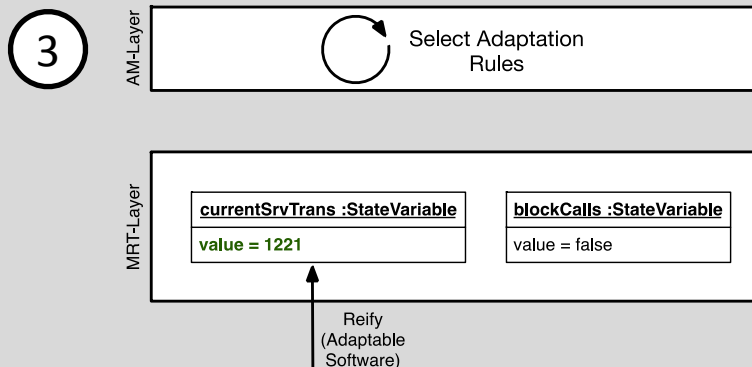
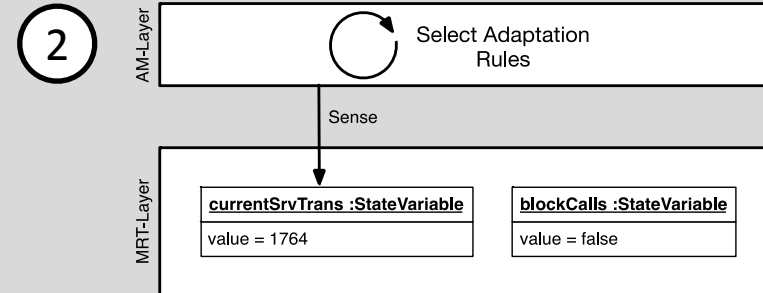
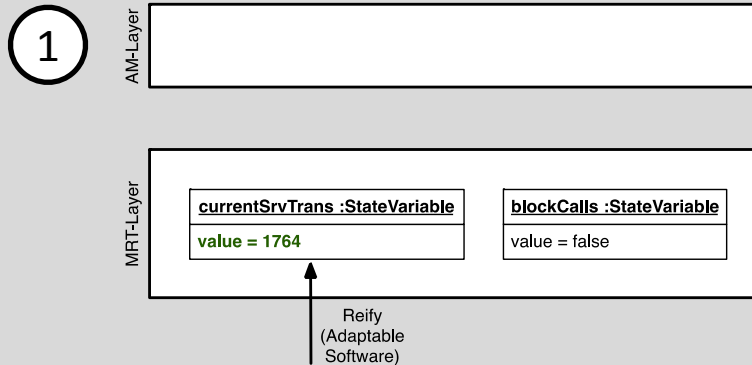
Solution Idea
Define tolerable derivations
in sensed changes

Outdated Adaptation

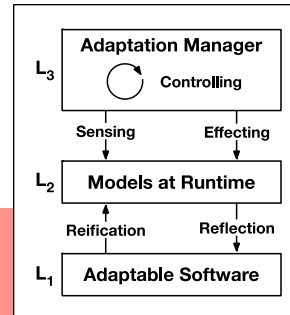


Problem: The adaptation is performed based on outdated information.

Example:

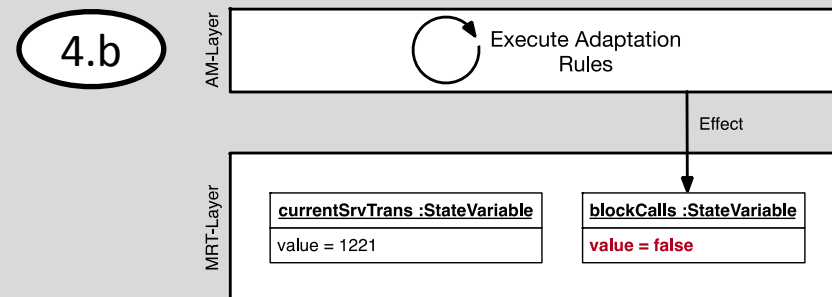
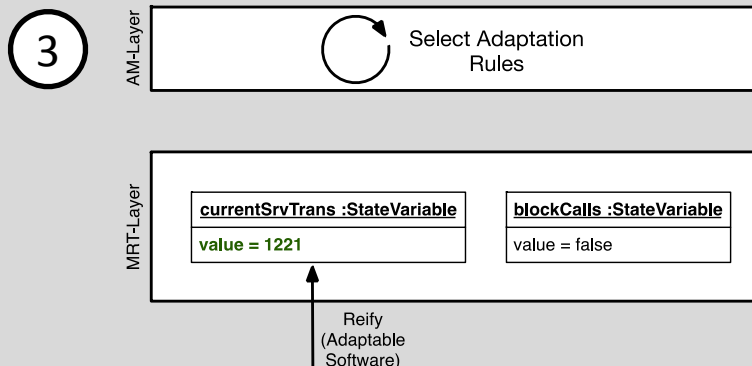
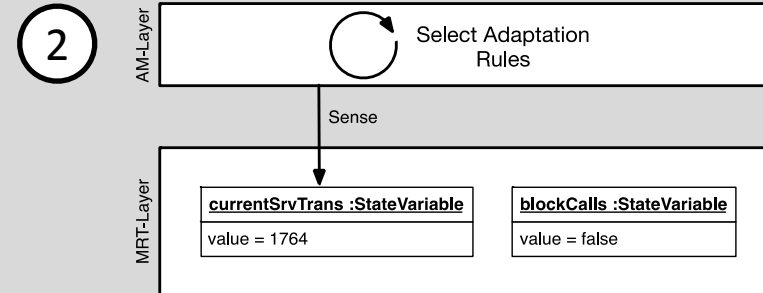
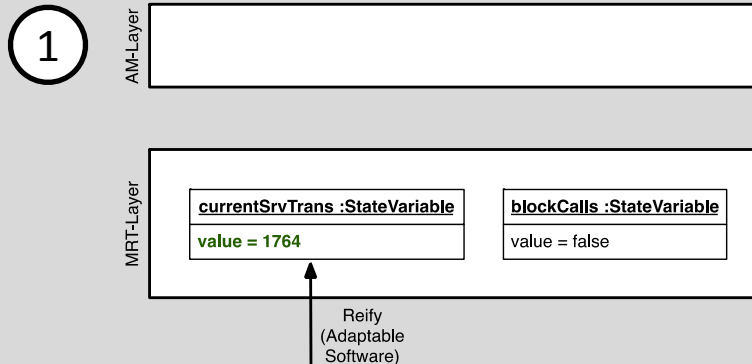


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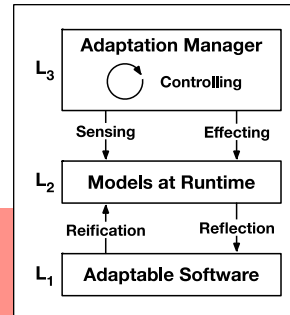


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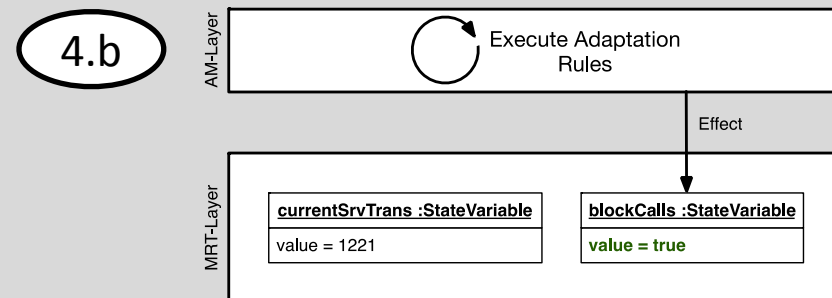
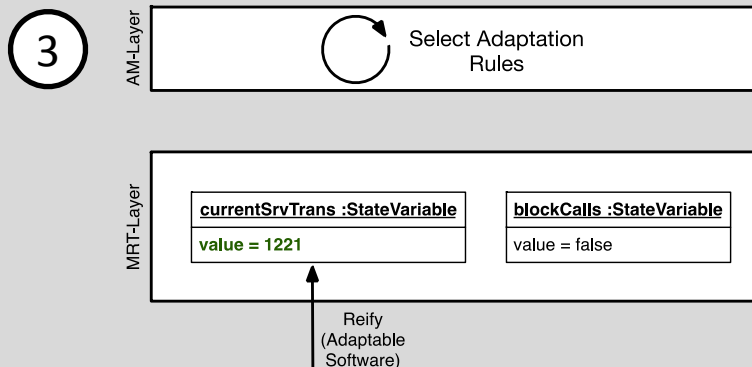
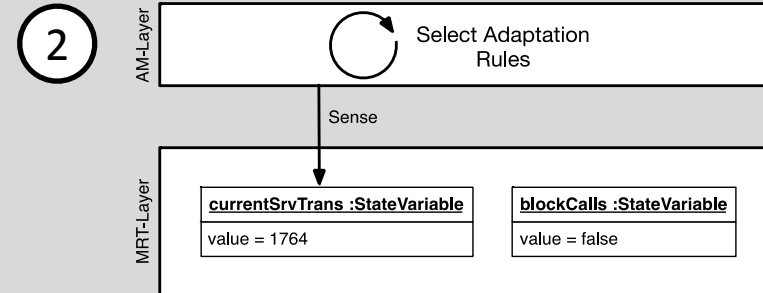
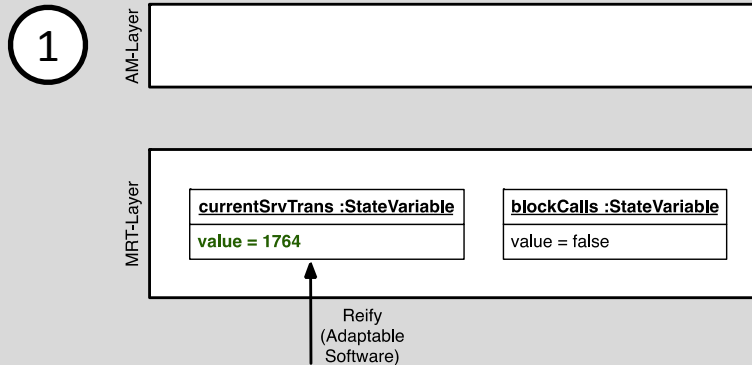


Outdated Adaptation

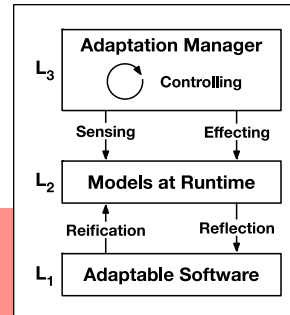


Problem: The adaptation is performed based on outdated information.

Example:

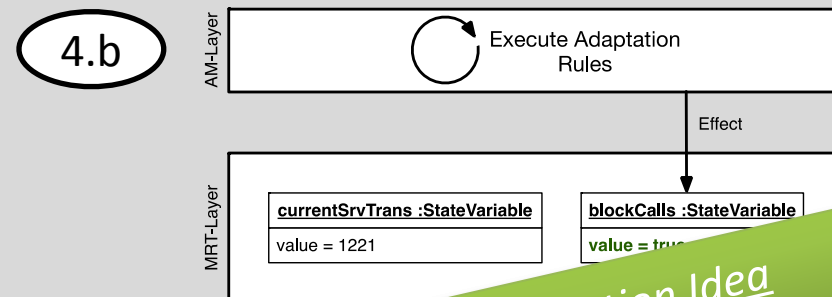
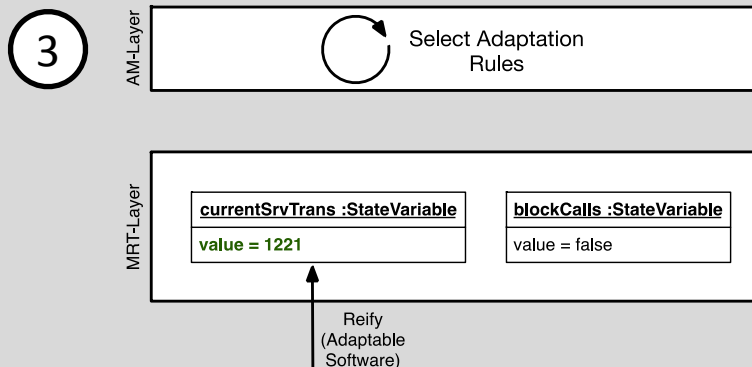
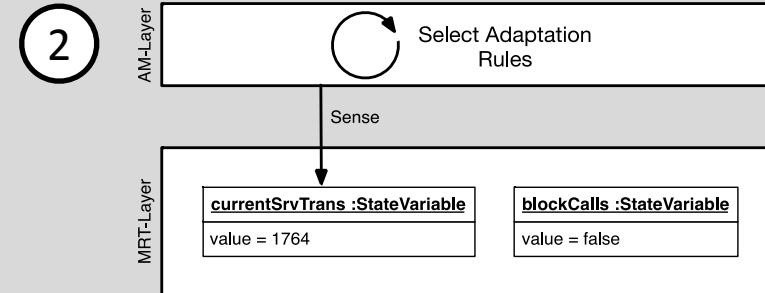
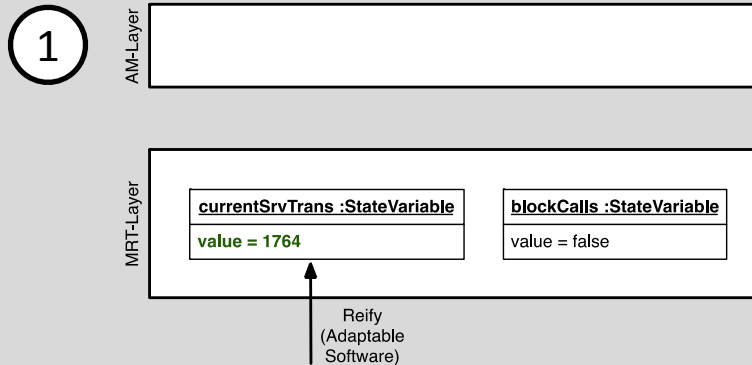


Outdated Adaptation



Problem: The adaptation is performed based on outdated information.

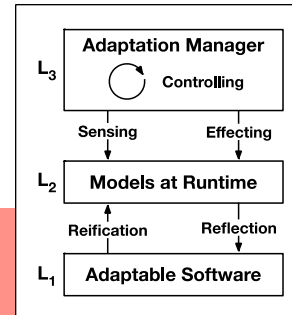
Example:



Solution Idea
Cancel ongoing adaptation

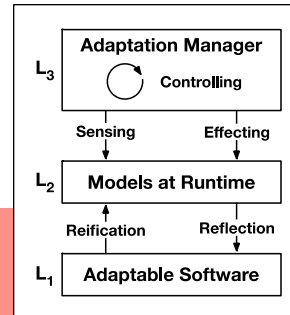
Missed Adaptation

Problem: The adaptation is not performed.

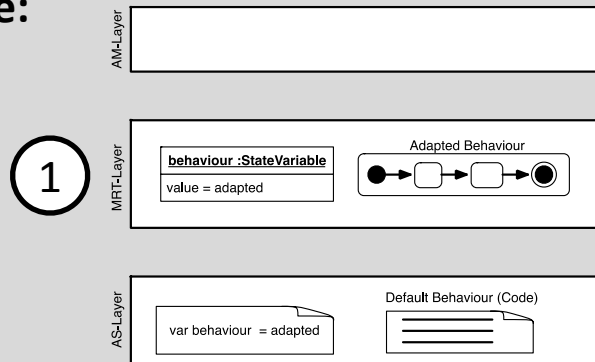


Missed Adaptation

Problem: The adaptation is not performed.

