



A first attempt to combine SysML requirements diagrams and B

Régine Laleau, Farida Semmak, Abderrahman Matoussi,
Dorian Petit, Ahmed Hammad, Bruno Tatibouet

*The TACOS project : founded by the French National
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Introduction : formal methods ...

- **Formal methods: initial specification (model) of systems and refinement towards implementation**

BUT:

Not a well-defined process to build the initial model

➔ difficult to validate it :

- ✓ understanding the formal model (for customers)
- ✓ linking it with initial requirements (for designers)

Introduction : ... and requirements engineering

- Requirements engineering : great variety of existing methods (goal-oriented, scenario-based, reuse-driven, ...)

BUT:

Stop at the requirements phase: need to use another method to develop systems

→ difficult to validate systems with regard to requirements

SysML: extension of UML, provides (few) concepts for requirements modelling

Overall objective of our project

Defining a method for bridging the gap between the requirements analysis level and the formal specification level



In this talk:

- **Goal concepts (KAOS) in SysML**
- **Derivation rules from Extended SysML to B**

Background: the B method

Based on first order logic and set theory

- B specification = set of machines :
 - ✓ State = **Variables + Invariant**
 - ✓ Operations = **State Transitions**
(specified by generalised substitutions)
- Structuration mechanisms between machines
- Refinement process
- Tool support

Background: KAOS method – basic concepts

KAOS (Knowledge Acquisition in autOmated Specification) is a goal-based RE method:

- Powerful and extensive set of concepts to specify goal models.
- Design of goal hierarchies at different levels of abstraction.

Goal: a prescriptive statement of intent the system should satisfy through cooperation of its agents.

System = software-to-be and its environment

Agent: active component of the system for goal satisfaction

ACHIEVE goal (functional goal): a property that the system will achieve some time in the future.

Background: KAOS method – goal model

Goal model = AND/OR refinement graph of goals

AND-refined goal: all the sub-goals must be satisfied for the parent goal to be satisfied

OR-refined goal: satisfaction of one of the sub-goals is sufficient for the satisfaction of the parent goal

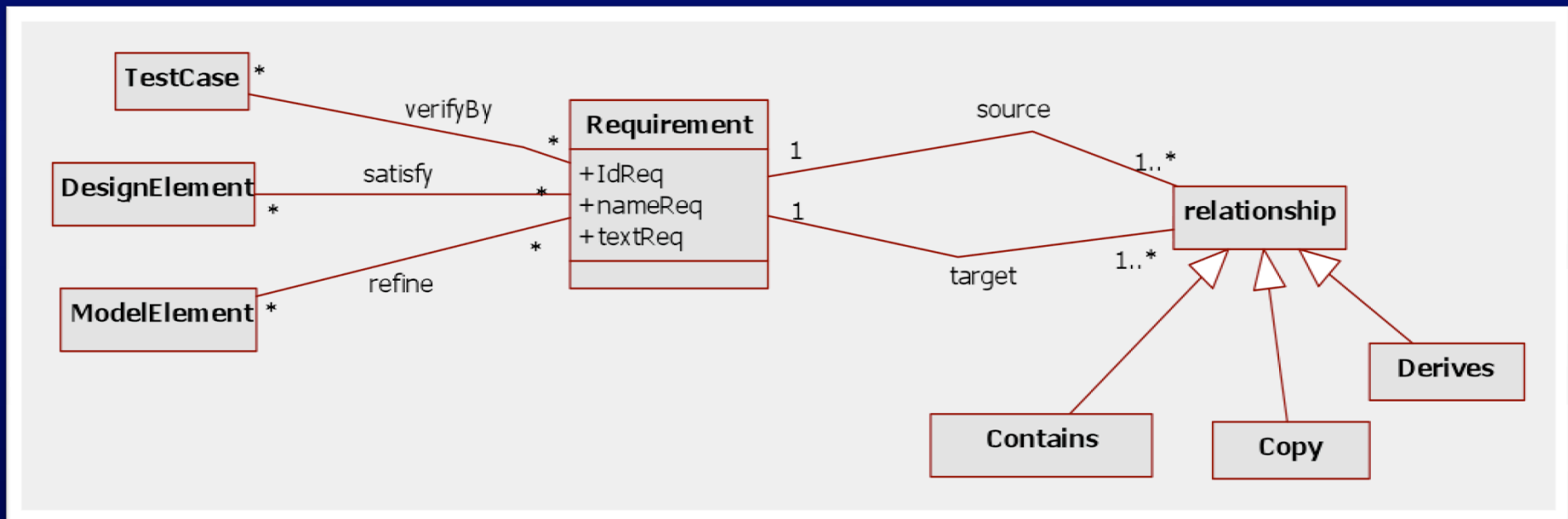
The refinement stops when all sub-goals are assignable to a system agent.

