

# Integrating Executable Requirements in Prototyping

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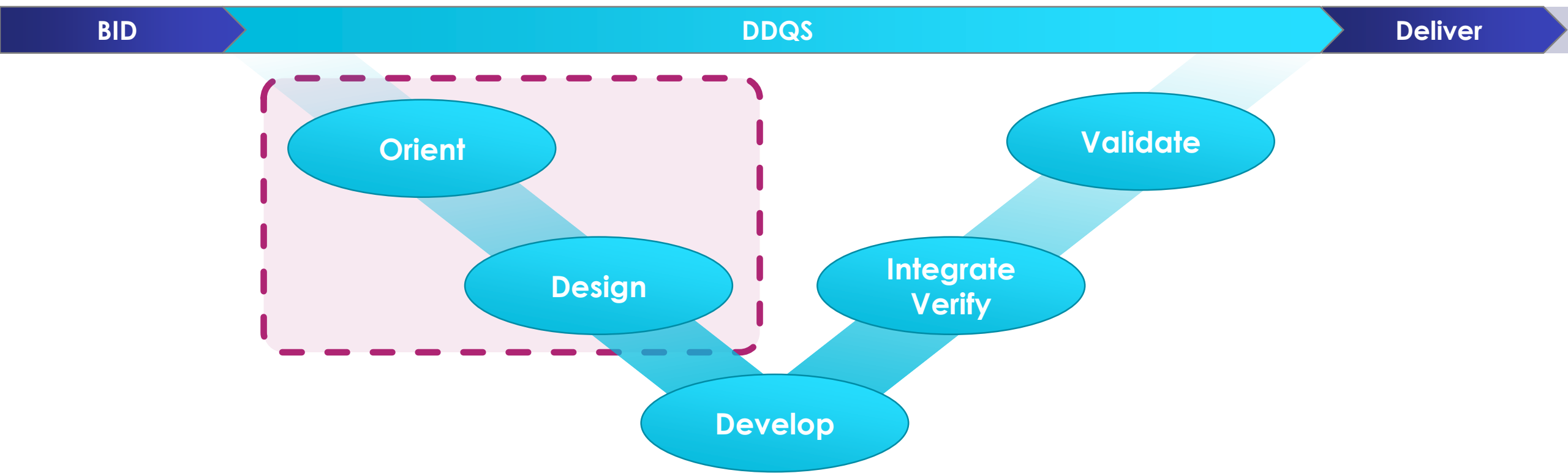
> Context

> Issue

> Proposal

> Conclusion

# Project Lifecycle at Thales



# Different Teams working together

## > System Engineering

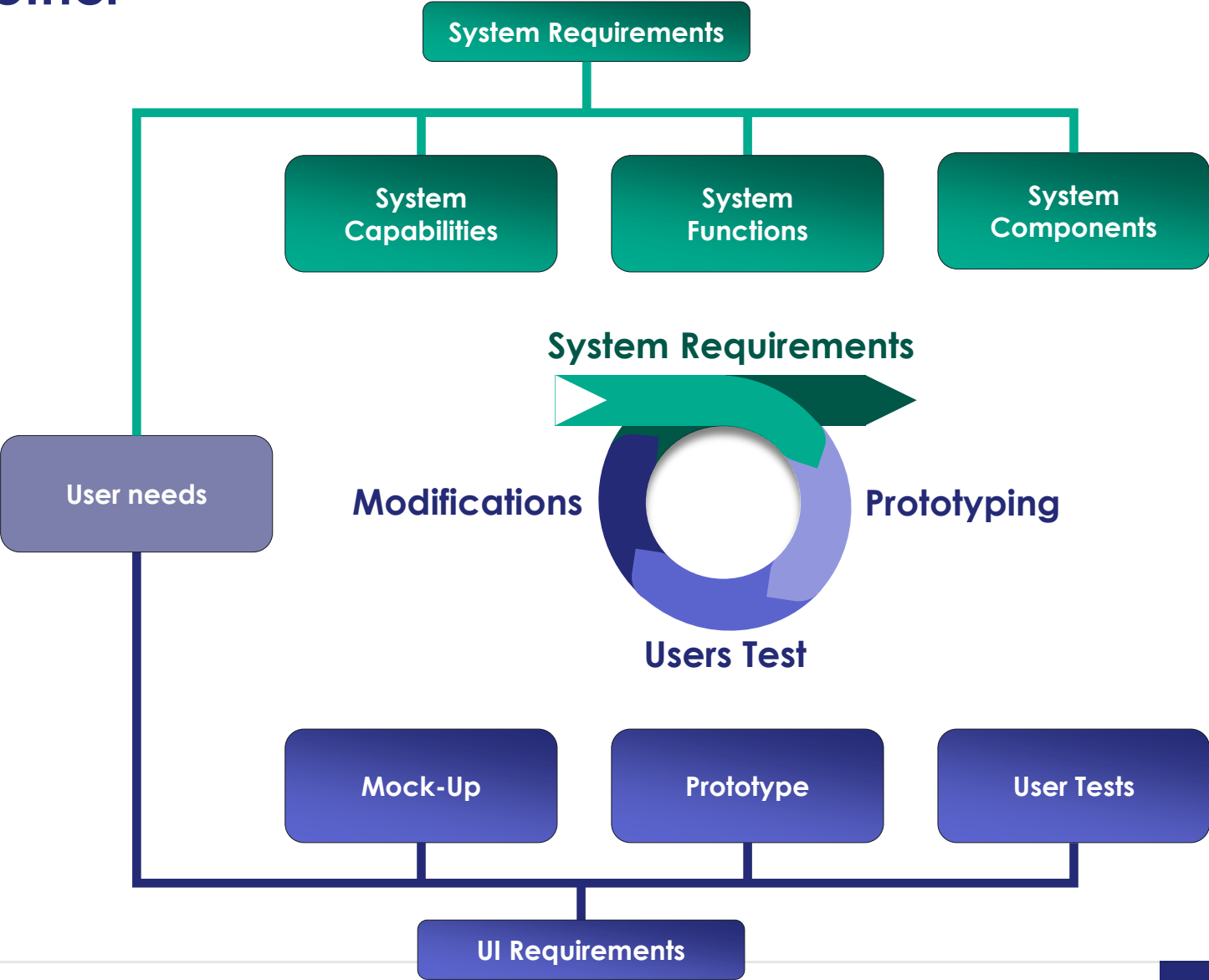
- **Definition** - The interdisciplinary approach governing the total technical effort required to transform a requirement into a system solution.