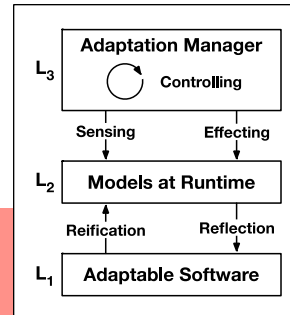


Example:

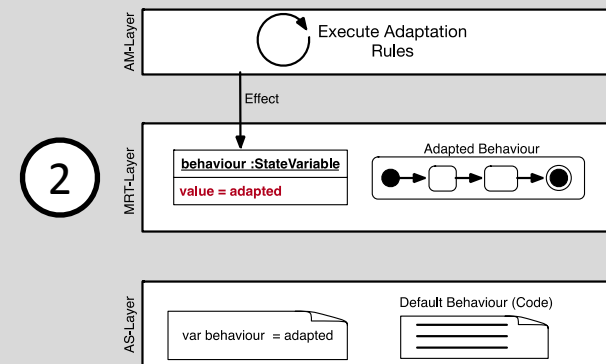
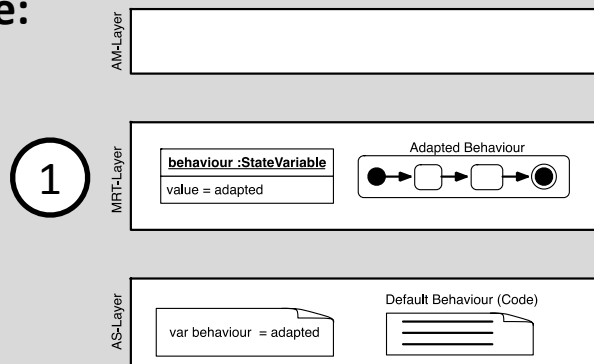


Missed Adaptation

Problem: The adaptation is not performed.

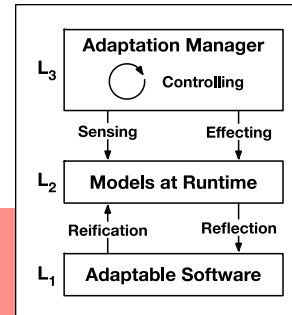


Example:

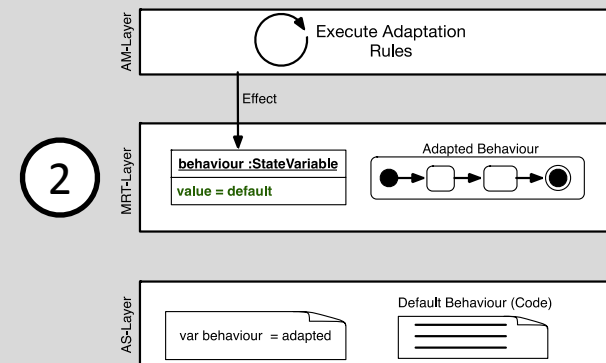
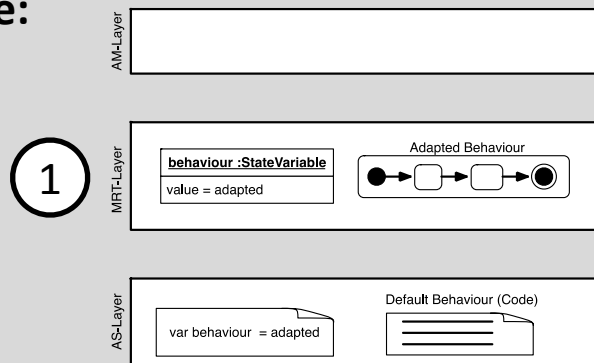


Missed Adaptation

Problem: The adaptation is not performed.

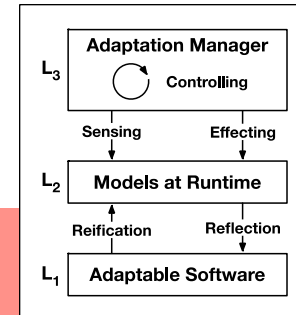


Example:

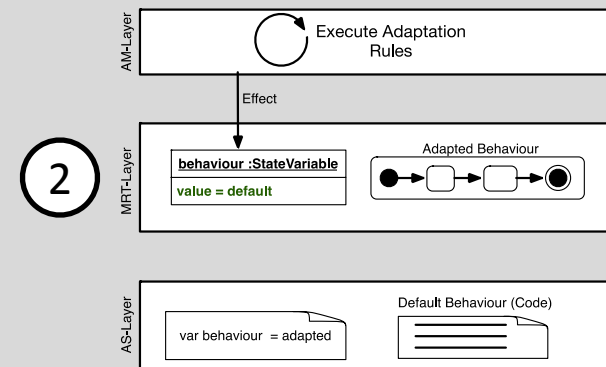
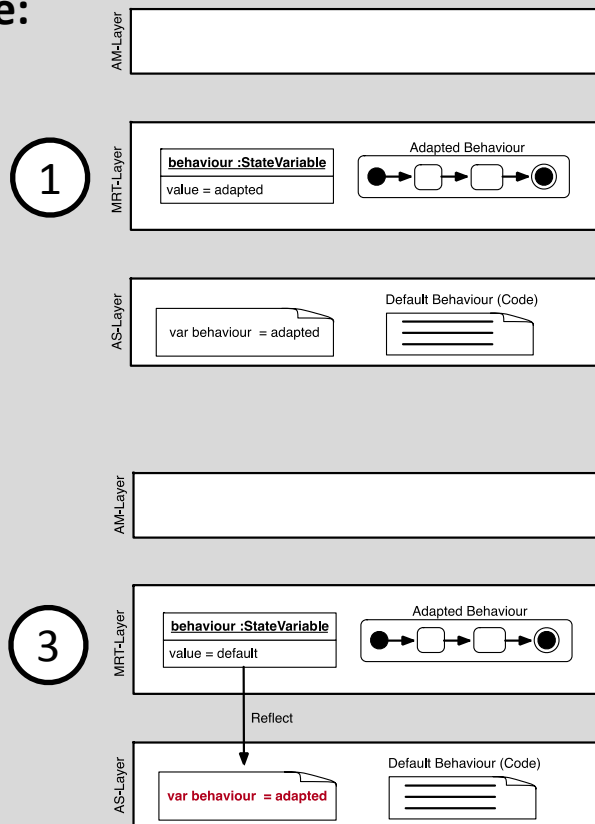


Missed Adaptation

Problem: The adaptation is not performed.

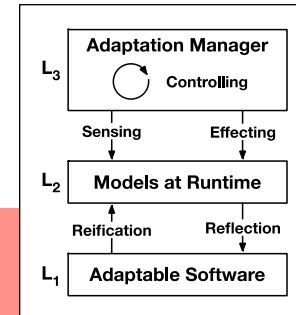


Example:

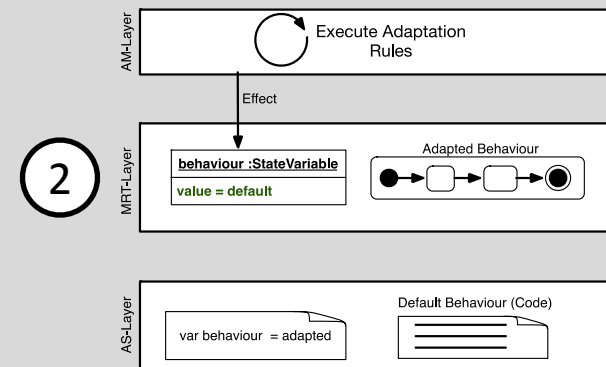
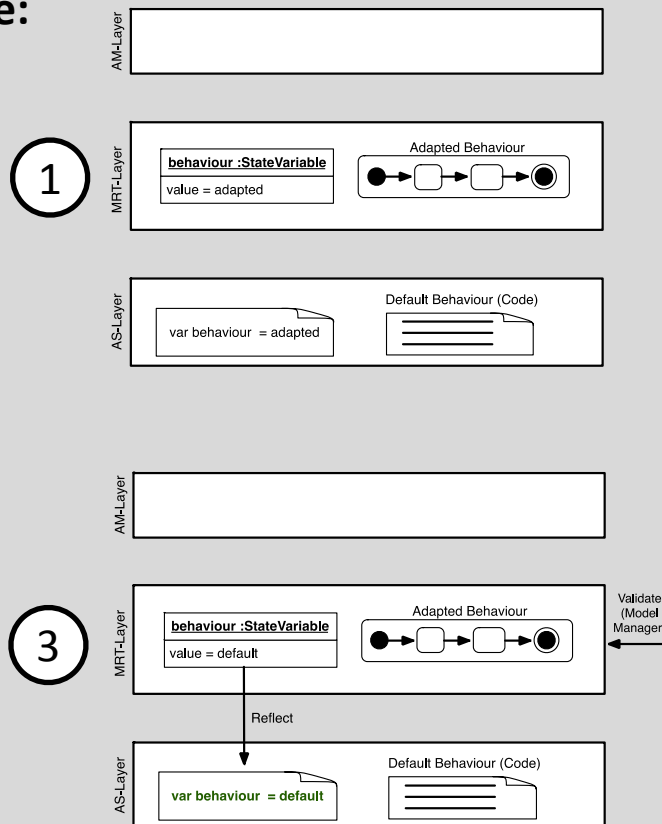


Missed Adaptation

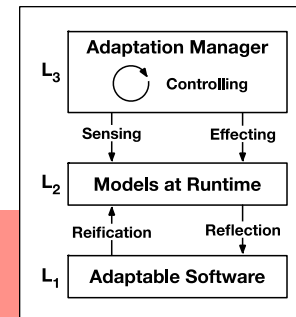
Problem: The adaptation is not performed.



Example:

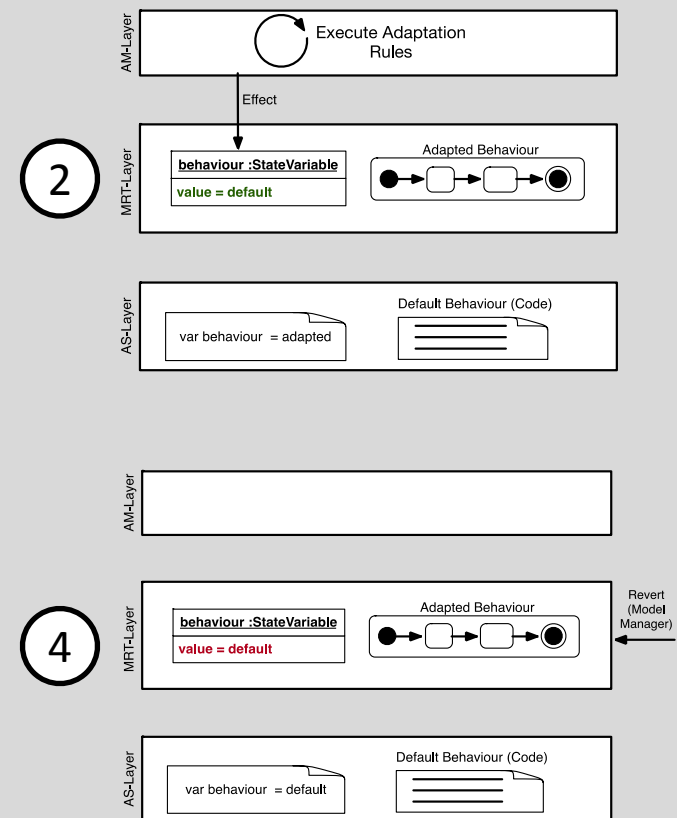
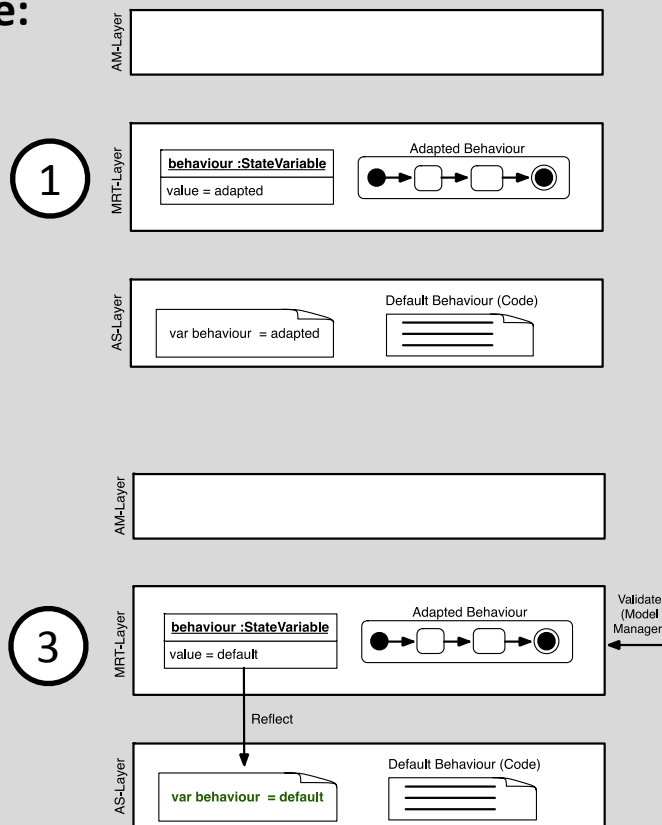


Missed Adaptation

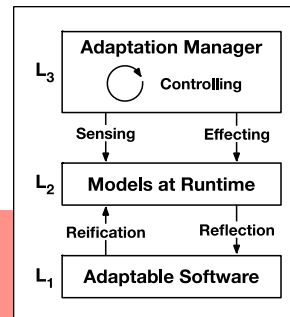


Problem: The adaptation is not performed.

Example:

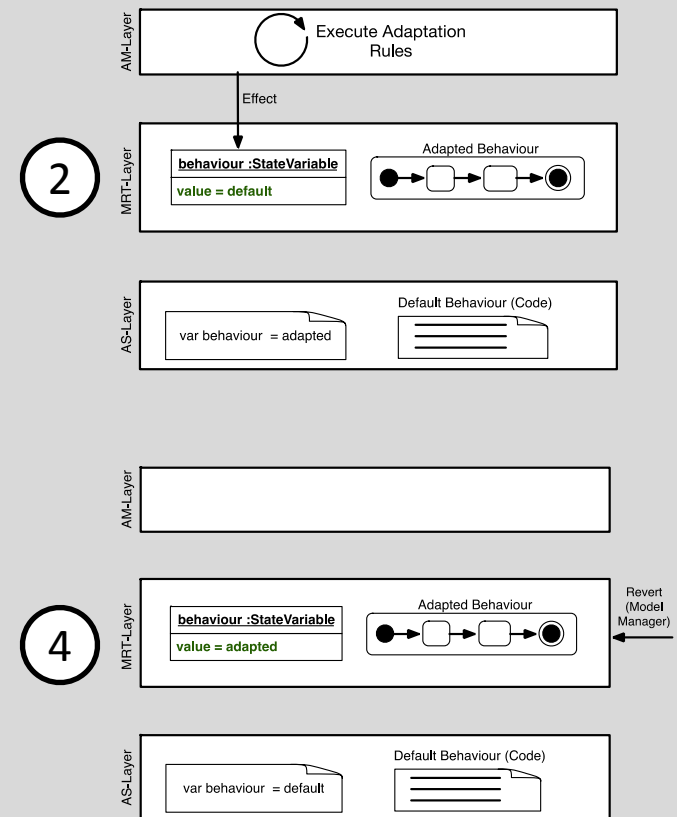
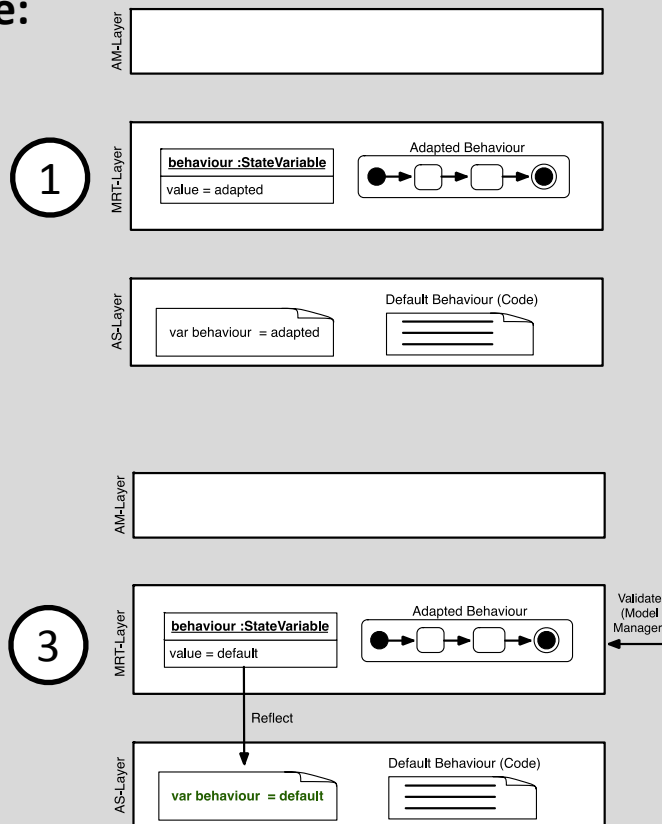


Missed Adaptation

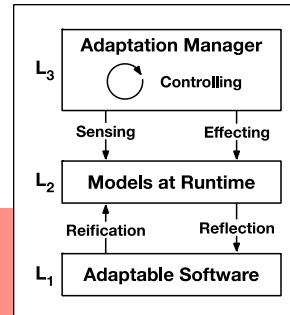


Problem: The adaptation is not performed.