Agent = **software-to-be** \longrightarrow goal = **requirement**

Agent = **environment** \longrightarrow goal = **expectation**

Background: SysML Requirements Diagrams

requirement : one or more properties or behaviours of a system that always have to be met

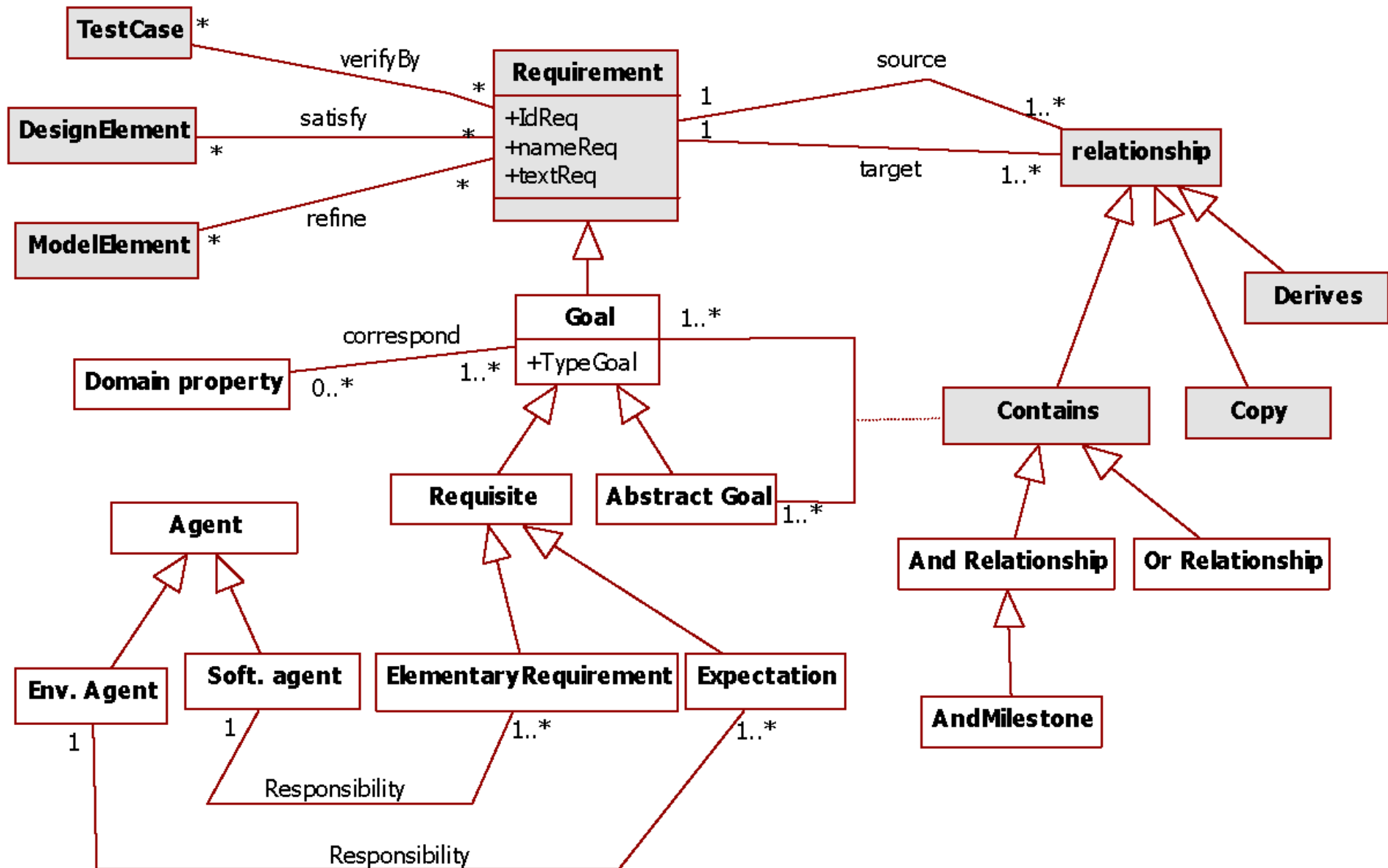