Source: Thales

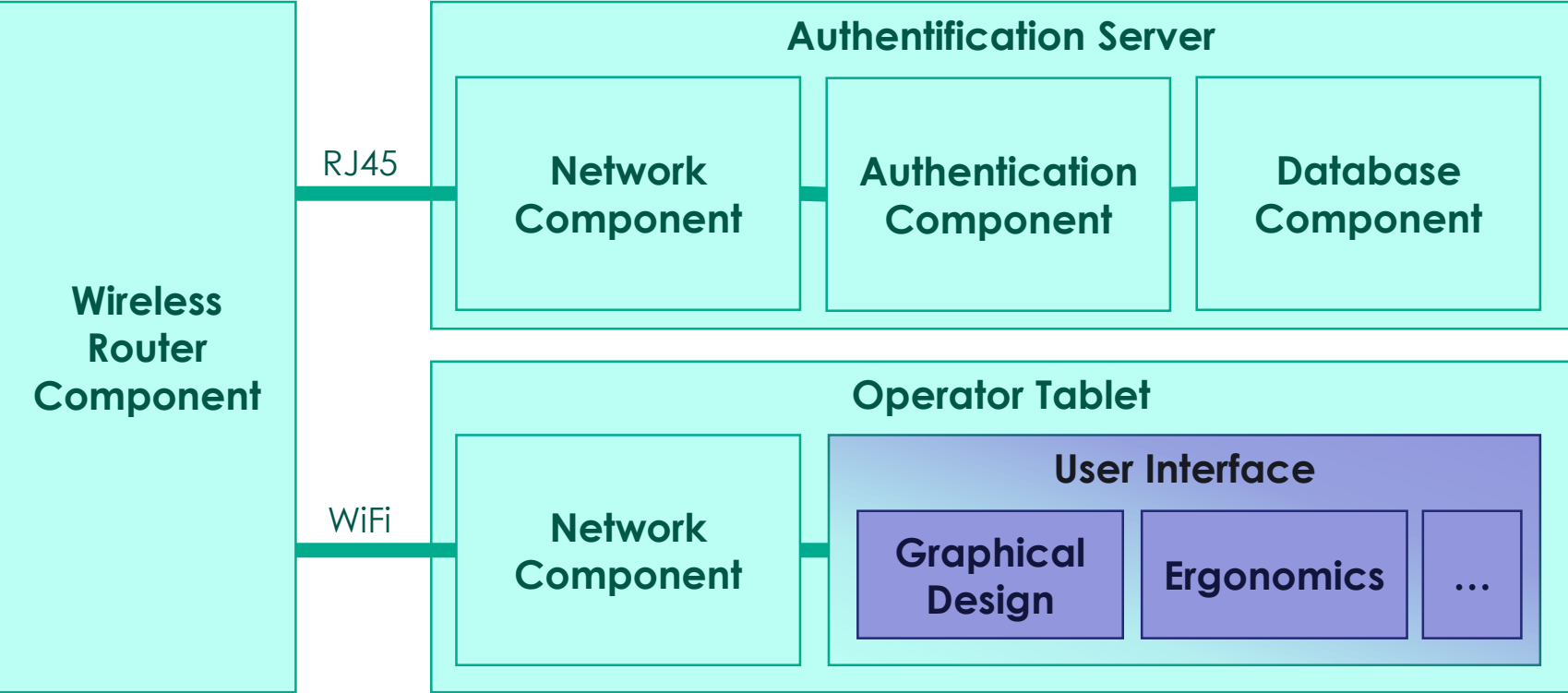
## > User Experience

- **Definition** - Person's perceptions and responses that result from the use or anticipated use of a product, system or service