Example:

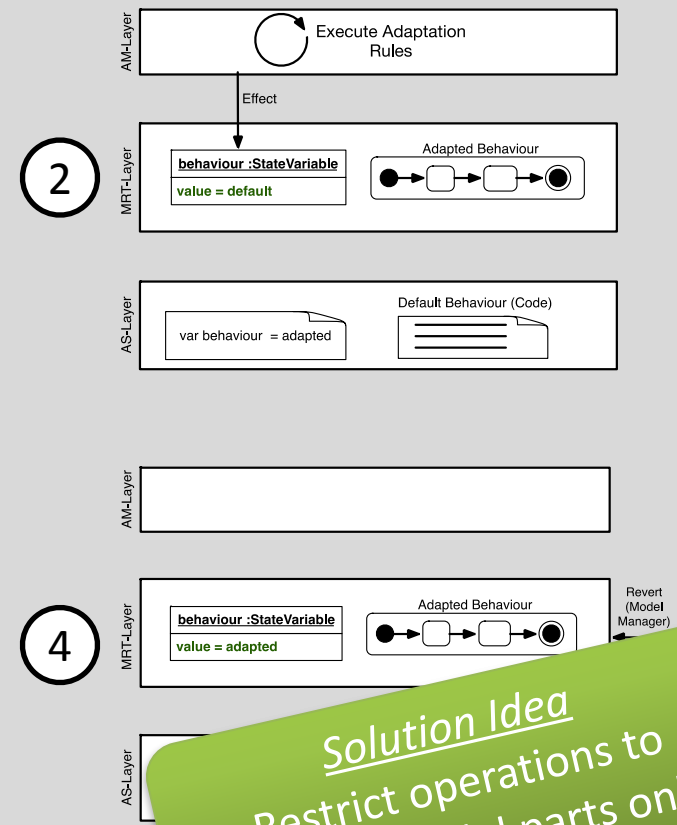
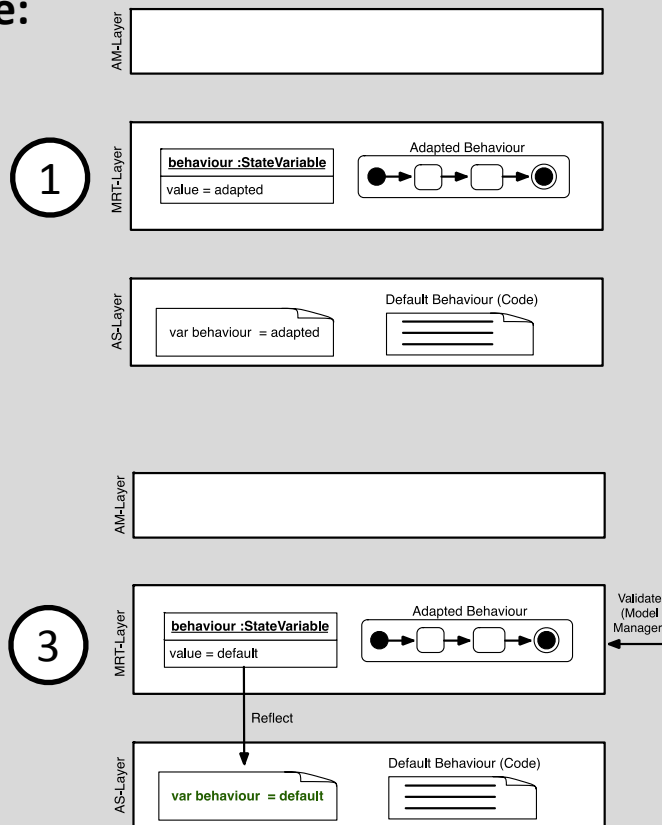


Missed Adaptation



Problem: The adaptation is not performed.

Example:



Solution Idea
Restrict operations to
verified model parts only

(Q2) What are the specific needs for a transaction concept for models at runtime in the broader sense?

DESIRED FEATURES

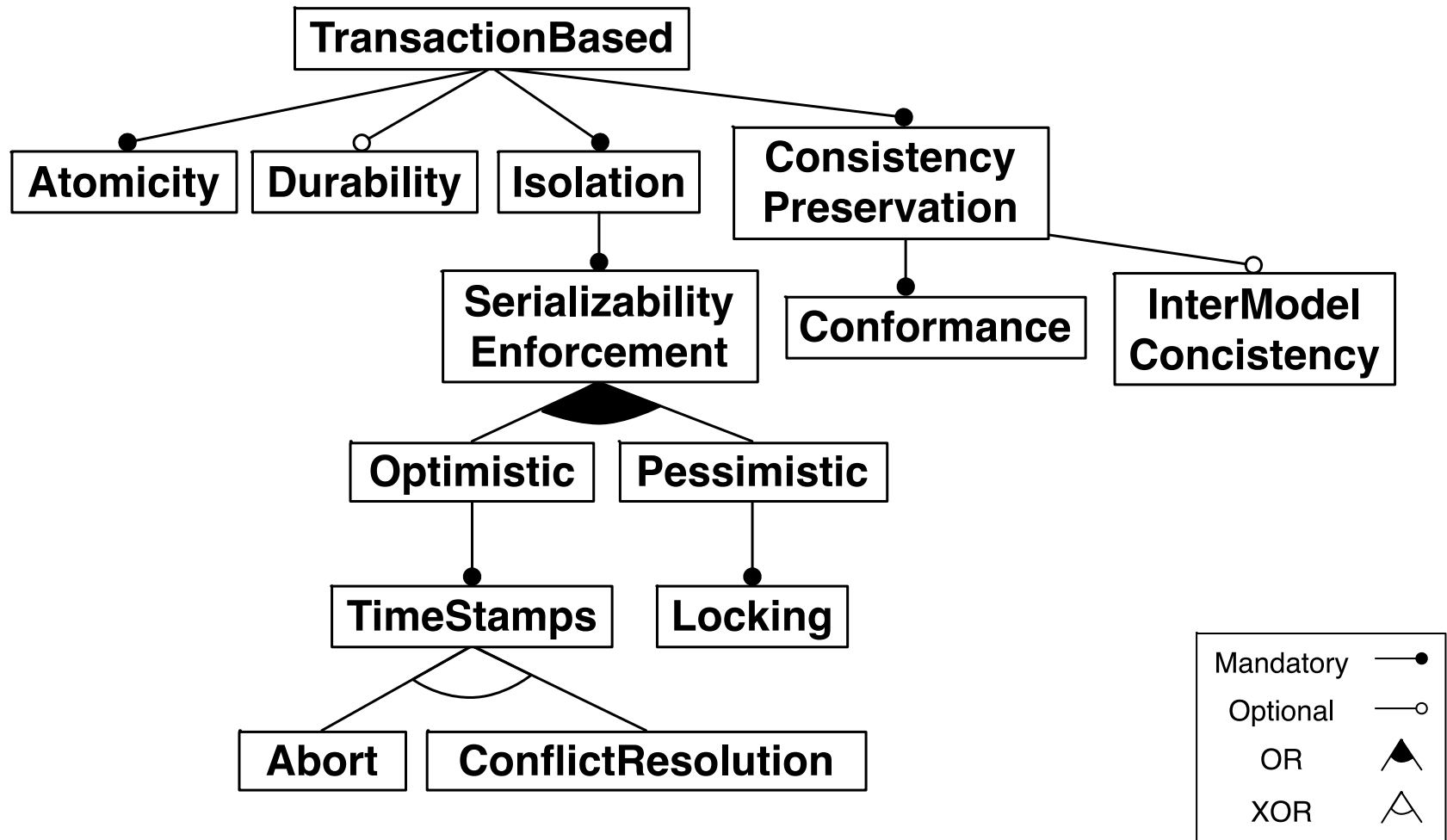
Towards a Solution

While related work on relevant sub-problems exists, a discussion of the **transaction problem in the broader sense** for **models@run.time** and **SAS** seems to be rare.

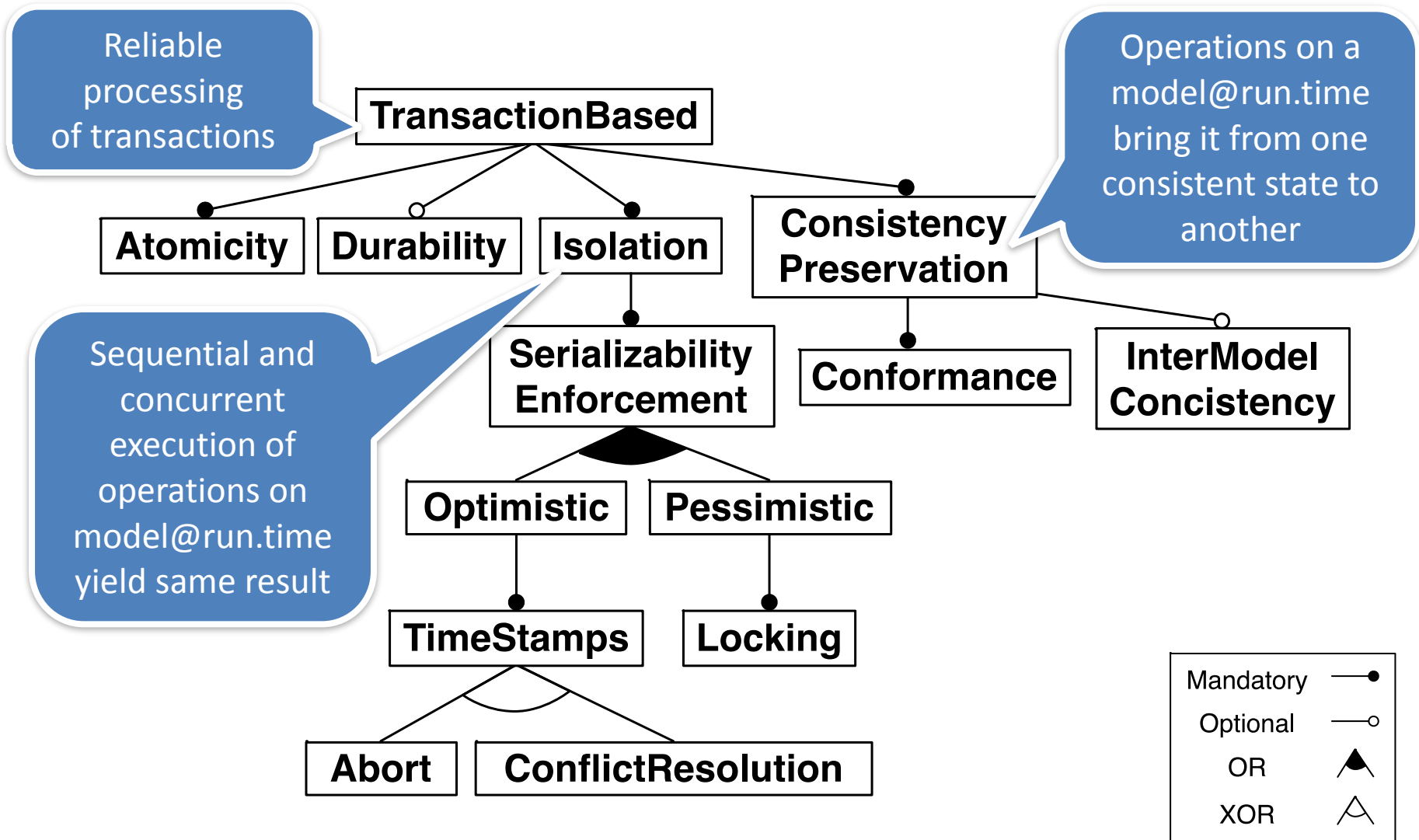
Based on the described issues, we structured an **initial model of desired features** related to transactions for models@run.time. It is structured into three groups:

- **transactions-based features,**
- **causal connection features and**
- **model-based features.**

