An IEC-61131-based Rule System for Integrated Automation Engineering

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Contents

- Motivation
  - Rule based engineering
  - Integrated rule based system
  - IEC-61131-based rule system
- ACPLT/RE - the IEC-61131-based rule system
- Case study: flow path monitoring
- Conclusion

Rule-based Automation System Engineering

- Wide set of automation functions bases itself on strict rules

FOR EACH **A** THERE HAS TO BE **B**

or

IF **A** HOLDS THEN **B** MUST HOLD

or

...

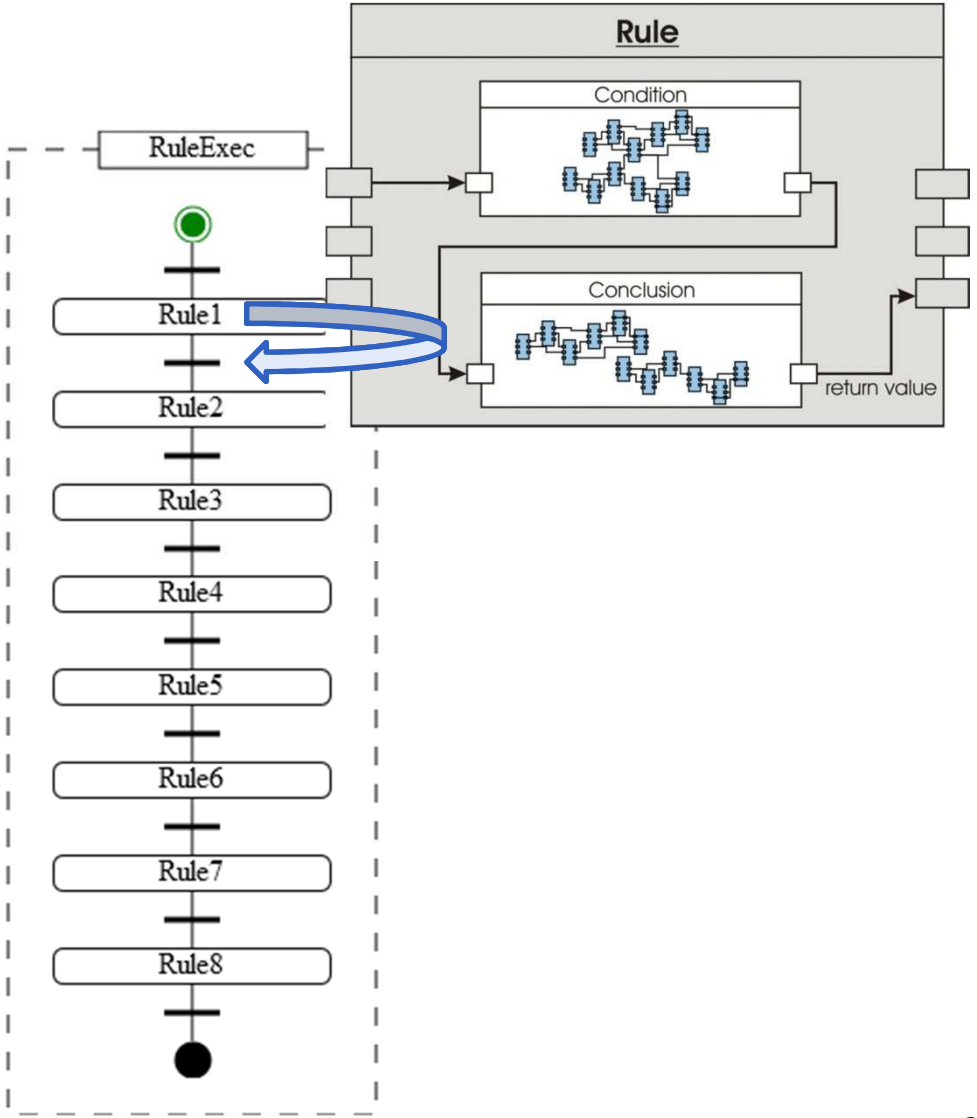
- Approaches:
  - do it by hand
  - use a rule-based system (RBS)
    - external tool
    - integrated in the automation system

