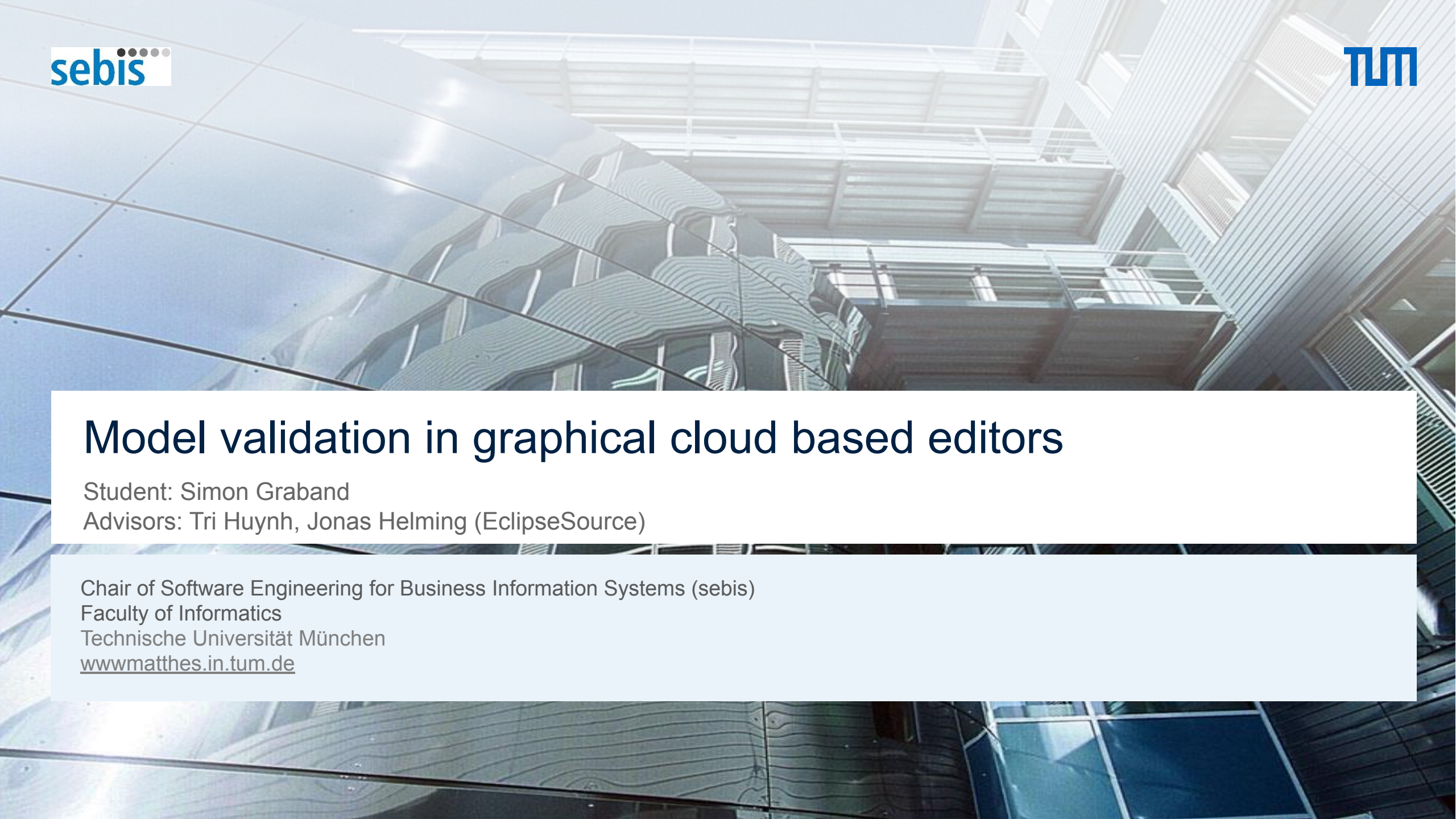

Model validation in graphical cloud based editors

Student: Simon Graband
Advisors: Tri Huynh, Jonas Helming (EclipseSource)

Chair of Software Engineering for Business Information Systems (sebis)
Faculty of Informatics
Technische Universität München
wwwmatthes.in.tum.de

Outline

Motivation

Research Questions

Proposed Solution

Live Demo

Evaluation

Outlook

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Motivation

for cloud-based tools

Advantages:

- zero installation time
- portability
- scalability

for model validation

Advantages:

- less errors
- faster error fixing
- more consistent models

A solution to enable model validation in the cloud

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Research Questions

1. **What are the existing solutions for constraint validation?**
   - *Literature Research*

2. **How can those solutions be applied to a cloud-based tool?**
   - *Architecture Proposal*

   2.1. **How to execute and visualize model validation in a client server architecture?**
   - *Split Validation between Client and Server*

3. **What user benefits can be measured with a case study?**
   - *CMMN-Editor as Proof of Concept, User Study*

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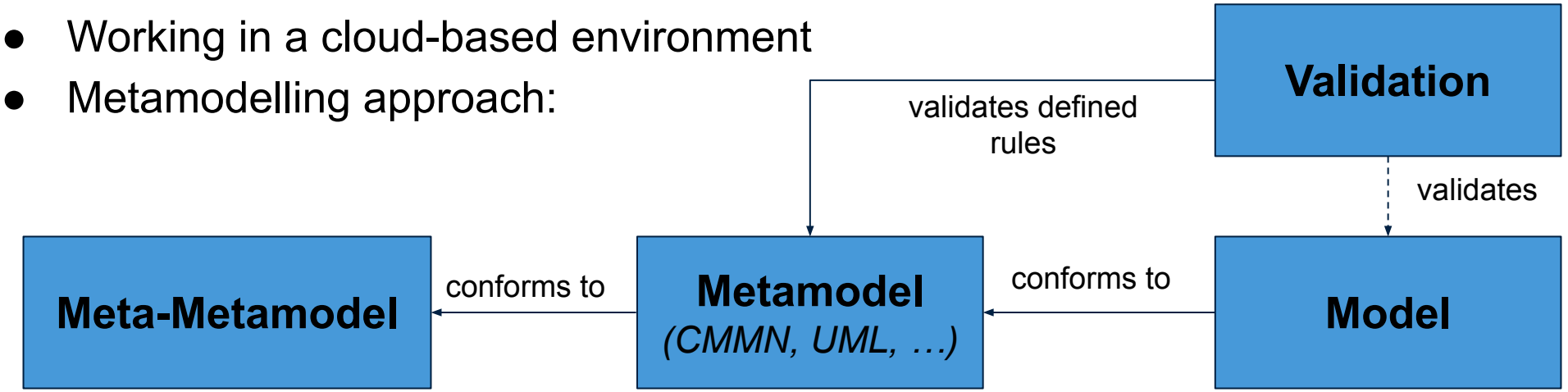
Proposed Solution - Background

- Working in a cloud-based environment
- Metamodelling approach:



- All information stored in metamodel
  - Features of the language
  - Connections between the features
  - **All constraints (correct naming, nesting rules, …)**
- **Generic Solution working for every language with a metamodel**

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Proposed Solution - Existing Solutions

Eclipse Modelling Framework (EMF)

- Metamodelling language Ecore
- Define Constraints via Multiplicity, Facets, ...
- Validate EMF models

Graphical Language Server Platform (GLSP)

- Communication between Client and Server
- Client handles the representation
- Server handles the logic
- Offers useful functionalities

Eclipse Theia

- Extensible cloud-based IDE
- Eases Client implementation

Modelserver

- Synchronize different views
- Update & subscribe to the model
- Centralized model management

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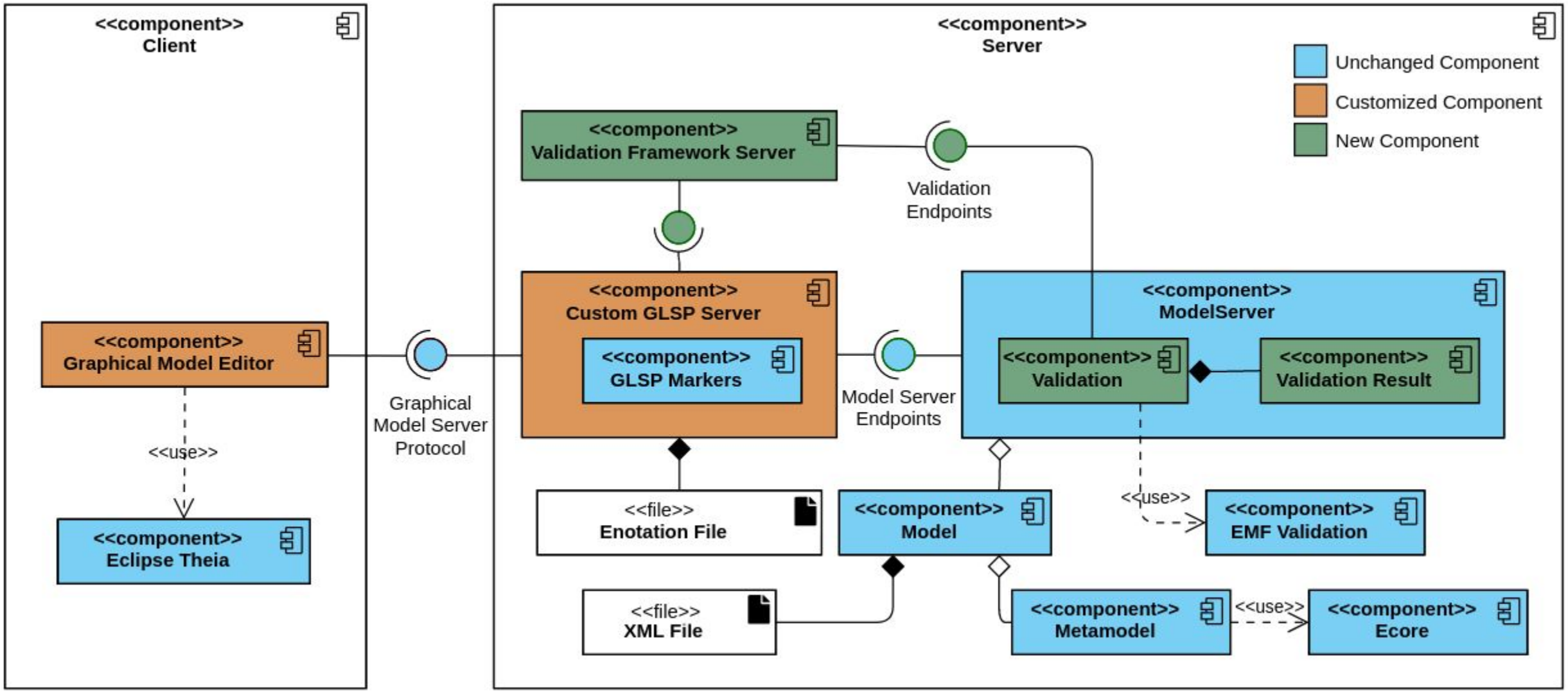
Proposed Solution - Architecture



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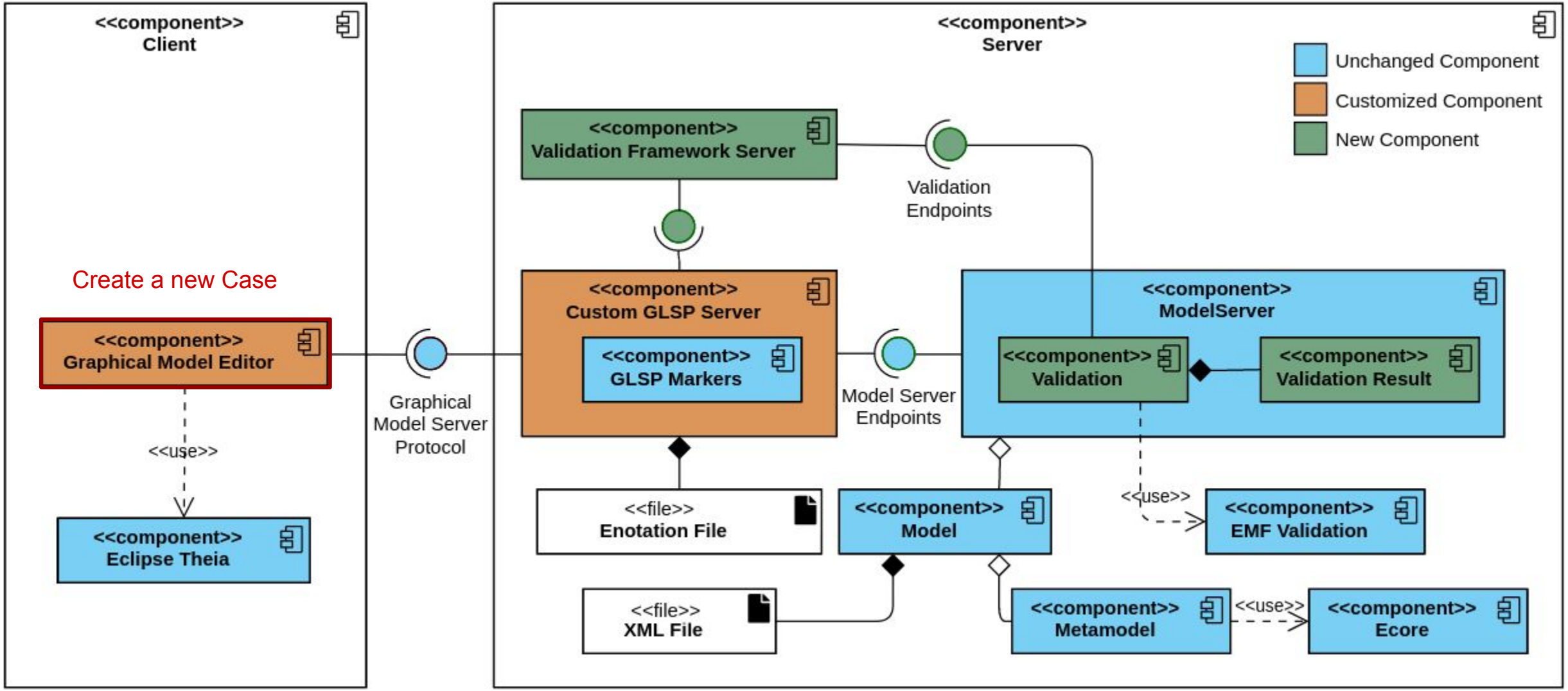
Proposed Solution - Architecture



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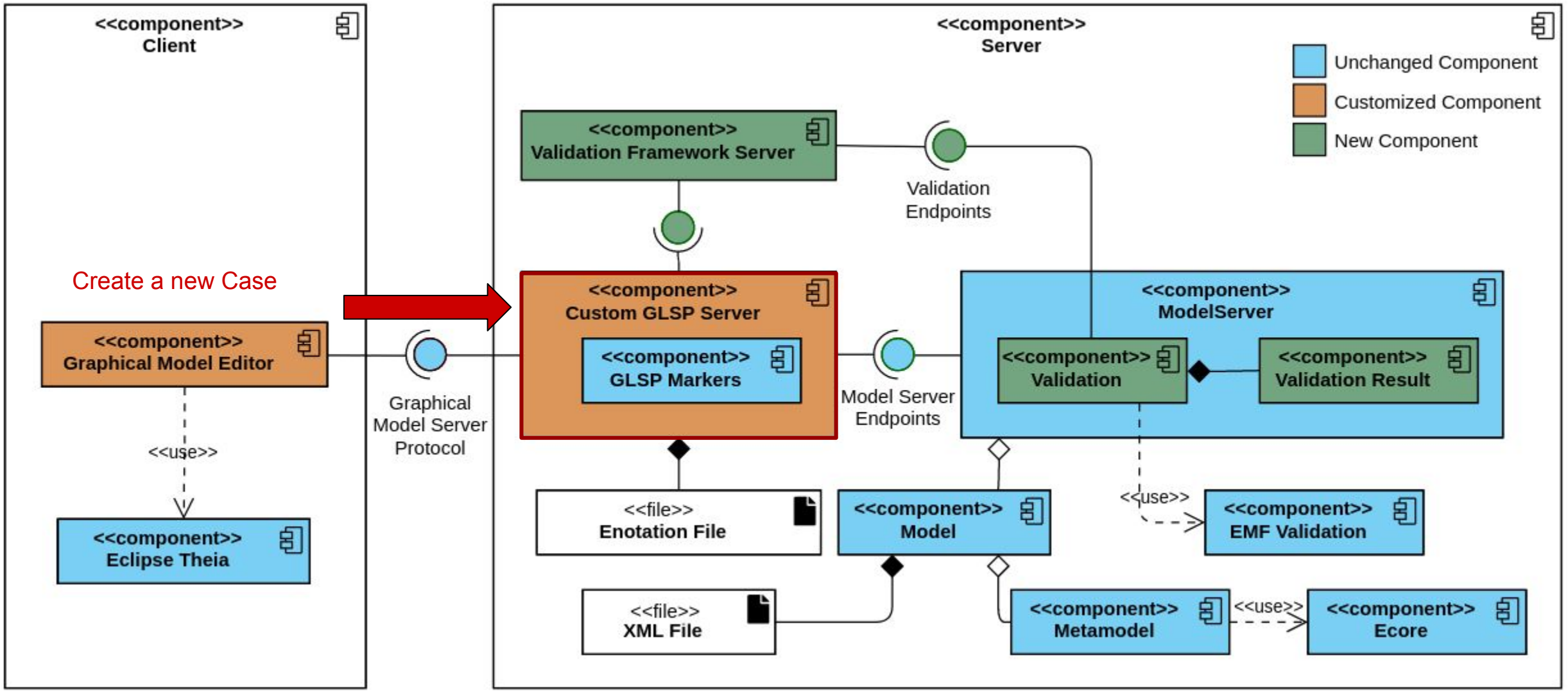
Proposed Solution - Architecture