Source: ISO 24765 et Thales



# An example



**SYS** System Engineering

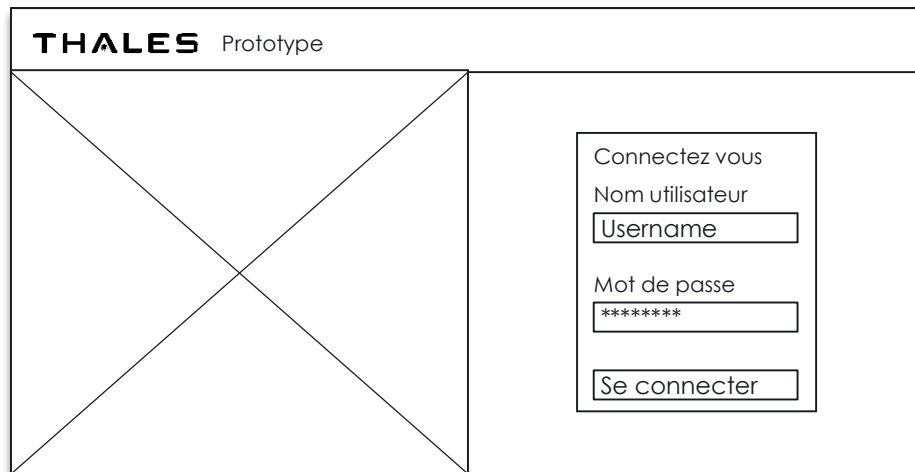
**UX** UX Engineering

# A prototype to specify the User Interfaces

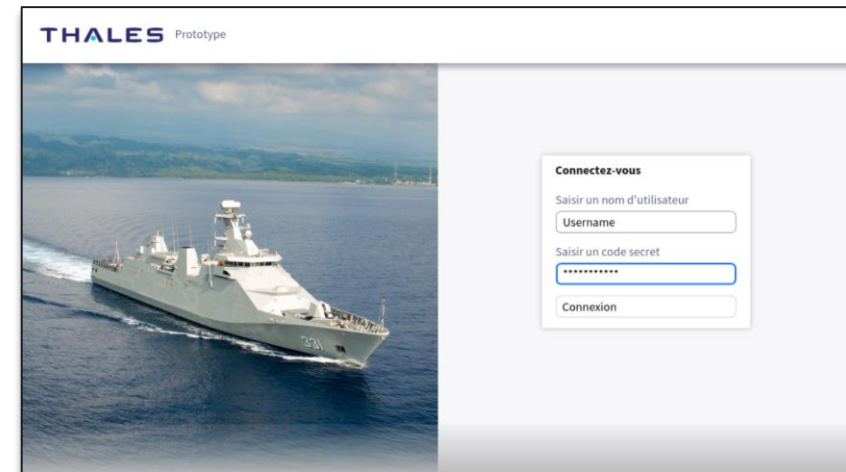
## > Prototype

- ▶ Preliminary type, form, or instance of a system that serves as a model for later stages or for the final, complete version of the system.
- ▶ **A prototype is used to get feedback from users for improving and specifying a complex human interface, for feasibility studies, or for identifying requirements.**

– Definition ISO 24765



Low Fidelity (LoFi) : WireFrames, Mock-Ups



High Fidelity (HiFi) : Dynamic Prototypes

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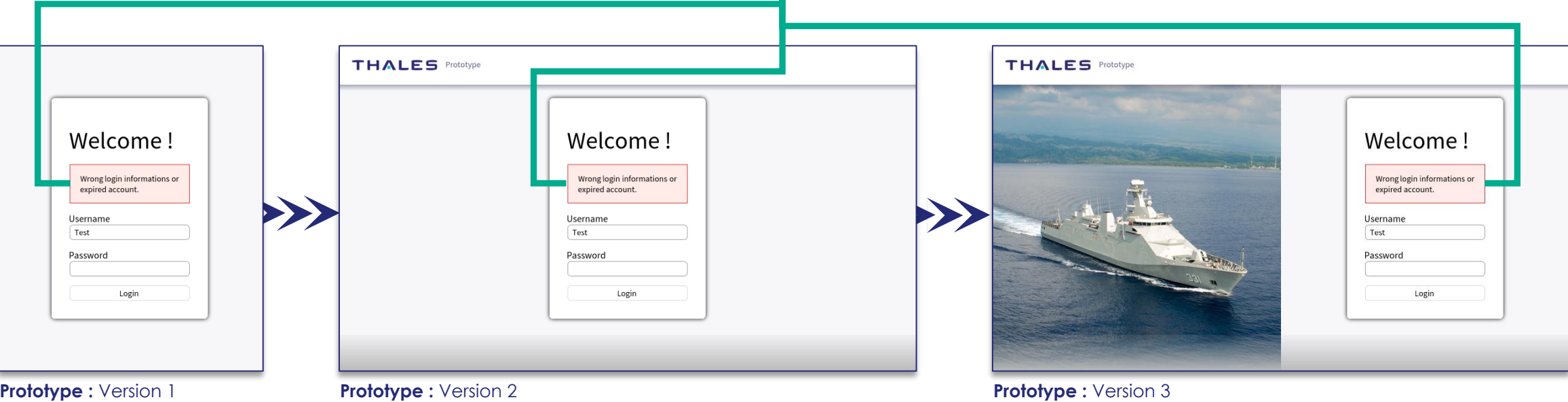
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# Avoid regression on requirements

