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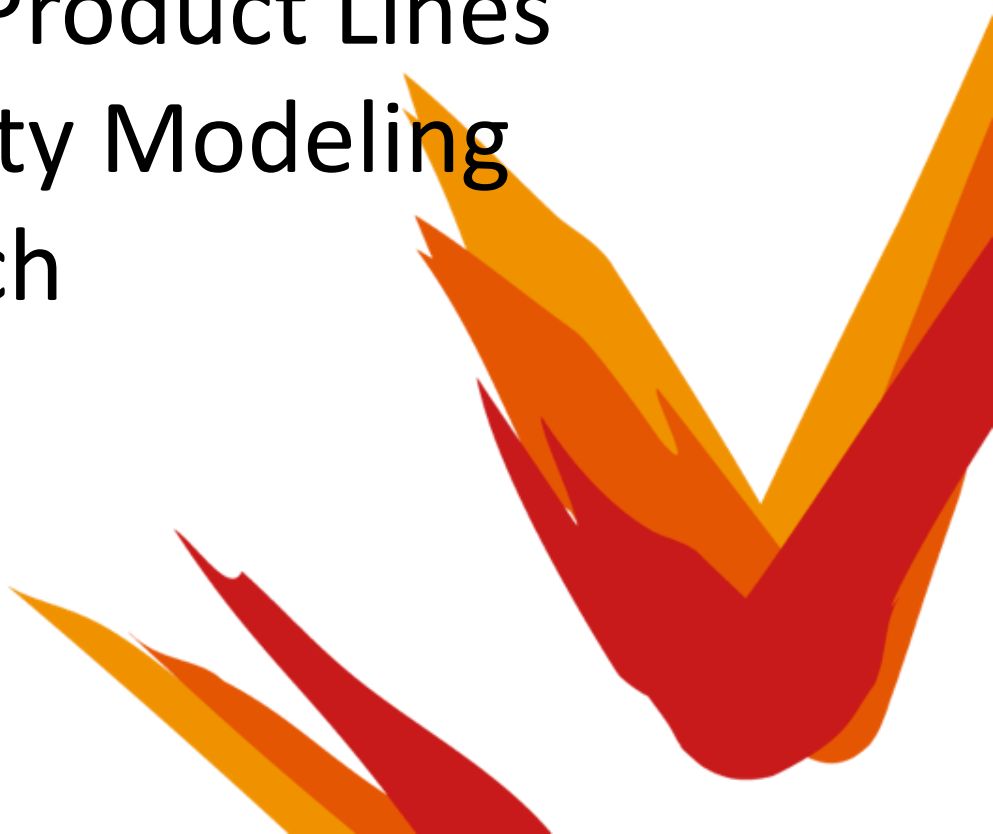
Achieving Run-time Evolution of Dynamic Software Product Lines through a Variability Modeling Approach

Lorena Arcega

FOSD 2015



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Introduction

Dynamic Software Product Lines (DSPLs) extend existing product line engineering approaches by moving their capabilities at run-time.

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Introduction

Software evolution has emerged as a key research field in software engineering.

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Introduction

However, Dynamic Software Product Lines (DSPLs) evolution has not yet deserved enough attention.

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Introduction

This work addresses the use of DSPLs to achieve the evolution by means of integrating new developed components.

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Background

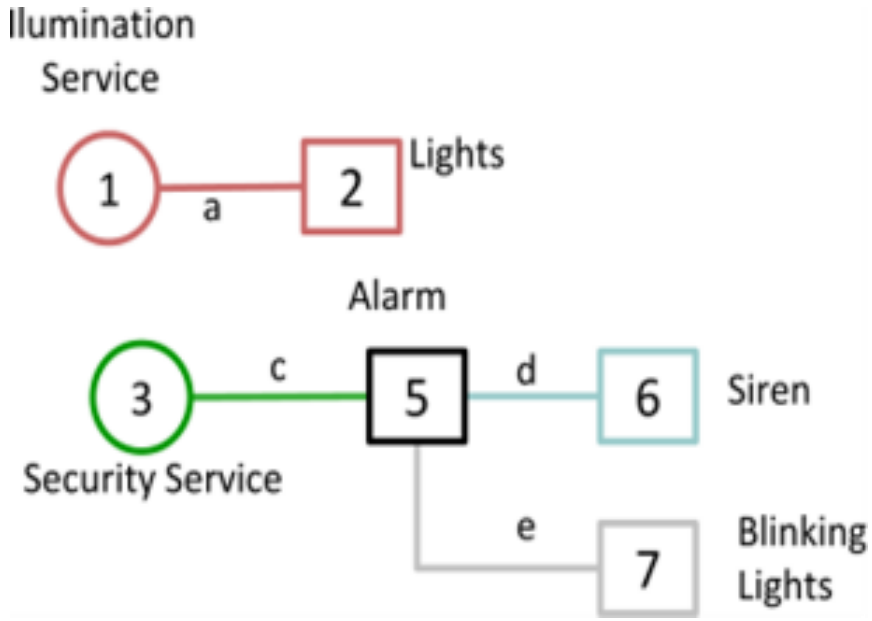
PervML DSL

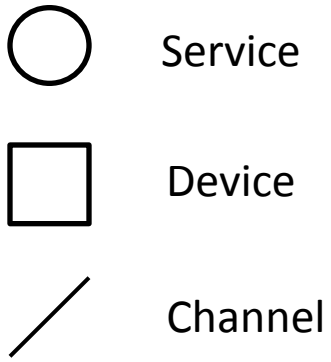
DSL for describing pervasive systems using high-level abstraction concepts.