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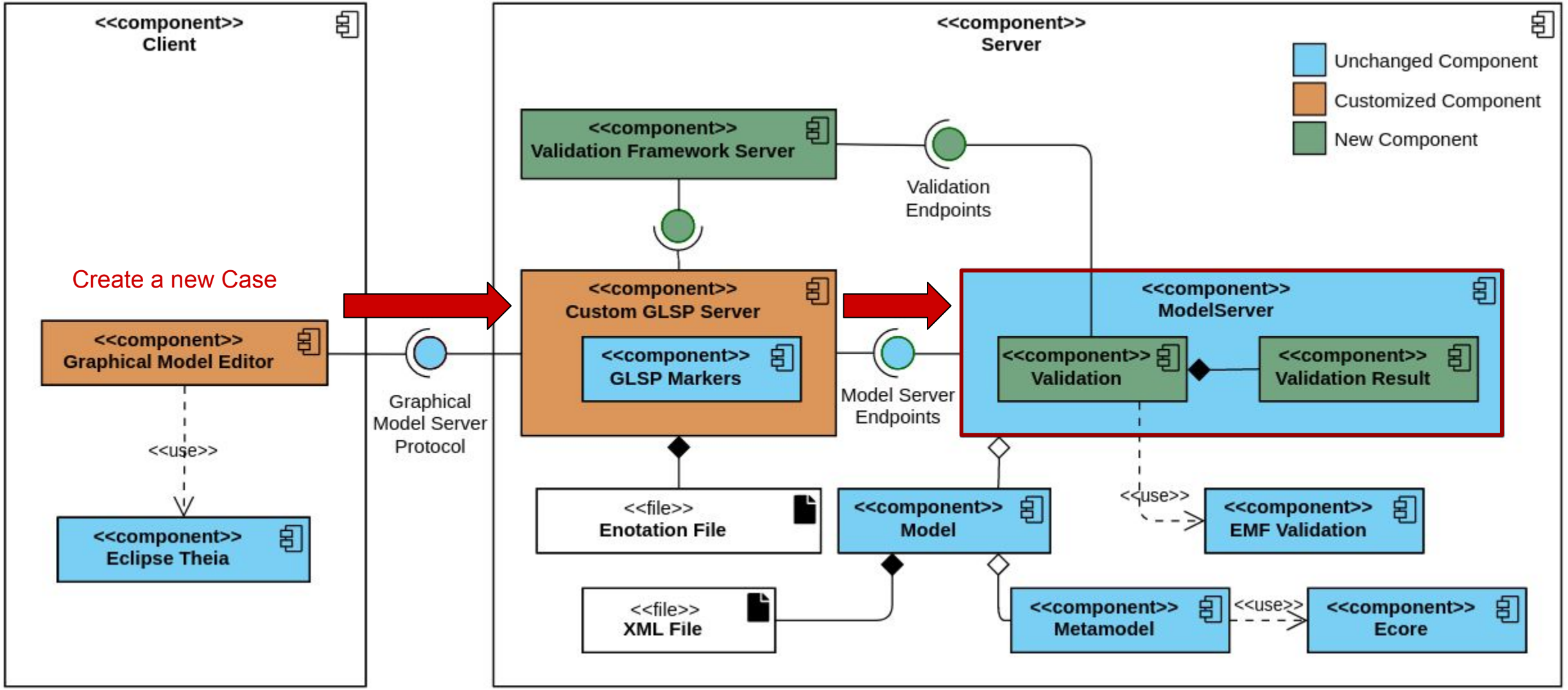
Proposed Solution - Architecture



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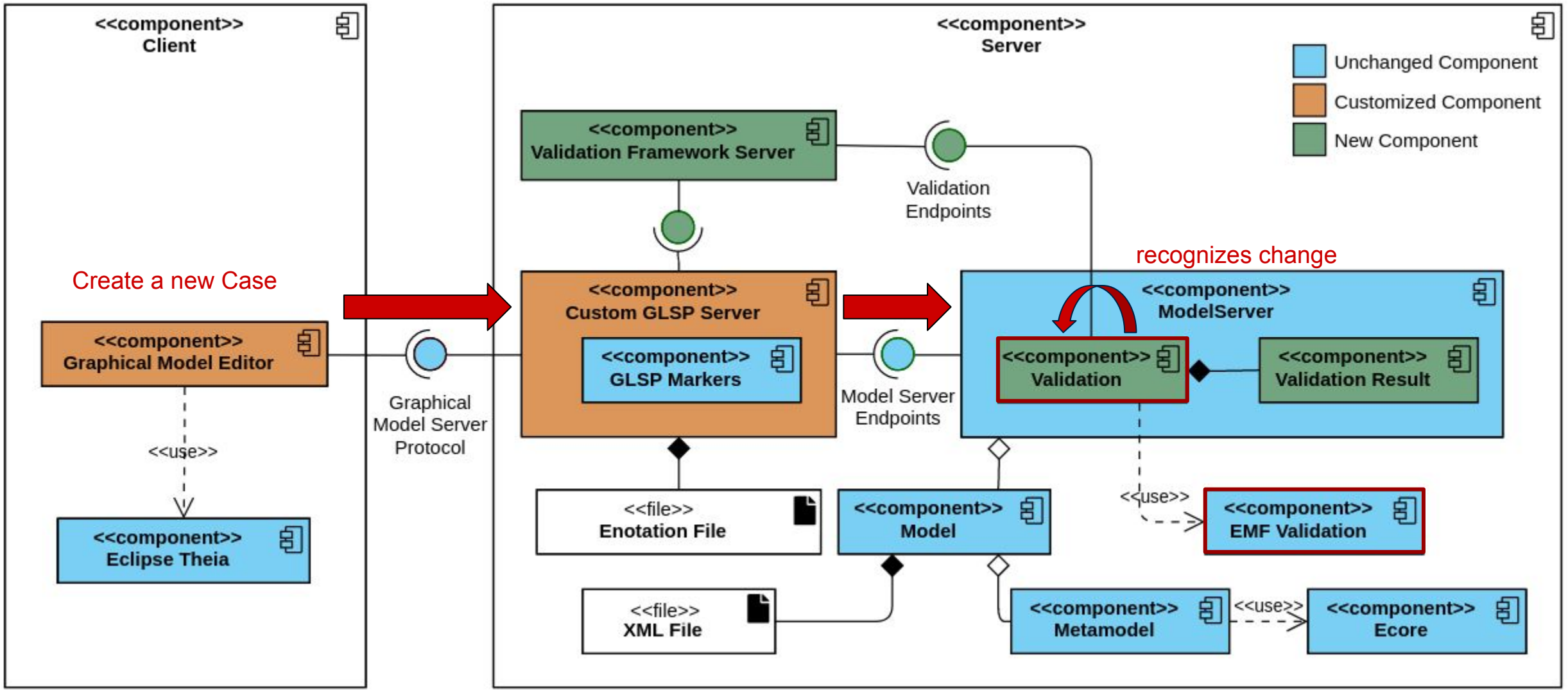
Proposed Solution - Architecture



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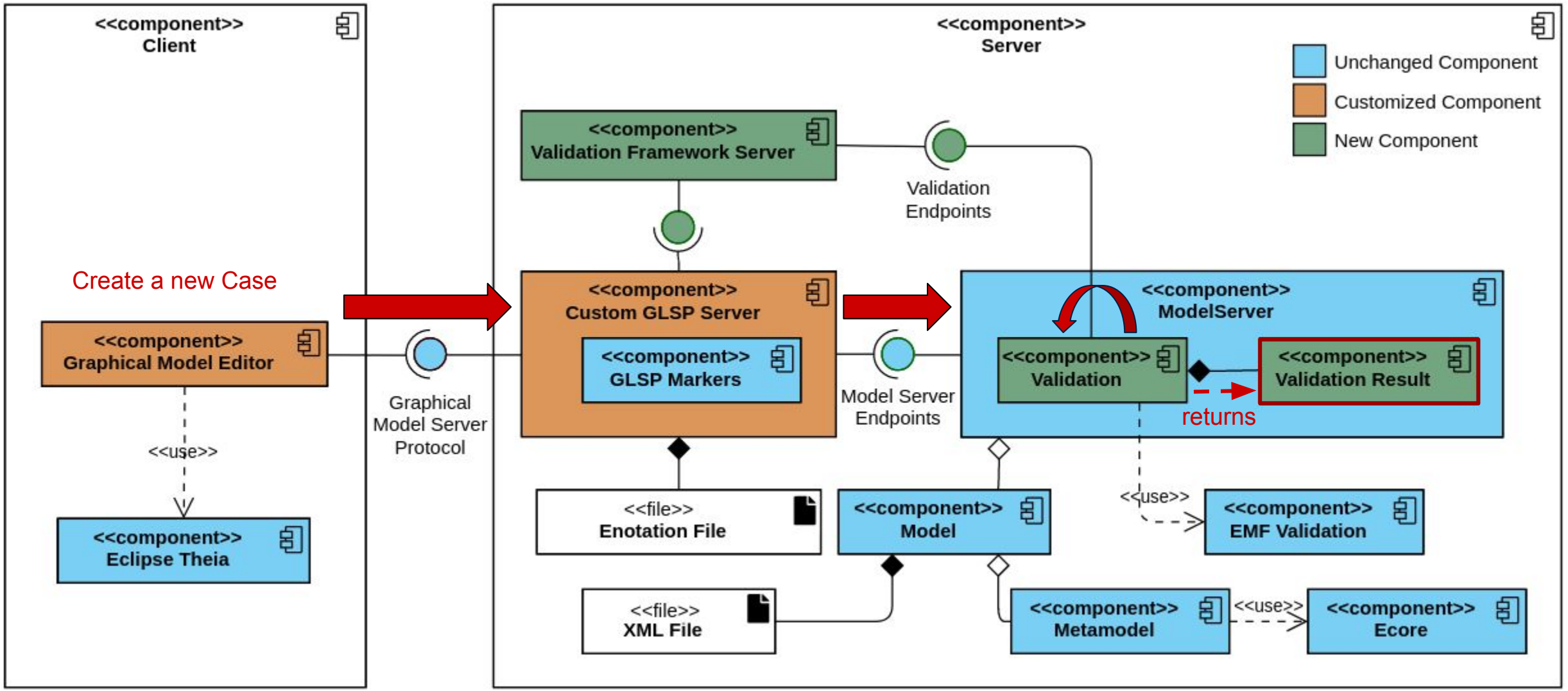
Proposed Solution - Architecture



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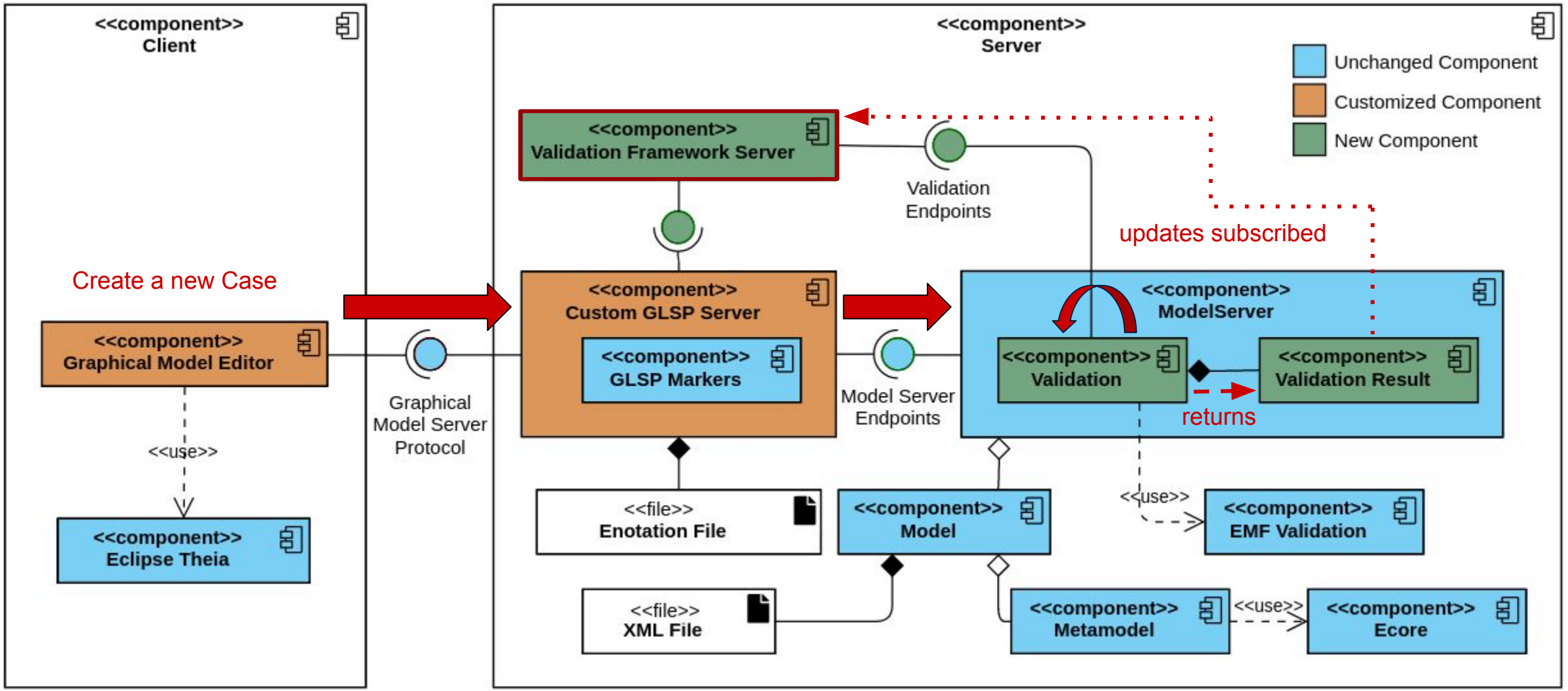
Proposed Solution - Architecture



