Building

Web-based Modeling Tools

with

Theia and Che

eclipsecon Europe 2019

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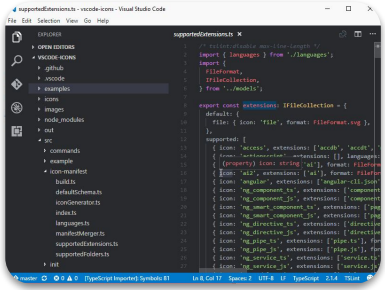
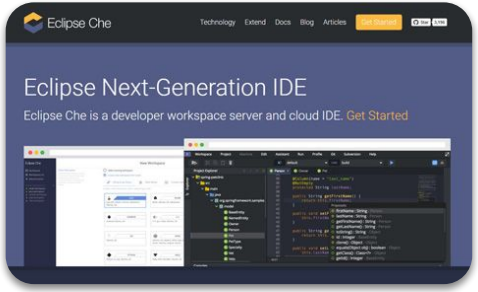
EclipseSource

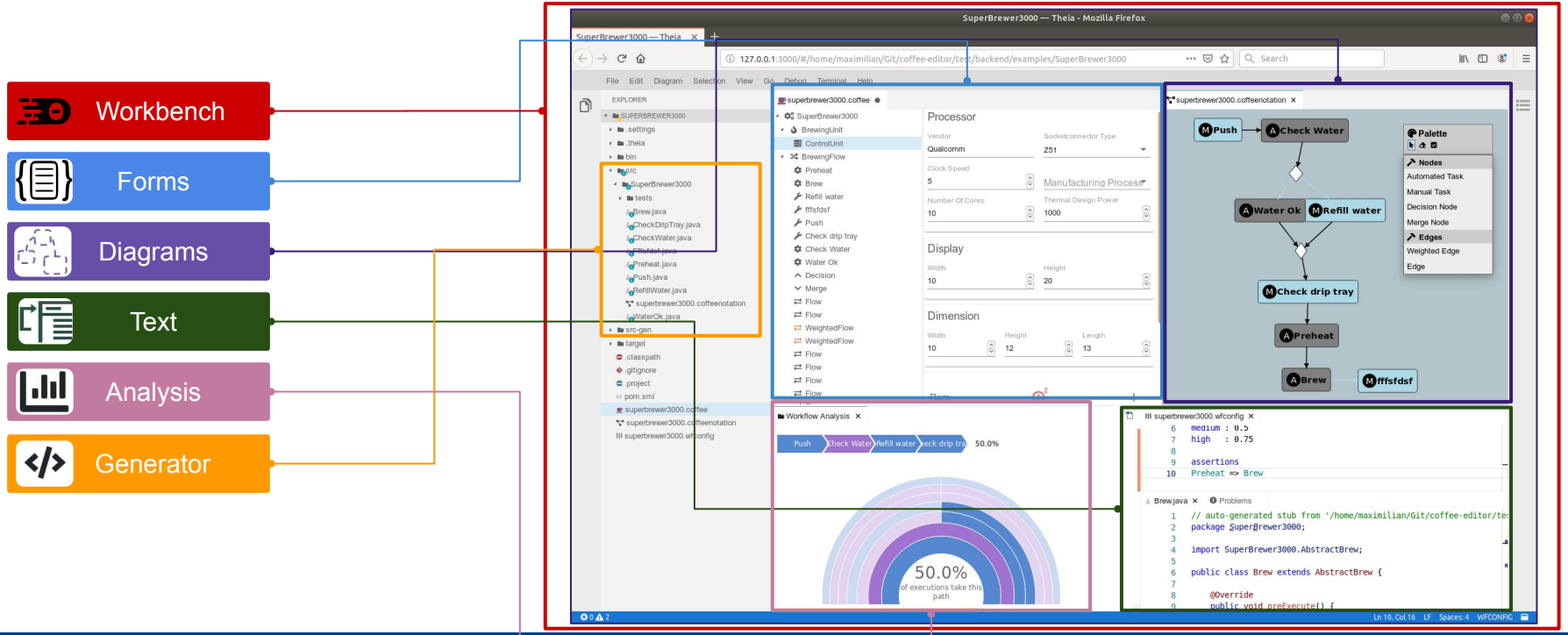
Why web-based tools?