**System Requirement**

The UI must display an error message in case of an invalid login.





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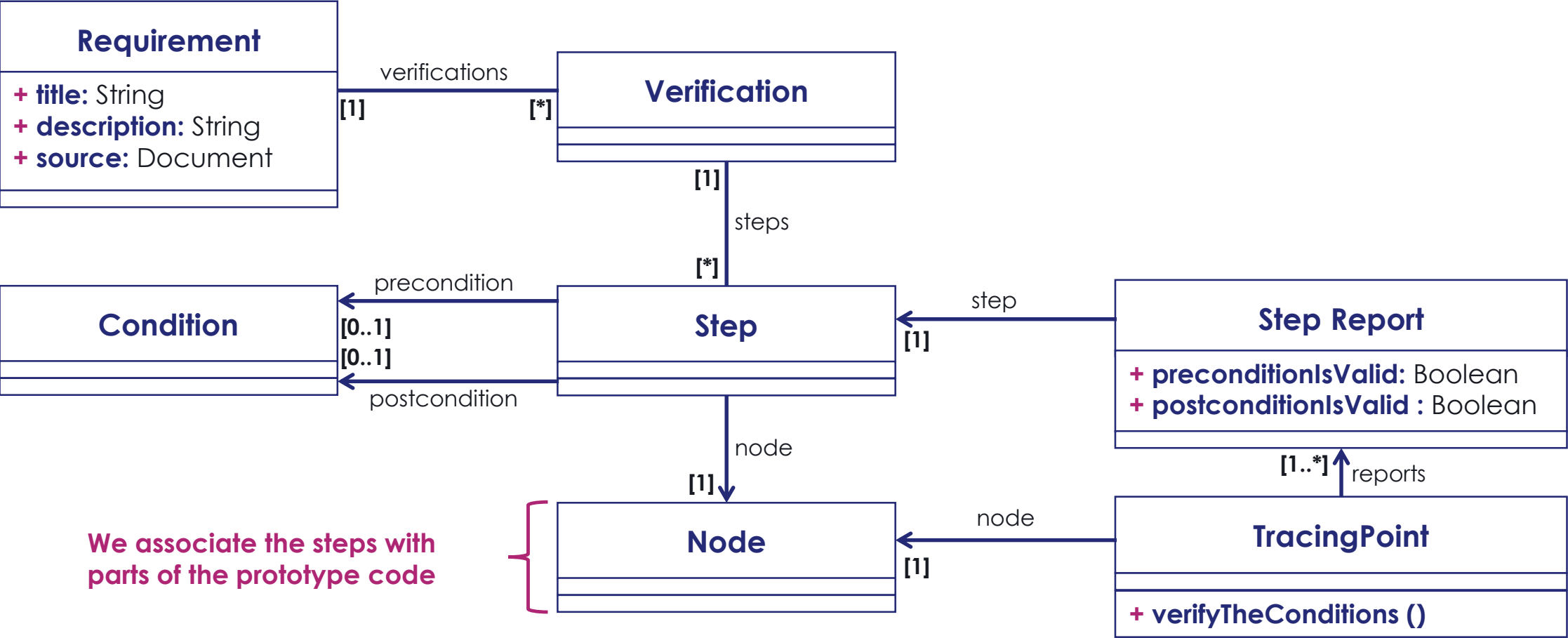
> Context