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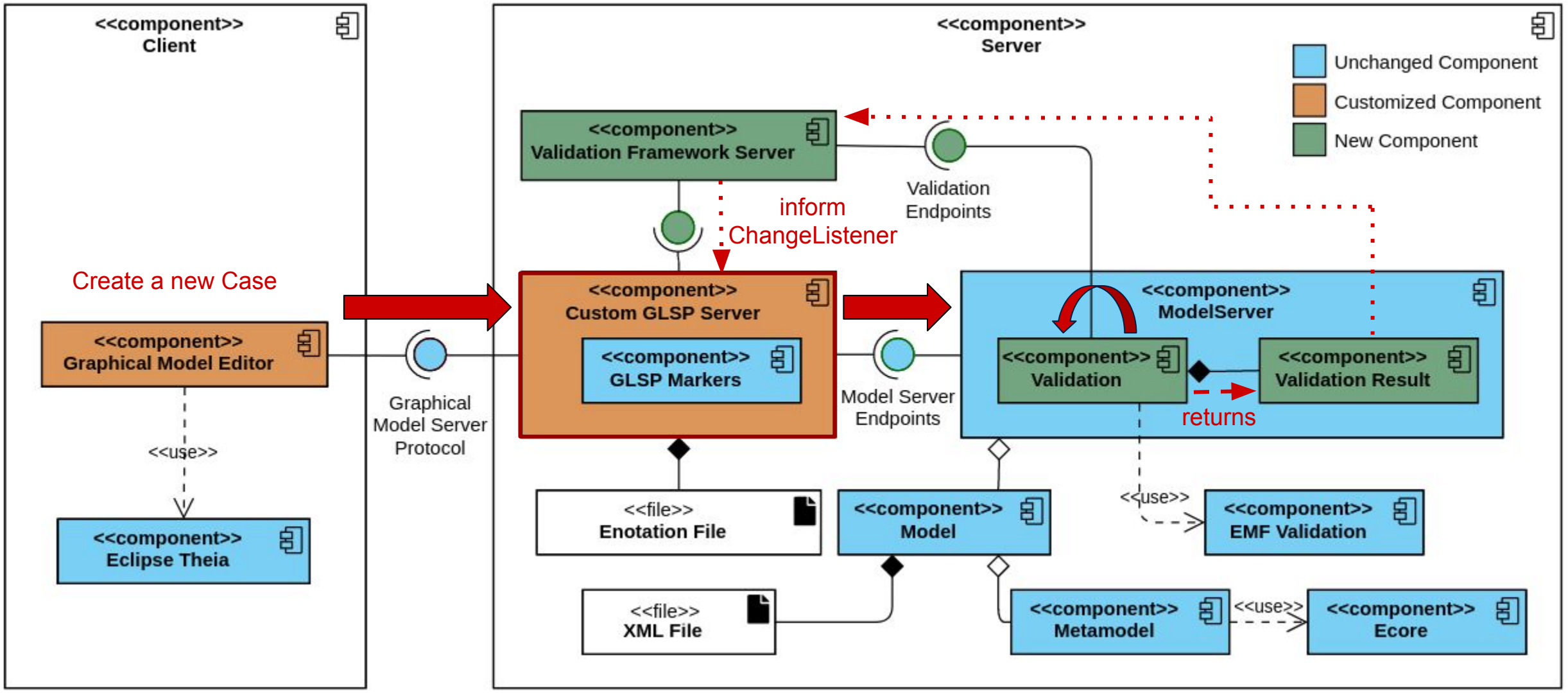

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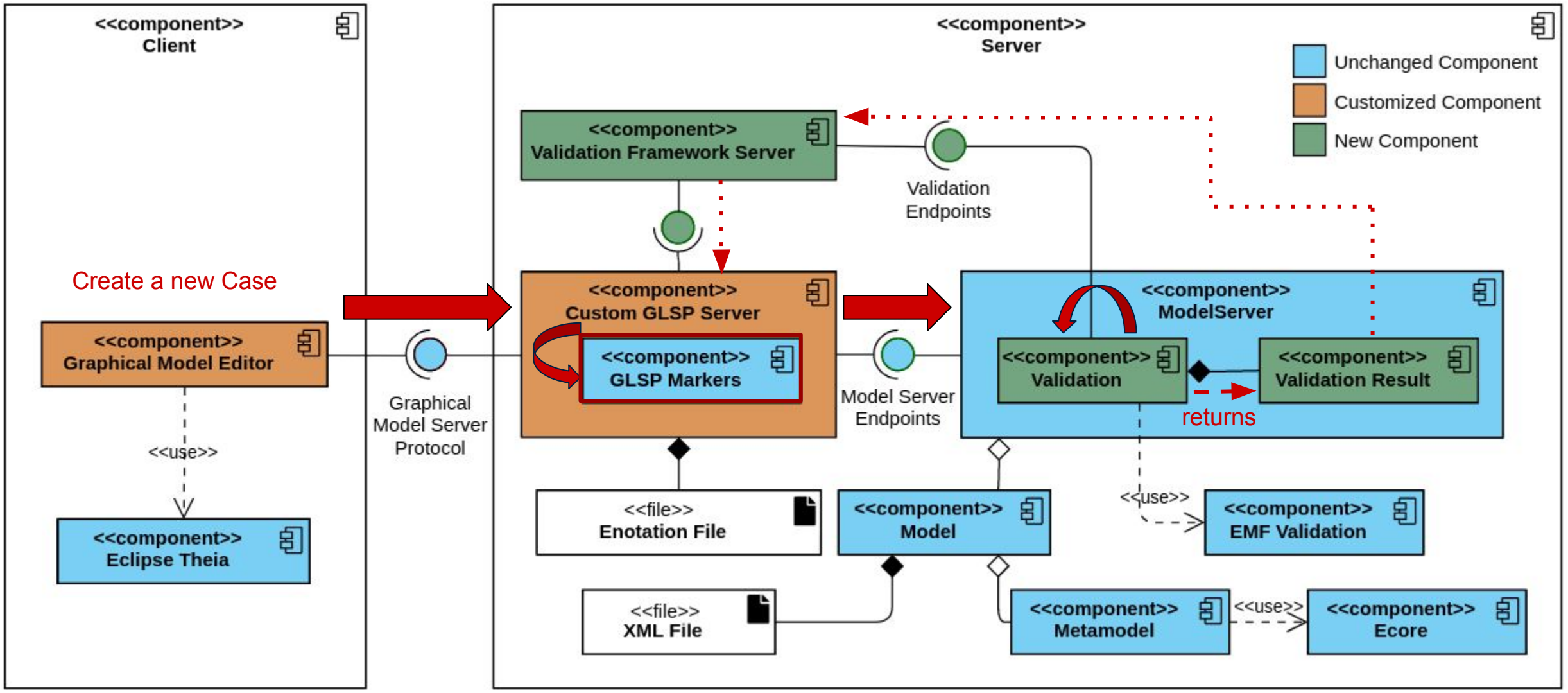
Proposed Solution - Architecture



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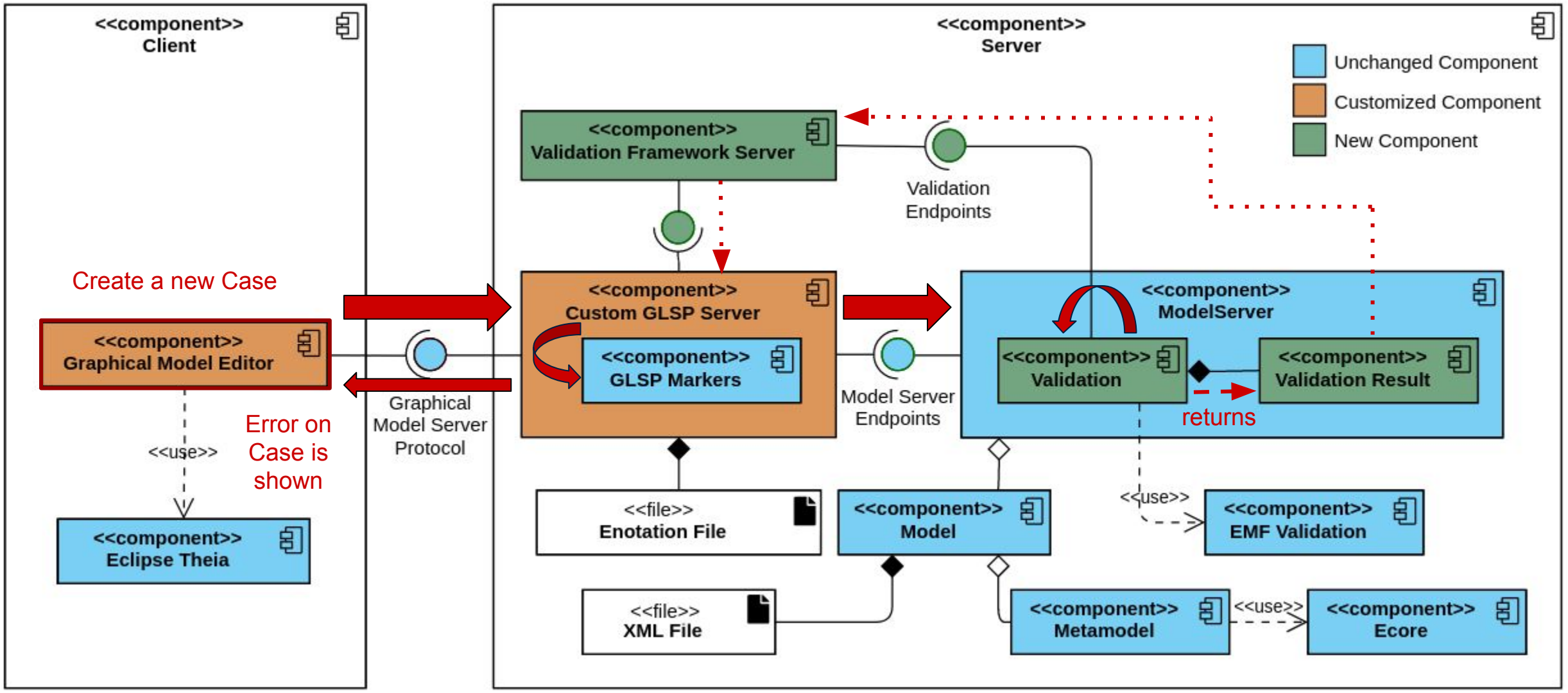
Proposed Solution - Architecture



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Proposed Solution - Relevance of Client

- Need for client validation?
- Conducted tests with:
  - 50 mbit/s + 0ms Latency
  - 50 mbit/s + 1000ms Latency
  - 0.5 mbit/s + 0ms Latency
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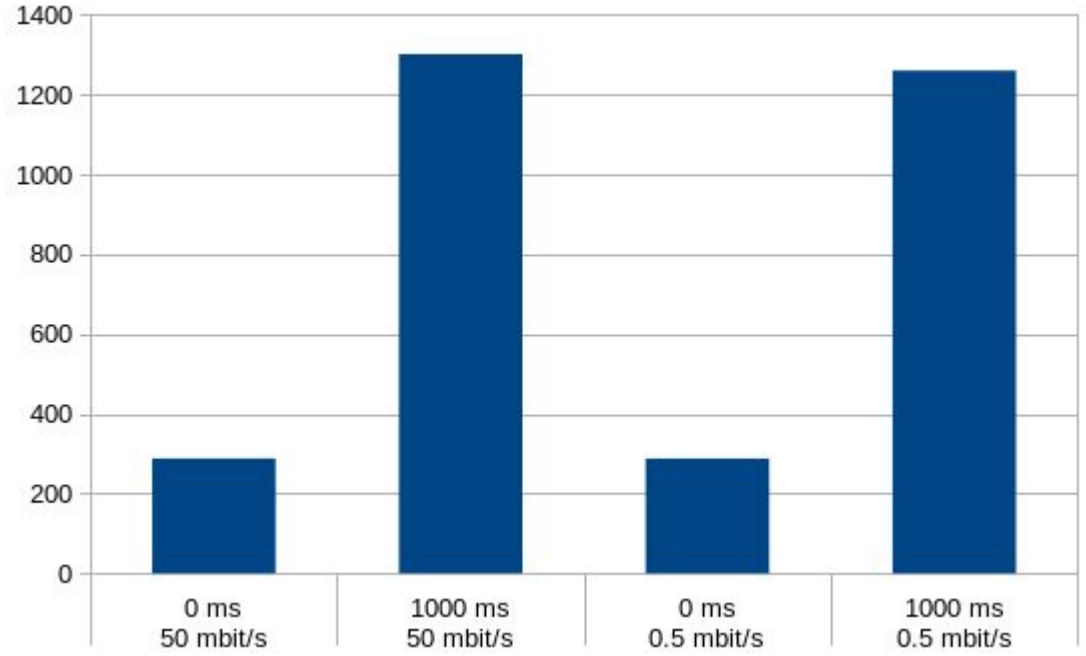

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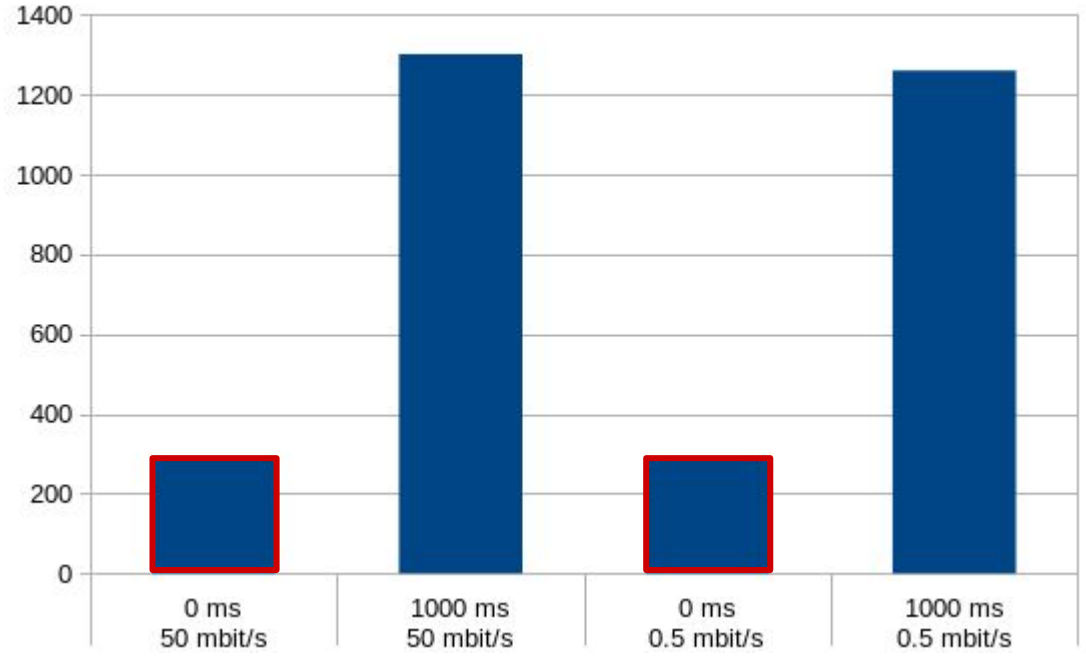
⇒ Bandwidth does not matter



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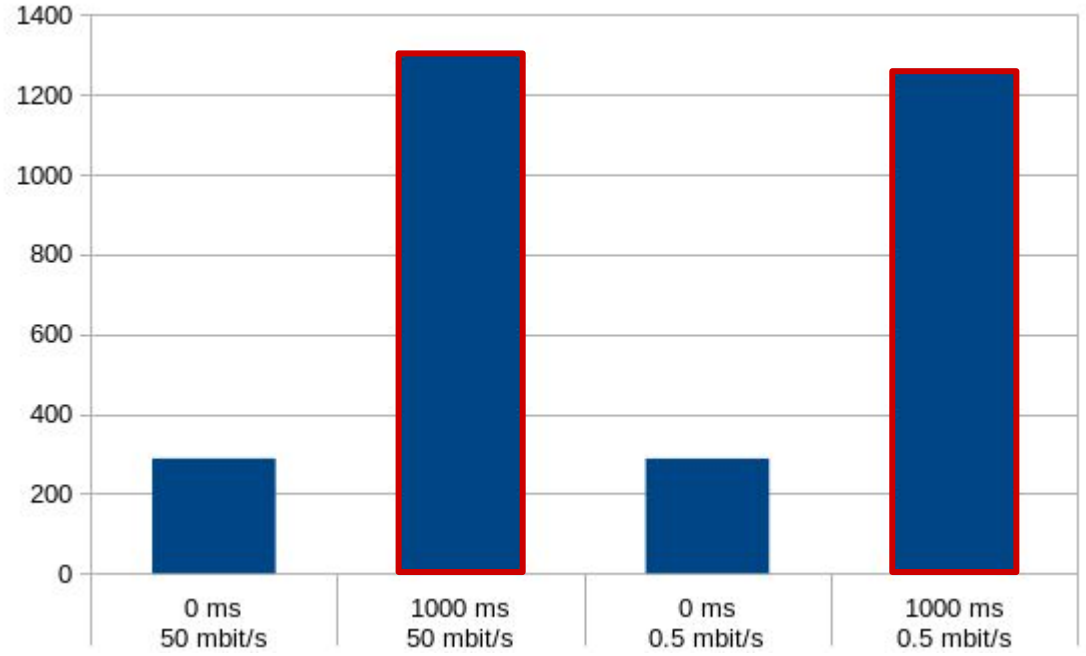