- Accessibility
  - No client installation
  - Access through a web link
  - Simple client updates
  - Physical resource sharing
- Usability
  - Modern UI look and feel
  - SWT vs. HTML5
  - GEF 3 vs. SVG
- Maintainability
  - Room for evolution
  - Availability of developers



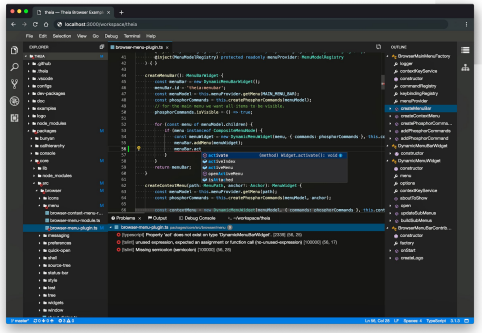


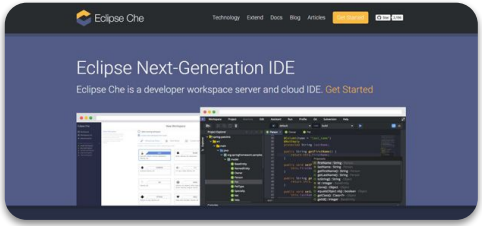
A prototypical (modeling) tool



Key enablers for building domain-specific, web-based tools

- Eclipse Theia
  - Extensible cloud IDE
  - Default frontend for Eclipse Che
- Eclipse Che
  - Kubernetes-native IDE platform
  - Management of workspaces and dev environments
- Monaco & Language server protocol (LSP)
  - Protocol enabling the separation of editor (front-end) and language implementation (back-end)
  - Feature-rich and broadly adopted (VS Code)

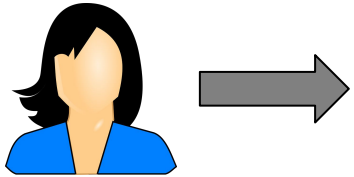


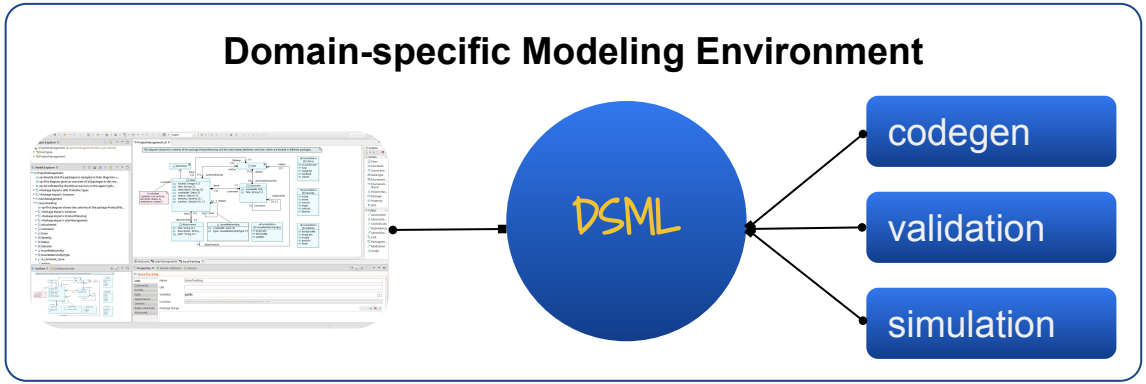


⇒ Related talk: "Eclipse Theia and Che, explained and explored!", Today 17:00, Theater Stage

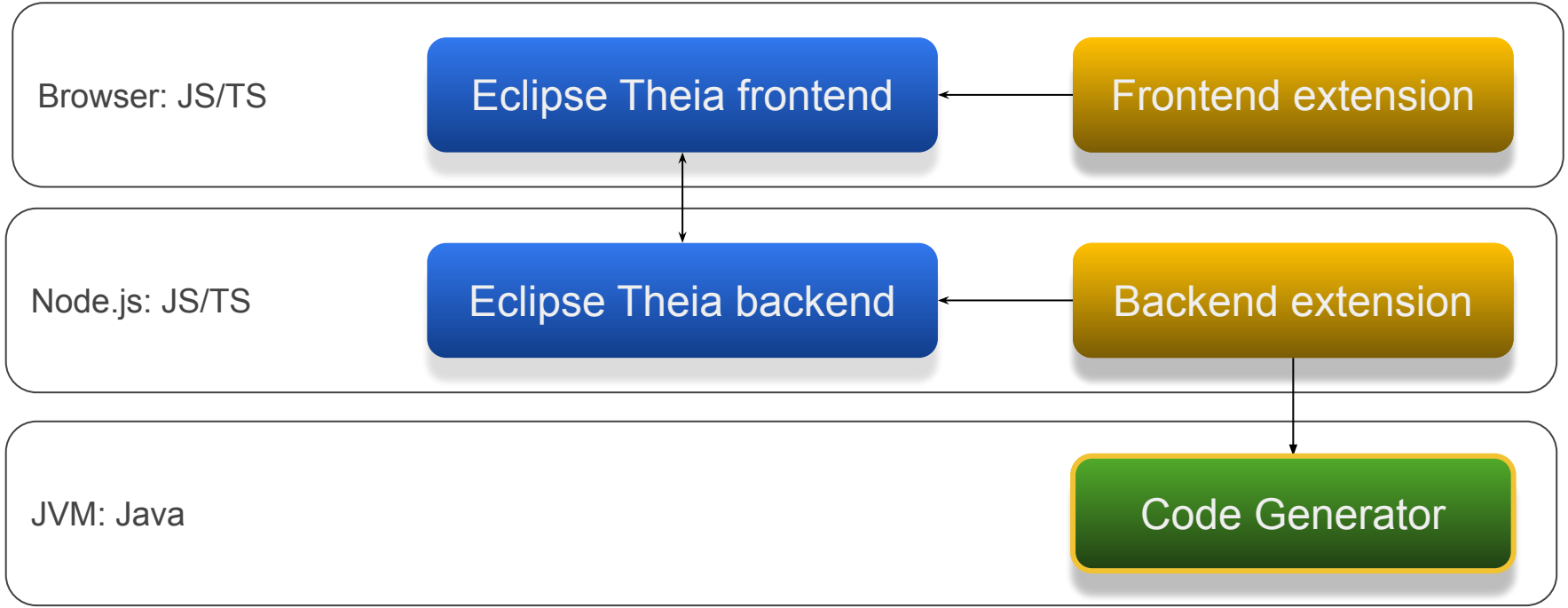
Reinventing the wheel?