J. Muñoz. *Model Driven Development of Pervasive Systems. Building a Software Factory.* PhD thesis, Universidad Politécnica de Valencia, 2008.

Background

PervML Model





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Background

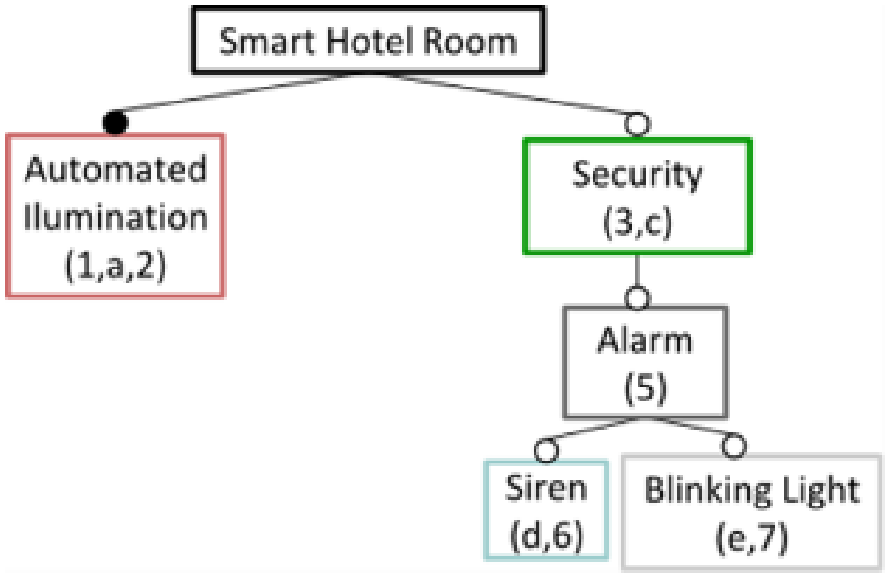
Feature Modelling

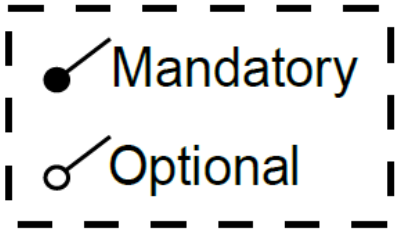
A widely used formalism for modeling and reasoning about commonality and variability of a system.

S. She, R. Lotufo, T. Berger, A. Wąsowski and K. Czarnecki. *Reverse Engineering Feature Models.* In Prodeedings of the 33rd International Conference on Software Engineering, ICSE'11.