Integrated Rule-based System

- Target applications: dynamic advanced automation functions
- Runtime information and context needed for the implementation
- Our approach:
  - Implement a rule-based system in the runtime environment of an automation system
  - describe the advanced functionality by means of the underlying rules
    - Dynamically usable for operation areas that are unknown at engineering time

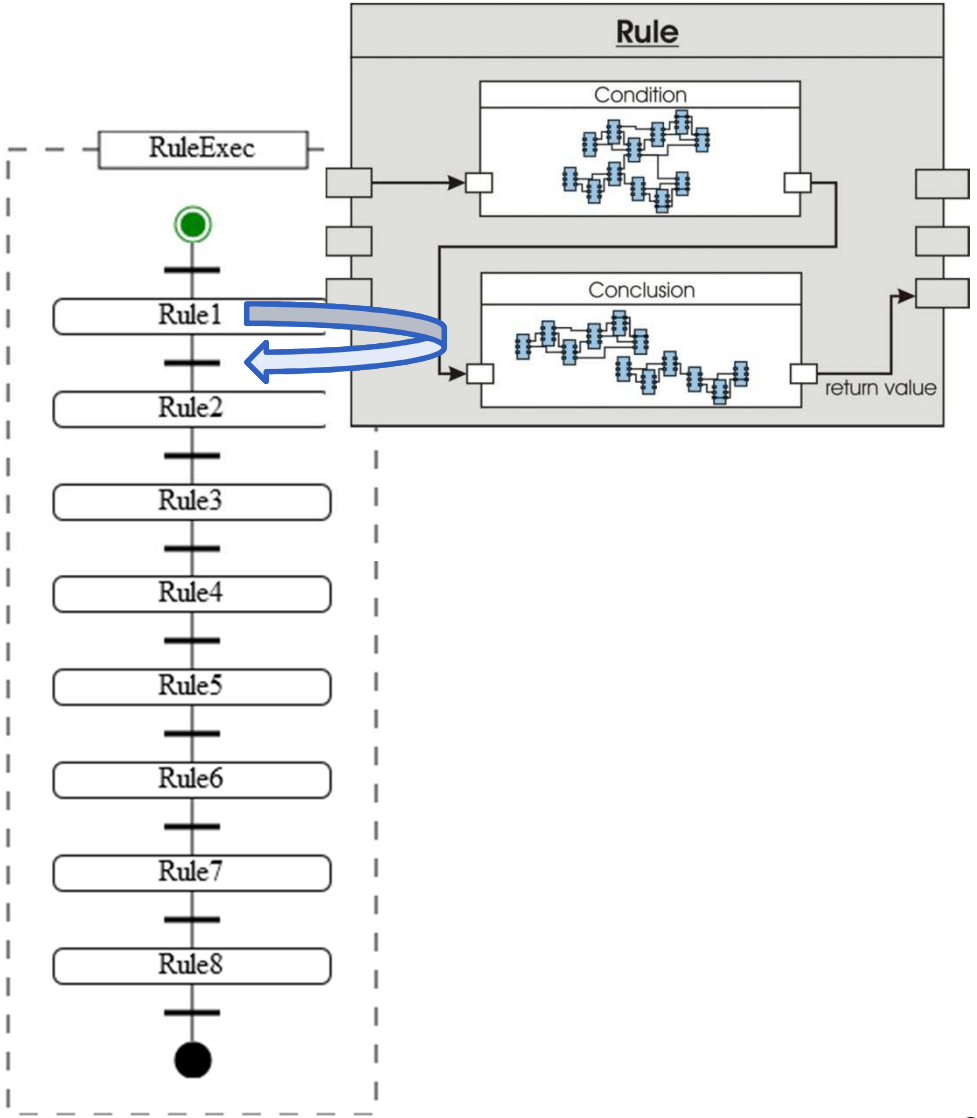
IEC-61131-based Rule System

- Standard used in most automation systems
- Well known languages for automation system engineers
- Two parts
  - Rules
  - Rule execution system