- Which components can be reused?
- What needs to be reimplemented?
- How do we separate frontend and backend functionality?

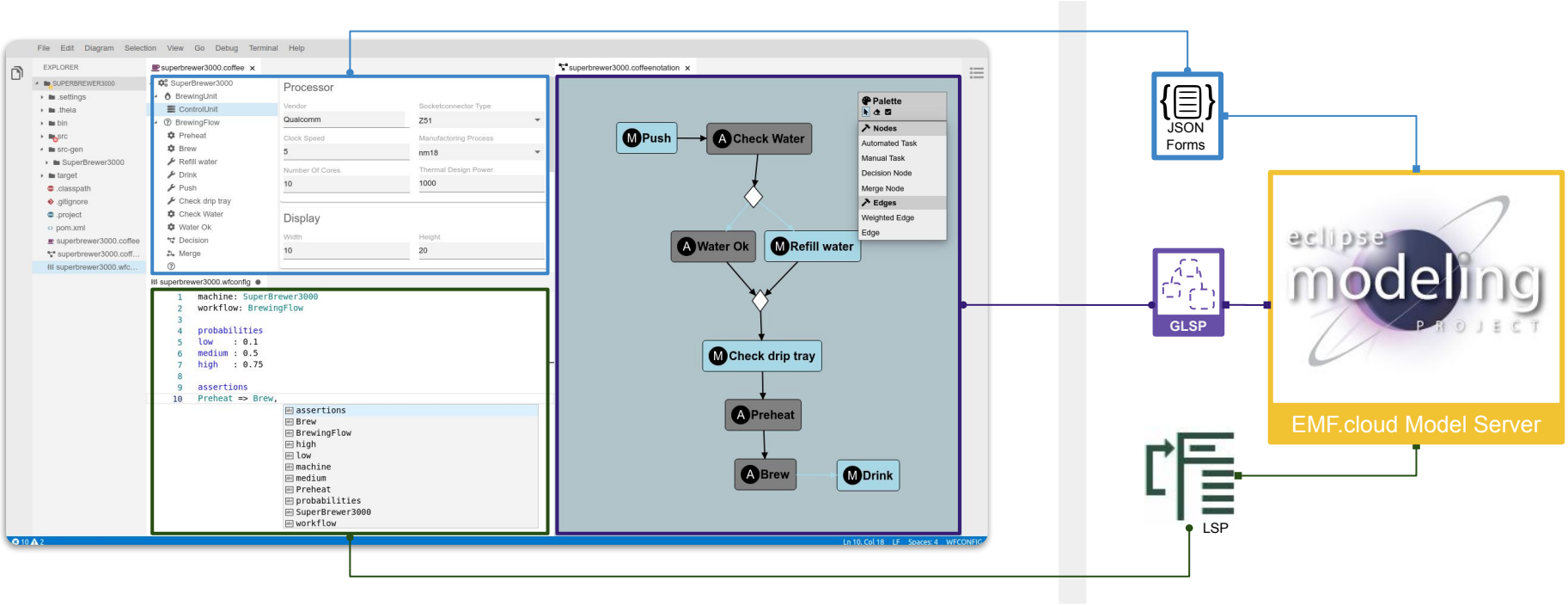




Typical reuse example: Code Generation

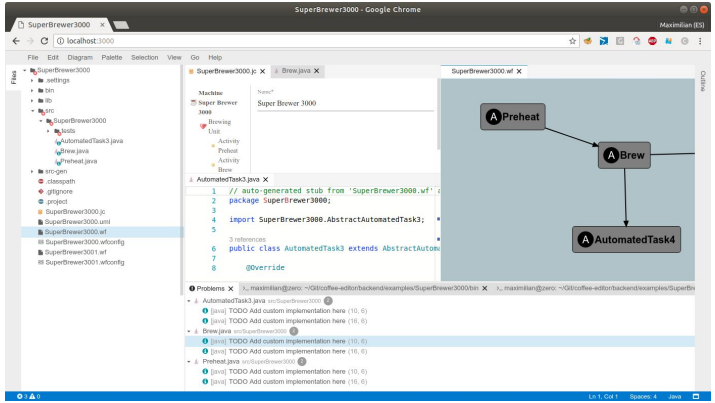


Overall tool architecture

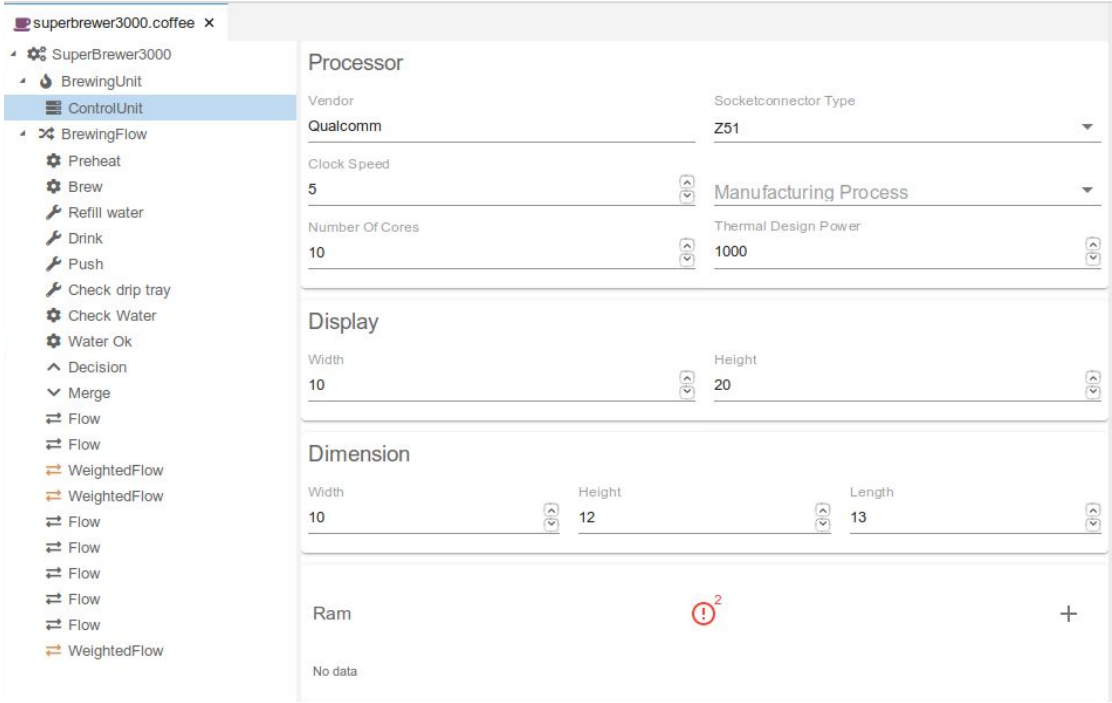


Demo overview

- One connected model for coffee makers
  - Structural model
  - Behavioral model
- Example IDE with the following features:
  - Tree-Editor for structural modeling with forms
  - Graphical editor for behavioral model
  - Code generation
  - Working with source code
  - Textual Modeling
  - Model Analysis
  - Multi-User Support

