Laboratório de Engenharia de Software

On the Development of Multi-agent Systems Product Lines: A Domain Engineering Process

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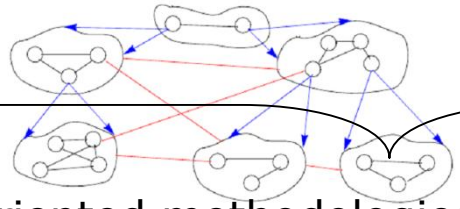
Outline

- Introduction
- A Domain Engineering Process for MAS-PLs
- MAS-PL Case Studies
- Conclusion
- References

Introduction

- Agent-oriented Software Engineering
  - Important new direction of software engineering
  - Allow the development of distributed complex applications



- Software Product Lines
  - New trend of software reuse
  - Lower costs
  - Reduced time-to-market
  - Quality improvement

- Most of the agent-oriented methodologies do not take into a adoption of extensive reuse practices
- SPL methodologies do not detail or barely detail the modeli documentation of SPLs that take advantage of agent techno
- Only some recent research has explored the integration of SPLs and MASs technologies
  - Incorporating their respective benefits
  - Helping the industrial exploitation of agent technology
- There are still many challenges to be overcome in the **Multi-agent Systems Product Lines** (MAS-PLs) development

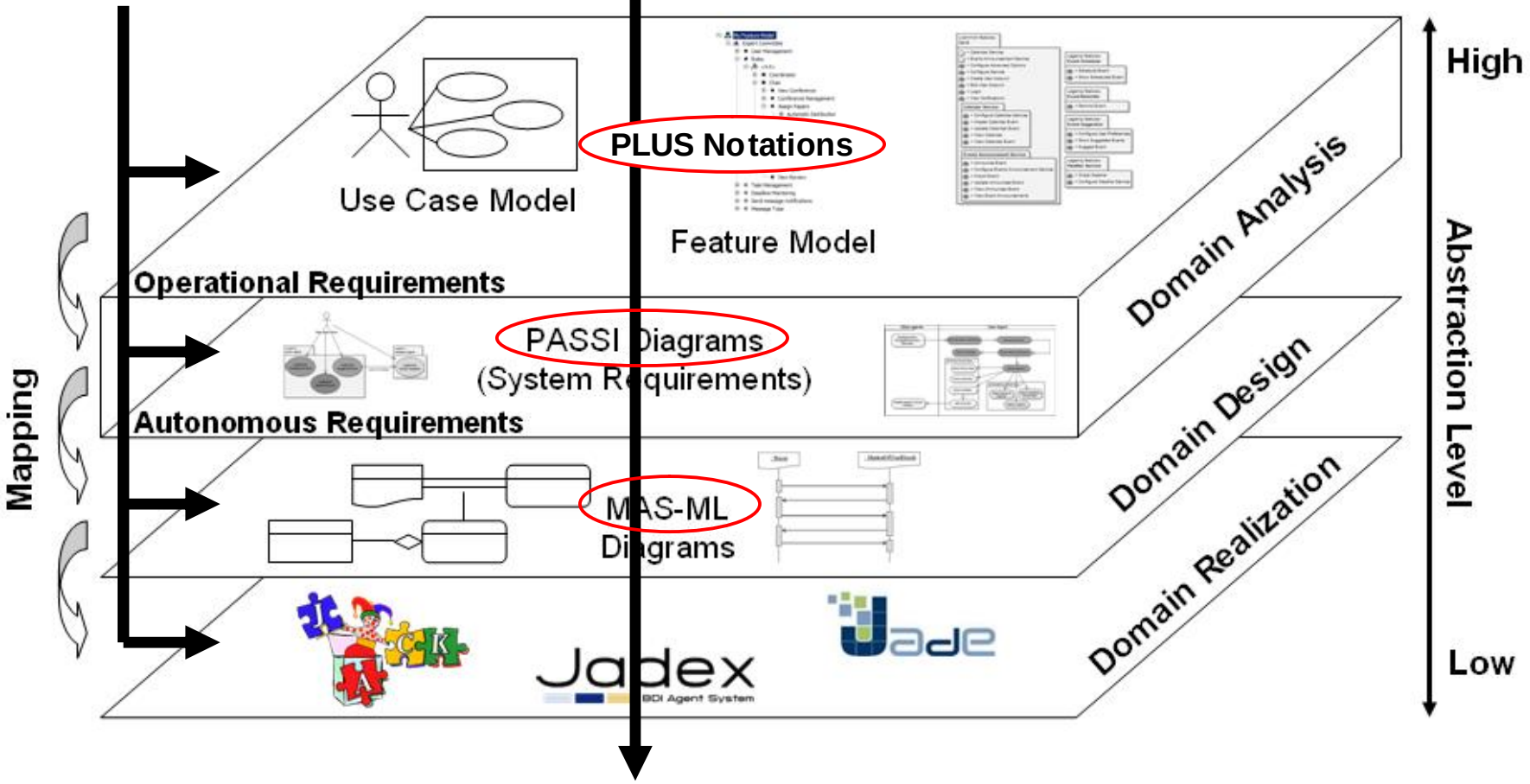
Introduction

- Proposed Solution
  - Definition of a **domain engineering process** for developing MAS-PLs
    - Detailing its activities and their respective artifacts
  - Notations to model and document agent variability
  - Models to capture agent features traceability
  - Modeling agent features independently
    - Incorporation of agents into existing systems designed with other technologies with a low impact