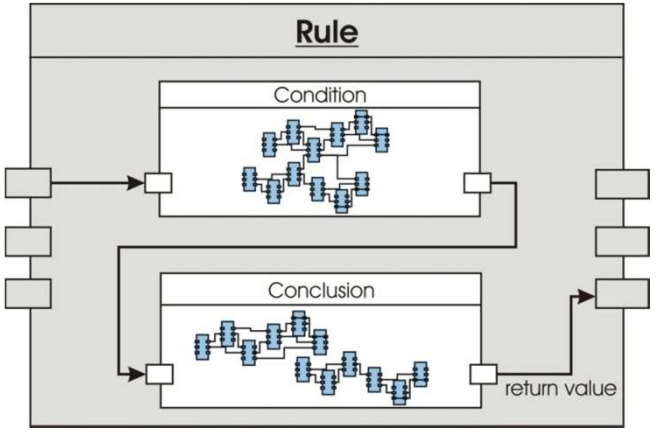
Rule execution system

- Observation: predefined sequence of engineering-steps
- SFC
- Engineer can simply add new rules to the rule execution
- Engineer can add other rule executions as a complex rule



Rule

- Requirements:
  - Automation system is organized in a graph structure (e.g. domain structure with edges between parent and children)
  - Exploration functionality available
  - getVar/ setVar available