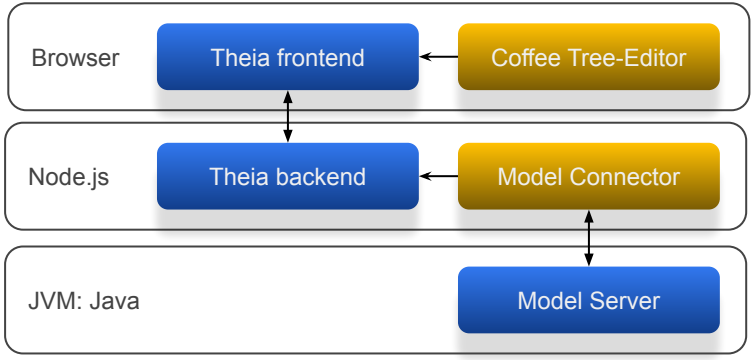


Demo: Form-based editing



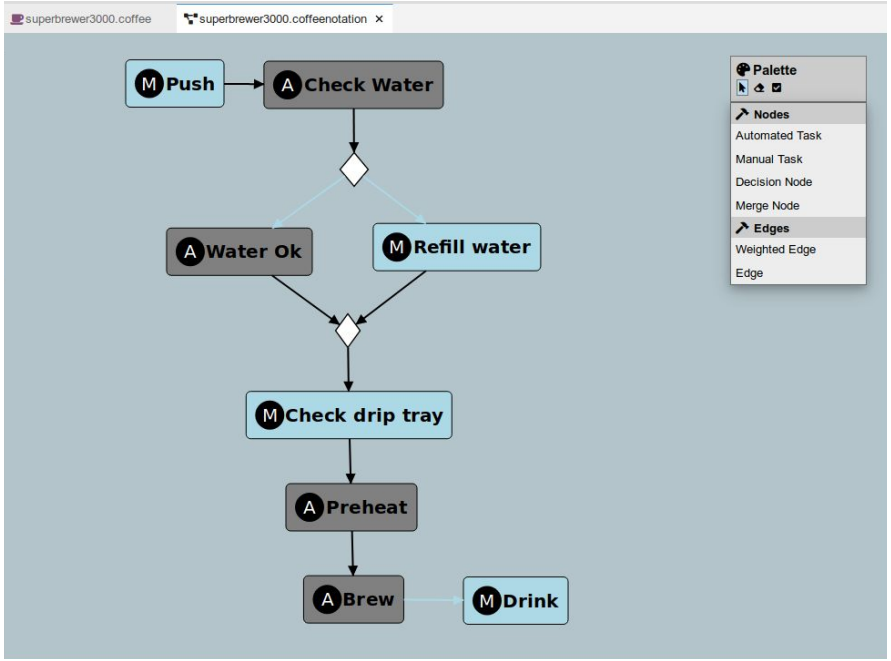
Form-based editing

- Tree
  - Based on Theia Tree Widget
  - LabelPovider and ContentProvider
- Detail-Form
  - Based on JSON Forms
  - Declarative approach: JSON + UI Schema
- Synchronization
  - Based on EMF.cloud Model Server
  - Typescript-based Model Server client API
    - Push changes as commands
    - Subscribe to updates



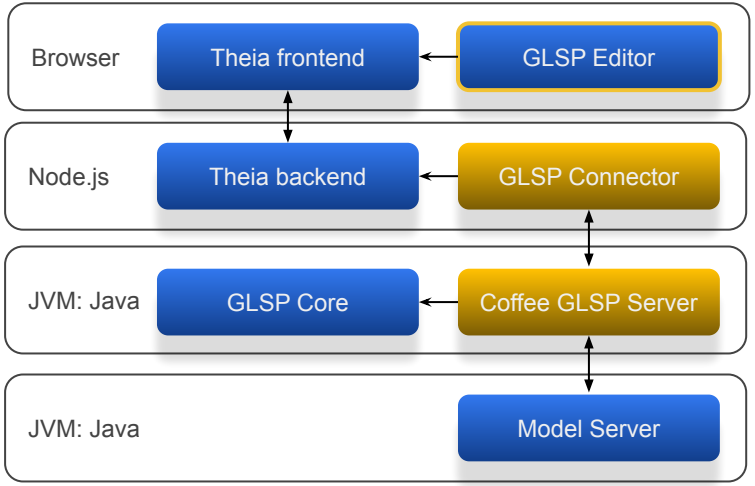
⇒ Related talk: "Property editors in space", Thursday 1pm, Theater Stage