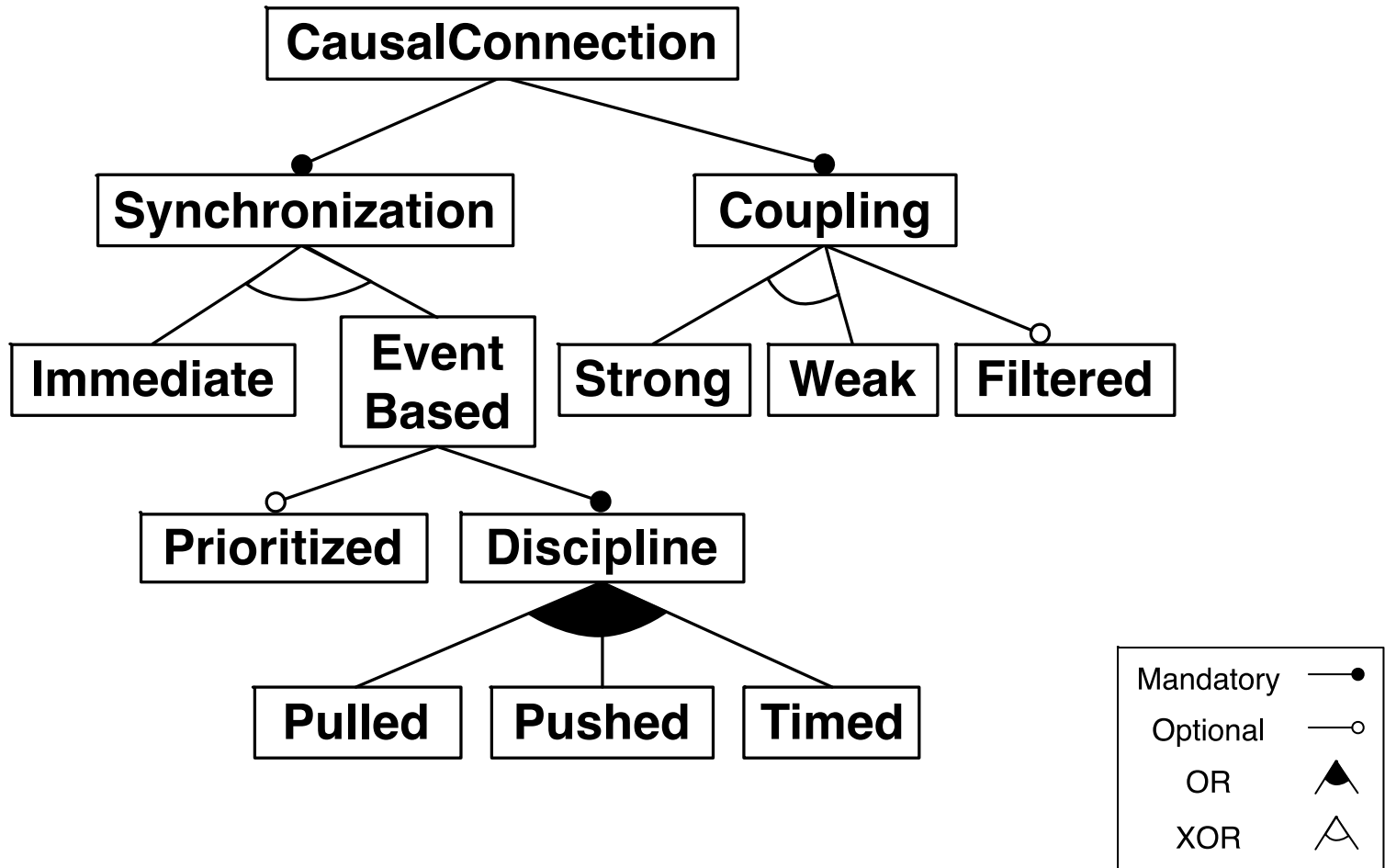
Transaction-based Features



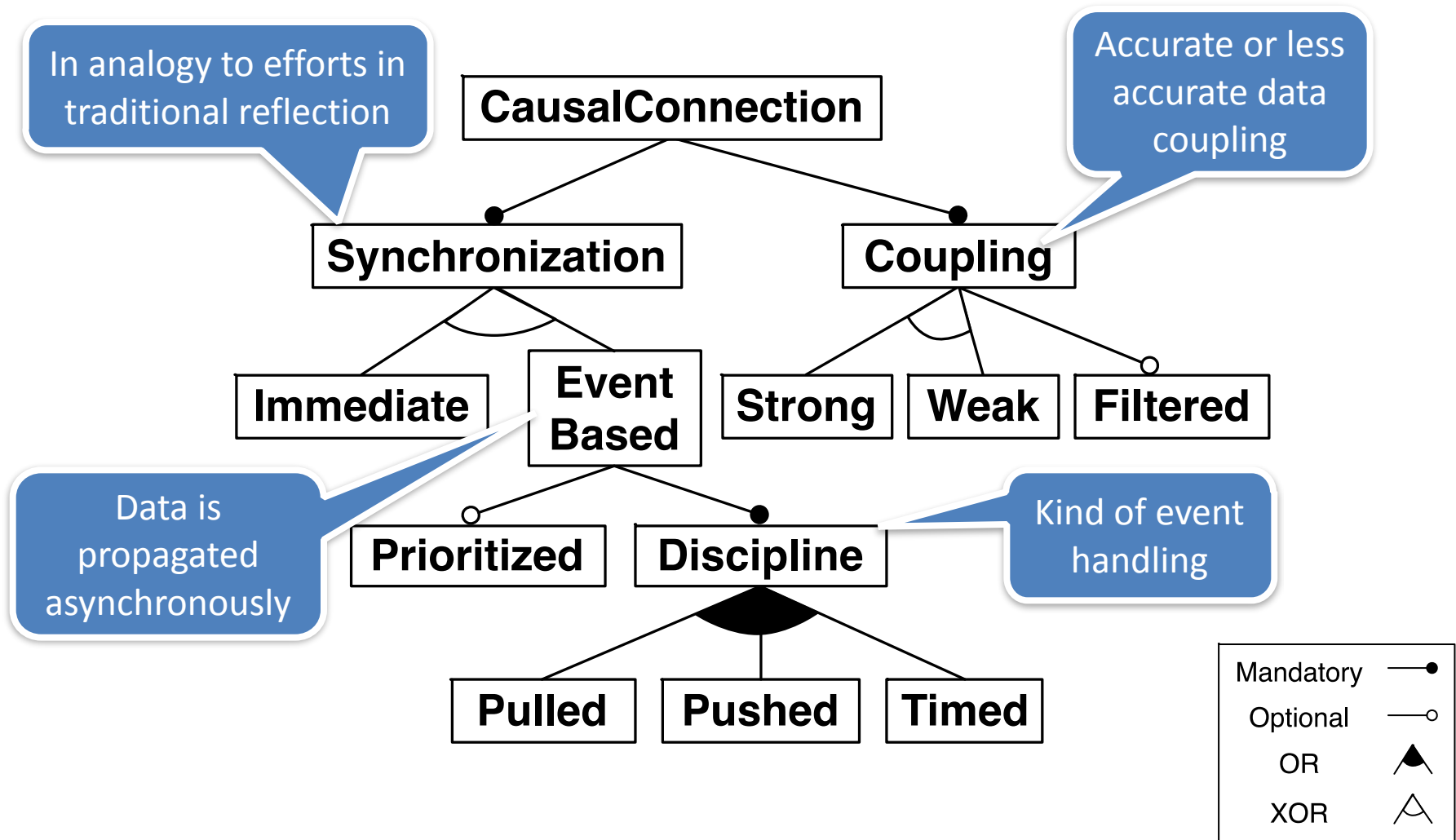
Transaction-based Features



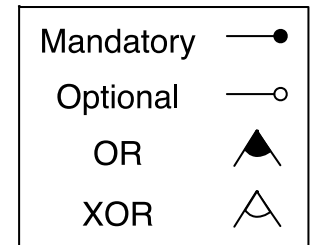
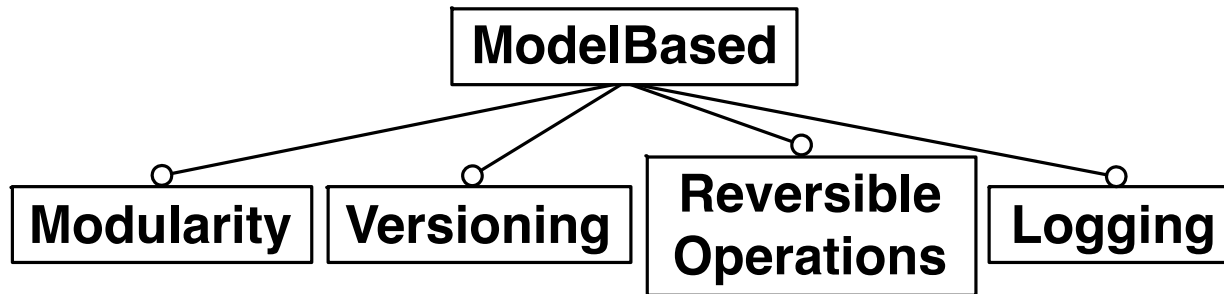
Causal Connection Features



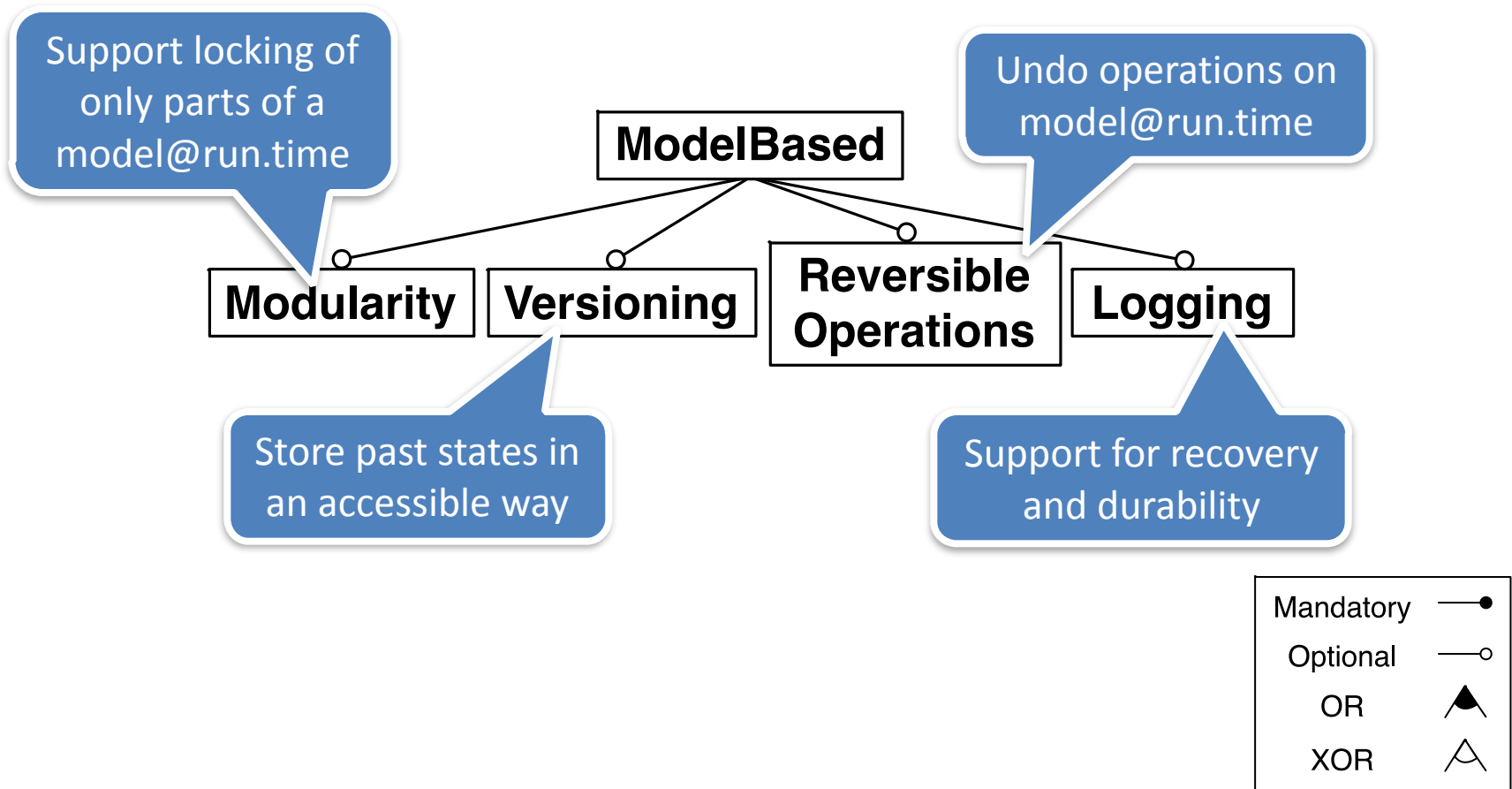
Causal Connection Features



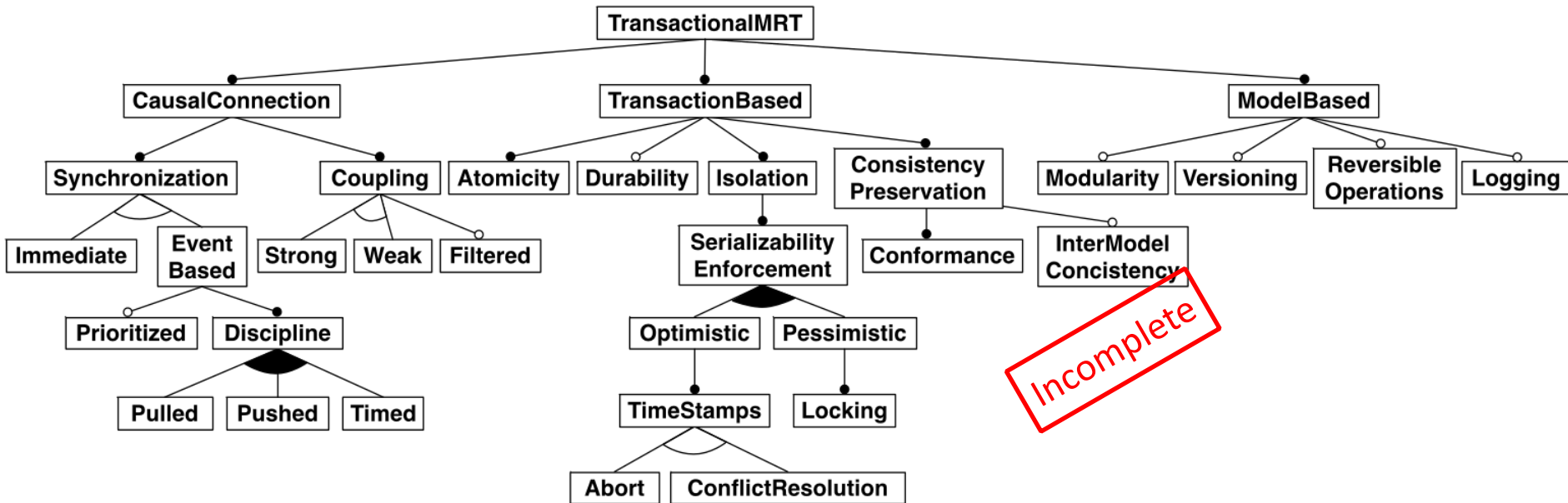
Model-based Features



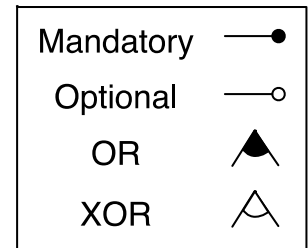
Model-based Features



Preliminary Feature Model



Incomplete



Presentation of this research's summary.

CONCLUSIONS AND FUTURE WORK

Conclusions

Various kinds of issues with models@run.time can be elicited that are intuitively related to transactions:

- **Fundamental, known issues** (e.g., ACID in databases)
- **Adaptation-specific issues** (e.g., SAS domain)

Ad-hoc solutions are no longer acceptable.

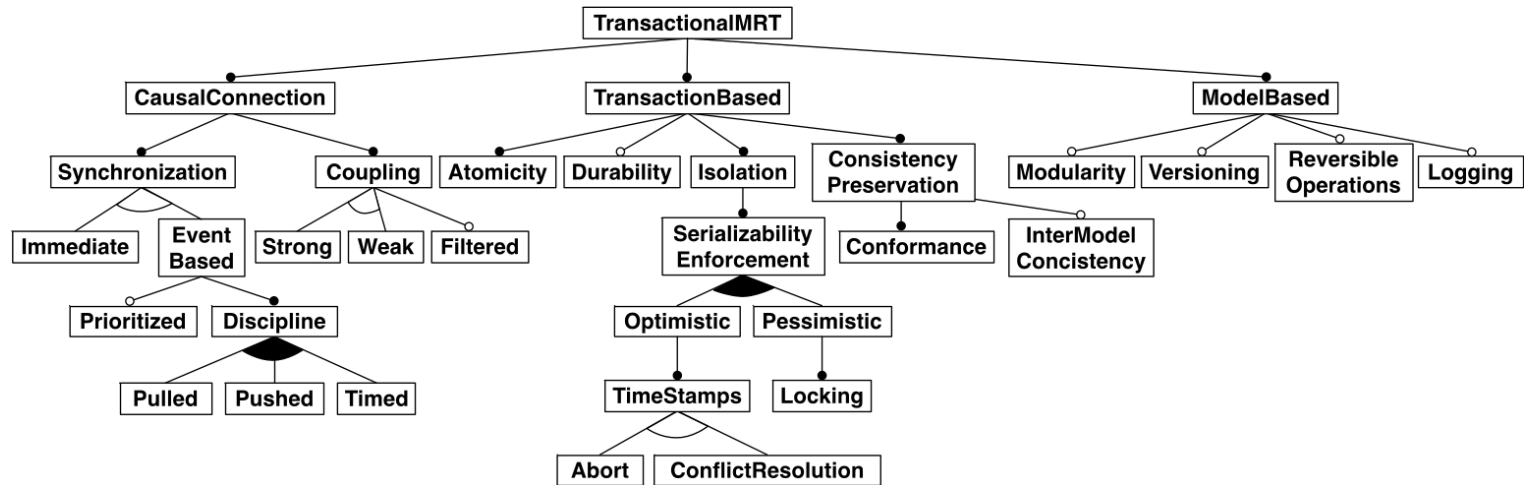
We provided eight **examples** derived from previous research and an **initial feature model** as an initial basis towards a solution concept.