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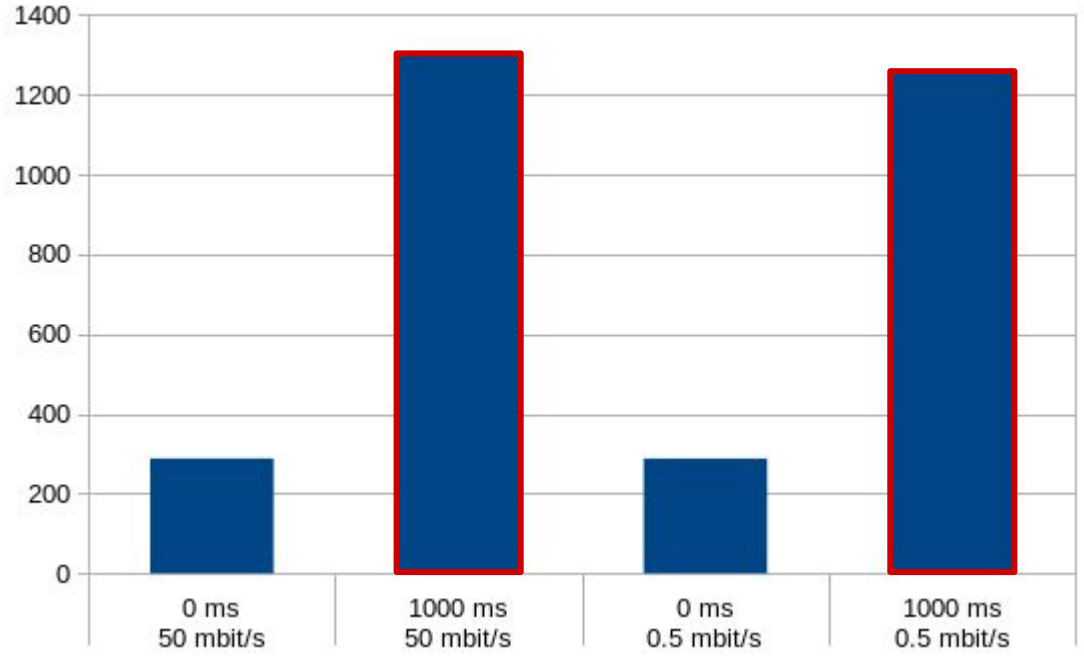

Bandwidth does not matter, Latency does

But: Latency is a general problem of cloud-based solutions

Centralized architecture without Client validation

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Live Demo

Outline

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Evaluation

Benefits for developers (My Findings):

- No need for implementing validation
- Metamodel/rule-set might already exist
- Modelserver handles model operations
- Easy implementation of:
  - GUI
  - Error Markers

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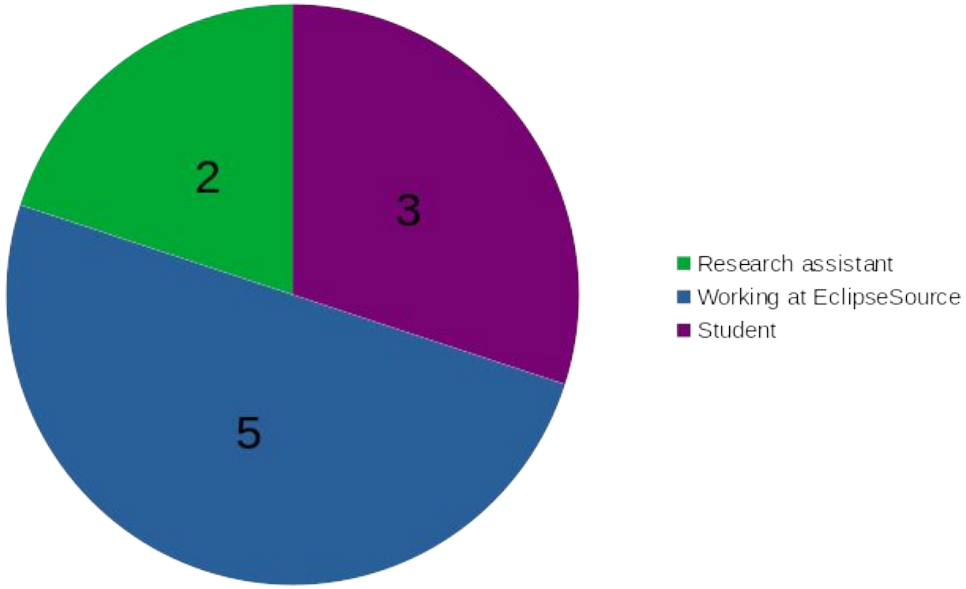
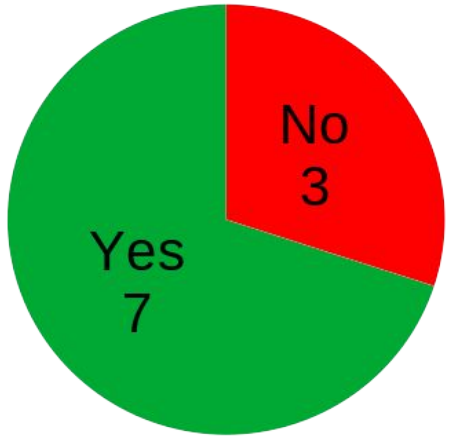
Evaluation

Benefits for users:

- A user study was conducted
  - Within CMMN-editor
  - No experience with CMMN
  - Small modelling task
  - Scripted intentional errors
  - Testing for accuracy & usability
- Feedback via Likert-Scale
- Open answers for feedback/explanation
- Usability evaluation via SUS
- Model validator not the editor was evaluated



Occupation



Experience with modelling editors?

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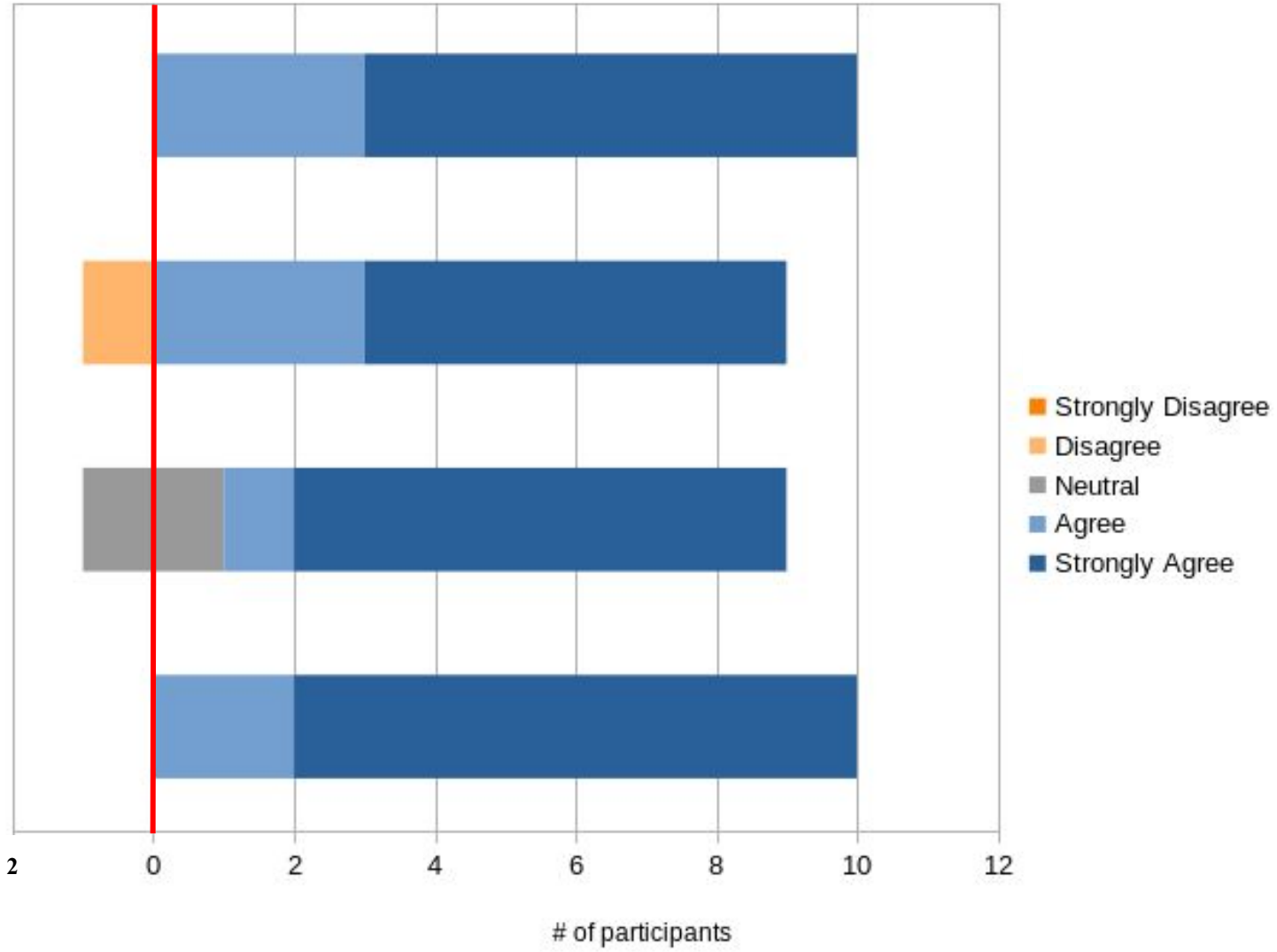
Evaluation - User Study Results

It is clear which elements are missing to resolve an error.

It is clear what characters are allowed in a specific input field.

It is clear how inputs have to be formed.

The error messages were always concise enough to recognize the error.



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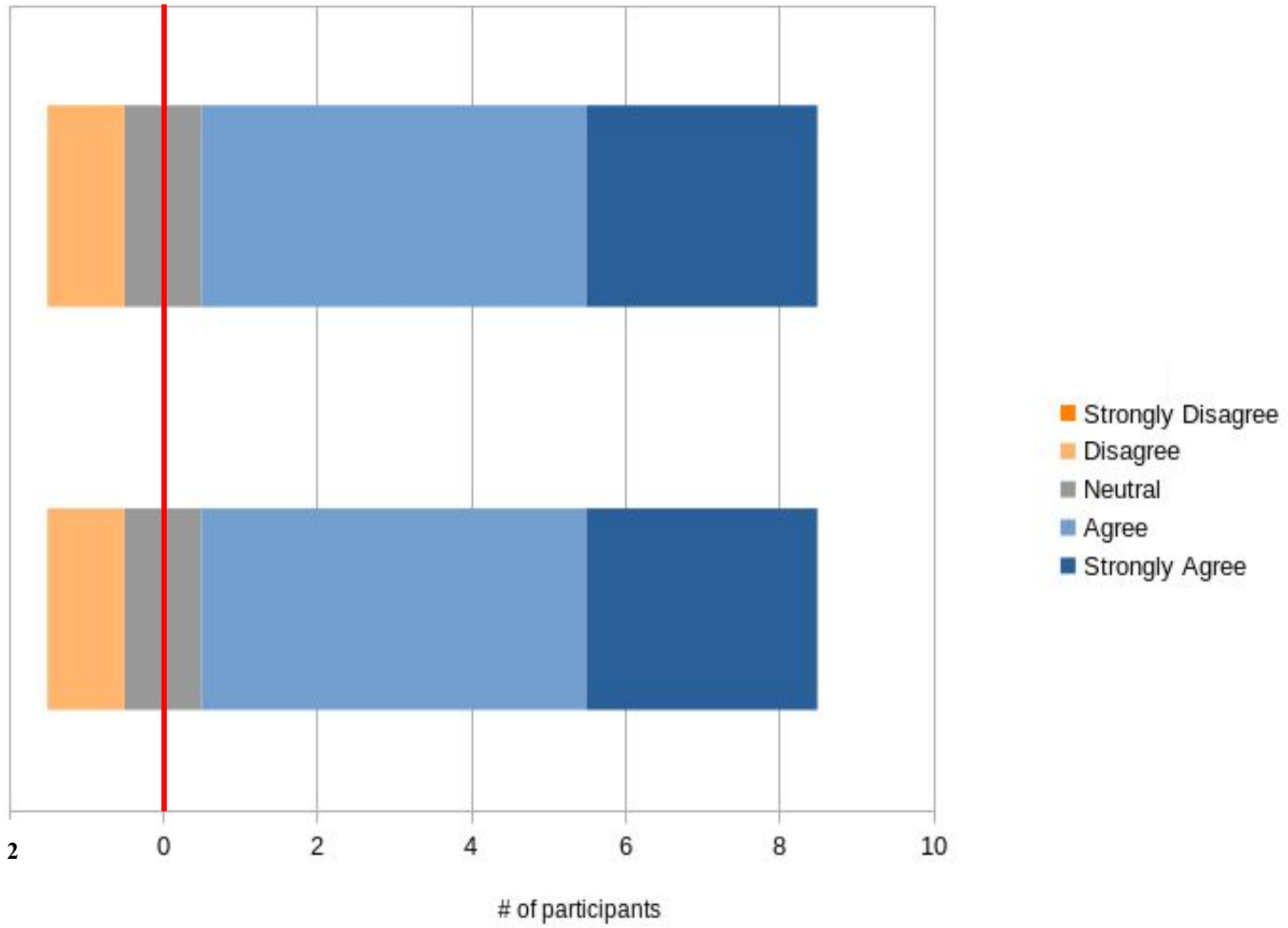
Evaluation - User Study Results

It is clear where sentrys can be created.

It is clear which elements can be nested within each other.



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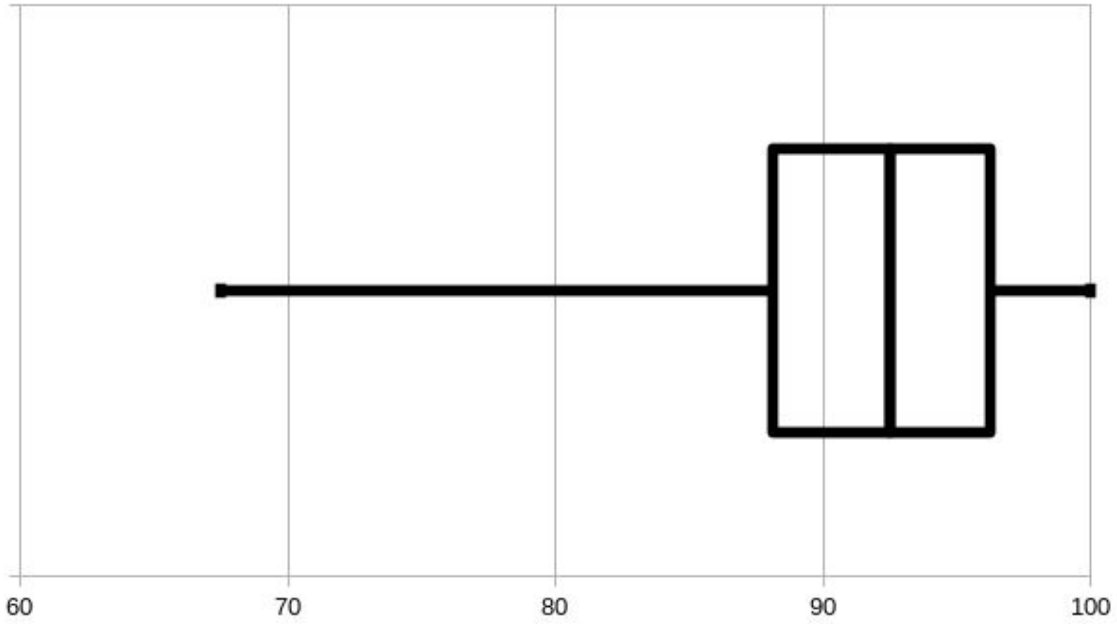
Evaluation - SUS Score