Background

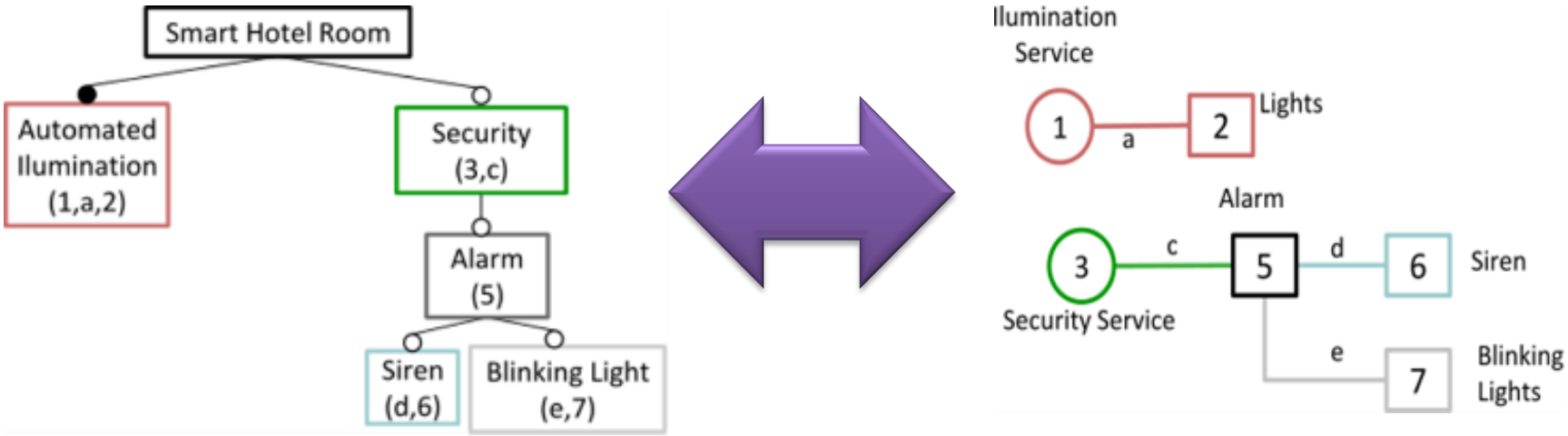
Feature Modelling





Background

Weavig Model



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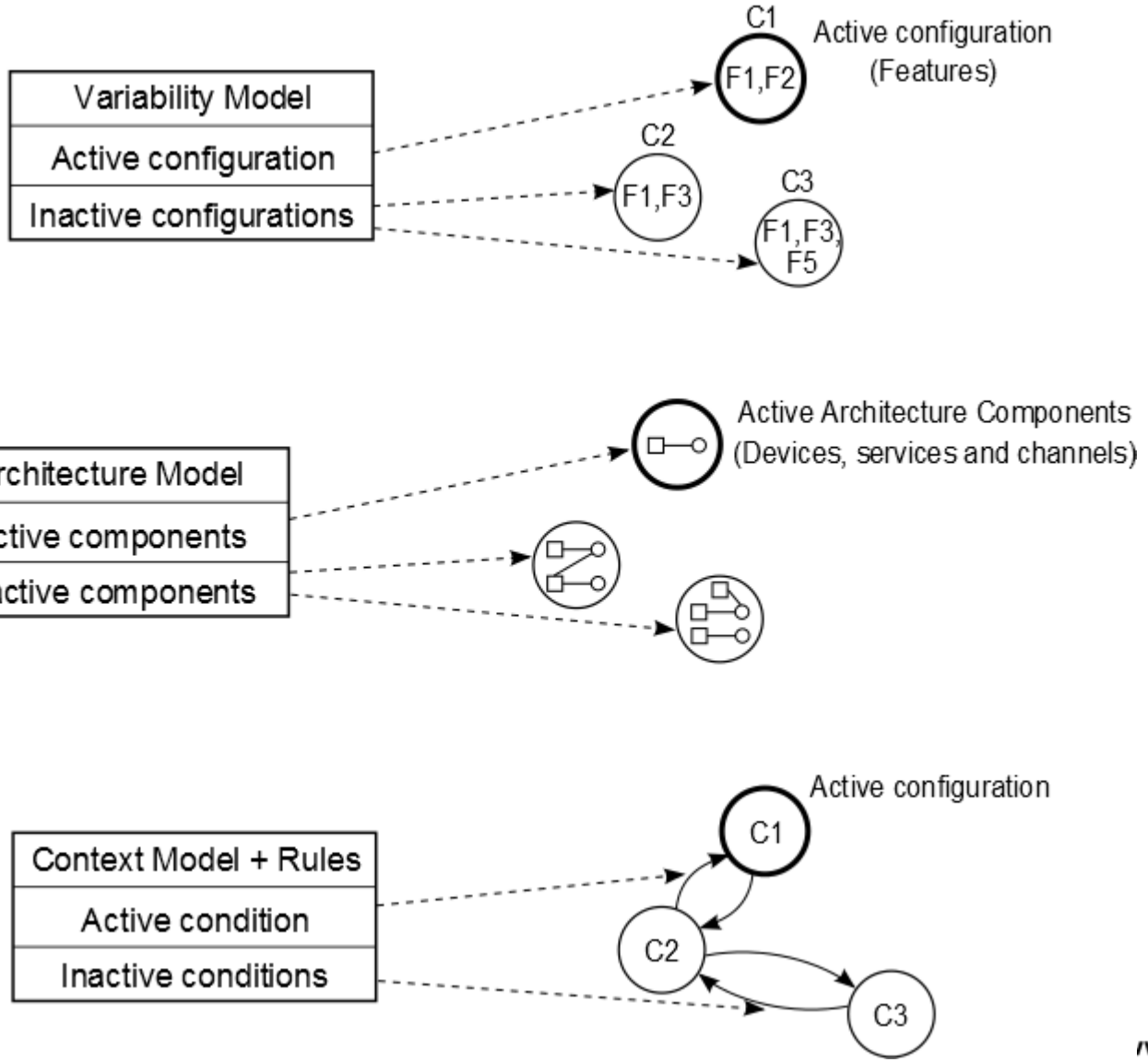
Background