Future Work

We plan to propose a full concept for **Transactional Models@Run.Time** (TMRT).

The envisioned concept shall

- go beyond low-level transaction issues and
 - provide a **pattern-based approach** to
 - tackle transaction-related issues in the broader sense
- when developing software using models at runtime.



On the Need for Extended Transactional Models@Run.Time

OPEN DISCUSSION

Literature

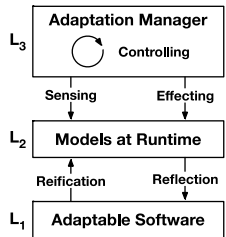
[Amoui2012ADA] M. Amoui, M. Derakhshanmanesh, J. Ebert, & L. Tahvildari, **Achieving Dynamic Adaptation via Management and Interpretation of Runtime Models**. *Journal of Systems and Software*, 85(12), 2720 – 2737. doi:10.1016/j.jss.2012.05.033, 2012.

[Derakhshanmanesh2015MSC] M. Derakhshanmanesh, **Model-Integrating Software Components - Engineering Flexible Software Systems**. Springer, pp. 1 – 333, 2015.

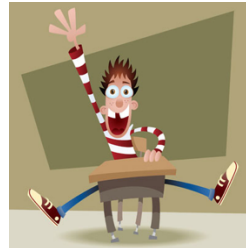
Presentation of additional information.

BACKUP SLIDES

Issues - Overview



Unrepeatable
Adaptation



Overeager
Adaptation

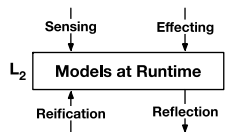


Outdated
Adaptation



Missed
Adaptation

Adaptation-Specific Issues



Lost Model
Update



Dirty Model
Read



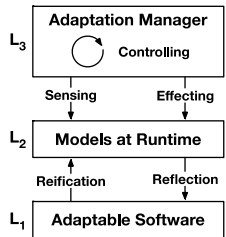
Unrepeatable
Model Read



Conflicting
Model Update

MRT-Specific Issues

Issues - Overview



Unrepeatable
Adaptation



Overeager
Adaptation

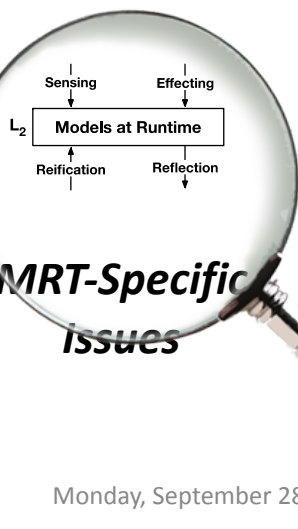


Outdated
Adaptation



Missed
Adaptation

Adaptation-Specific Issues



MRT-Specific Issues



Lost Model
Update



Dirty Model
Read



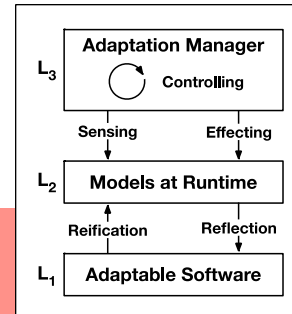
Unrepeatable
Model Read



Conflicting
Model Update

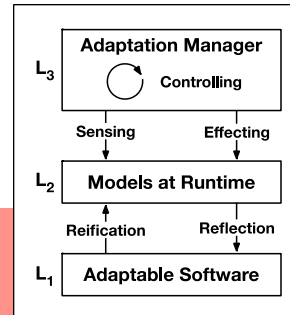
Lost Model Update

Problem: A change of the model gets lost.

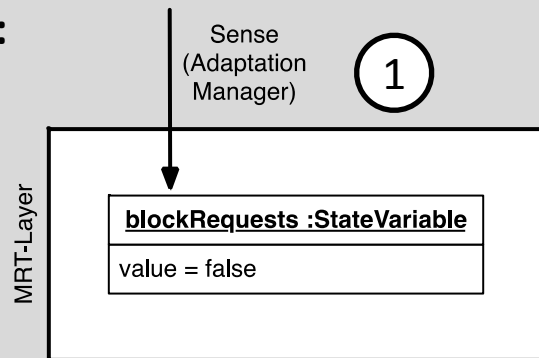


Lost Model Update

Problem: A change of the model gets lost.

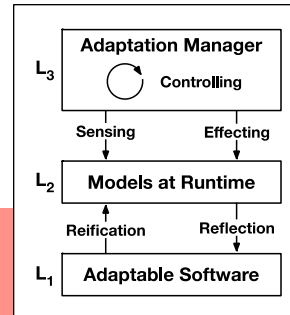


Example:

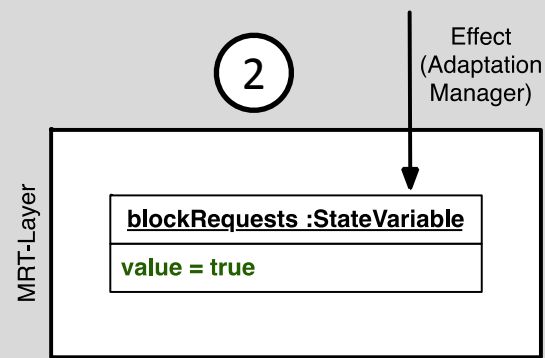
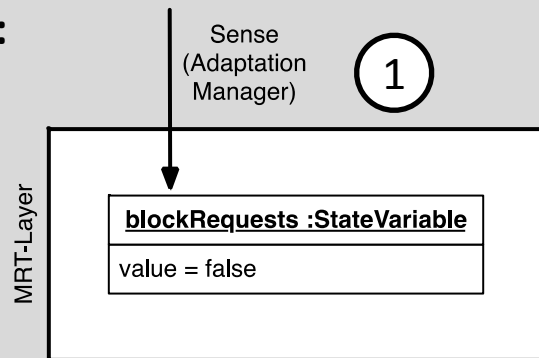


Lost Model Update

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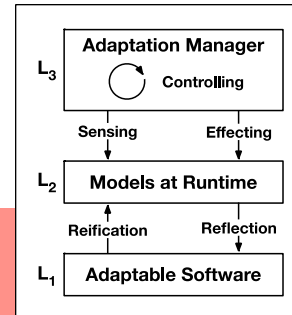


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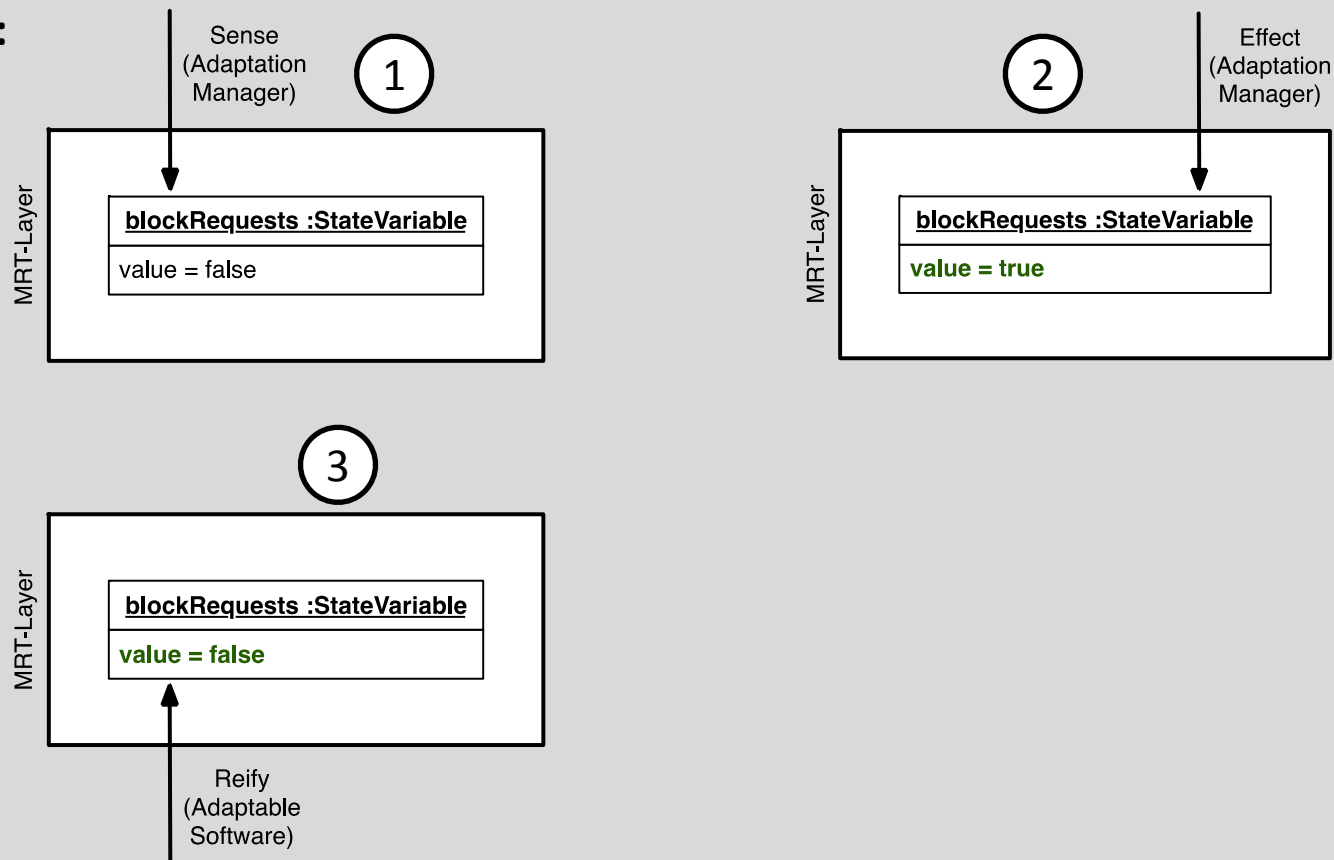


Lost Model Update

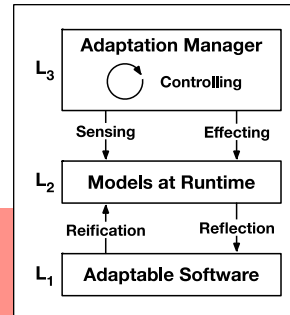
Problem: A change of the model gets lost.



Example:

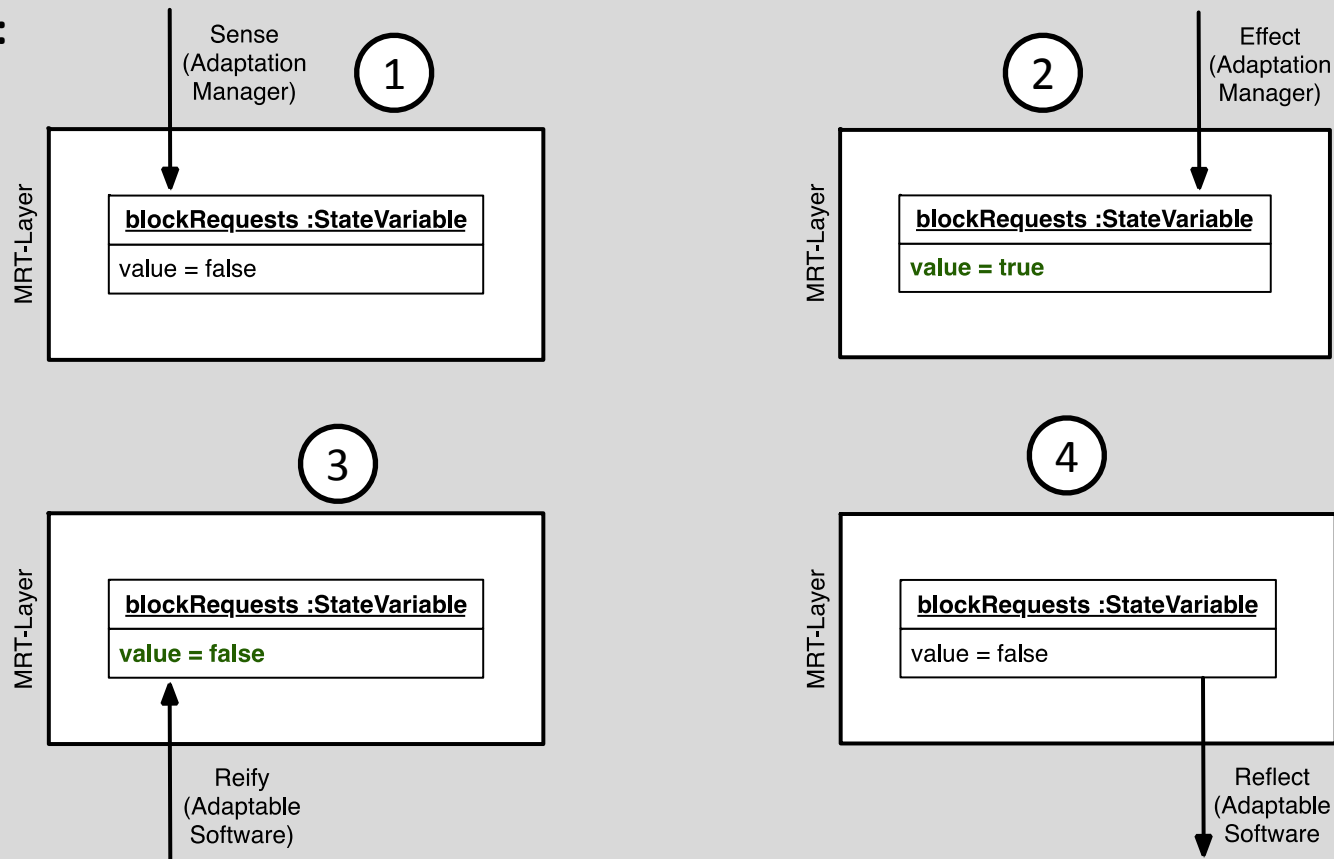


Lost Model Update

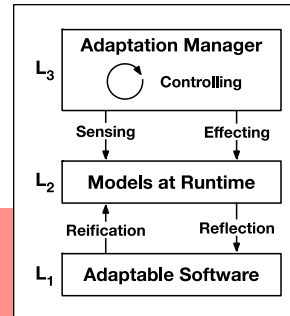


Problem: A change of the model gets lost.