Median SUS-Score of 92.5

Accurate and useable solution

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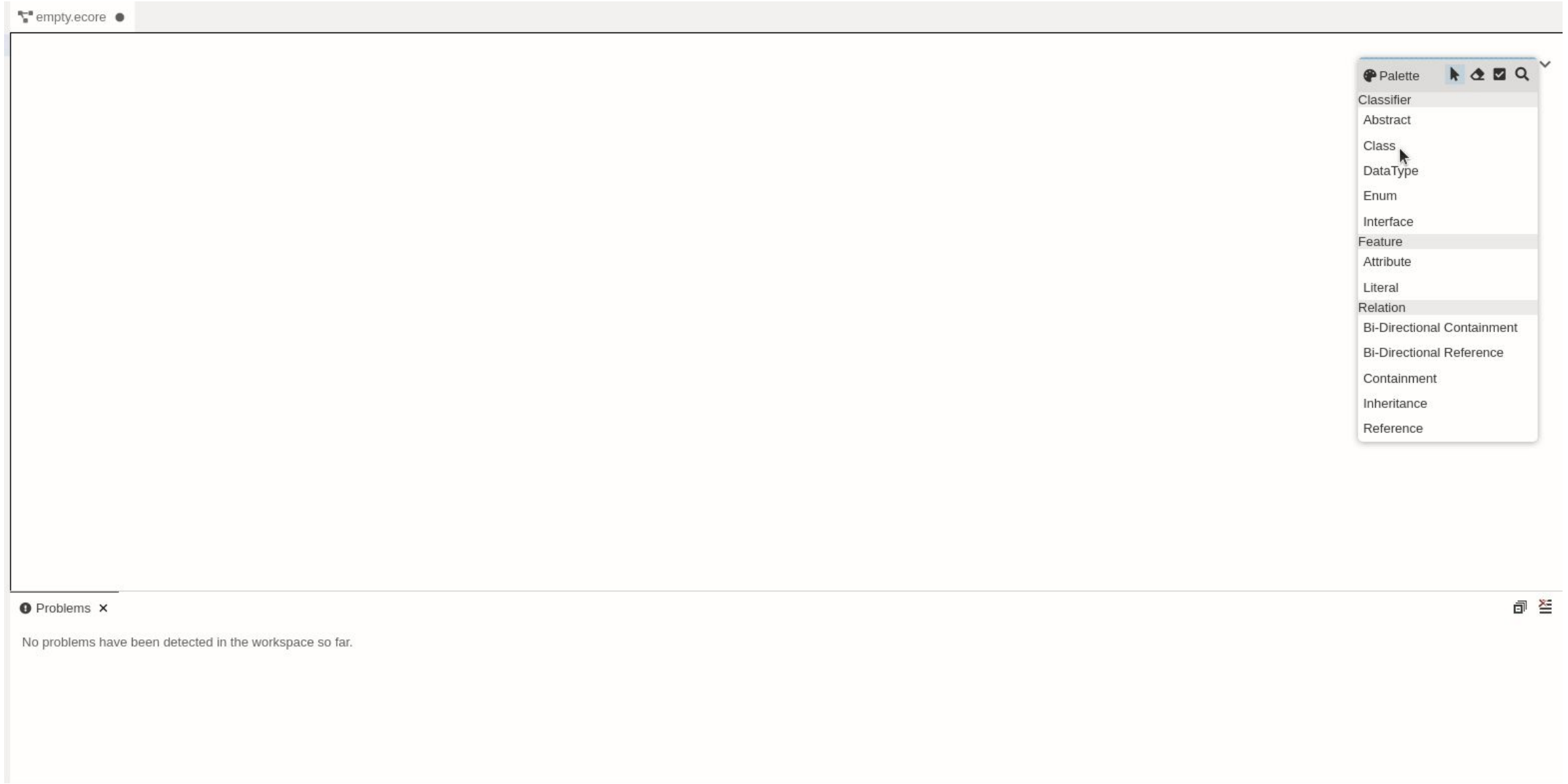
Outlook - Ecore Editor



Outlook - Future Work

- Improvements:
  - Single error message file
  - Usability improvements of GLSP

- Long-term goals:
  - Custom constraint builder

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wwwmatthes.in.tum.de

Evaluation - SUS Score

Score	67.5	85	87.5	90	92.5	97.5	100
N	1	1	1	1	3	2	1

Average SUS-Score of 90.25

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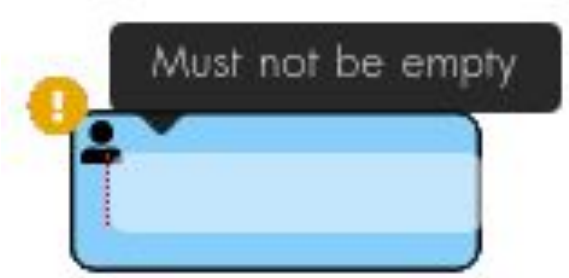
Evaluation - Limitations

- One participant broke the live validation, due to a bug
- Participants had some problems with the input validation feedback



Improvement of GLSP graphical elements would be beneficial

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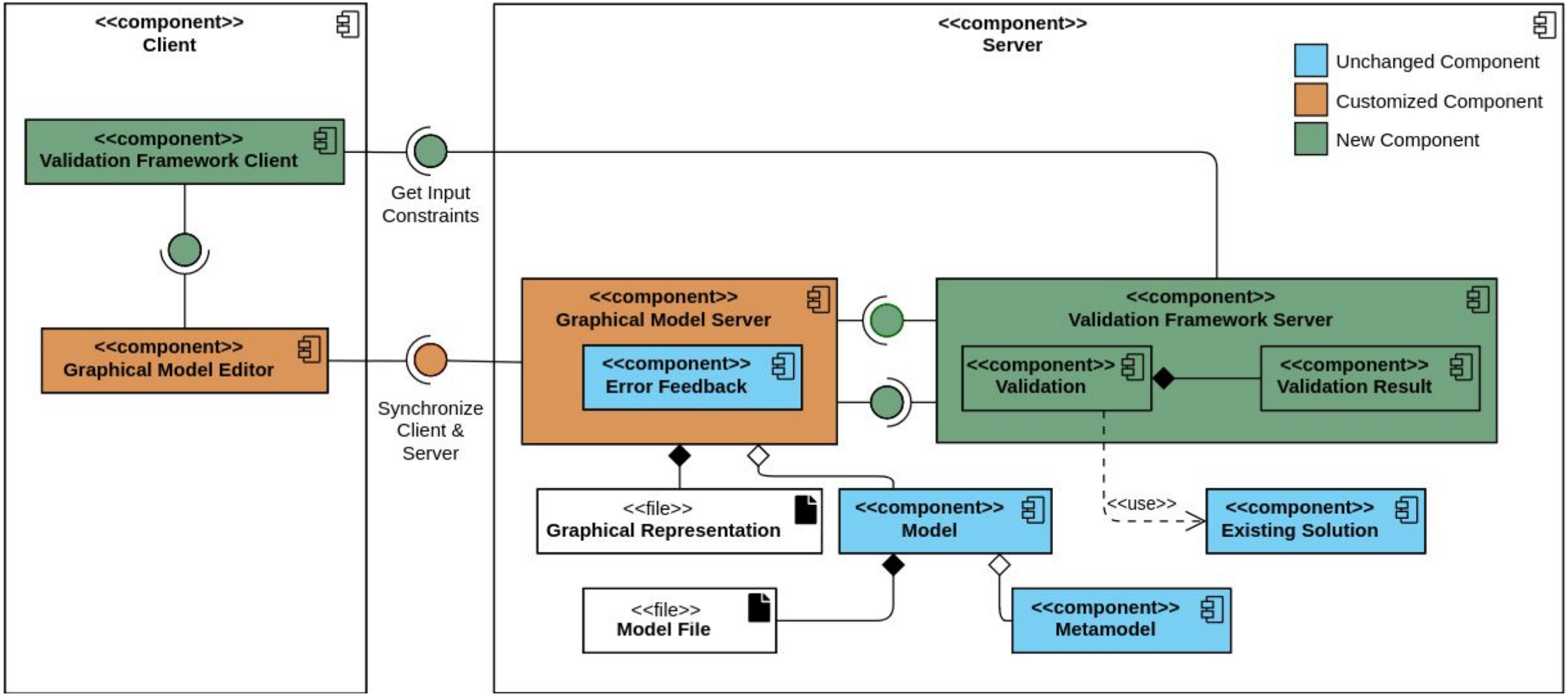
Architecture - Basic



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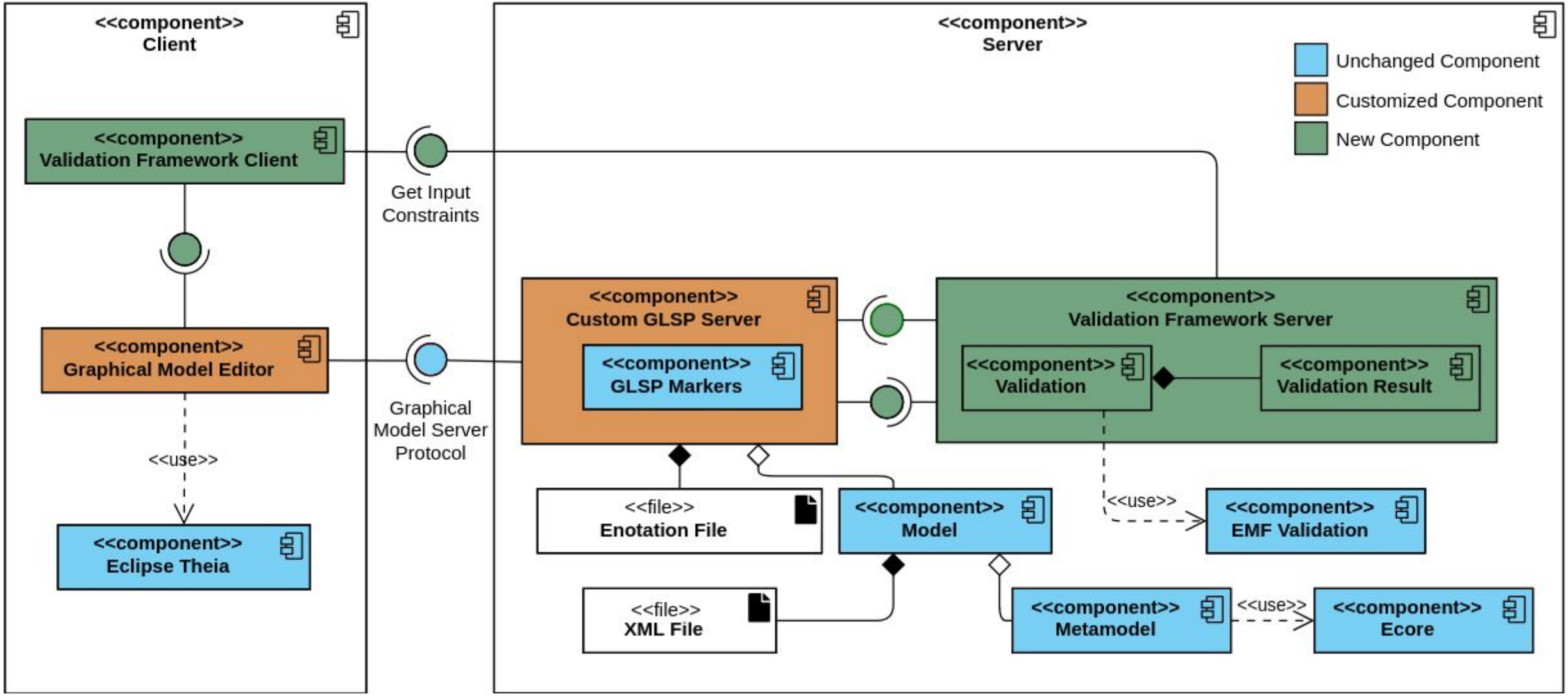
Architecture - Without Modelserver



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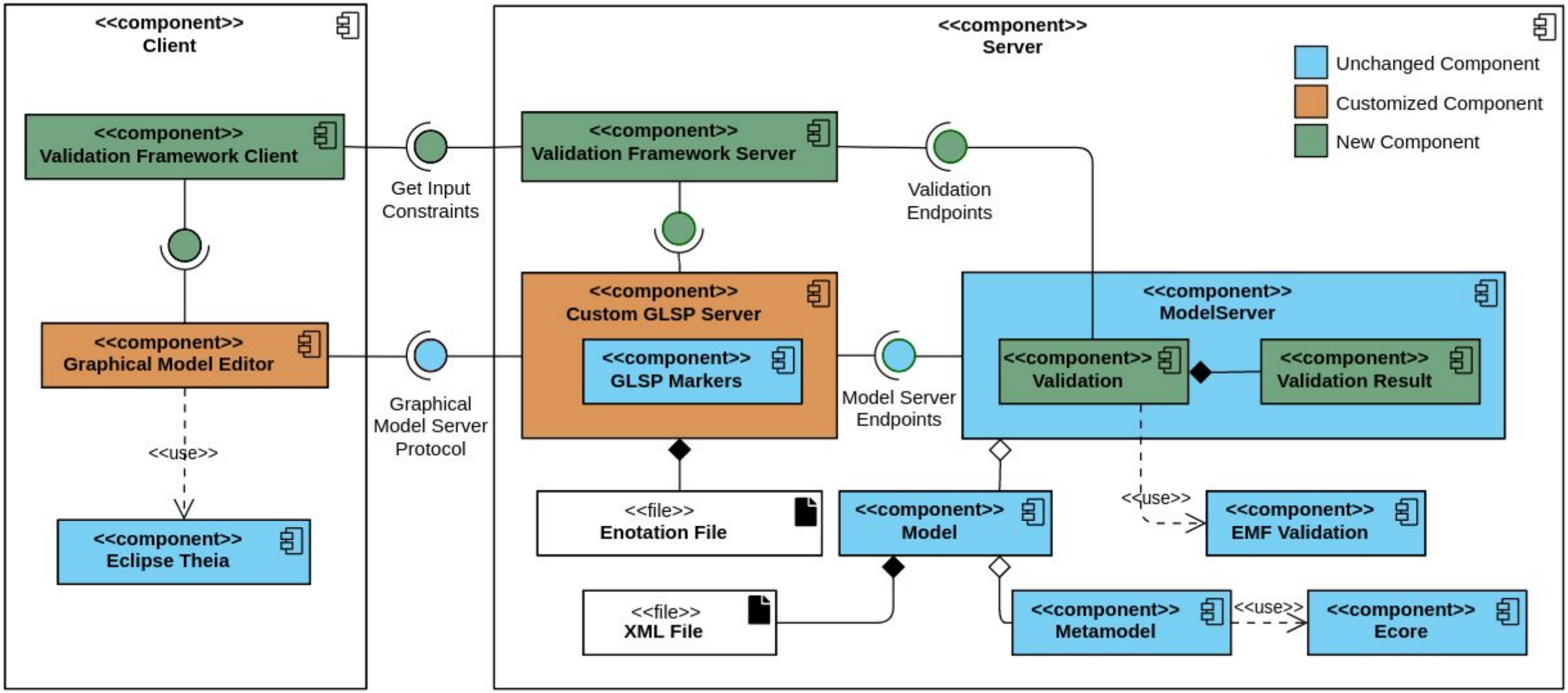
Architecture - With Modelserver



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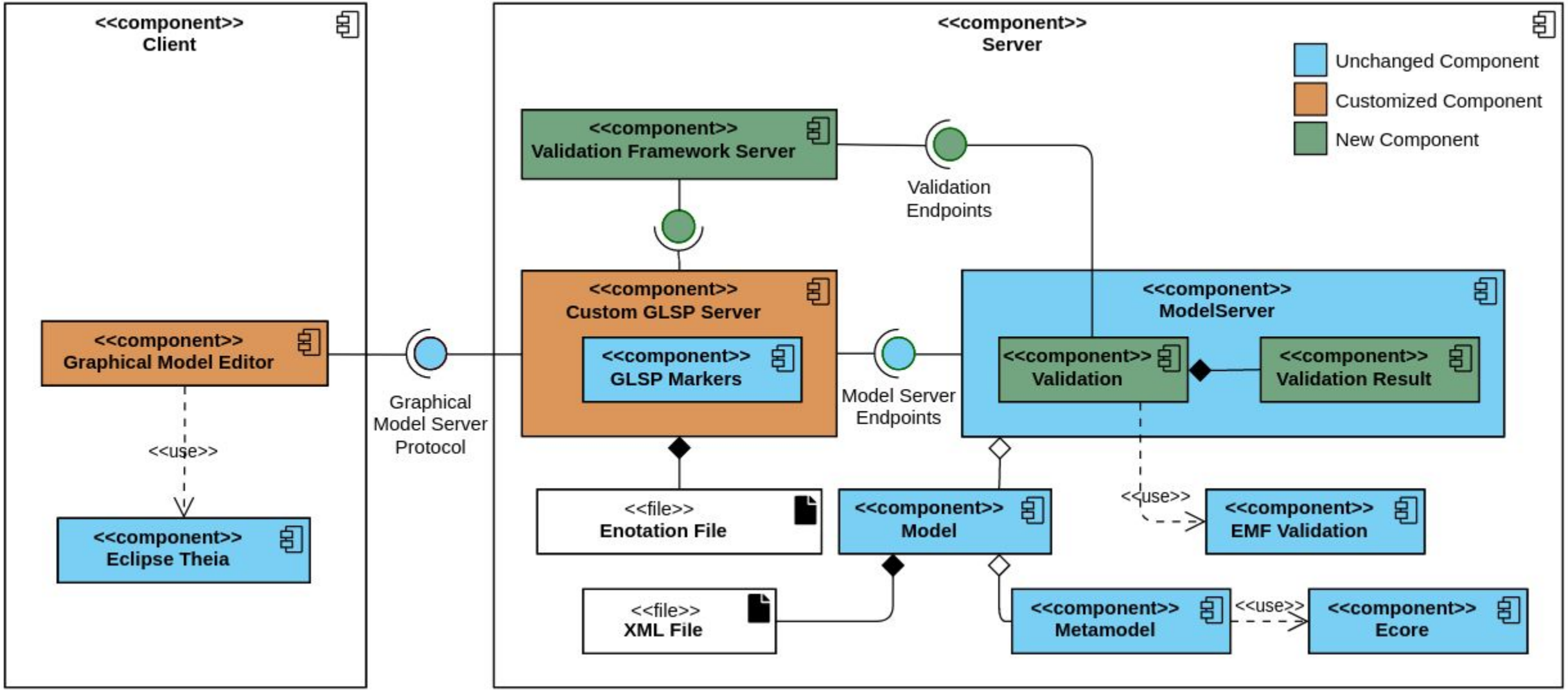
Architecture - Without Client