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Background

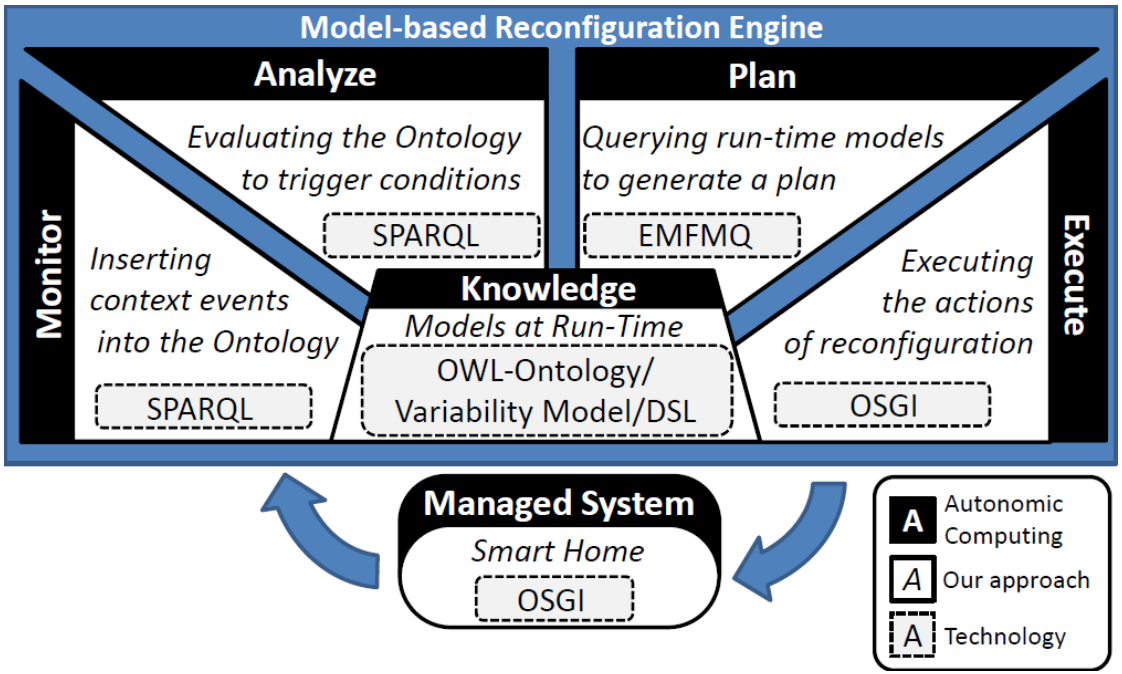
Model-based Reconfiguration Engine (MoRE)

Translate context changes into changes in the activation/deactivation of features. Then these changes are translated into reconfiguration actions that modify the system components accordingly.

C. Cetina. *Achieving Autonomic Computing through the Use of Variability Models at Run-time.* PhD thesis, Universidad Politécnica de Valencia, 2010.

Background

Model-based Reconfiguration Engine (MoRE)



Evolution Challenges

Challenge 1

Co-evolution as in SPLs but maintaining more models such as the context model and the reconfigurations.

Evolution Challenges

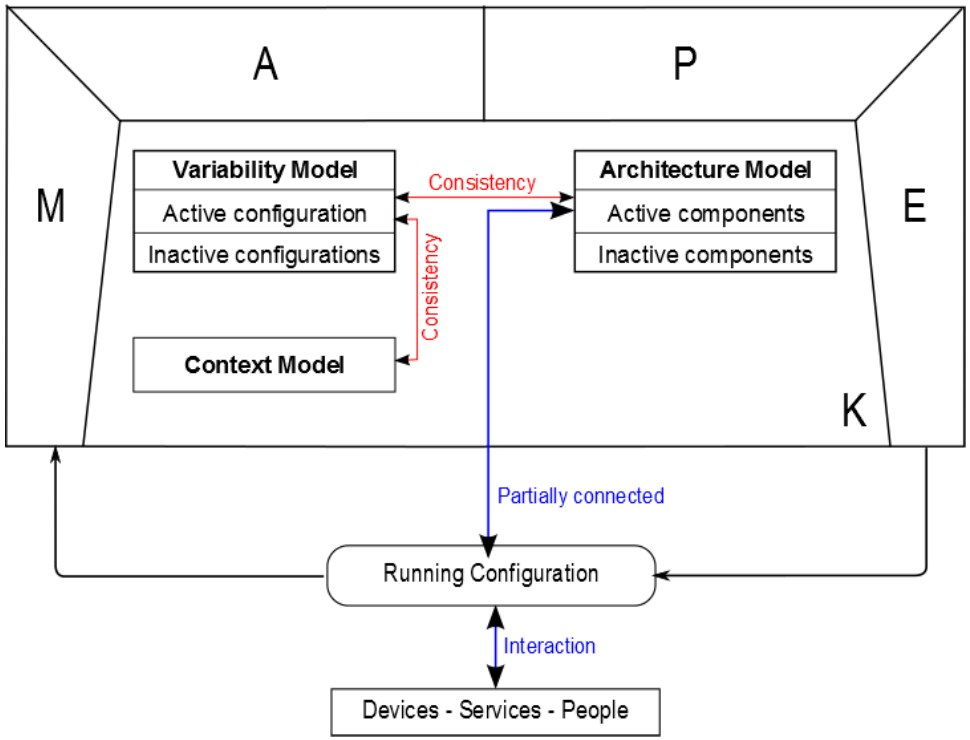
Challenge 2

Keep the models partially connected to the running system and keep the interaction between the running system and the context throughout the evolution.