Process Overview

(ii) Systematic
Structure according to SPEM

(i) Feature-oriented

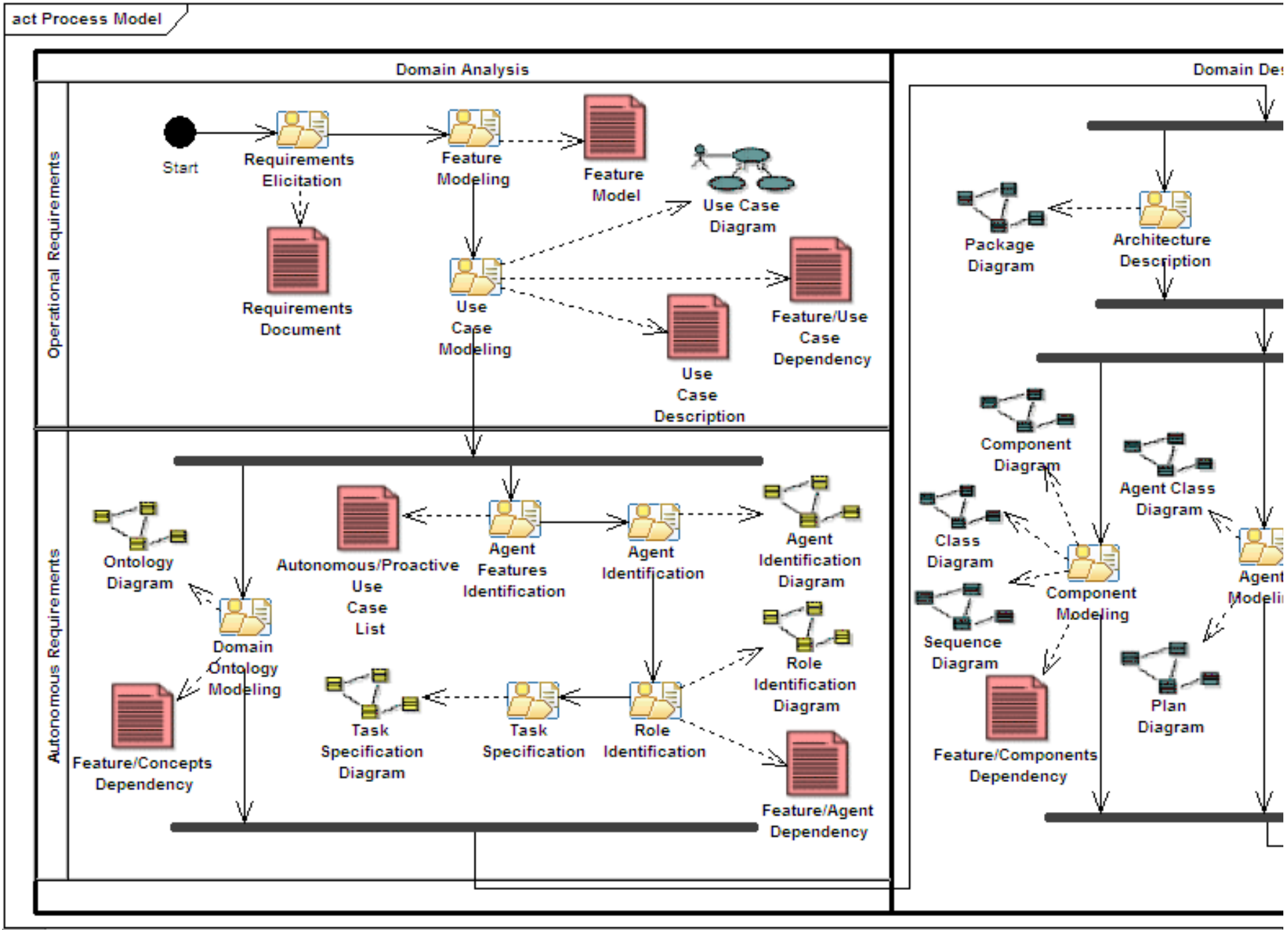


(iii) Incorporate notations and activities of existing SPL and MAS approaches

Process Overview

- Notations and guidelines adopted along all our process
  - Use of <<kernel>>, <<optional>> and <<alternative>> stereotypes to indicate variability in the models
  - Use of colors to distinguish features in models
  - Provide features traceability
- Agent Features Granularity
  - Features granularity refers to the degree of detail and precision that a design element that implements a feature presents
  - Besides the usual variabilities present in SPLs, three different kinds of agent variability
    - **Agents**
    - **Roles**
    - **Capabilities**

Capabilities is mechanism to support **modularity** and **reusability** while still allowing meta-level reasoning


act Process Model
Domain Analysis
Operational Requirements
Start
Requirements Elicitation
Feature Modeling
Feature Model
Use Case Diagram
Requirements Document
Use Case Modeling
Feature/Use Case Dependency
Use Case Description
Autonomous Requirements
Ontology Diagram
Domain Ontology Modeling
Feature/Concepts Dependency
Autonomous/Proactive Use Case List
Agent Features Identification
Agent Identification
Agent Identification Diagram
Task Specification Diagram
Task Specification
Role Identification
Role Identification Diagram
Feature/Agent Dependency
Domain De
Package Diagram
Architecture Description
Component Diagram
Agent Class Diagram
Class Diagram
Component Modeling
Sequence Diagram
Plan Diagram
Feature/Components Dependency