> Issue

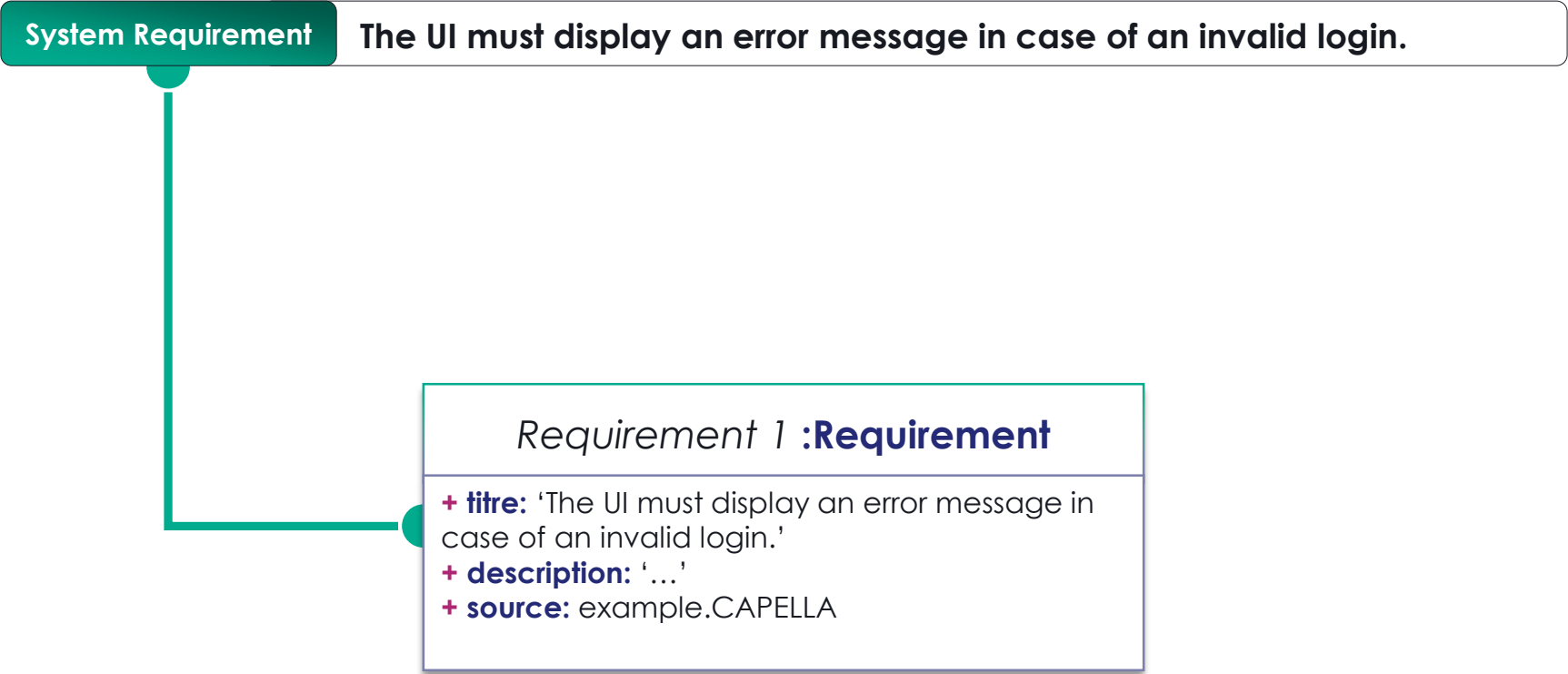
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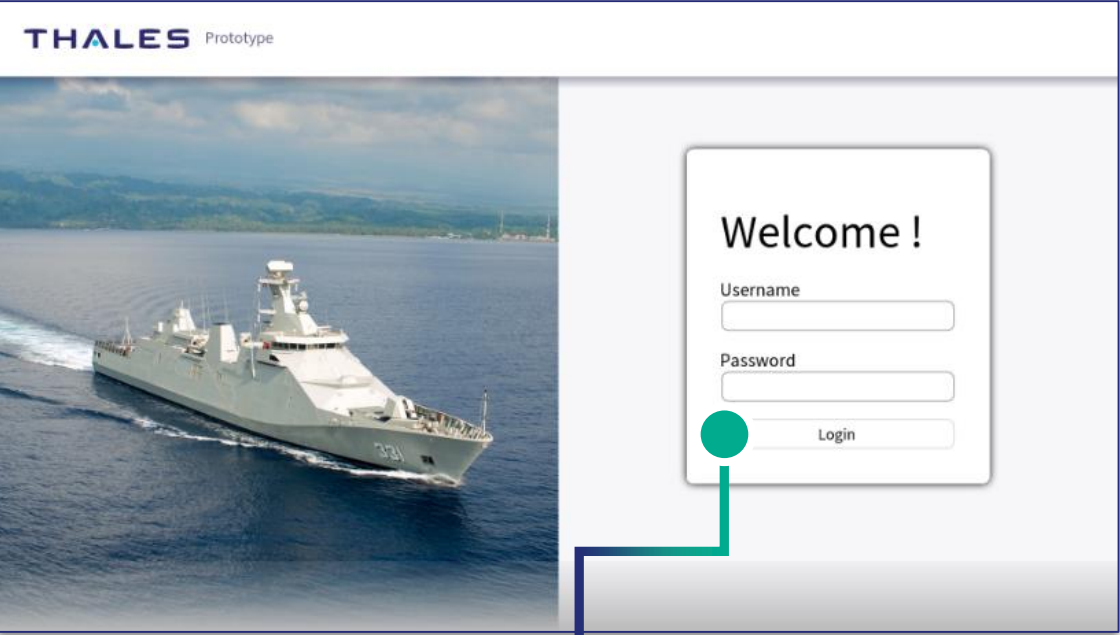
# Meta-model



# Link the requirements to the prototype (1/3)



# Link the requirements to the prototype (2/3)



Requirement 1 :Requirement

+ titre:

'The UI must display an error message in case of an invalid login.'