Demo: Graphical Modeling



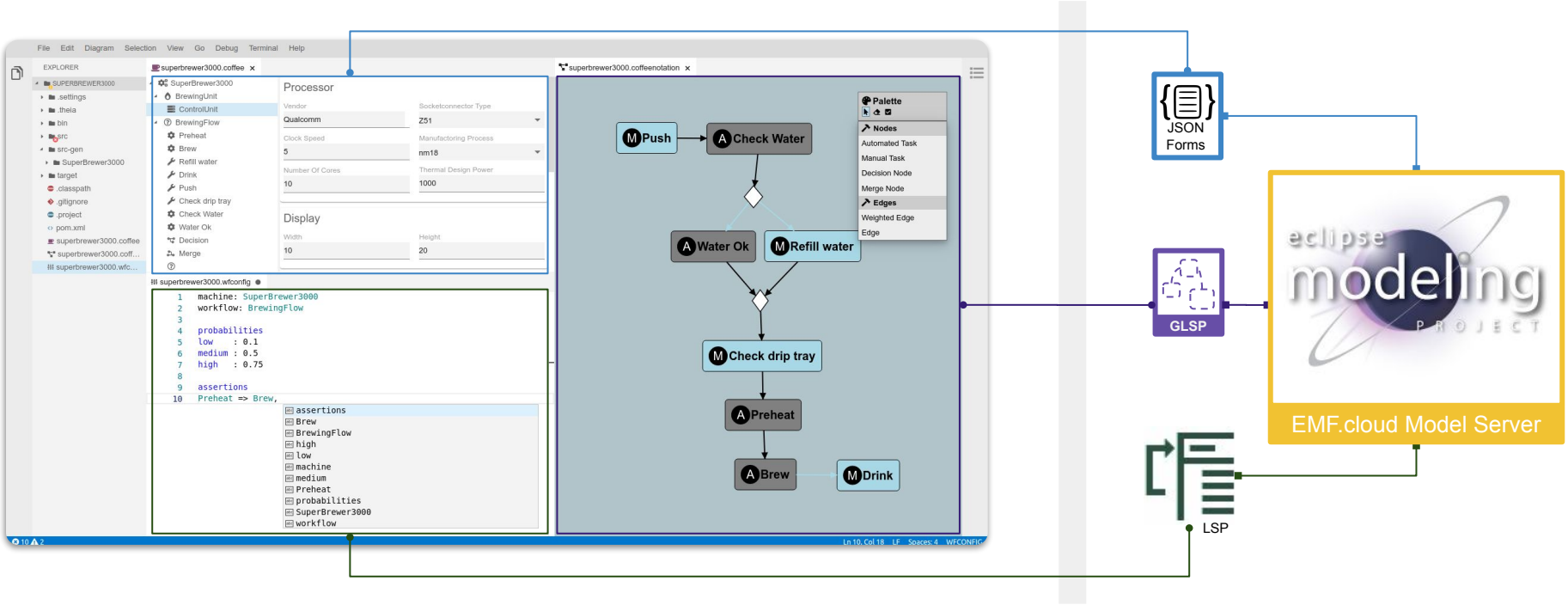
Graphical Modeling

- Graphical Language Server Platform (GLSP)
  - LSP for Graphical Editors
  - GLSP client:
    - generic
    - renders graphical visualization
  - GLSP server:
    - specific to DSL
    - maps model to graphical visualization
    - synchronization with model server
  - Based on Eclipse Sprotty