Documenting Agent Variability

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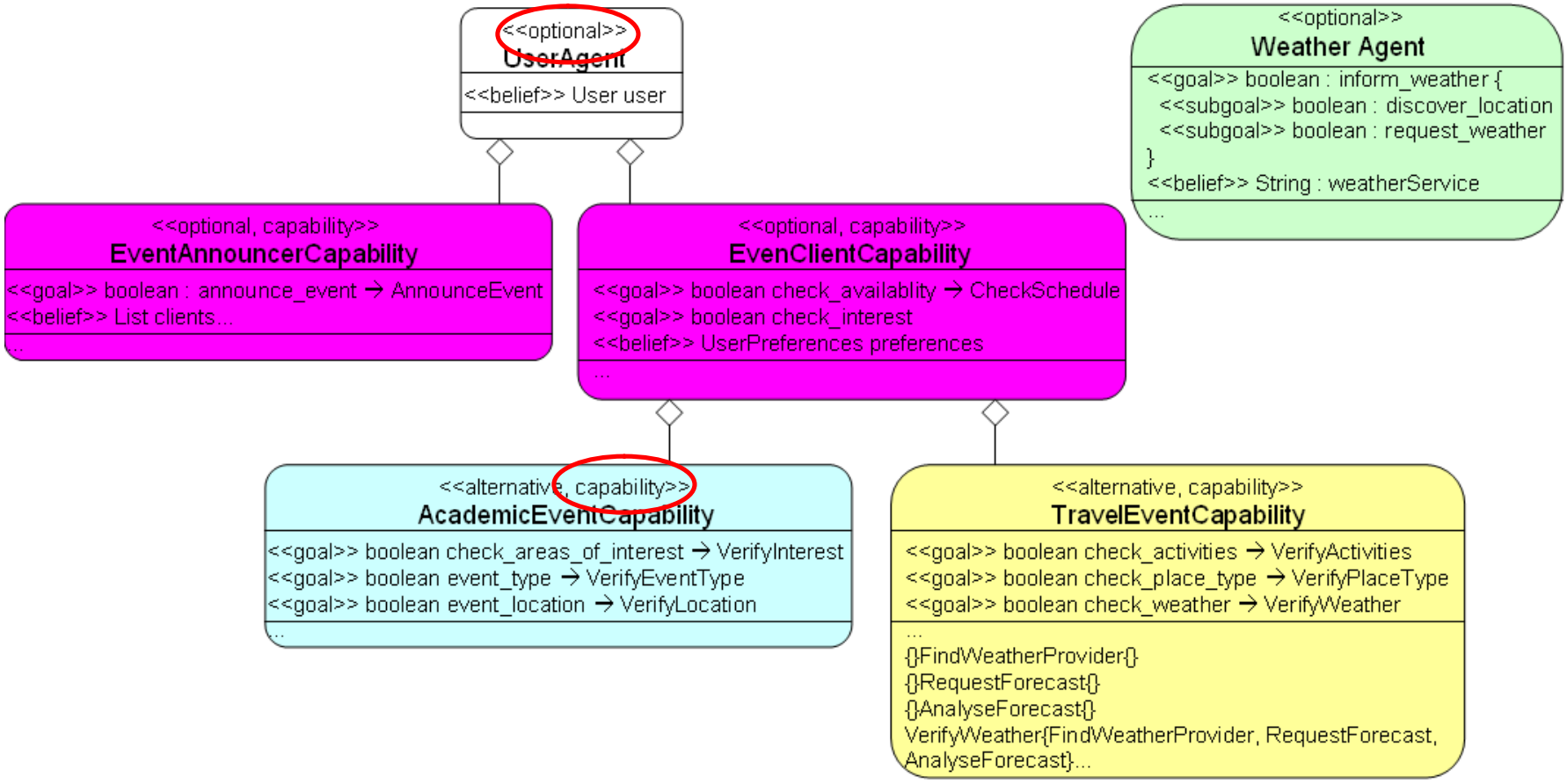
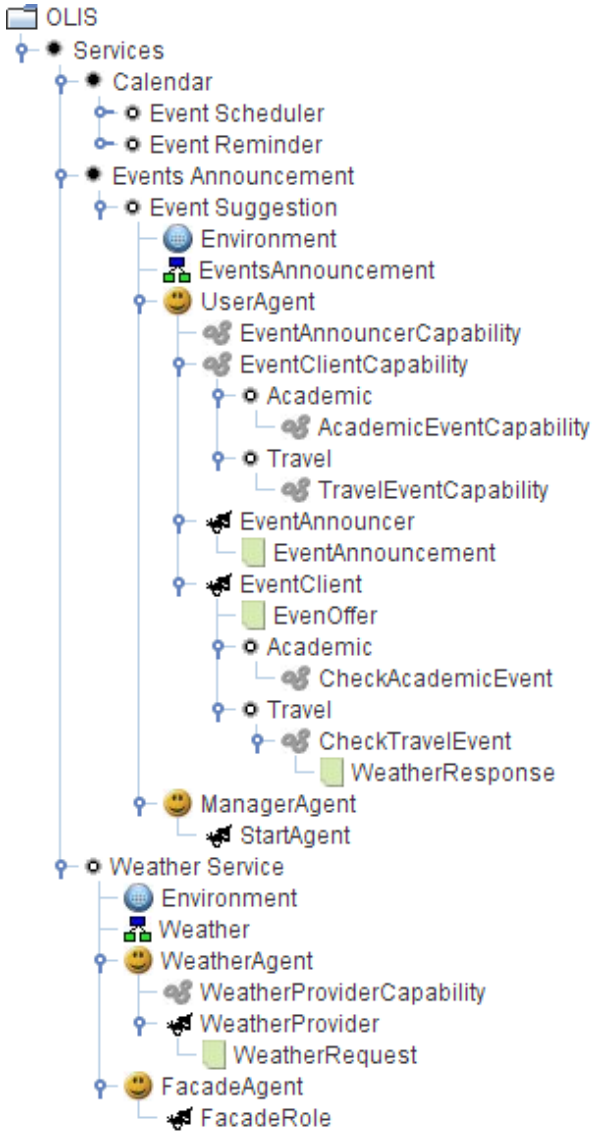
Our Extensions:
(v) UML 2.0 frames to indicate a behavior related to a crosscutting feature in dynamic models

MAS-ML Extensions:
Documenting Agent Variability In the Domain Design



Tracing Agent Features



- **Feature/Agent Dependency model**
  - **Indicates which design elements are related to each feature**