Extending SysML with KAOS goal concepts

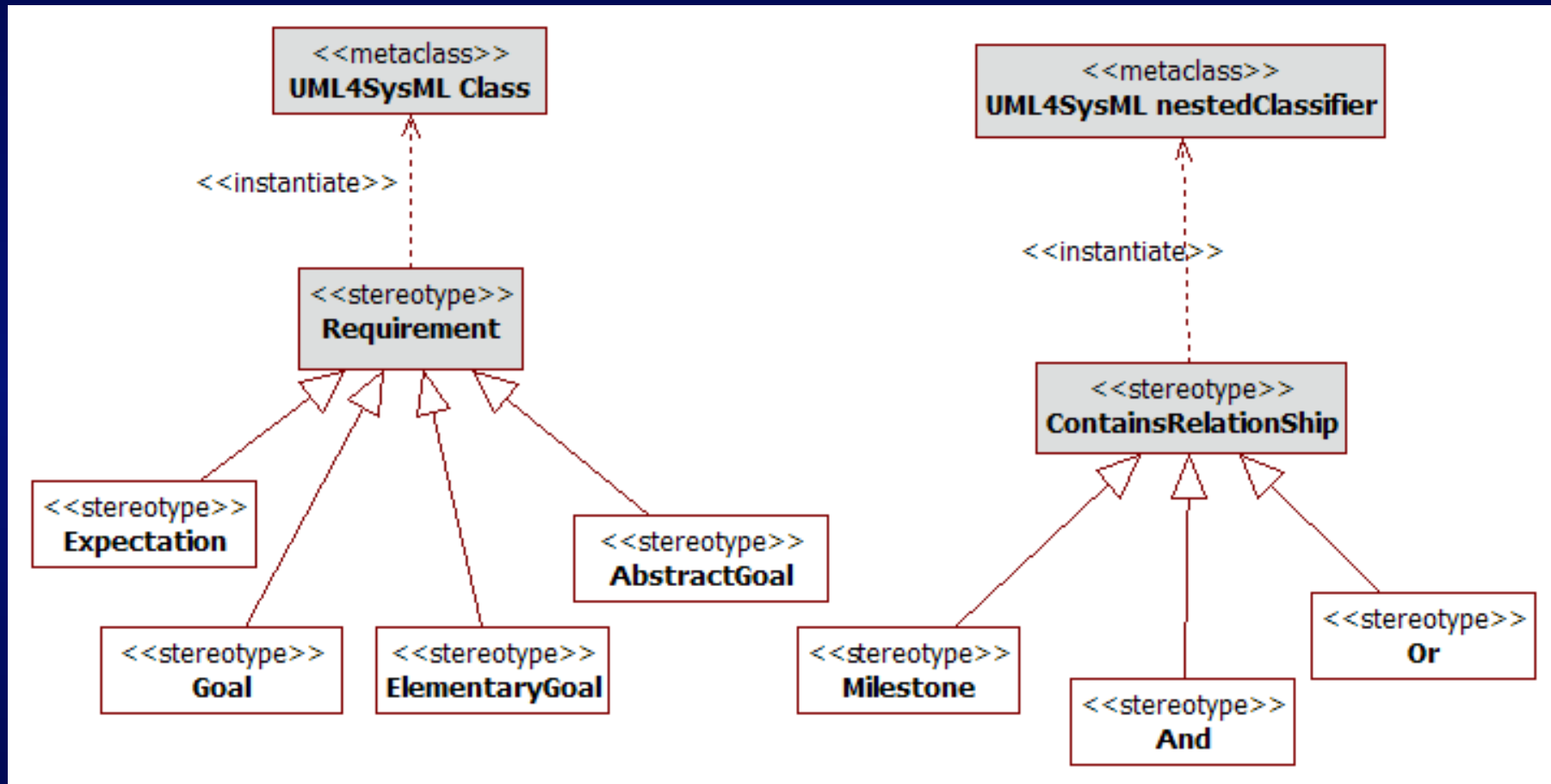
Refining the concept of requirement in SysML by KAOS goal concepts

- ✓ Integrating new concepts in the **SysML metamodel**
- ✓ Defining the **abstract syntax** of these new concepts