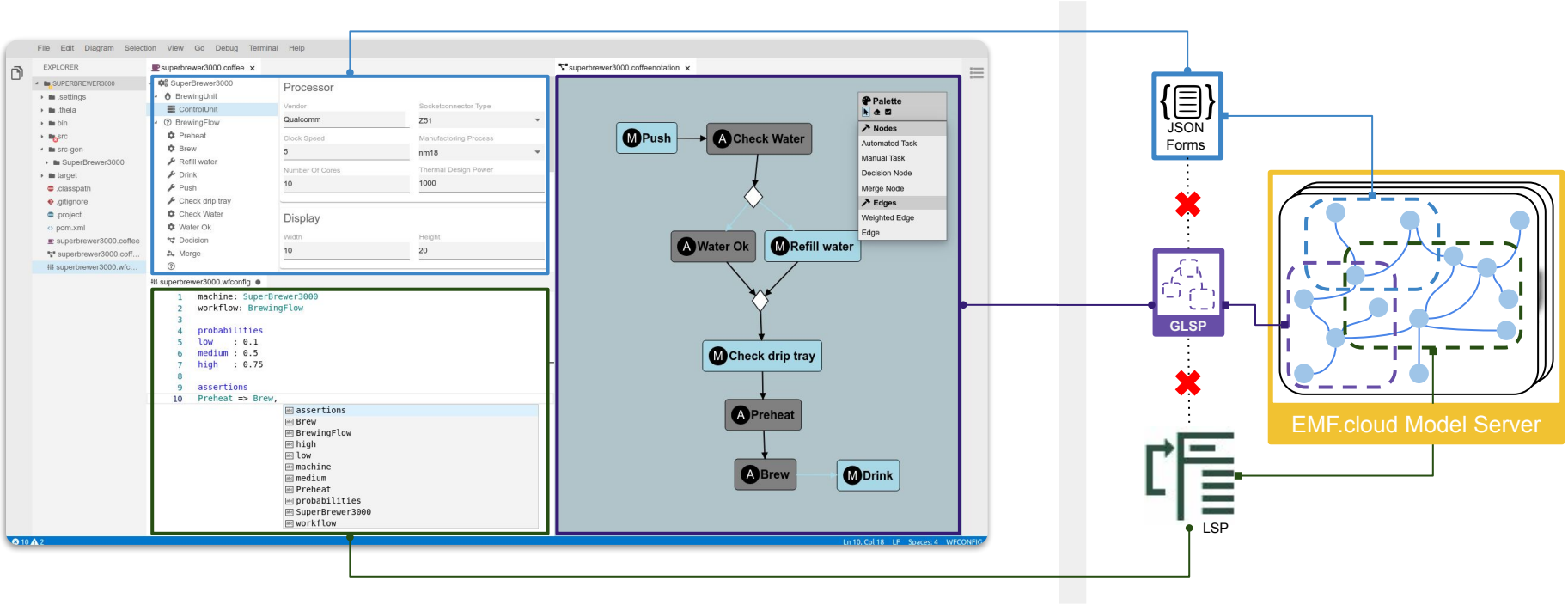


⇒ Related talk: "Diagrams in web and space with GLSP", Thursday 15:10pm, Bürgersaal 2

Demo: Model Server



Model Server



Model Server

- Component of EMF.cloud Eclipse project
- Features
  - Command-based change interface
  - Notification mechanism via sockets
  - Convenient model access with client APIs

EMF.cloud Model Server

⇒ Related talk: "Lifting the greatness of EMF into the cloud with EMF.cloud", Wednesday 12:35pm

Demo: Generators - Model to Text

SuperBrewer3000 — Theia - Mozilla Firefox

SuperBrewer3000 — Theia

127.0.0.1:3000/#/home/maximilian/Git/coffee-editor/current/backen

File Edit Diagram Selecti

Generating code for superbrewer3000.coffee

Close

EXPLORER

- SUPERBREWER3000
  - .settings
  - .theia
  - bin
  - src
    - SuperBrewer3000
      - tests
      - Brew.java
      - CheckDripTray.java
      - CheckWater.java
      - Drink.java
      - Ffsfdsf.java
      - Preheat.java
      - Push.java
      - RefillWater.java