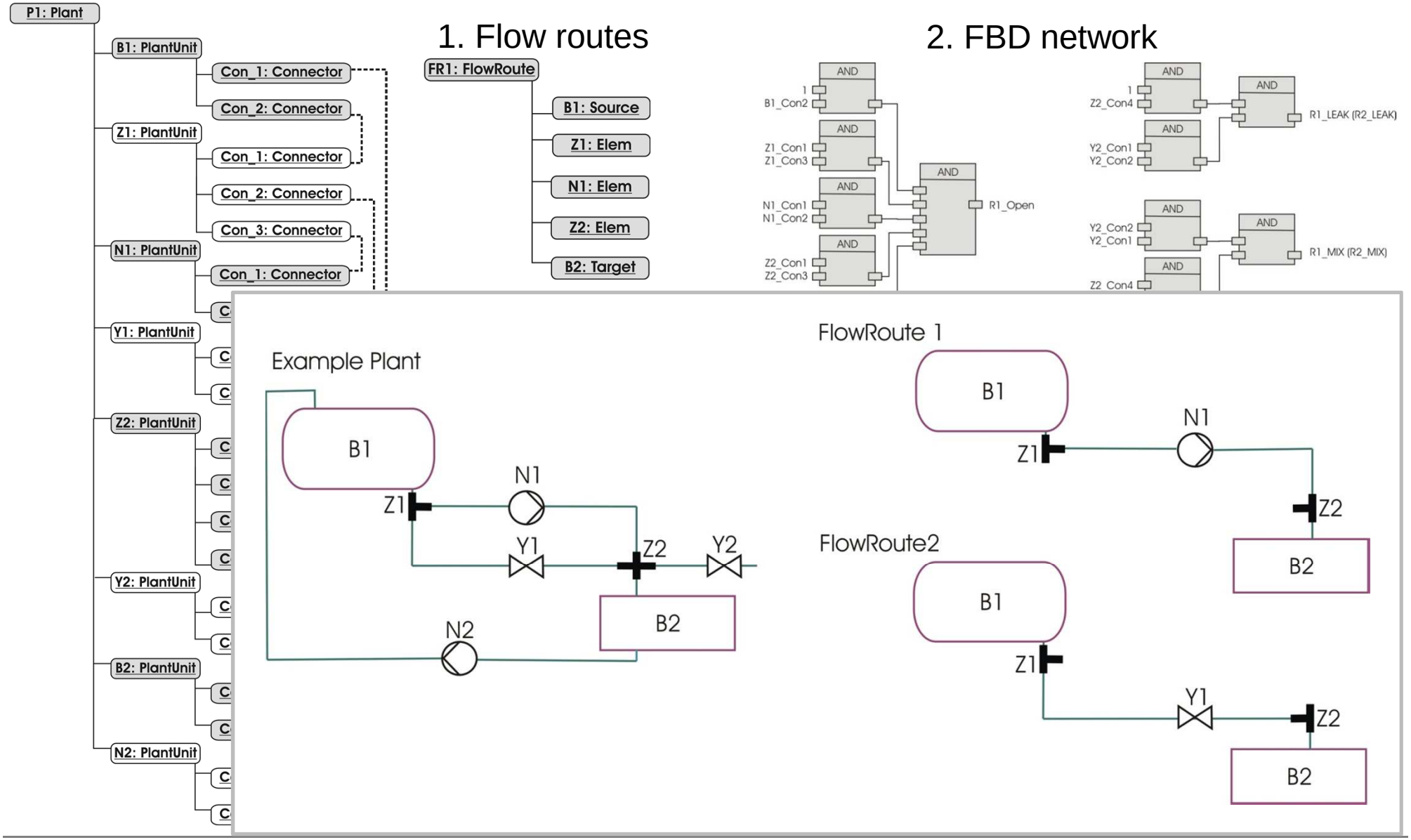


- Standard IEC 61131 function blocks or slightly extended blocks