+ description:

'...'

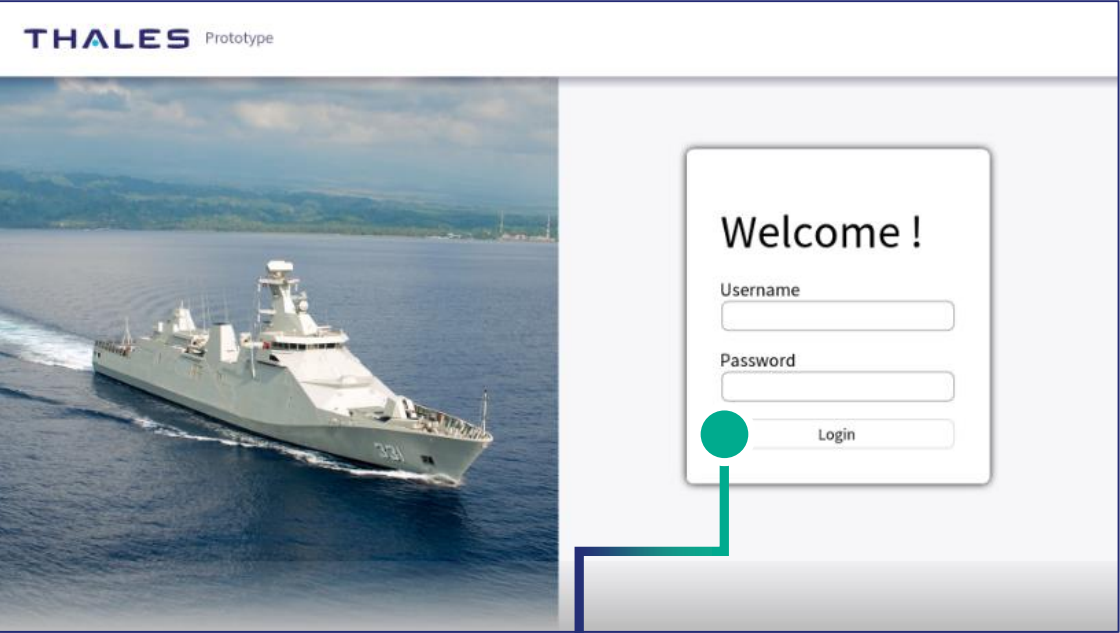
+ source:

example.CAPELLA

```
1 loginButtonAction
2
3   | simulationResult |
4   simulationResult := simulation
5     canAuthenticateUsername: self username
6     password: self password.
7   simulationResult
8     ifTrue: [ self validateLogin ]
9     ifFalse: [ self refuseLogin ]
10
```

- Verification of the login information
- The login information is valid
- The login information is not valid

# Link the requirements to the prototype (3/3)



```
1 loginButtonAction
2
3 | simulationResult |
4 simulationResult := simulation
5   canAuthenticateUsername: self username
6   password: self password.
7 simulationResult
8   ifTrue: [ self validateLogin ]
9   ifFalse: [ self refuseLogin ]
10 |
```

+ node

The login information is not valid

## Exigence 1 :Exigence

- + titre: 'The UI must display an error message in case of an invalid login.'
- + description: '...'
- + source: example.CAPELLA

## \_ :Verification

## \_ :Step

- + precondition: 'The error is not visible'
- + postcondition: 'The error is visible'

# Create, Install and Visualize TracingPoints

Installation of TracingPoint

List of requirements

Description

List of verifications and steps

Repository Report

Requirement Report

Step Report (1/1)

- Status of Step Reports
- Targeted node
- Precondition
- Postcondition

# Demo (1/2)

THALES Prototype

Repository Report

Pragma: ExReqToploExample

Inspect Repository

Install

Remove

Title

Person shall send "preliminary i

Authentication app shall send

database shall send "error" to A

Requirement Report

Title: database shall send "error" to Authentication app

Document: an ExReqCapellaDocument

Descripton

The component named "database"[a29b6cea-941d-416a-b6c0-818e73a84368] in the function "Verify Identity in database"[95bc149e-bce3-42fe-8d8f-7a4f123dea05] transmit "error"[141c2297-10ac-4e90-82c4-83fc9c7b3b14] to the component named "Input Identity UI"[300a7f2b-c0d2-48cd-854b-d9a8fcbadc24] in the function "Authentication app"[d68548ae-78af-44d6-85de-b5e5229541b5]

Verifications

Class

verif

step

Step Report (1/1)

ExReqToploLoginApplication >> #loginButtonAction

1 loginButtonAction

2

3 | simulationResult |

4 simulationResult := simulation

5 canAuthenticateUsername: self

6 username

7 password: self password.