Evolution Challenges

Challenge 1

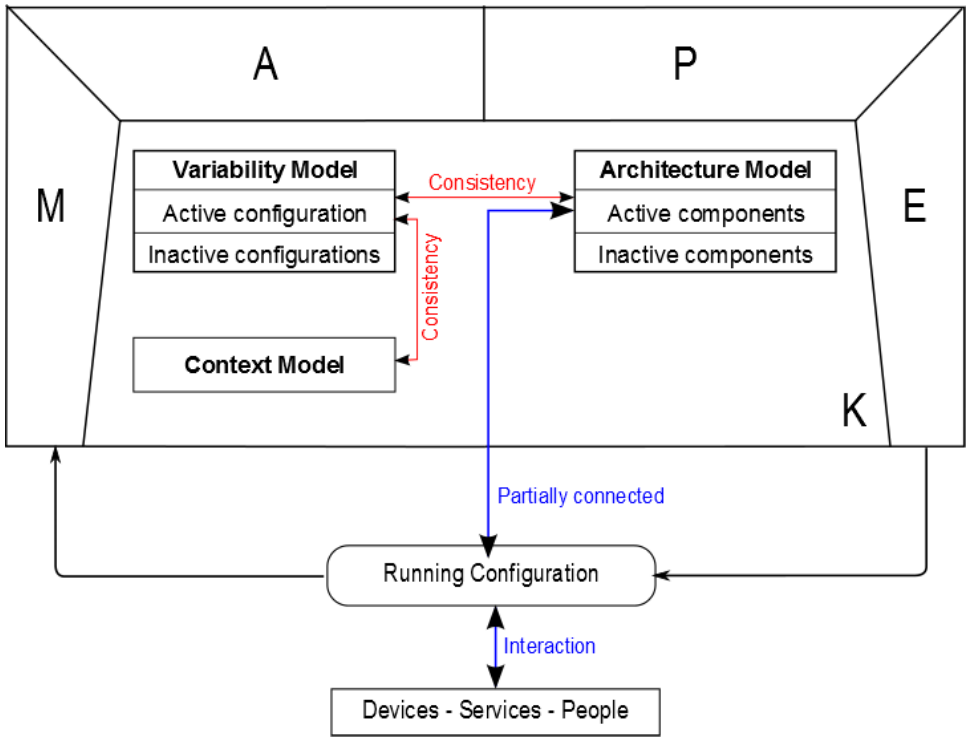
Co-evolution: If the assets evolve the variability specification must to evolve and vice versa.



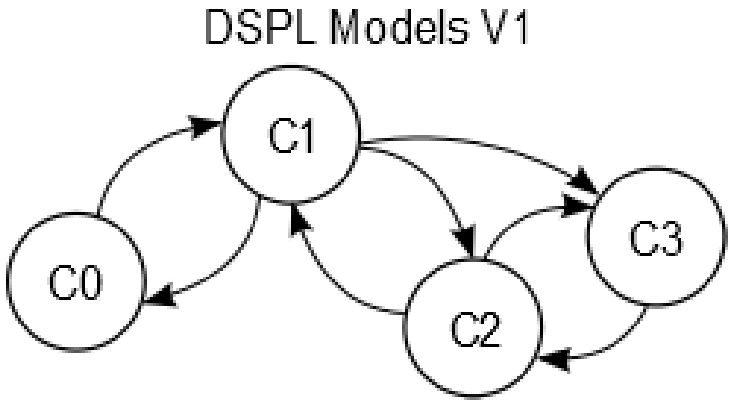
Evolution Challenges

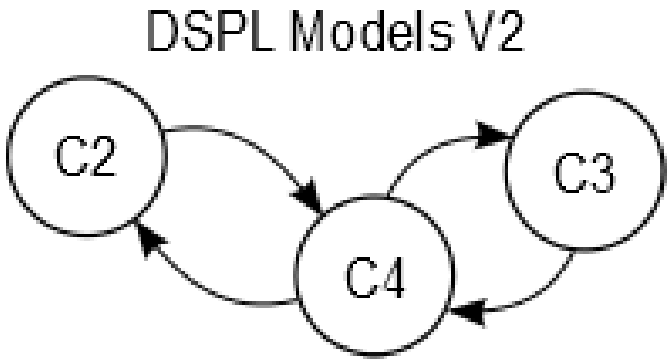
Challenge 2

Keep the models partially connected to the system and keep the interaction between the system and the context.