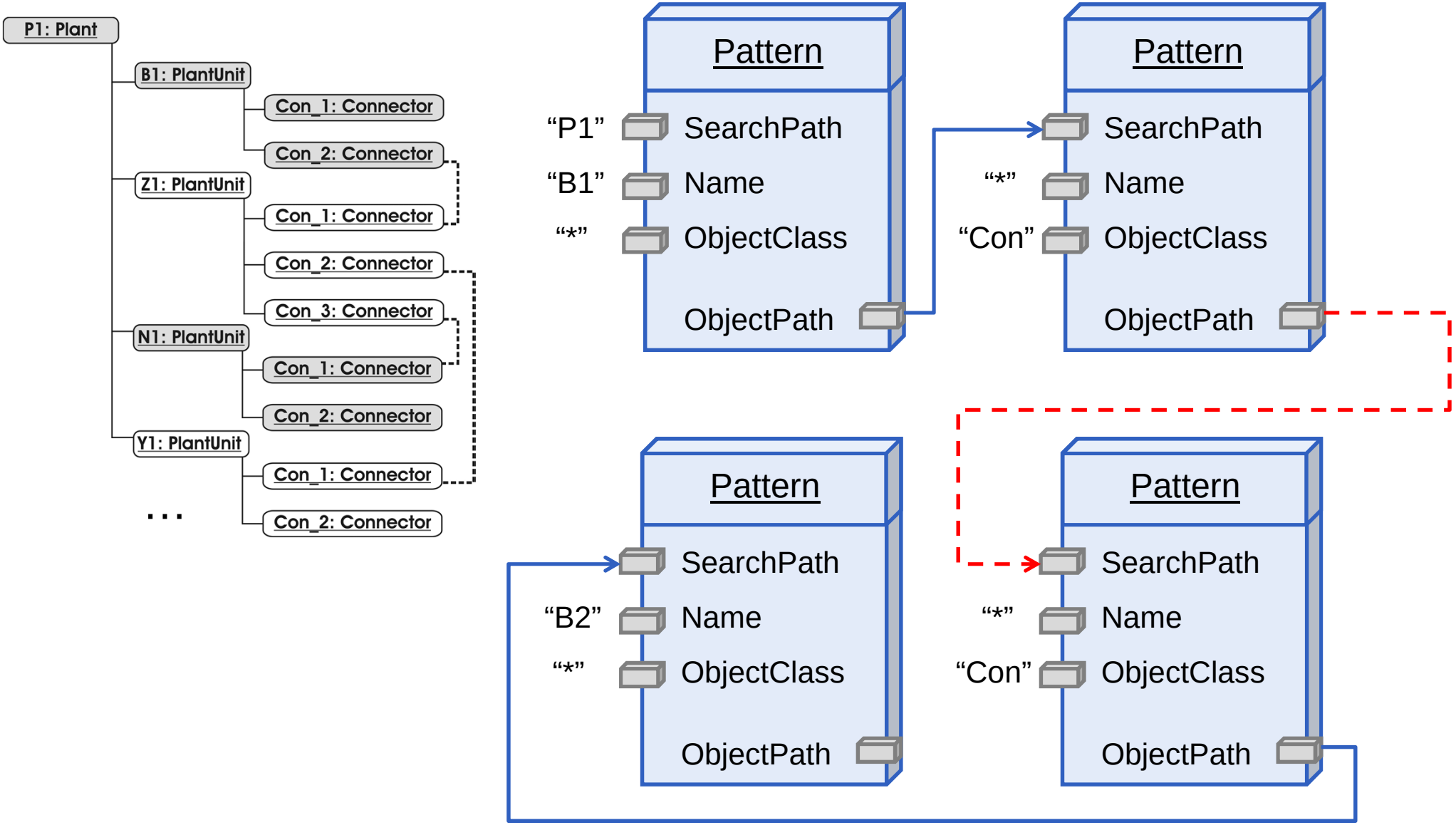
- Build up a pattern network for the source (condition) and one for the target (conclusion)