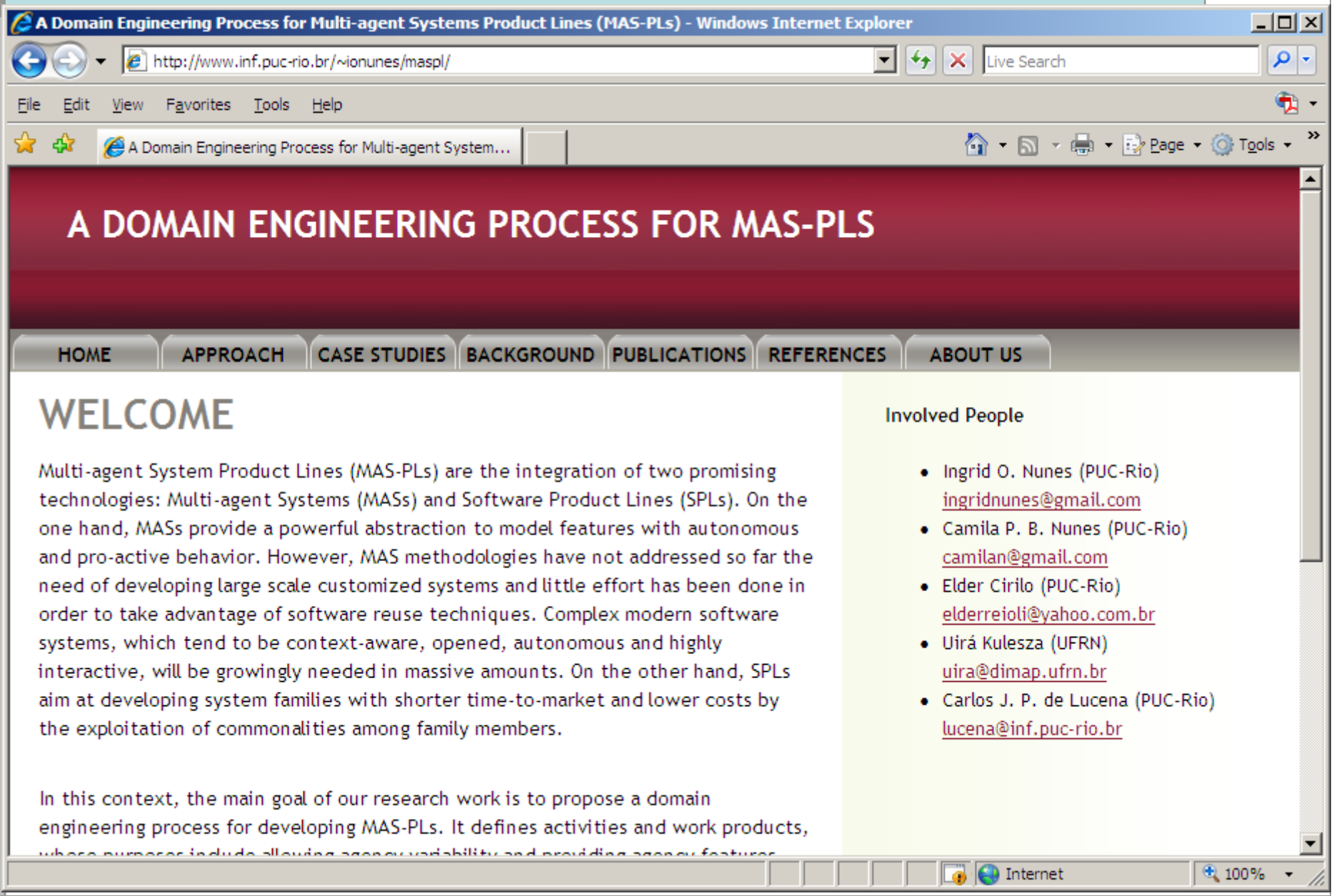
MAS-PL Case Studies

- Expert Committee 
  - MAS-PL of conference management systems
  - Examples of agent features
    - Automatic paper distribution
    - Conference suggestion
    - Task management
- olis OnLine Intelligent Services
  - MAS-PL of web-based systems that provide different personal services to the user
  - Examples of agent features
    - Events reminder
    - Events scheduler
    - Events suggestion

Conclusion

- We presented a process for domain engineering to develop MAS-PLs
  - Describing the activities to be performed in each one of the phase that compose the process
  - Built in a bottom-up fashion
    - Development of MAS-PL case studies
    - Use of SPL and MAS approaches to model them
    - Deficiencies identification
    - Process definition
      - Leverage existing approaches
      - Documenting and Tracing Agent Features
      - Separated Modeling of Agent Features

Website



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