      - superbrewer3000.coffeenotation
      - WaterOk.java
  - src-gen
  - target
  - .classpath
  - .gitignore
  - .project
  - pom.xml
  - superbrewer3000.coffee
  - superbrewer3000.coffeenotation
  - superbrewer3000.wfconfig

superbrewer3000.coffeenotation | Brew.java | superbrewer3000.coffee

```
1  // auto-generated stub from '/home/maximilian/Git/coffee-editor/current/backend/examples/Sup
2  package SuperBrewer3000;
3
4  import SuperBrewer3000.AbstractBrew;
5
6  public class Brew extends AbstractBrew {
7
8      @Override
9      public void preExecute() {
10         // TODO Add custom implementation here
11
12     }
13
14     @Override
15     public void postExecute() {
16         // TODO Add custom implementation here
17
18     }
19
20 }
21
```

Problems | Debug Console

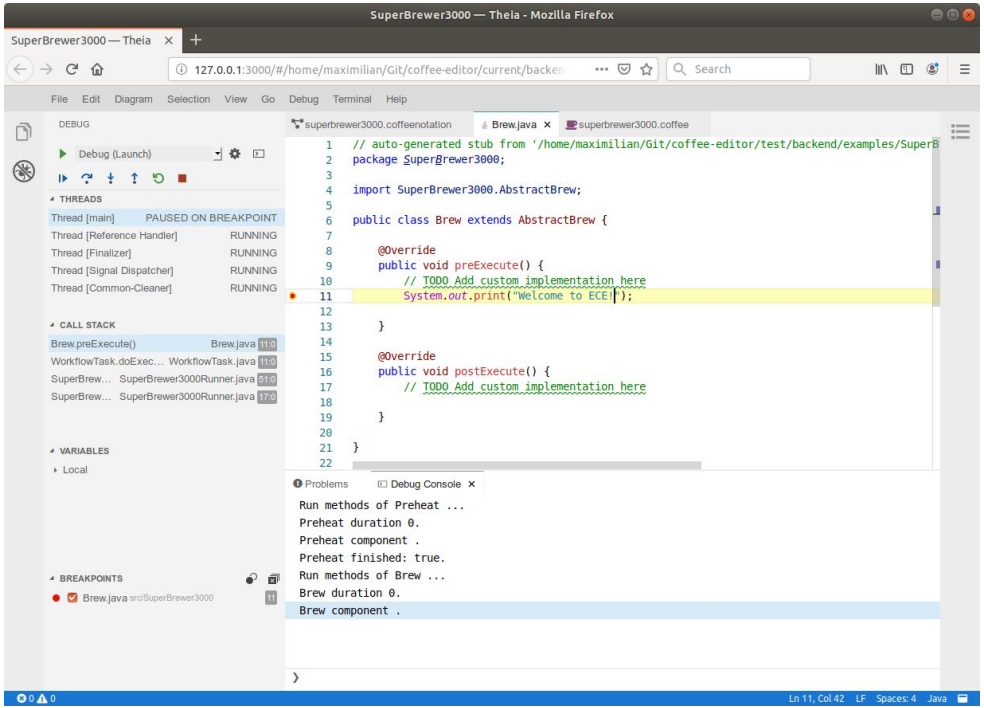
```
Run methods of Preheat ...
Preheat duration 0.
Preheat component .
Preheat finished: true.
Run methods of Brew ...
Brew duration 0.
Brew component .
```