- Let condition locate occurrence of its pattern and then trigger conclusion to produce a representative of its pattern

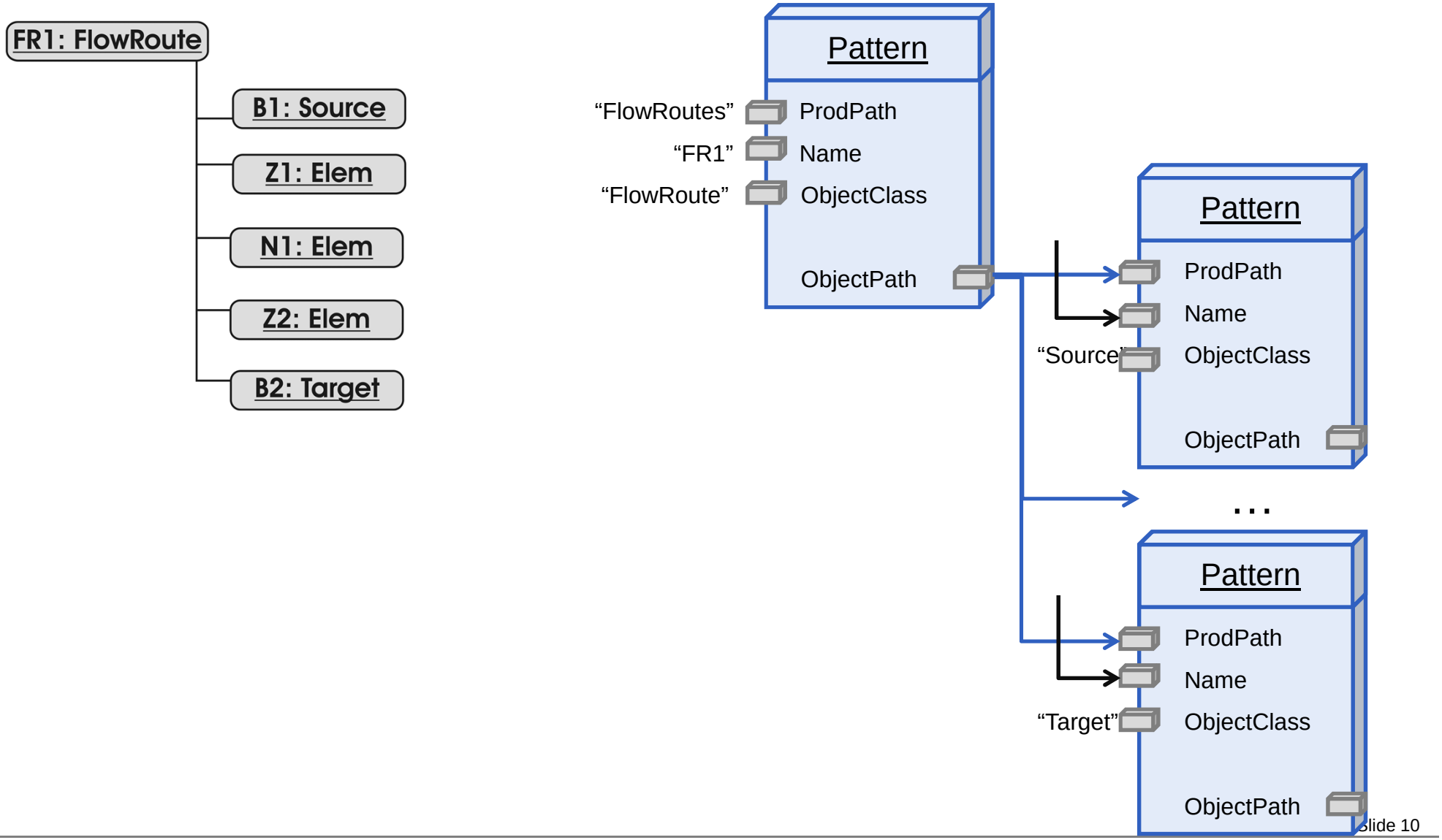
Use Case: Flow Path Monitoring



Use Case: Flow Path Monitoring (Condition)

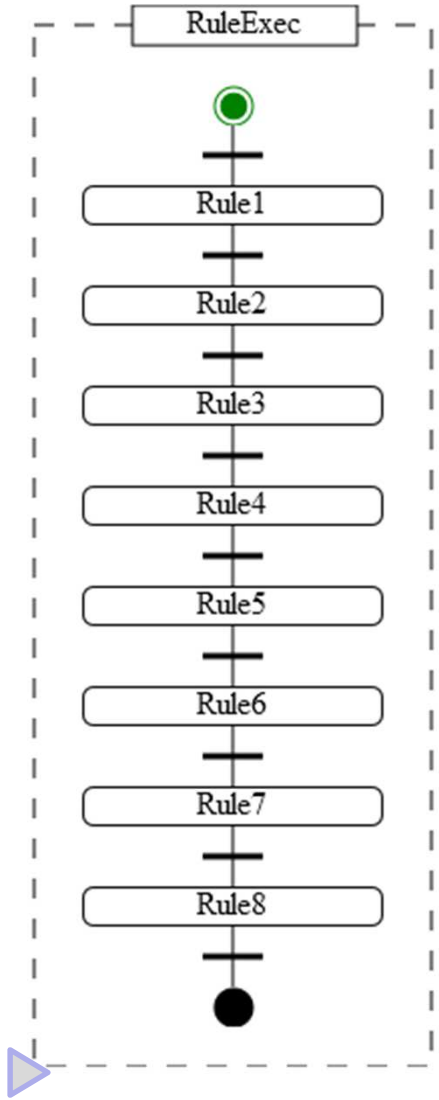


Use Case: Flow Path Monitoring (Conclusion)



Conclusion

- Blueprint implementation instead of repetitive implementation by hand
- Formal description/ representation of the rules
- Reusability of automation functions without reconfiguration
- Useful for dynamically changing contents
- Formulated in the native language of automation system engineers



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