Metamodel of the extended SysML

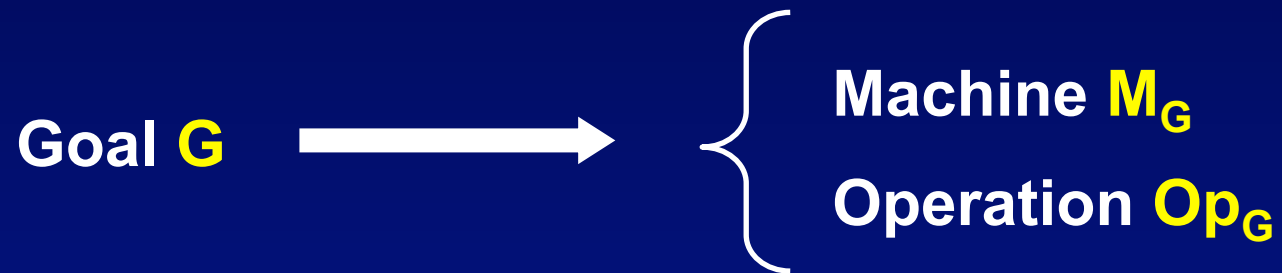


Abstract syntax for the goal stereotypes



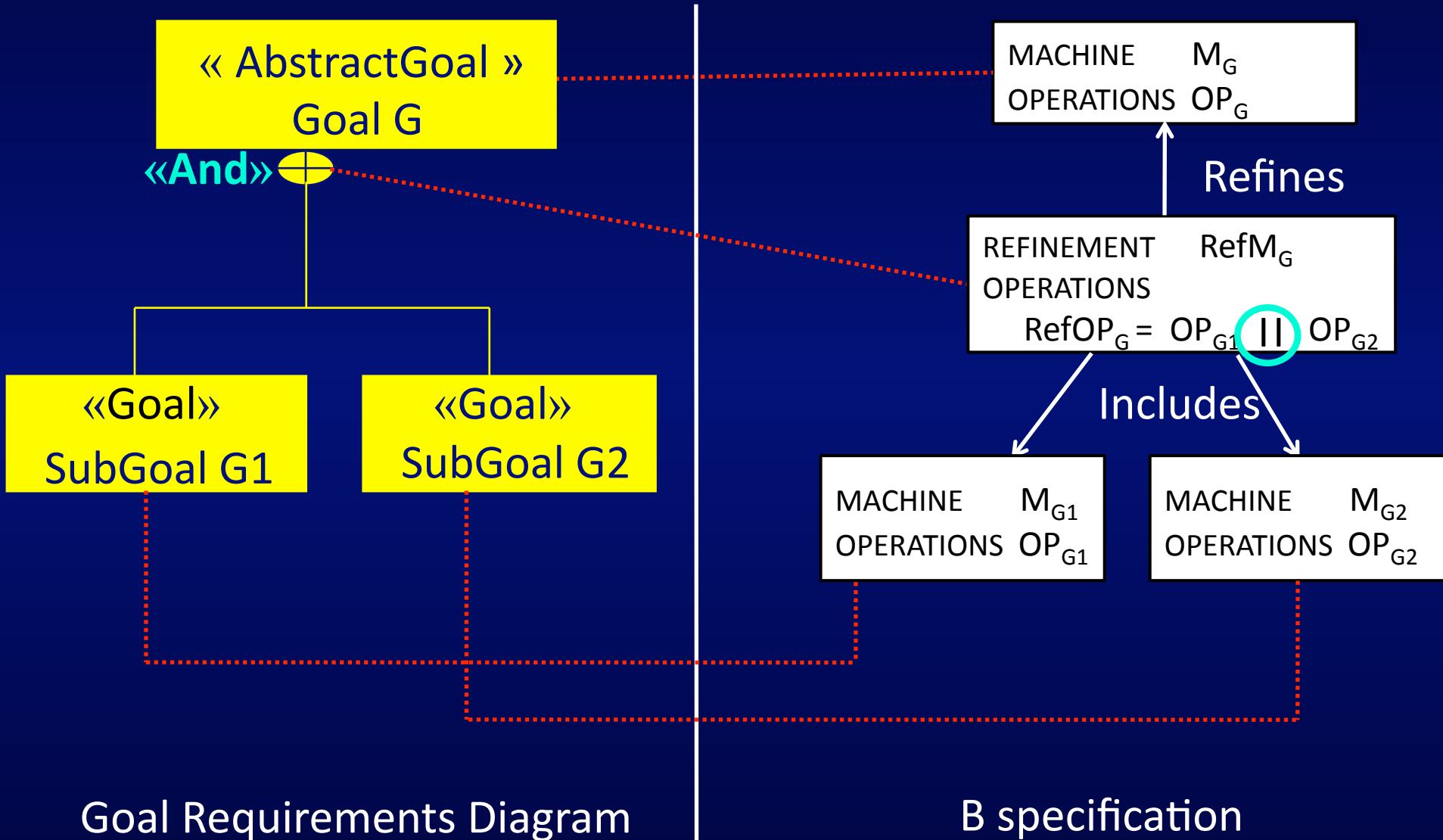
From SysML to B

Objective: deriving the architecture of B specifications from SysML goal hierarchies



OpG: the « work » to perform to reach the goal G, in terms of generalised substitutions

The AND refinement in SysML and B



Conclusion – Future Work

- **Just a first attempt ...**
 - **other KAOS concepts to be considered: non-functional goals, domain properties, ...**
 - **other RE methods concepts: scenarios, variability, ...**
- **A tool is under construction : based on the Topcased environment**