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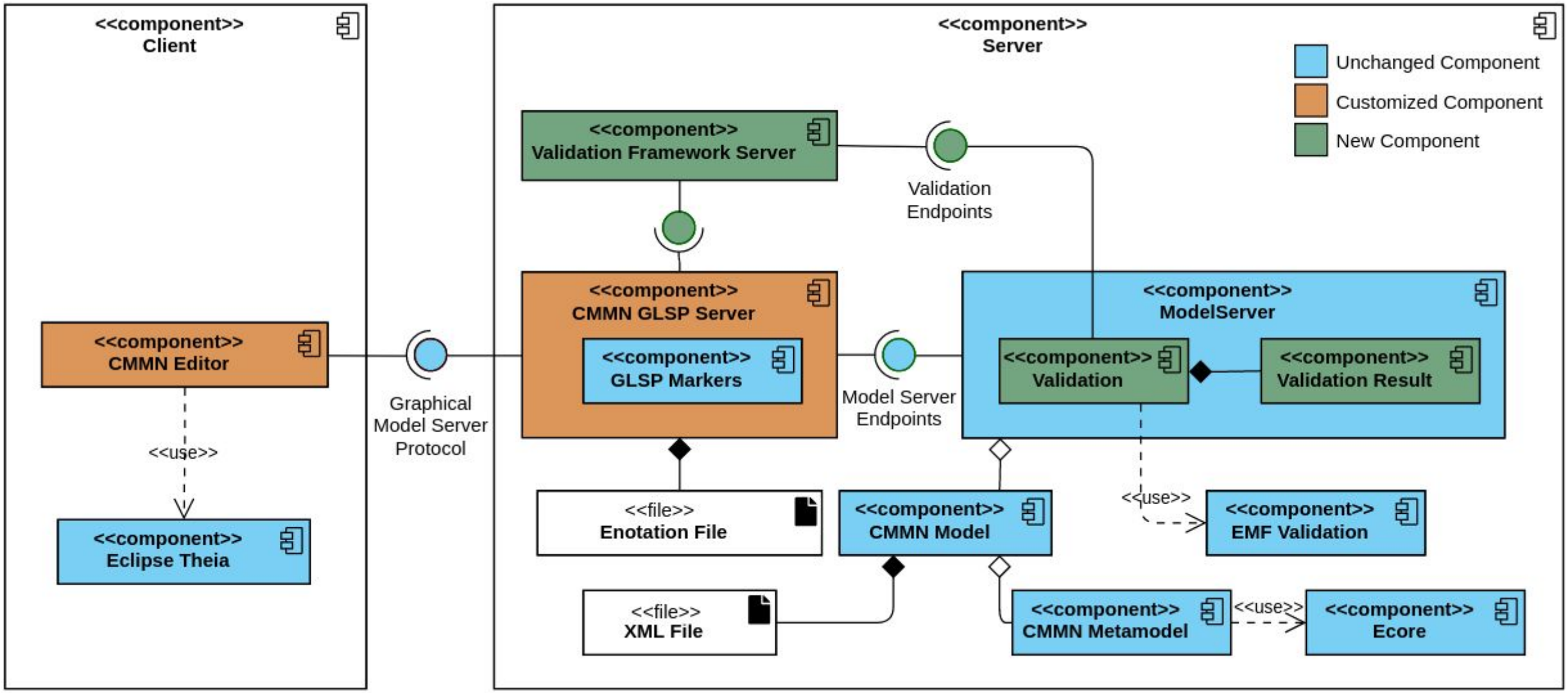
Architecture - CMMN-Specific



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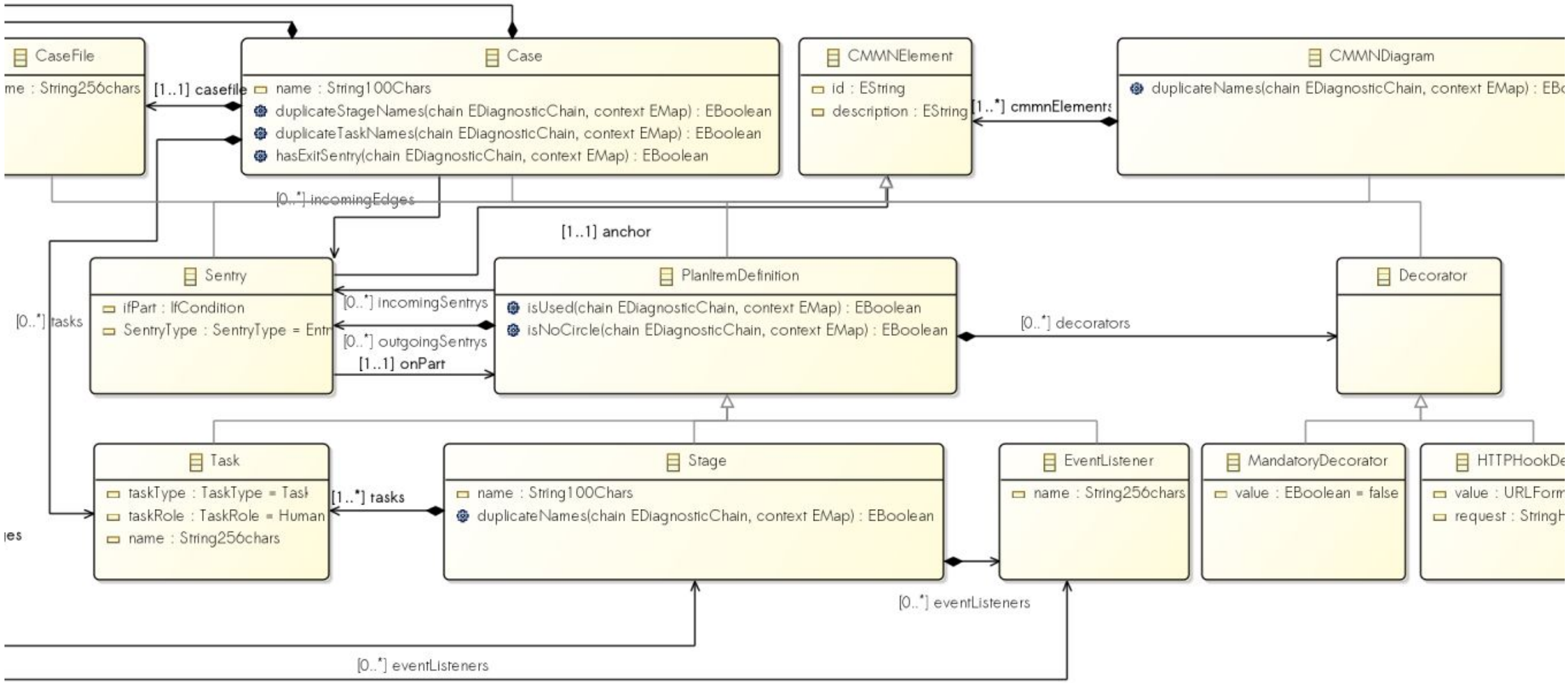
CMMN Metamodel



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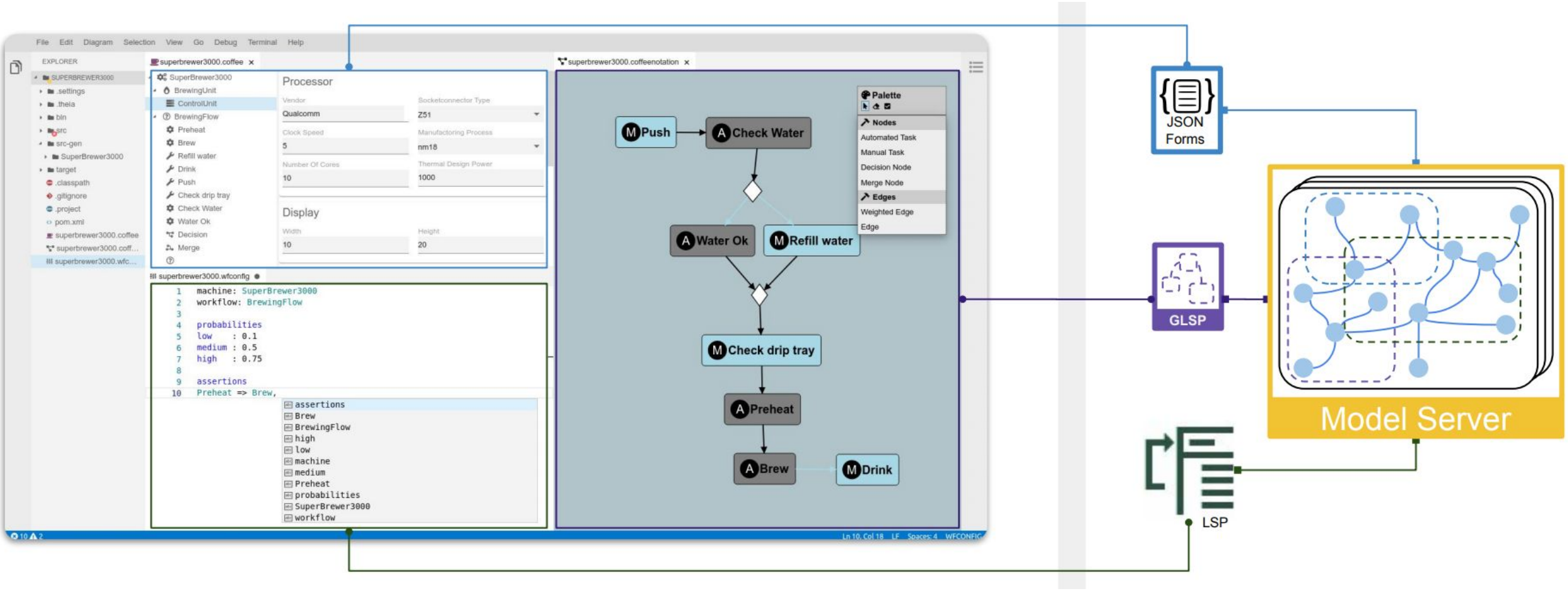
Modelserver



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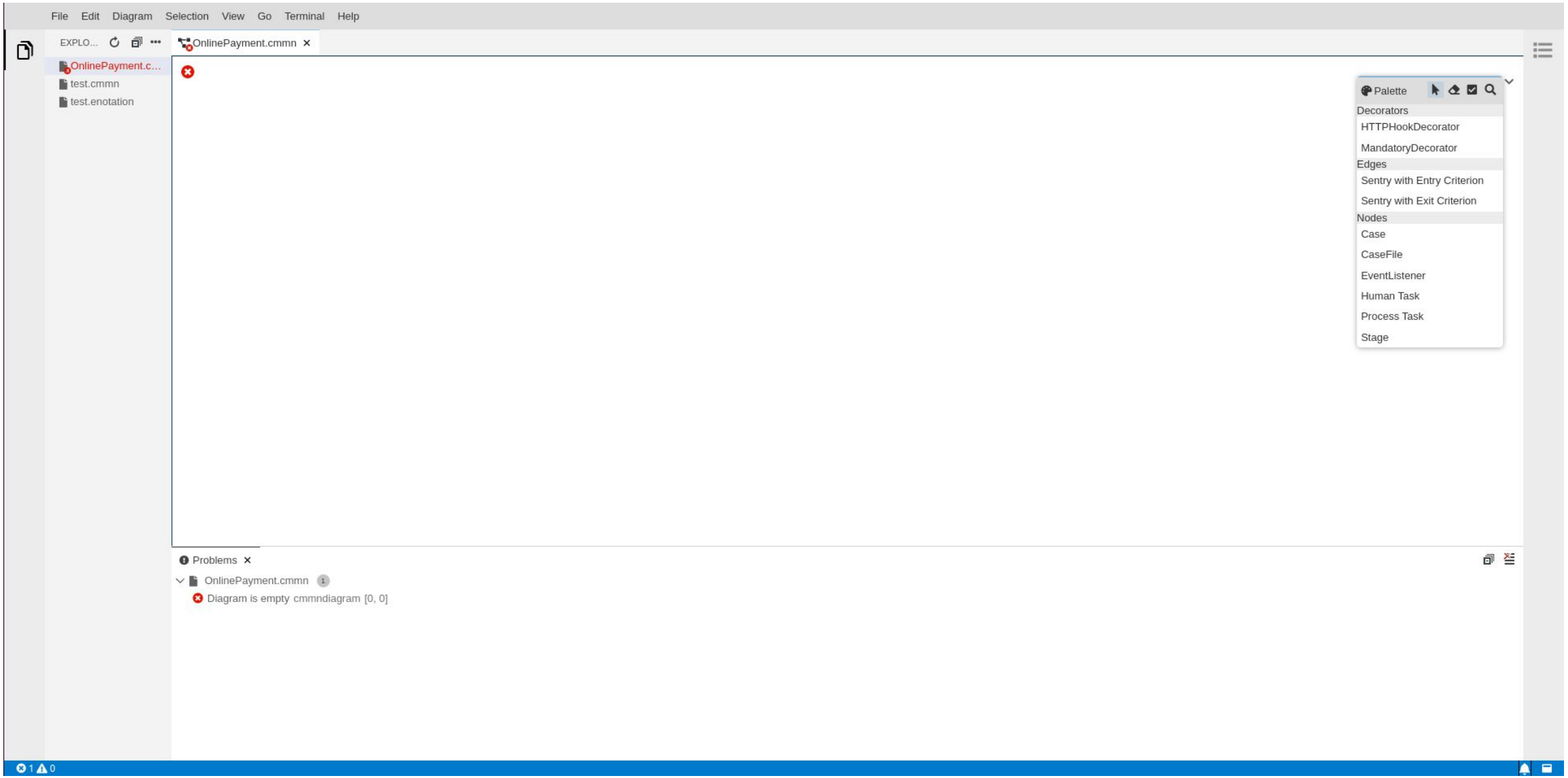
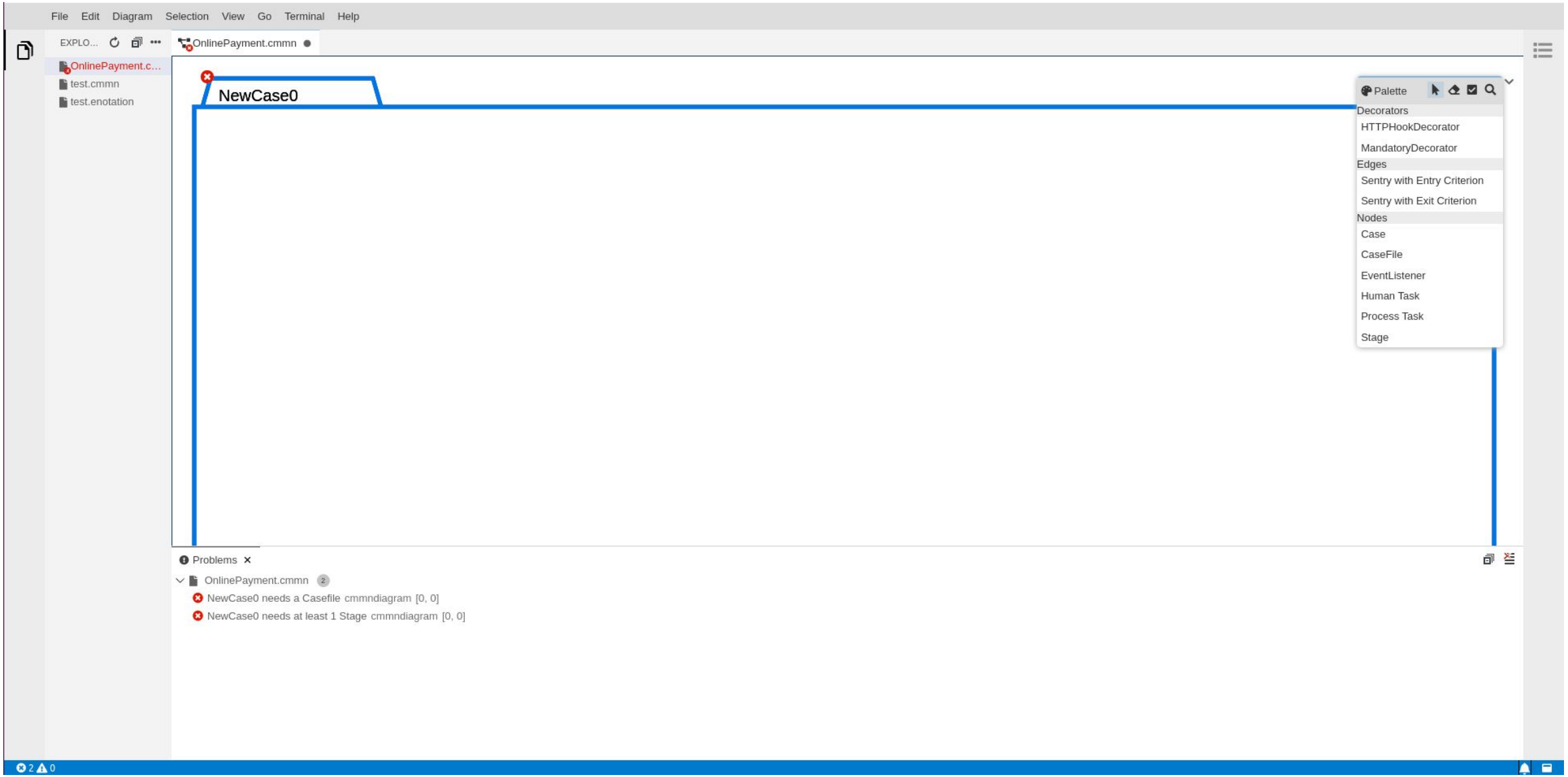
Live Demo