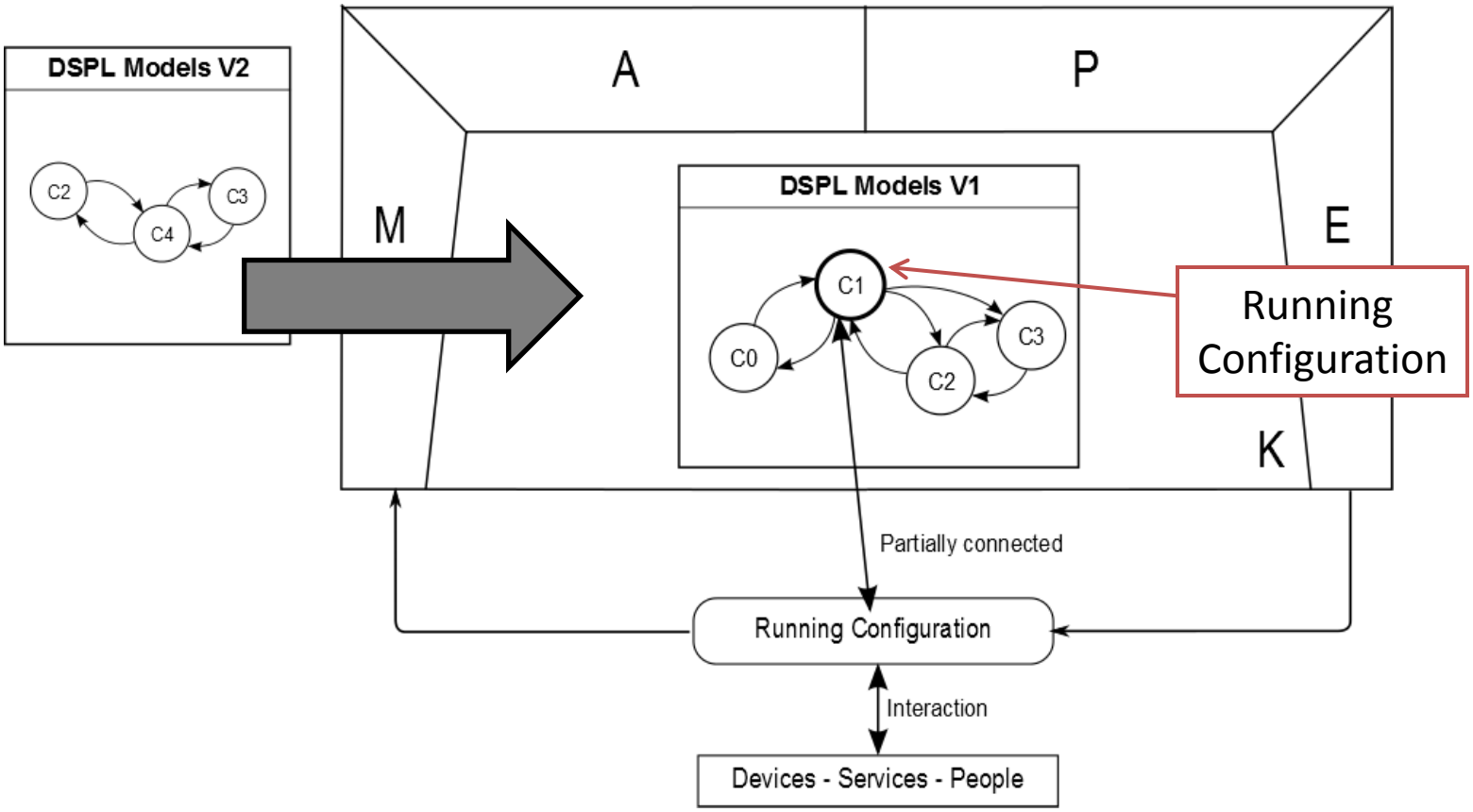


Evolution Strategy

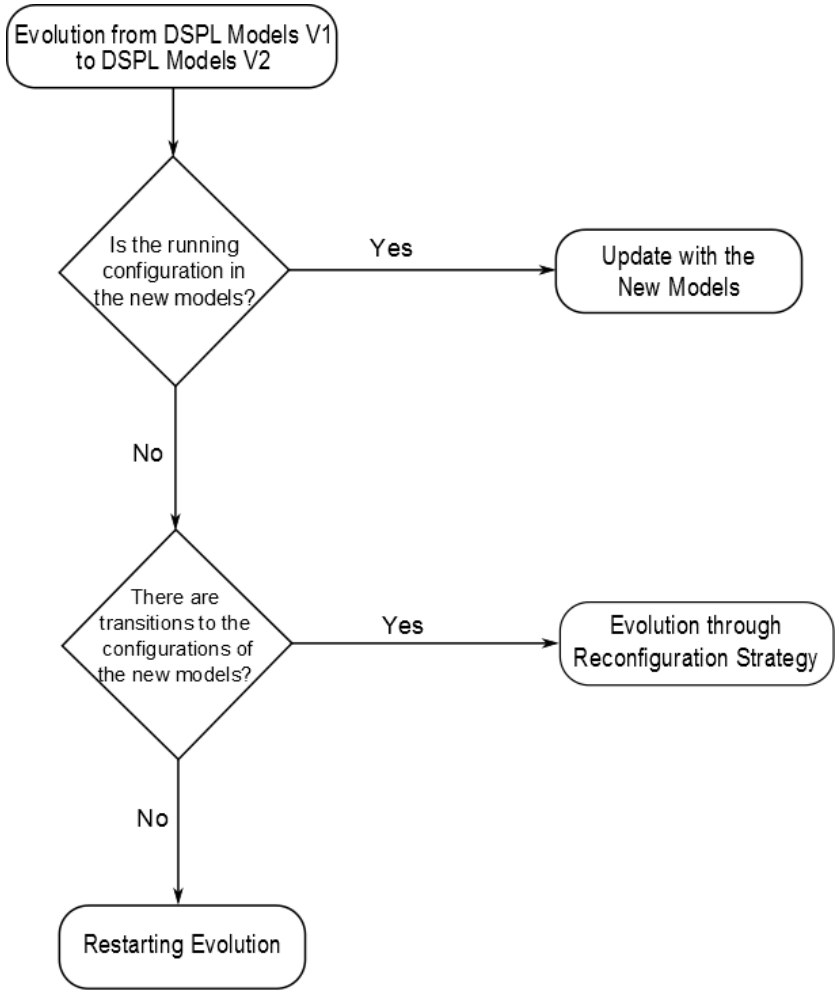


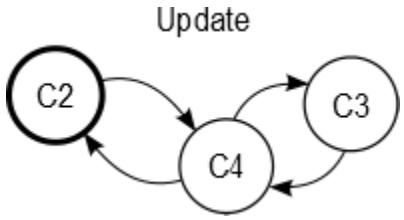


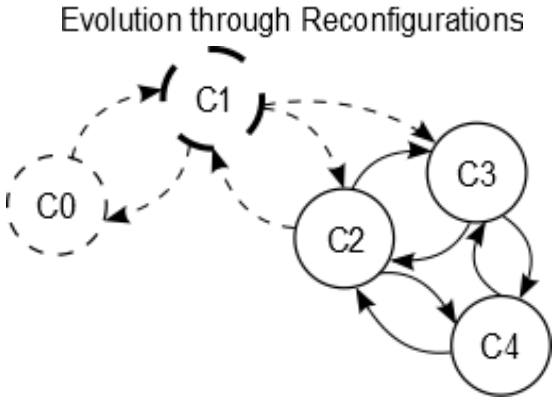
Evolution Strategy



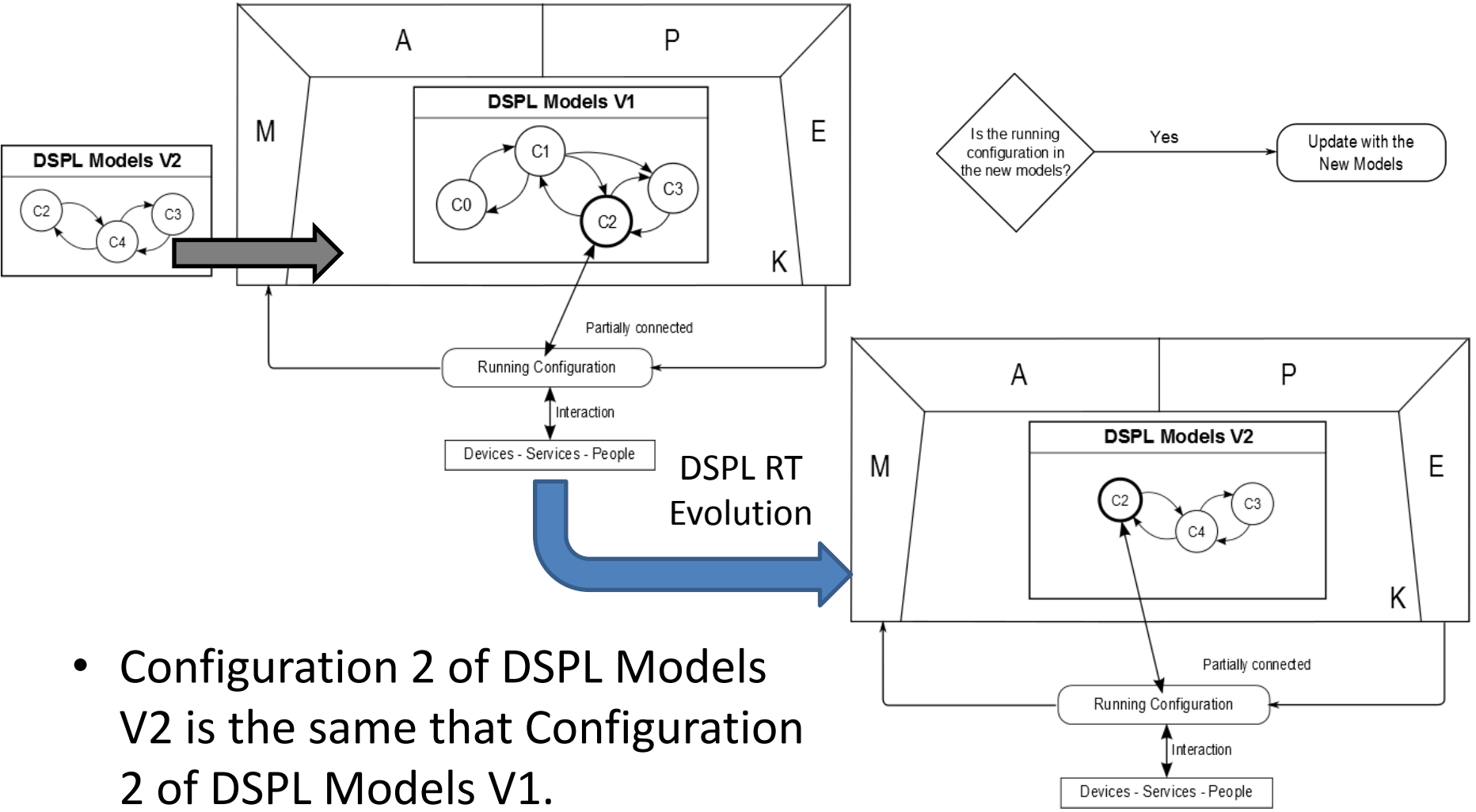
Evolution Strategy





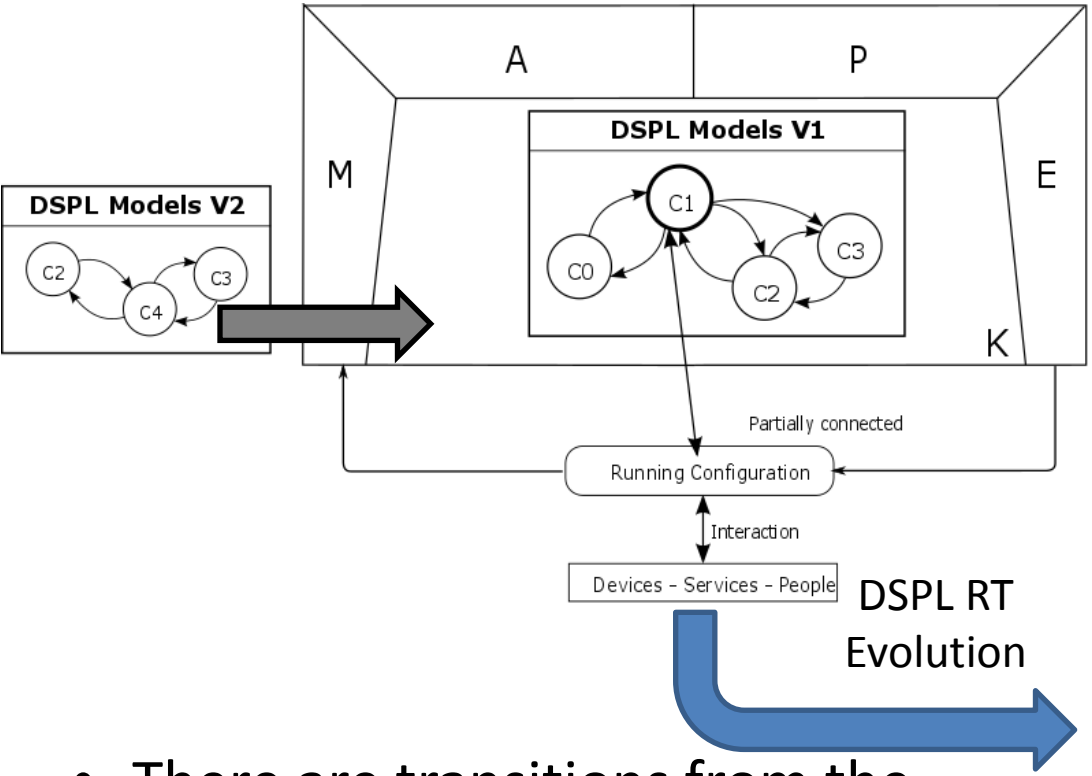


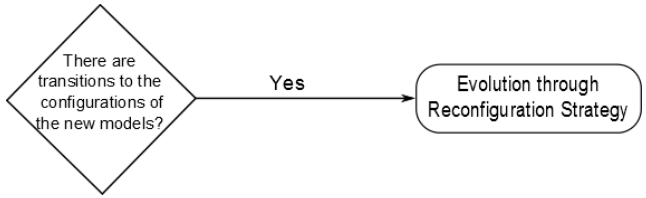
Evolution Strategy



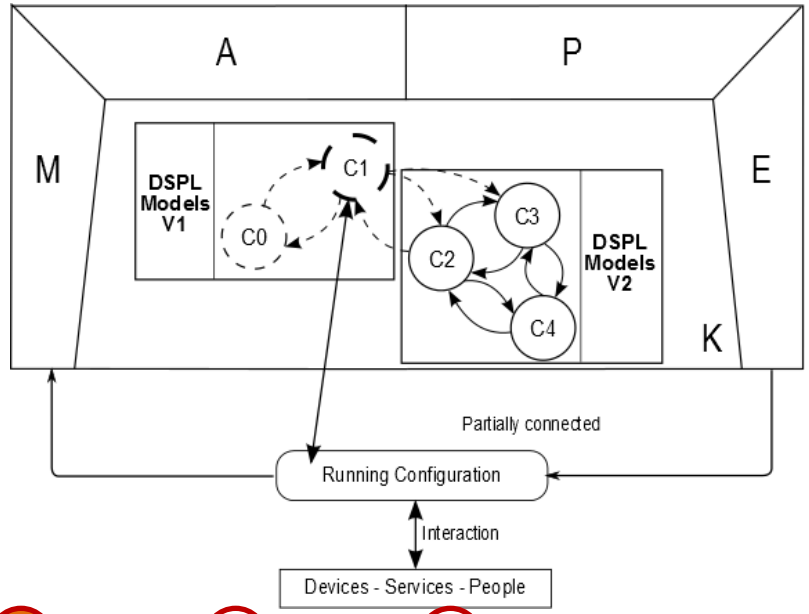
- Configuration 2 of DSPL Models V2 is the same that Configuration 2 of DSPL Models V1.

Evolution Strategy





DSPL RT Evolution



- There are transitions from the running configuration to some configurations involved in the new models.

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Case Study

- Smart Hotel case study:
  - Simulated environment.
  - Average occupancy of about 18 simultaneous clients.
  - MoRE reconfigures the system following the context changes triggered by the clients.

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Case Study

- Evolution in the Smart Hotel:
  - Eight versions were developed at design-time.
  - Initial derivation from version 1 to version 8.
  - MoRE reconfigured the architecture of the system.
  - An evolution to one of the next versions was performed.

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Conclusions

This work address the evolution of a DSPL by integrating newly developed components.

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Conclusions

The evaluation of our strategy in the Smart Hotel DSPL has shown that the models were evolved while the current configuration of the Smart Hotel kept running.

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