Example:

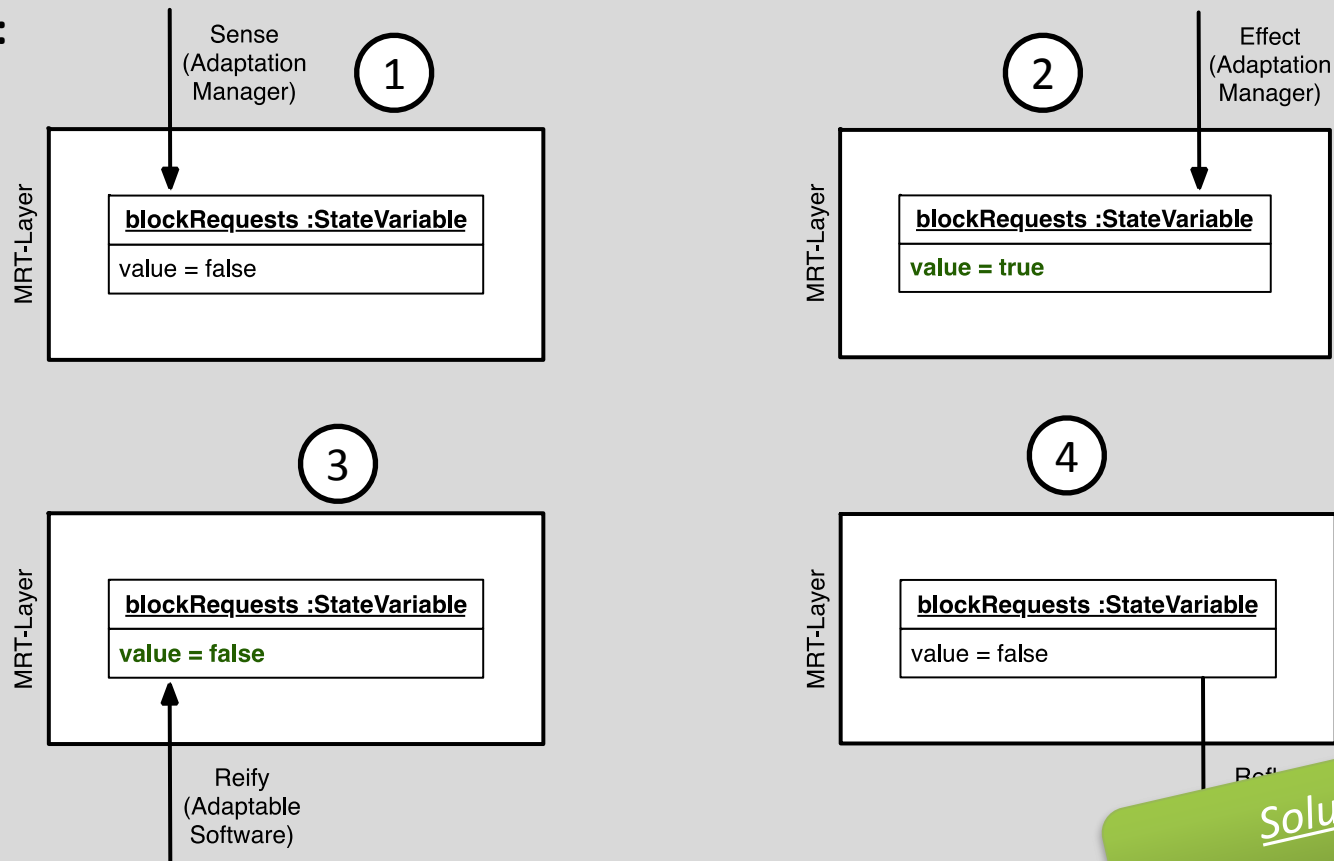


Lost Model Update



Problem: A change of the model gets lost.

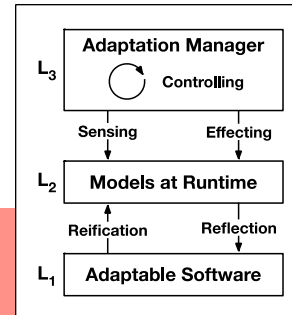
Example:



Solution Idea
Locking of model parts

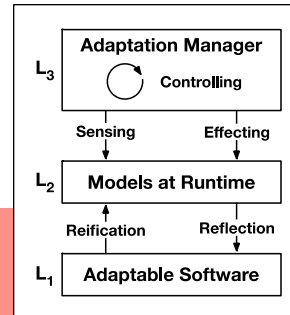
Dirty Model Read

Problem: An inconsistent state of the model is read.



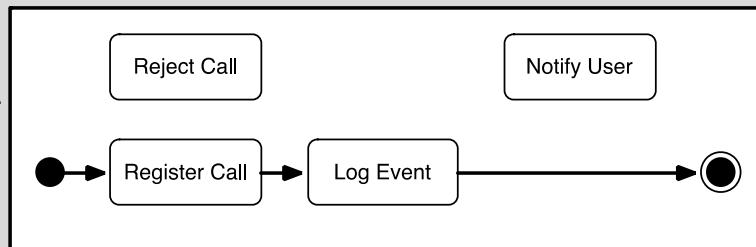
Dirty Model Read

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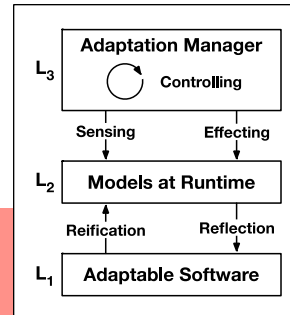
Example:

1



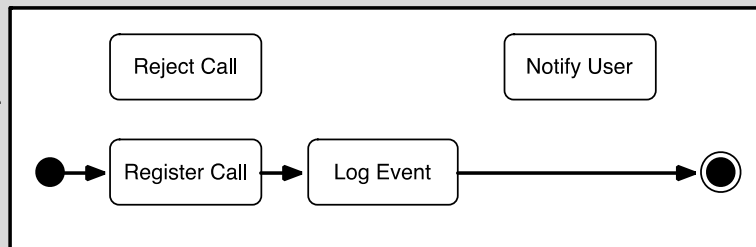
Dirty Model Read

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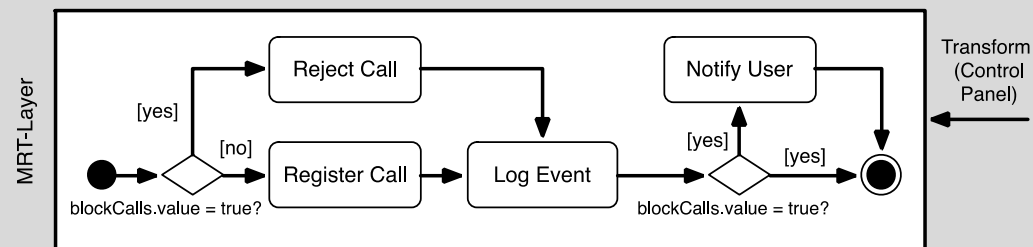


Example:

1

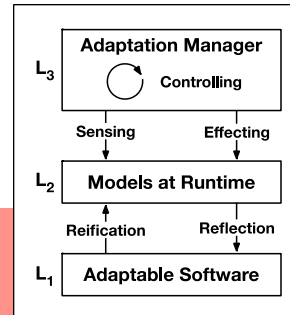


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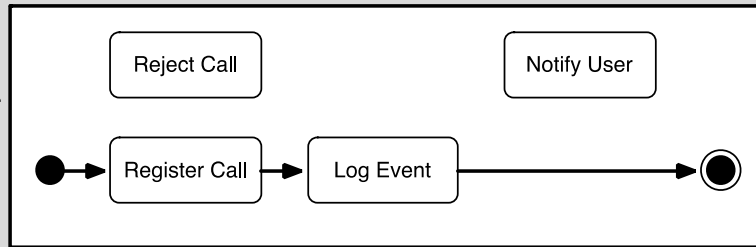
Dirty Model Read

Problem: An inconsistent state of the model is read.

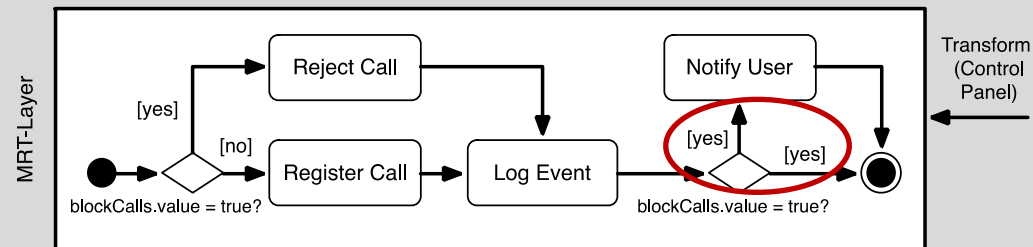


Example:

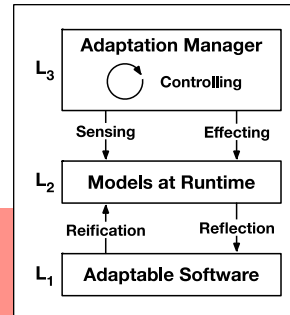
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2



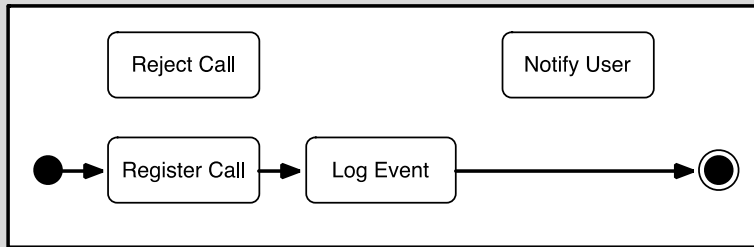
Dirty Model Read



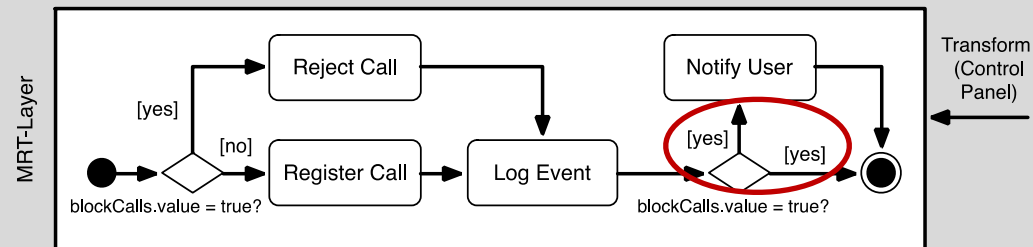
Problem: An inconsistent state of the model is read.

Example:

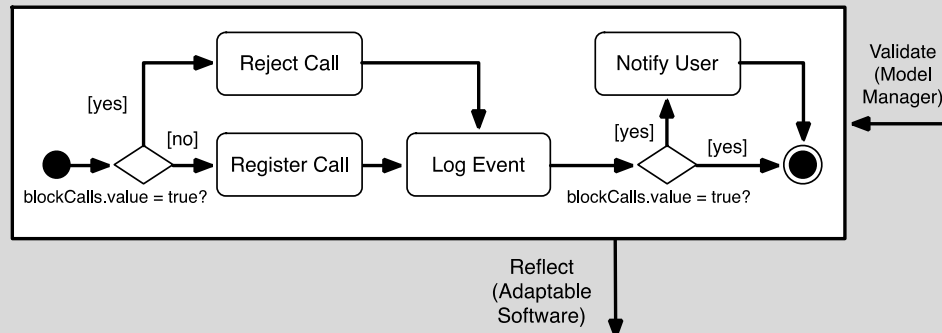
1



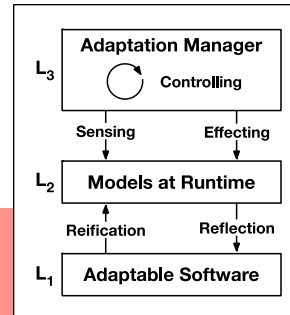
2



3



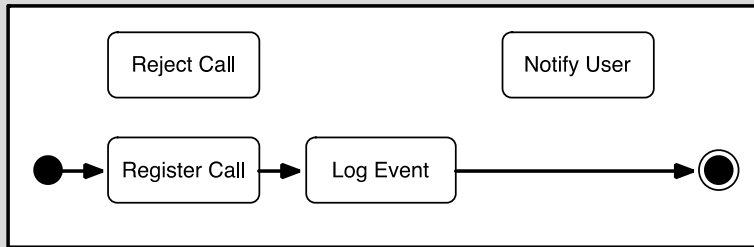
Dirty Model Read



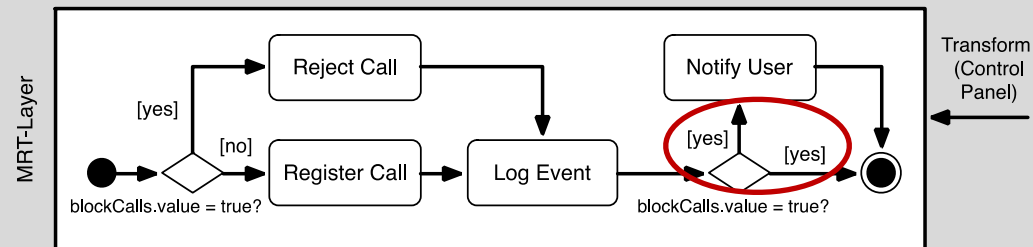
Problem: An inconsistent state of the model is read.

Example:

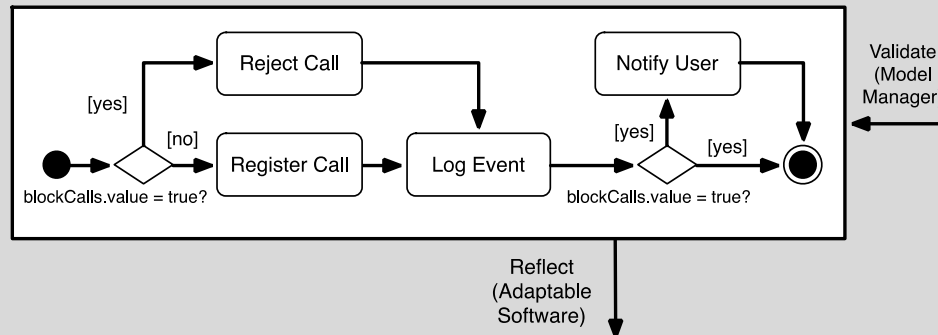
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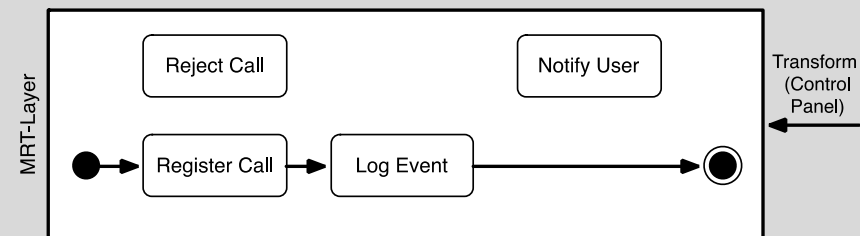
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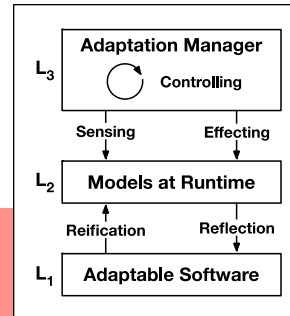
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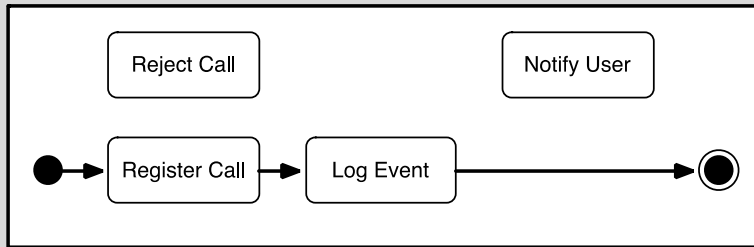
Dirty Model Read



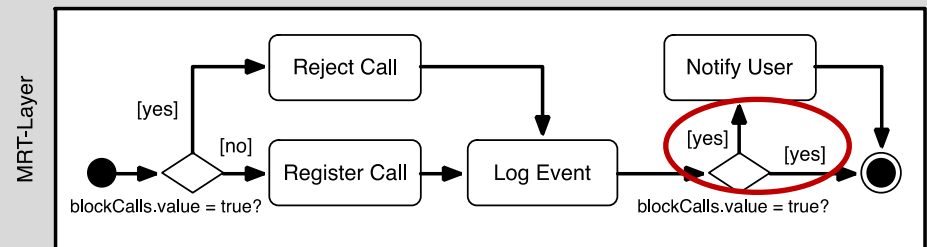
Problem: An inconsistent state of the model is read.