File Edit Diagram Selection View Go Terminal Help
EXPLO...
OnlinePayment.c...
test.cmmn
test.enotation
OnlinePayment.cmmn
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
OnlinePayment.cmmn 1
Diagram is empty cmmndiagram [0, 0]
1 0

Live Demo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EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
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NewCase0
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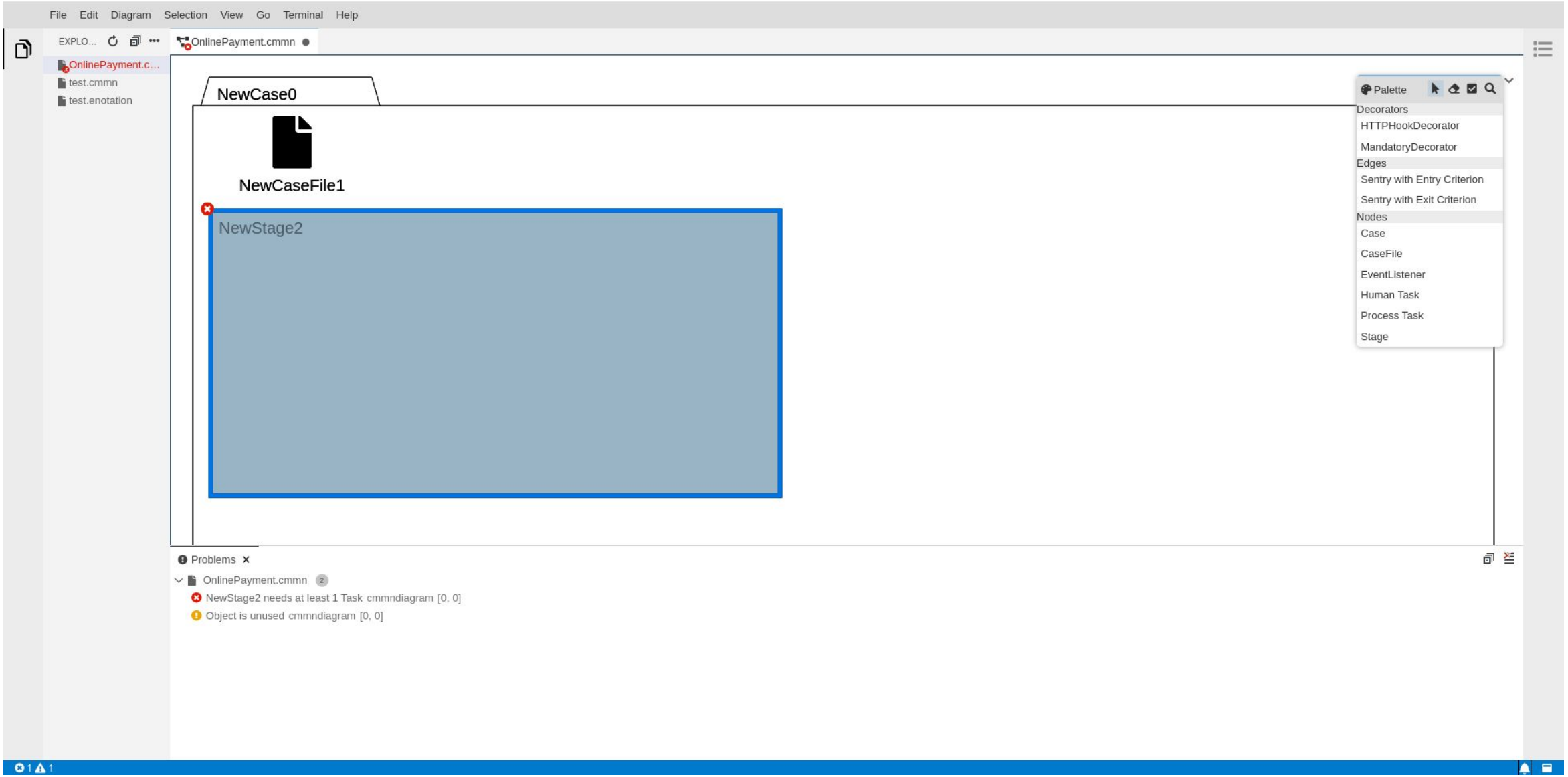
Problems
OnlinePayment.cmmn 2
NewCase0 needs a Casefile cmmndiagram [0, 0]
NewCase0 needs at least 1 Stage cmmndiagram [0, 0]
2 0

Live Demo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EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
Palette
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MandatoryDecorator
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Sentry with Exit Criterion
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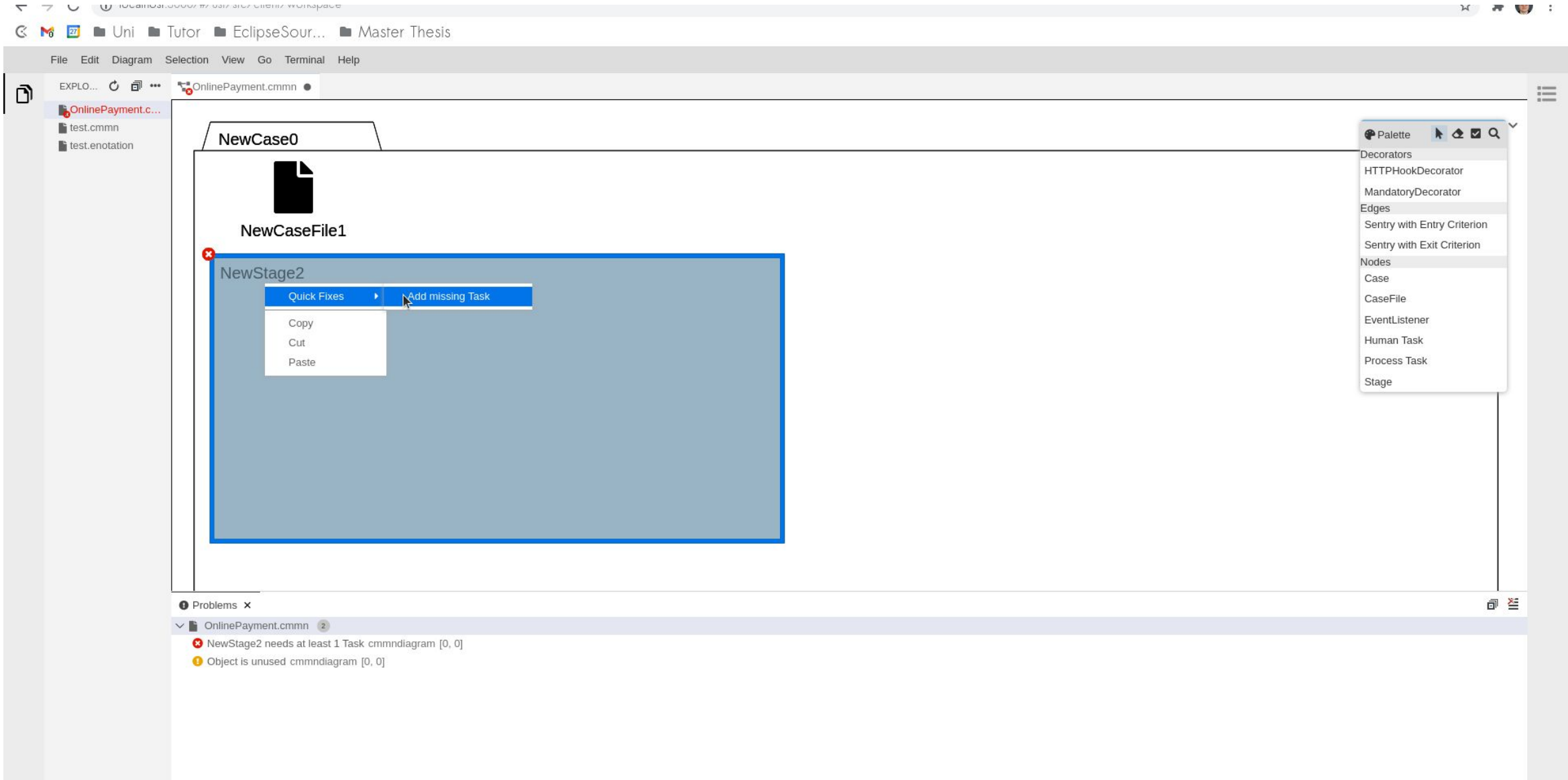
Human Task
Process Task
Stage
Problems
OnlinePayment.cmmn 2
NewStage2 needs at least 1 Task cmmndiagram [0, 0]
Object is unused cmmndiagram [0, 0]

Live Demo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Tutor
EclipseSour...
Master Thesis
File Edit Diagram Selection View Go Terminal Help
EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
Quick Fixes
Add missing Task
Copy
Cut
Paste
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
OnlinePayment.cmmn 2
NewStage2 needs at least 1 Task cmmndiagram [0, 0]
Object is unused cmmndiagram [0, 0]

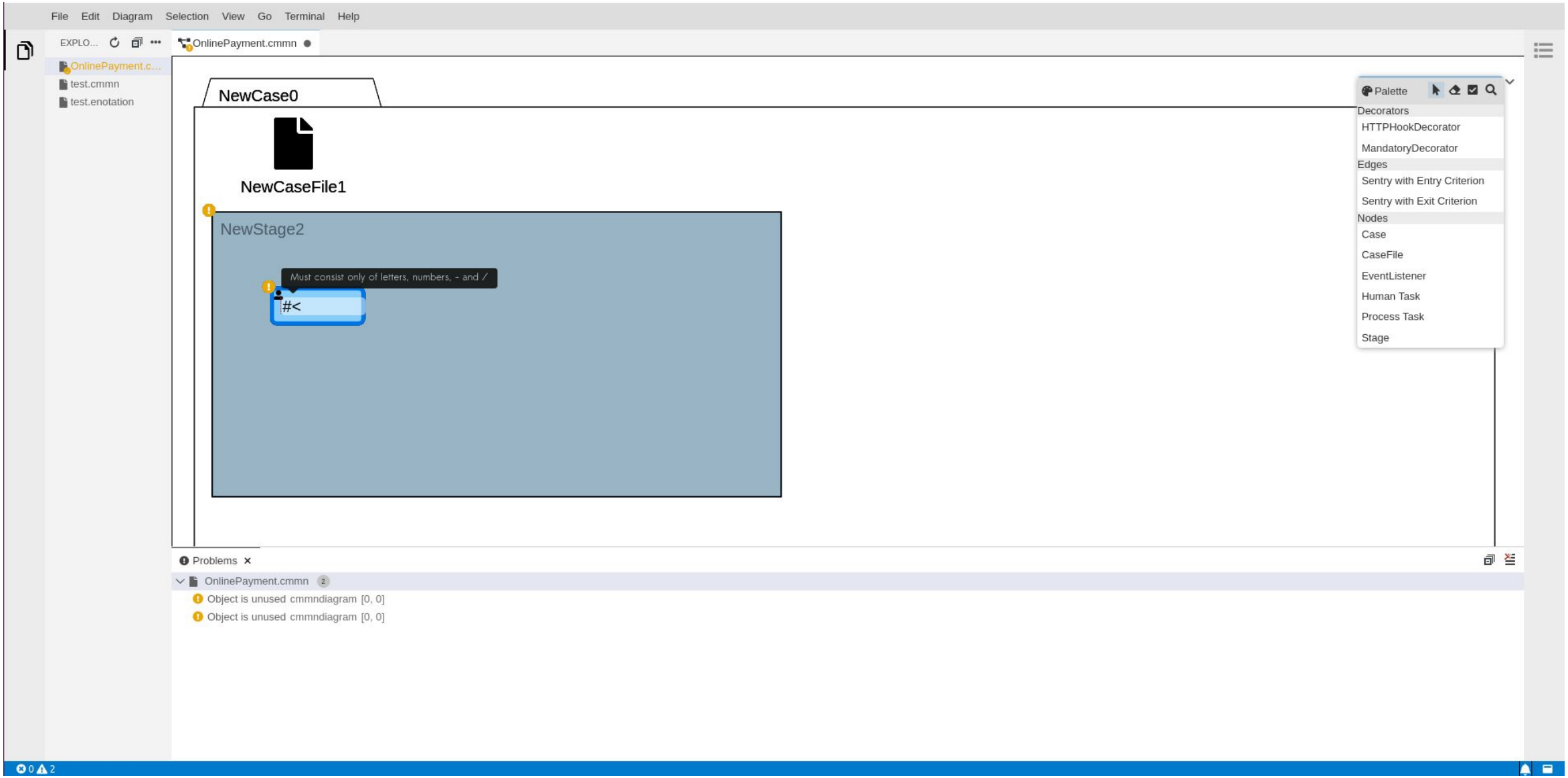
Live Demo

File Edit Diagram Selection View Go Terminal Help
EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
NewTask3
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
OnlinePayment.cmmn 2
Object is unused cmmndiagram [0, 0]
Object is unused cmmndiagram [0, 0]
0 2

Live Demo

File Edit Diagram Selection View Go Terminal Help
EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
Must not be empty
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
OnlinePayment.cmmn 2
Object is unused cmmndiagram [0, 0]
Object is unused cmmndiagram [0, 0]