8 simulationResult

9 ifTrue: [ self validateLogin ]

10 ifFalse: [ self refuseLogin ]

11

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18 withPrecondition: [ :obj |

19 obj card

20 isLoginStatusContainerVisible not ]

21 withPostcondition: [ :obj |

22 obj card

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Welcome !

Username

Password

Login



# Demo (2/2)

Repository Report

Pragma: ExReqToploExample

Inspect Repository

Install

Remove

Title

Person shall send "preliminary

Authentication app shall send

database shall send "error" to /

Requirement Report

Title: database shall send "error" to Authentication app

Document: an ExReqCapellaDocument

Description

The component named "database"[a29b6cea-941d-416a-b6c0-818e73a84368] in the function "Verify Identity in database"[95bc149e-bce3-42fe-8d8f-7a4f123dea05] transmit "error"[141c2297-10ac-4e90-82c4-83fc9c7b3b14] to the component named "Input Identity UI"[300a7f2b-c0d2-48cd-854b-d9a8fcbadc24] in the function "Authentication app"[d68548ae-78af-44d6-85de-b5e5229541b5]

Verifications

Class

verif

step

Untitled window

Step Report (1/1)

ExReqToploLoginApplication >> #loginButtonAction

loginButtonAction

simulationResult |

simulationResult := simulation

canAuthenticateUsername: self

username

password: self password.

simulationResult

ifTrue: [ ^ self validateLogin ]

ifFalse: [ ^ self refuseLogin ]

Precondition

withPrecondition: [ :obj |

obj card

isLoginStatusContainerVisible not ]

withPostcondition: [ :obj |

isLoginStatusContainerVisible not ]

withPostcondition: [ :obj |

obj card

isLoginStatusContainerVisible ] ];

yourself

Welcome !

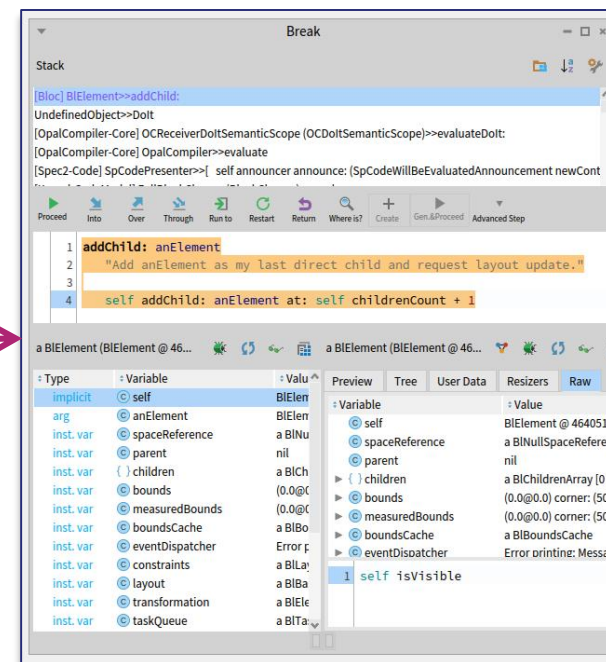
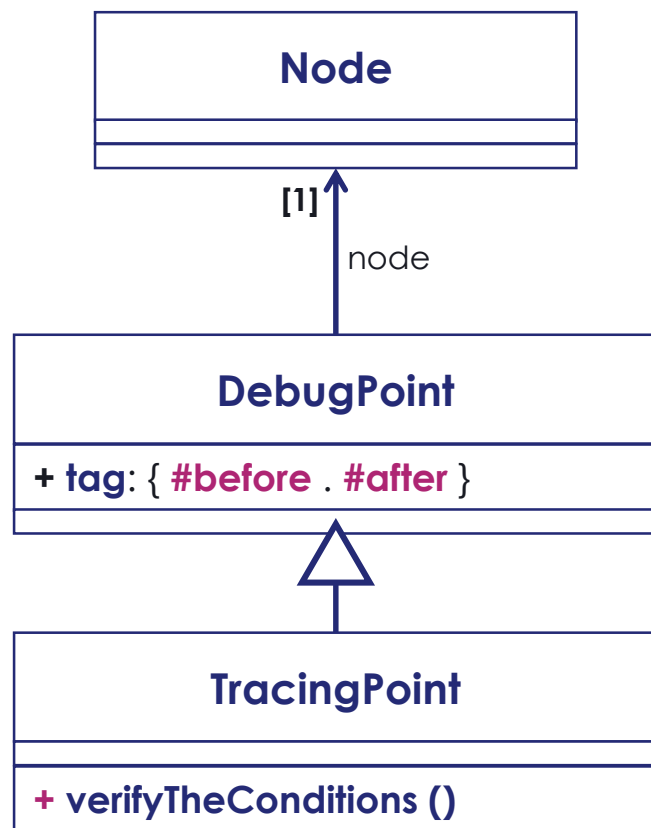
Username