Example:

1

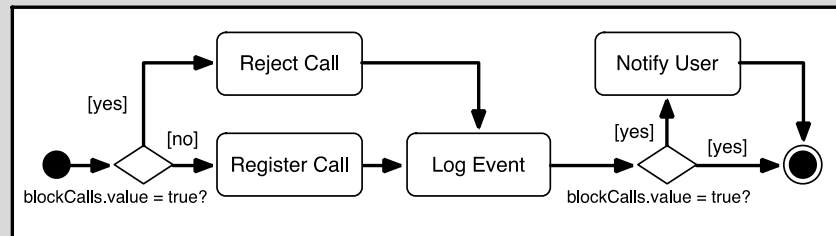


2



Transform
(Control Panel)

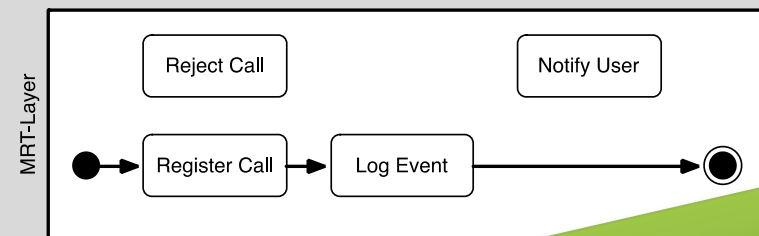
3



Validate
(Model Manager)

Reflect
(Adaptable Software)

4

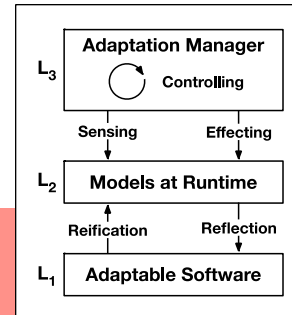


Transform
(Control Panel)

Solution Idea
Isolation of model access

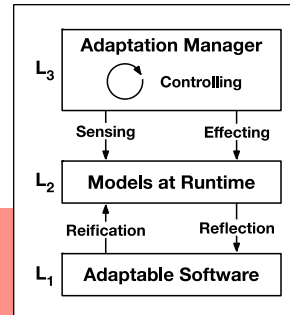
Unrepeatable Model Read

Problem: Two subsequent read operations yield different values.

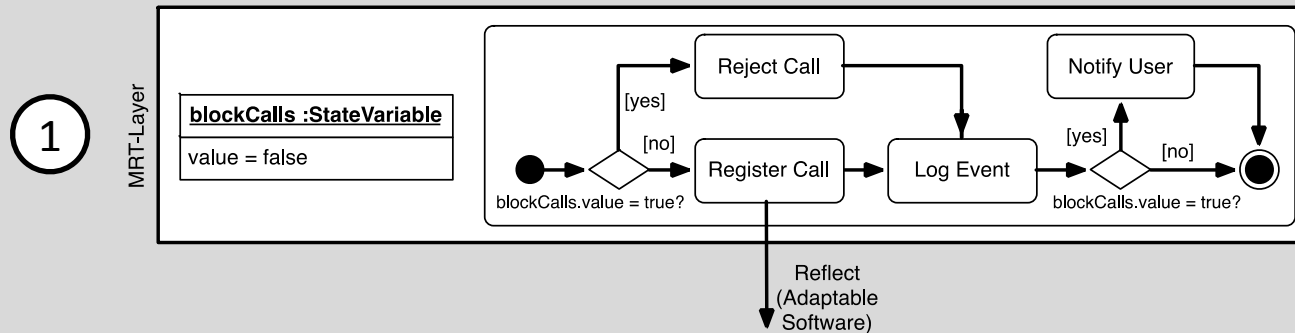


Unrepeatable Model Read

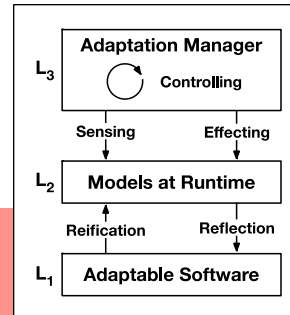
Problem: Two subsequent read operations yield different values.



Example:

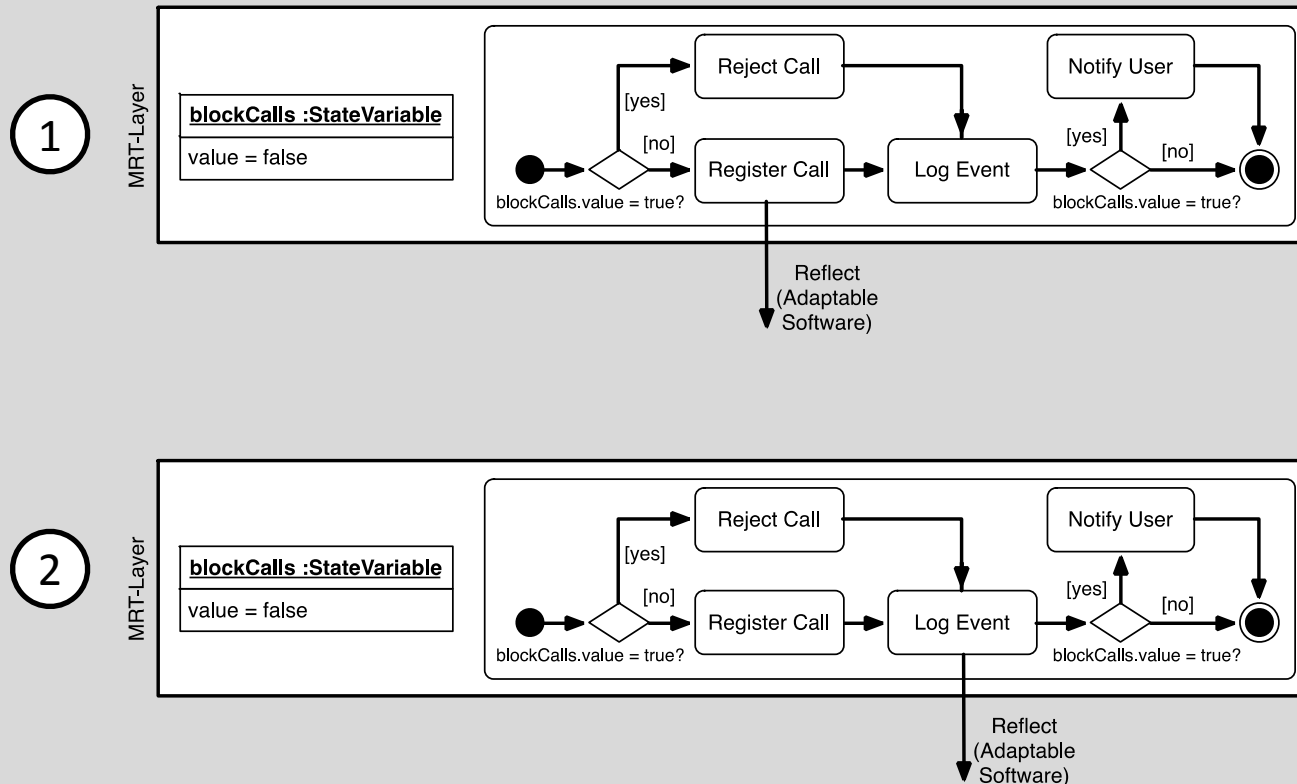


Unrepeatable Model Read

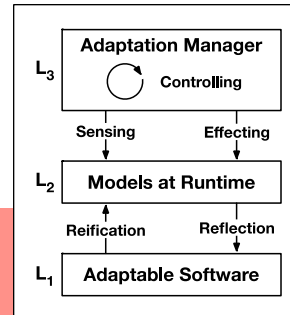


Problem: Two subsequent read operations yield different values.

Example:

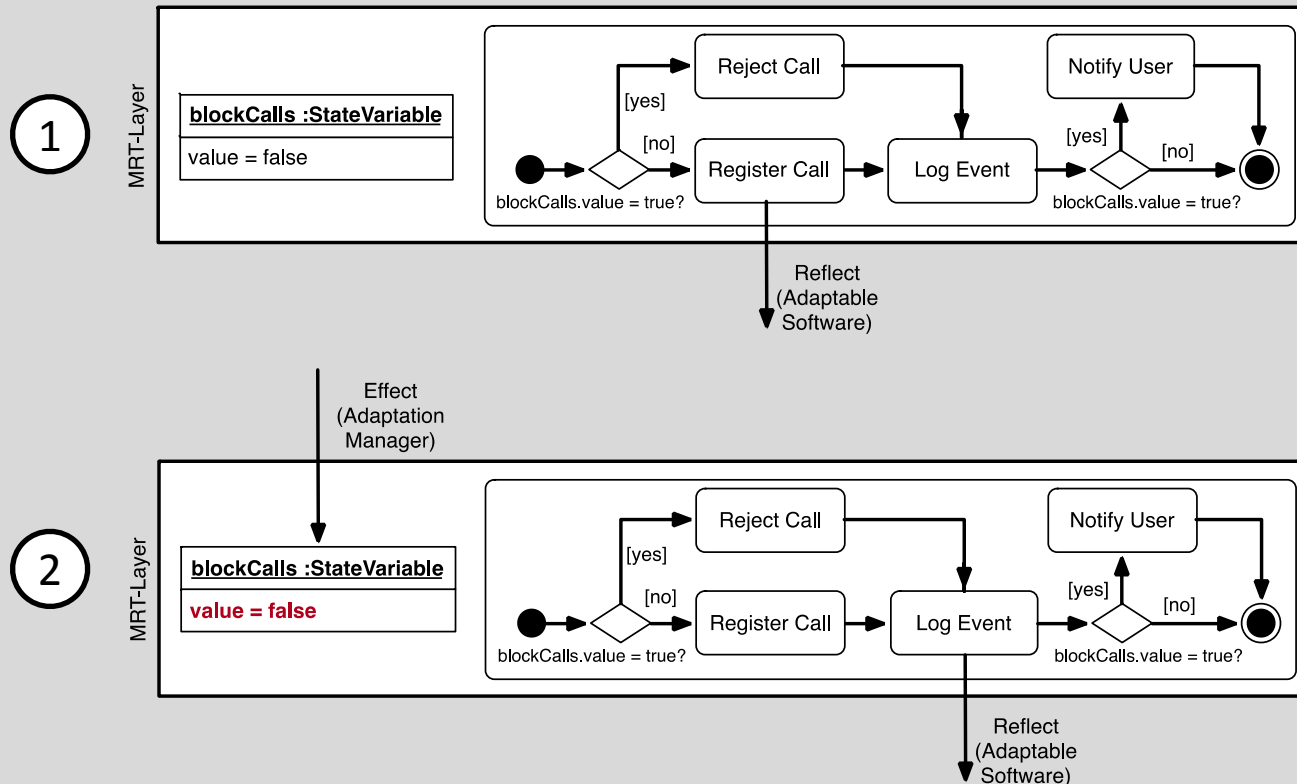


Unrepeatable Model Read

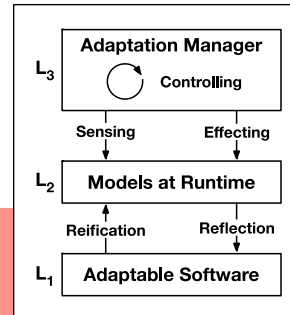


Problem: Two subsequent read operations yield different values.

Example:

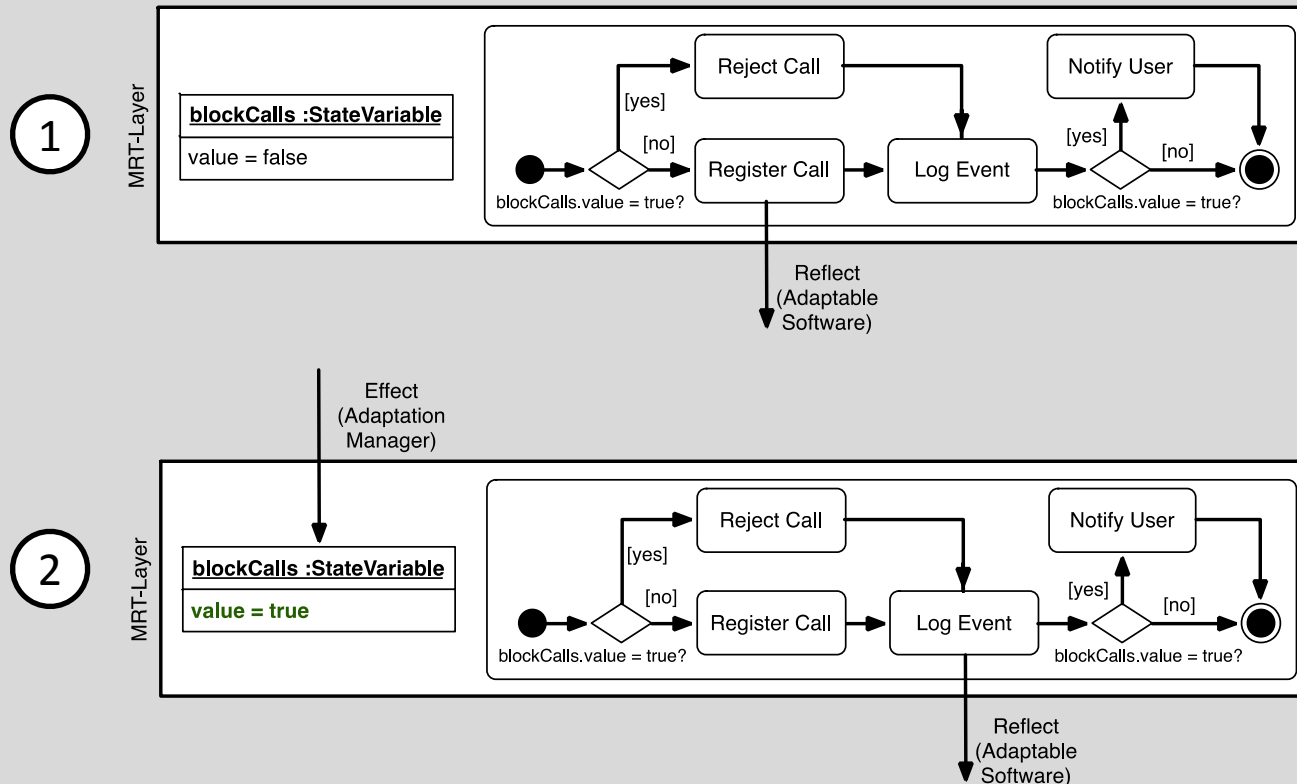


Unrepeatable Model Read

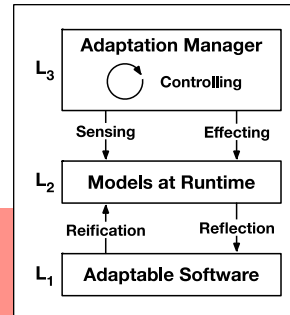


Problem: Two subsequent read operations yield different values.

Example:

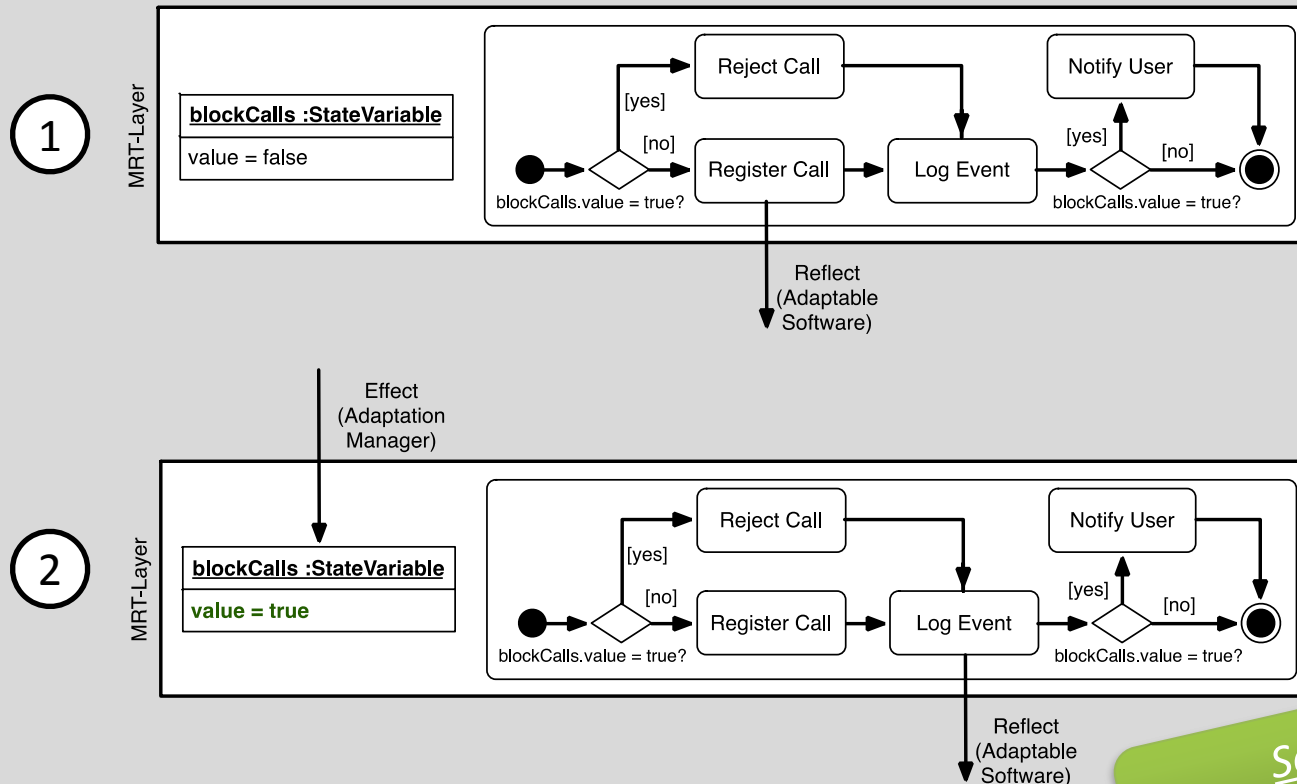


Unrepeatable Model Read



Problem: Two subsequent read operations yield different values.