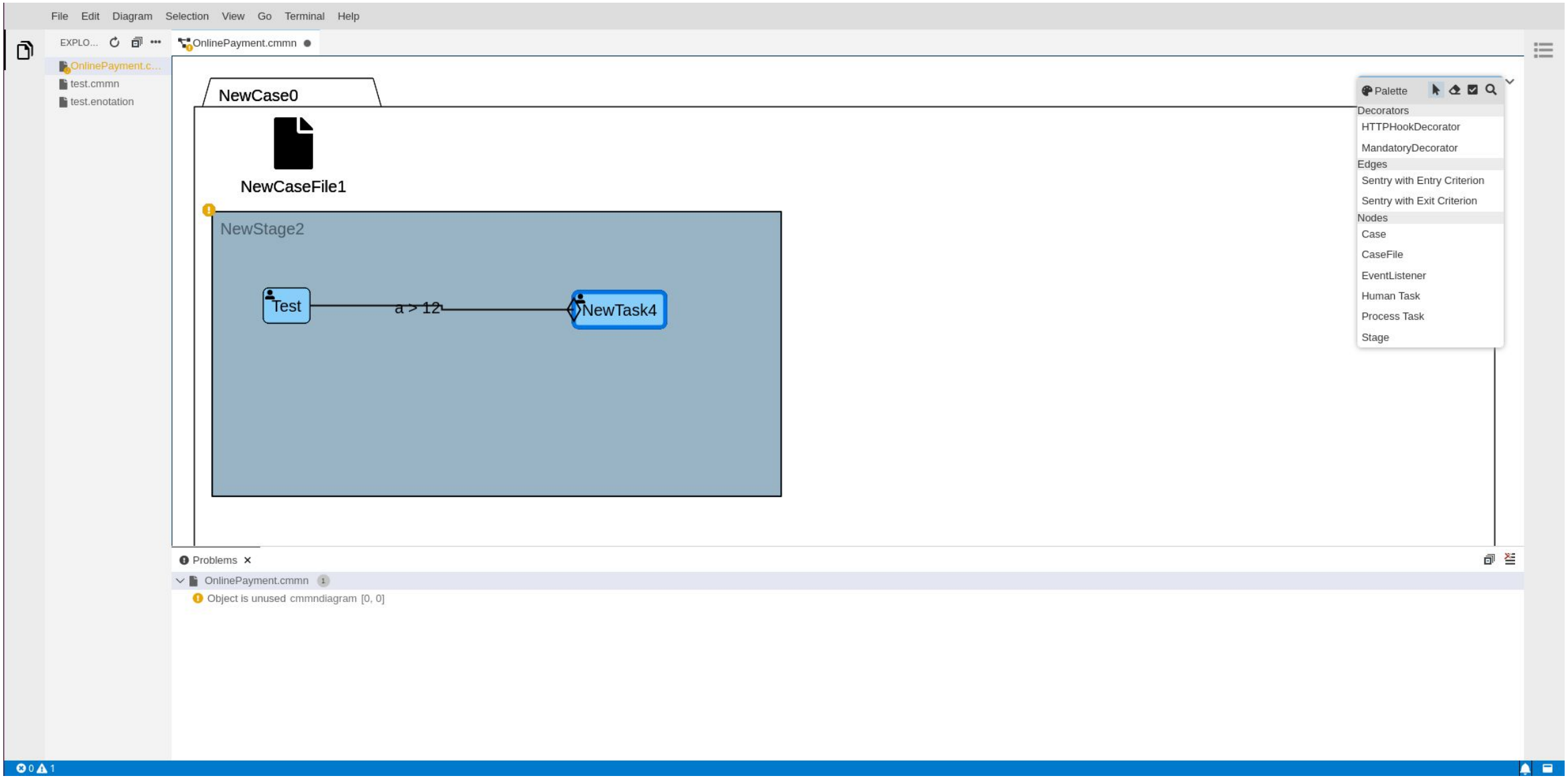
Live Demo


File Edit Diagram Selection View Go Terminal Help
EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
Must consist only of letters, numbers, - and /
#<
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
OnlinePayment.cmmn 2
Object is unused cmmndiagram [0, 0]
Object is unused cmmndiagram [0, 0]
0 2

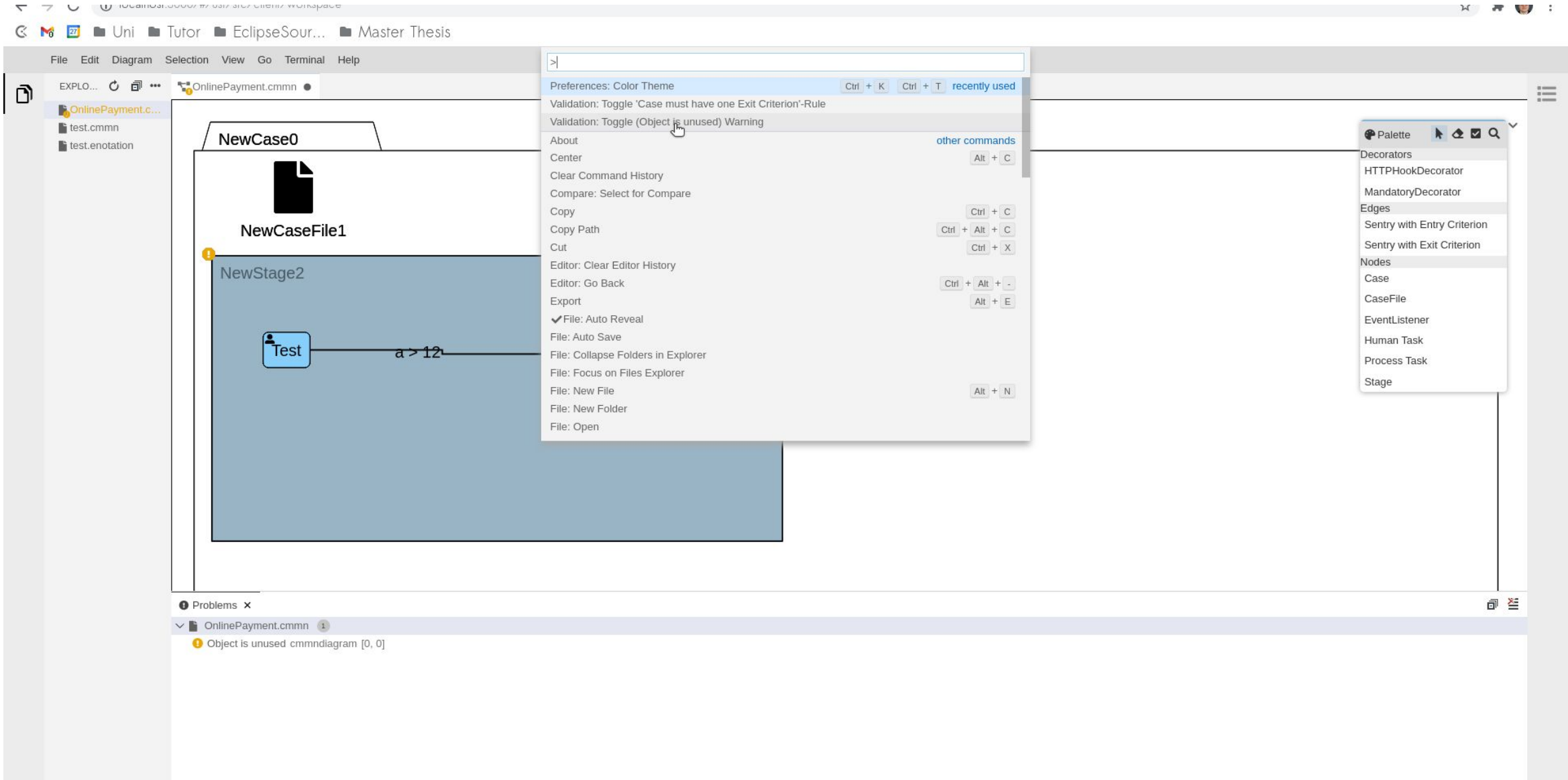
Live Demo

File Edit Diagram Selection View Go Terminal Help
EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
Test
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
OnlinePayment.cmmn 2
Object is unused cmmndiagram [0, 0]
Object is unused cmmndiagram [0, 0]
0 2

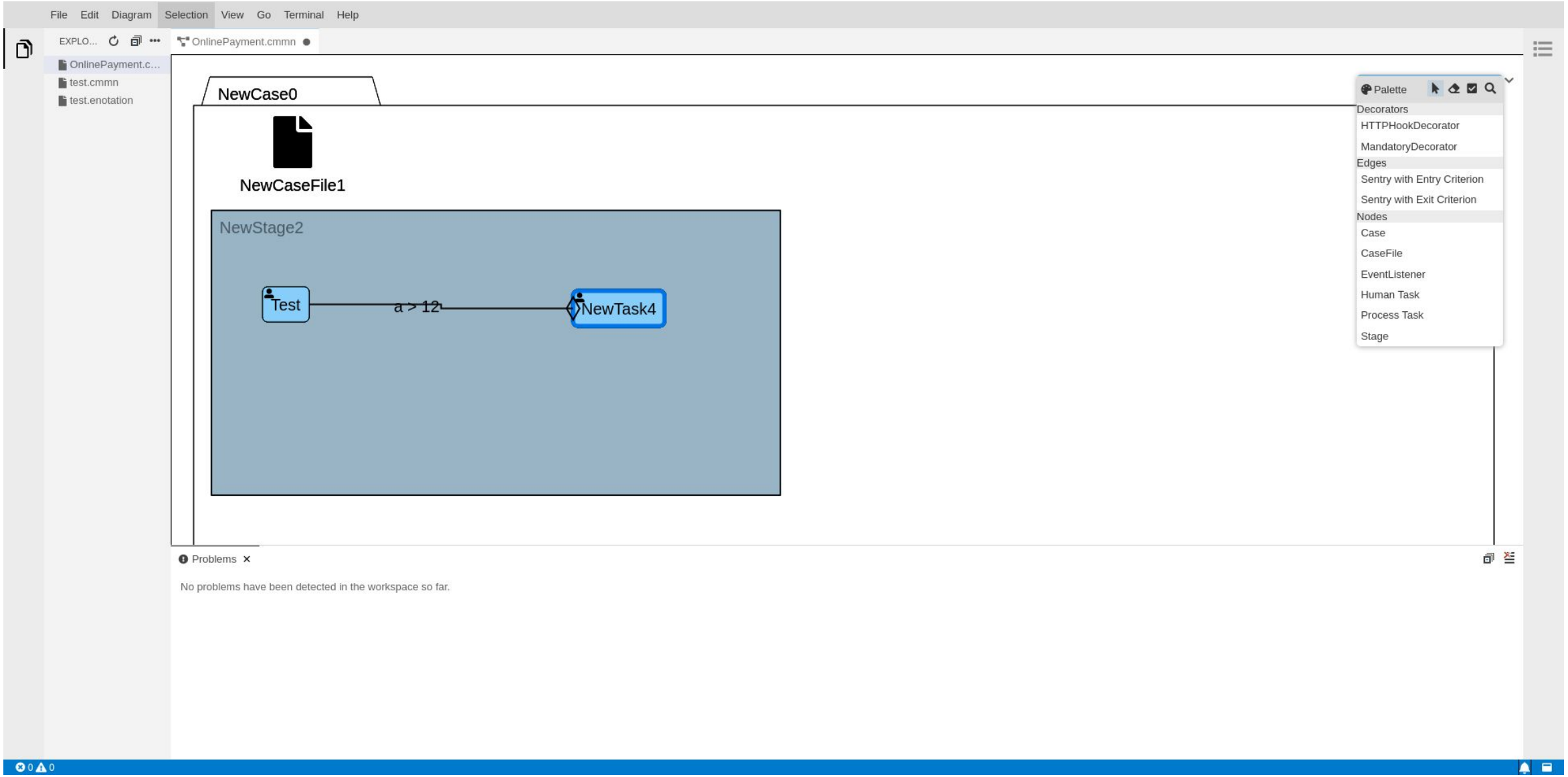
Live Demo


File Edit Diagram Selection View Go Terminal Help
EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
Test
a > 12
NewTask4
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
OnlinePayment.cmmn
Object is unused cmmndiagram [0, 0]

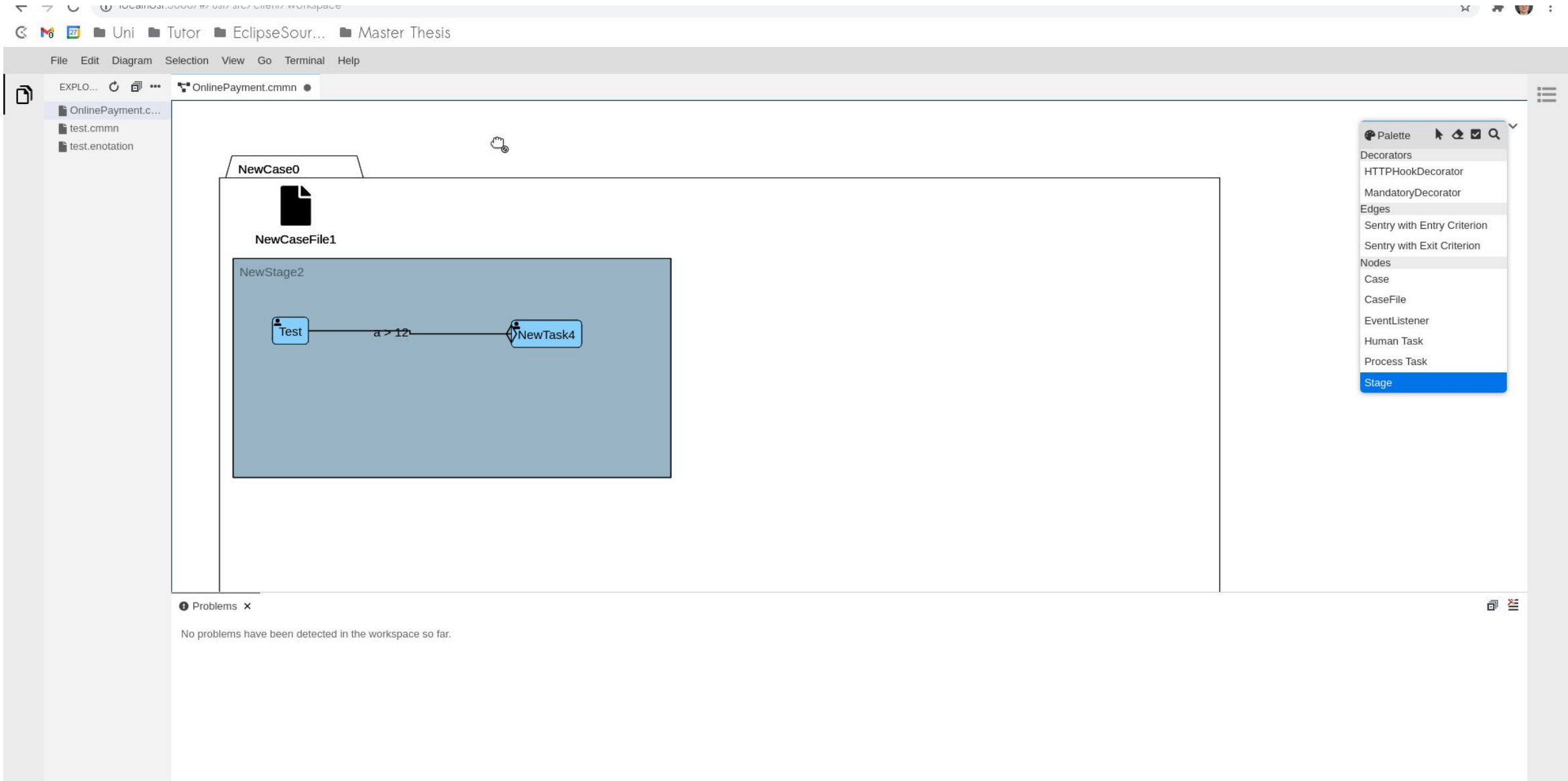
Live Demo


Uni
Tutor
EclipseSour...
Master Thesis
File Edit Diagram Selection View Go Terminal Help
EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
Test
a > 12
>
Preferences: Color Theme Ctrl + K Ctrl + T recently used
Validation: Toggle 'Case must have one Exit Criterion'-Rule
Validation: Toggle (Object is unused) Warning
About other commands
Center Alt + C
Clear Command History
Compare: Select for Compare
Copy Ctrl + C
Copy Path Ctrl + Alt + C
Cut Ctrl + X
Editor: Clear Editor History
Editor: Go Back Ctrl + Alt + -
Export Alt + E
File: Auto Reveal
File: Auto Save
File: Collapse Folders in Explorer
File: Focus on Files Explorer
File: New File Alt + N
File: New Folder
File: Open
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
OnlinePayment.cmmn 1
Object is unused cmmndiagram [0, 0]

Live Demo


File Edit Diagram Selection View Go Terminal Help
EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
Test
a > 12
NewTask4
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
No problems have been detected in the workspace so far.

Live Demo


Uni
Tutor
EclipseSour...
Master Thesis
File
Edit
Diagram
Selection
View
Go
Terminal
Help
EXPLO...
OnlinePayment.cmmn
OnlinePayment.c...
test.cmmn
test.enotation
NewCase0
NewCaseFile1
NewStage2
Test
a > 12
NewTask4
Palette
Decorators
HTTPHookDecorator
MandatoryDecorator
Edges
Sentry with Entry Criterion
Sentry with Exit Criterion
Nodes
Case
CaseFile
EventListener
Human Task
Process Task
Stage
Problems
No problems have been detected in the workspace so far.