Password

Login



# The DebugPoint System



- ▶ Verify the precondition (with the tag **#before**)
- ▶ Verify the postcondition (with the tag **#after**)
- ▶ Produce a step report

# Handling non-local return and unwinding exceptions (1/2)

## > Nominal Case

- The precondition is executed
- The node refuseLogin is executed
- The postcondition is executed

### loginButtonAction

```
| simulationResult |
simulationResult := simulation
  canAuthenticateUsername: self username
  password: self password.
simulationResult
  ifTrue: [ self validateLogin ]
  ifFalse: [ self refuseLogin ]
```

## > Handling of non local returns

- The precondition is executed
- The node refuseLogin is executed
- **The method return**
- The postcondition is **not** executed

### loginButtonAction

```
| simulationResult |
simulationResult := simulation
  canAuthenticateUsername: self username
  password: self password.
simulationResult
  ifTrue: [ self validateLogin ]
  ifFalse: [
    [
      self refuseLogin.
      ^ self ] value ]
```

## > Handling of exceptions

- The precondition is executed
- The node refuseLogin is executed
- **The Error is signaled**
- The postcondition is **not** executed

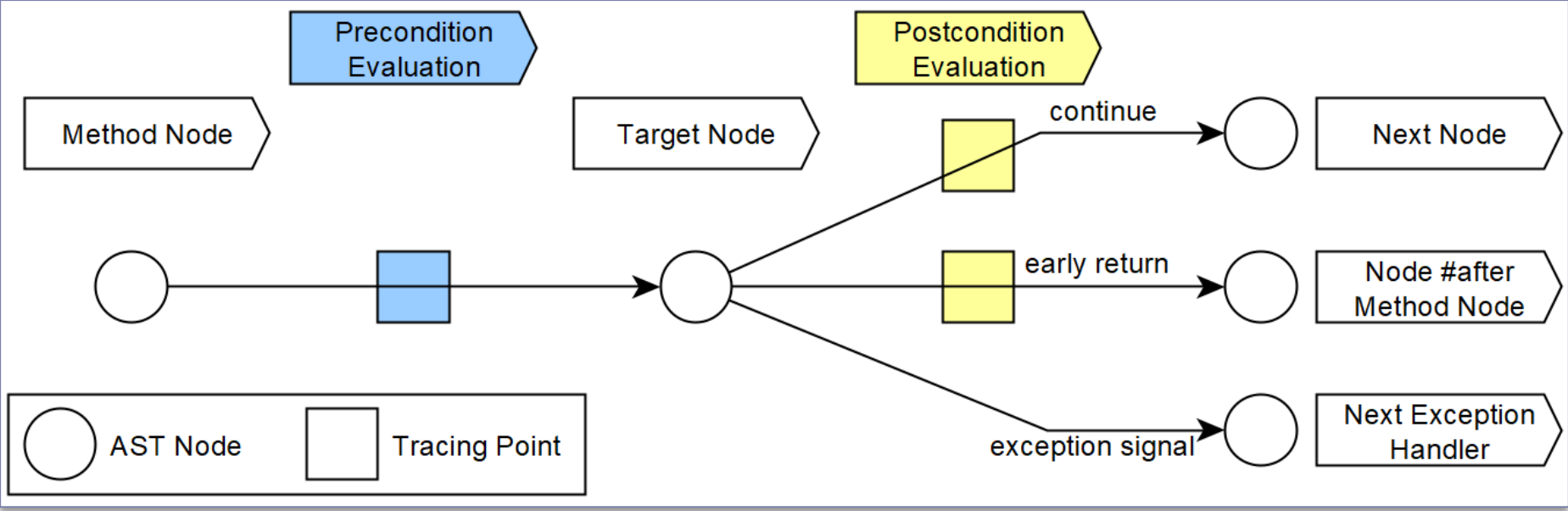
### loginButtonAction

```
| simulationResult |
simulationResult := simulation
  canAuthenticateUsername: self username
  password: self password.
simulationResult
  ifTrue: [ self validateLogin ]
  ifFalse: [ self refuseLogin ]
```

### refuseLogin

Error signal: 'Wrong login information'

# Handling non-local return and unwinding exceptions (2/2)



> The exceptions are currently not handled

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# Conclusion

- > Integrating Executable Requirements in Prototyping
- > Tool to install the TracingPoint in the code
- > Futur Works:
  - Testing the solution on industrial prototypes
  - Generalize to other models beyond System models
  - Track the evolution of requirements over time