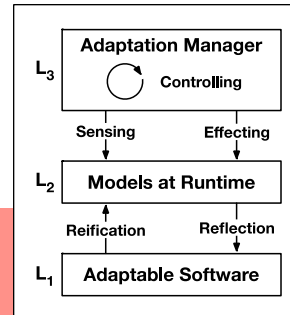
Example:



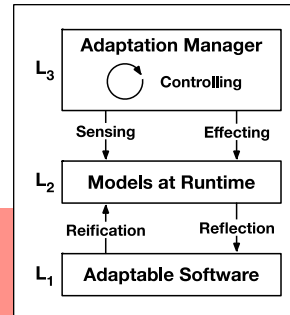
Solution Idea
Isolation of model access

Conflicting Model Update

Problem: Concurrent operations on the model conflict.



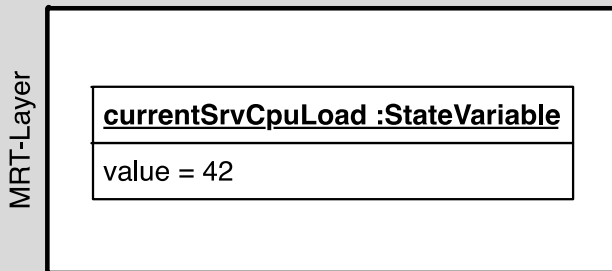
Conflicting Model Update



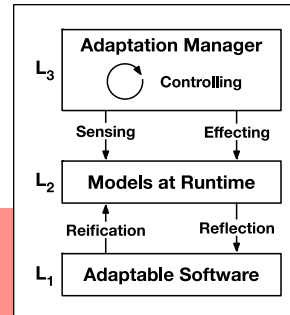
Problem: Concurrent operations on the model conflict.

Example:

1

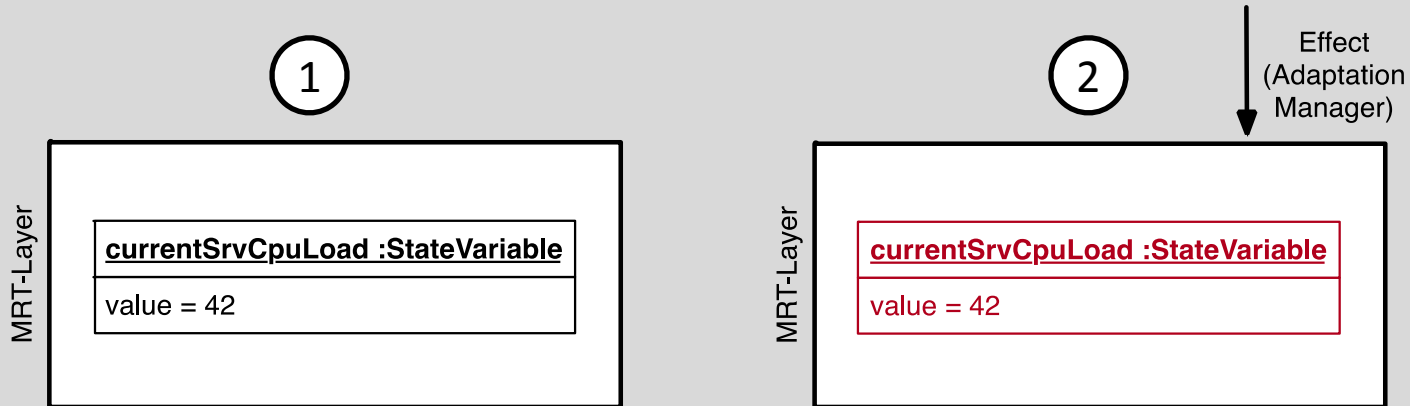


Conflicting Model Update

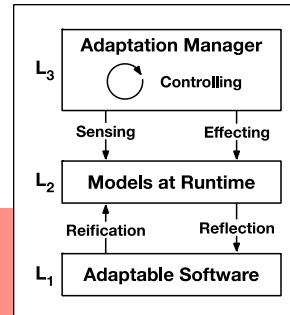


Problem: Concurrent operations on the model conflict.

Example:

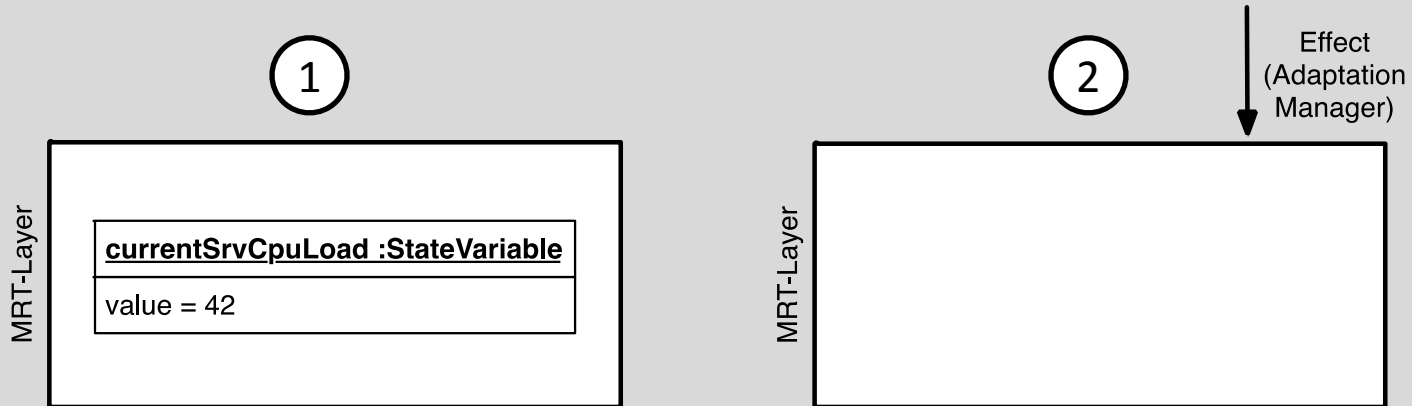


Conflicting Model Update

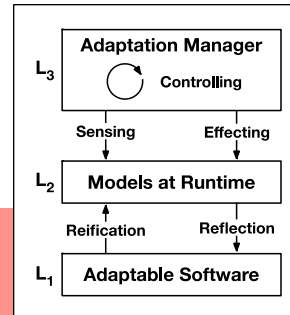


Problem: Concurrent operations on the model conflict.

Example:

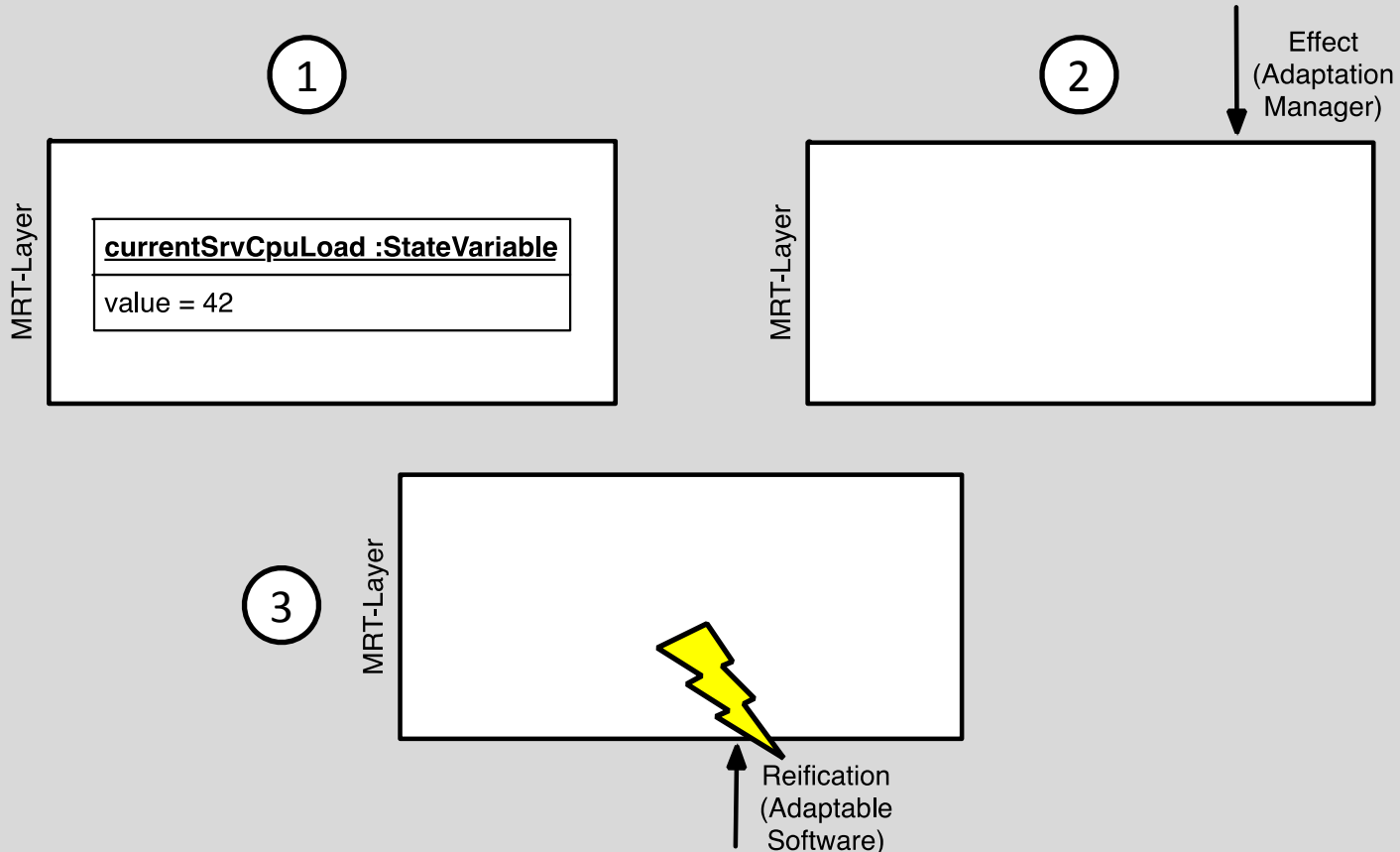


Conflicting Model Update

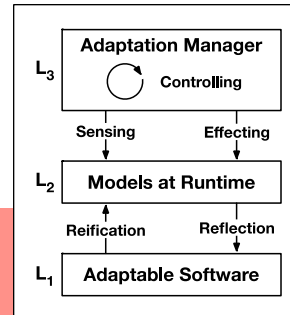


Problem: Concurrent operations on the model conflict.

Example:

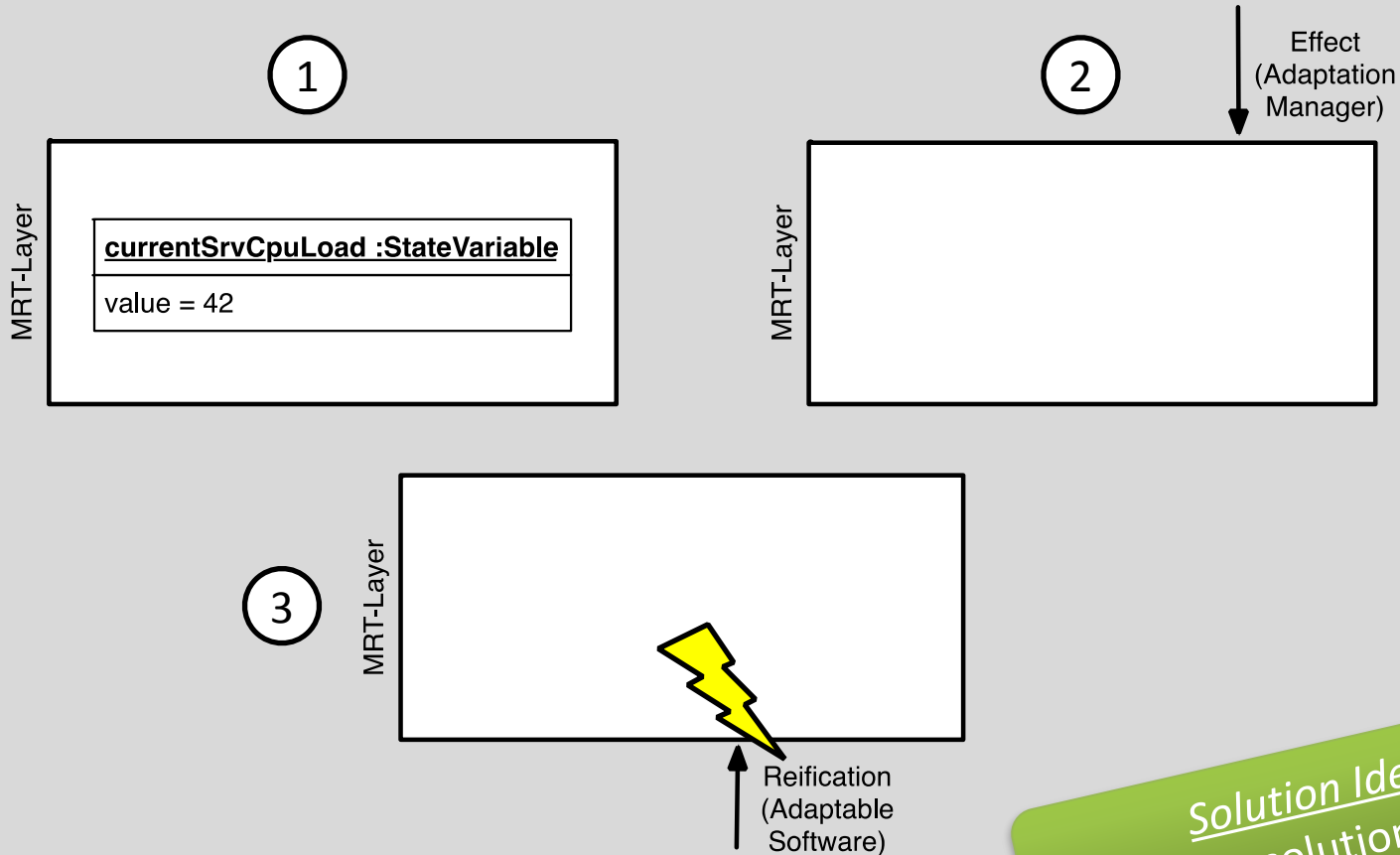


Conflicting Model Update



Problem: Concurrent operations on the model conflict.

Example:



Solution Idea
Conflict resolution strategy