Ln 15, Col 23 LF Spaces: 4 Java

Generators: Model to Text

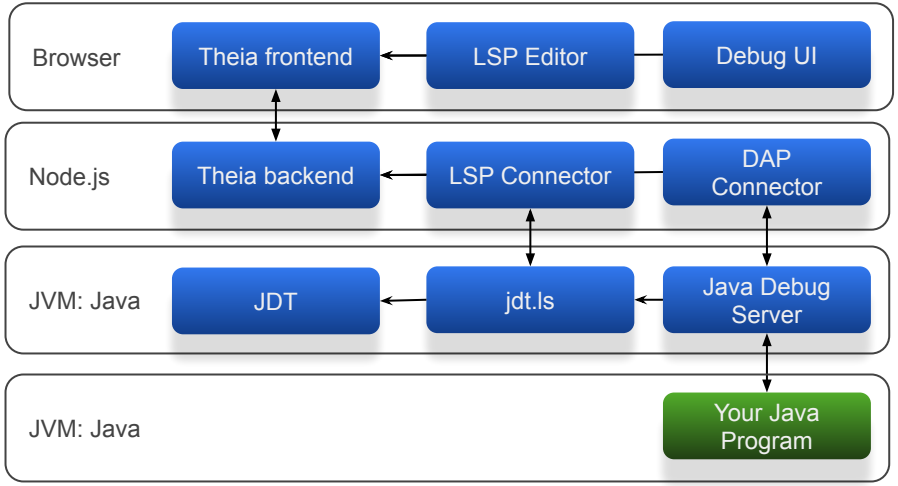
- Based on Eclipse Xtend
- Generator jar build with Maven
- Launched on demand via CLI
- Generates into selected Theia workspace folder

Demo: Working with source code



Working with source code

- Enablers:
  - Language Server Protocol (LSP)
  - Debug Adapter Protocol (DAP)
- Theia Code Editor
  - Monaco-based (VS Code)
  - Uses LSP to “understand” language
- Theia Debug Extension (DAP)
  - Uses DAP to support language debug



Demo: Textual Modeling

superbrewer3000.coffeenotation | Brew.java | superbrewer3000.wfconfig | superbrewer3000.coffee

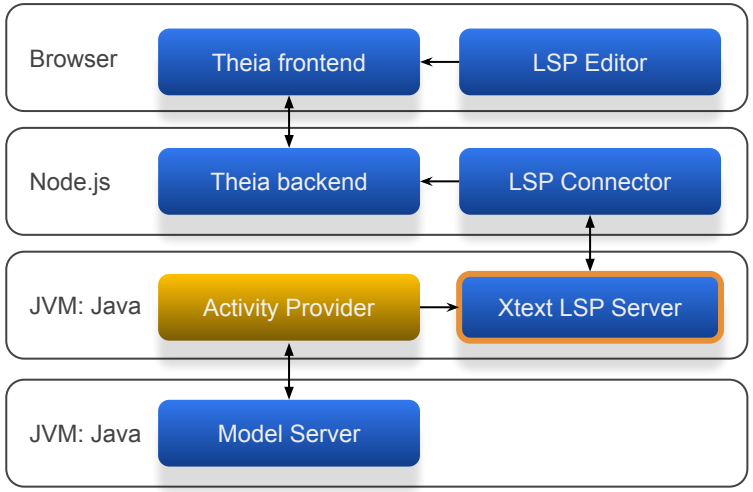
```
1   machine: SuperBrewer3000
2   workflow: BrewingFlow
3
4   probabilities
5   low    : 0.1
6   medium : 0.5
7   high   : 0.75
8
9   assertions
10  Preheat => Brew, Preheat =>
```

- Brew
- Check drip tray
- Check Water
- fffsfdsf
- Preheat
- Push
- Refill water
- Water Ok

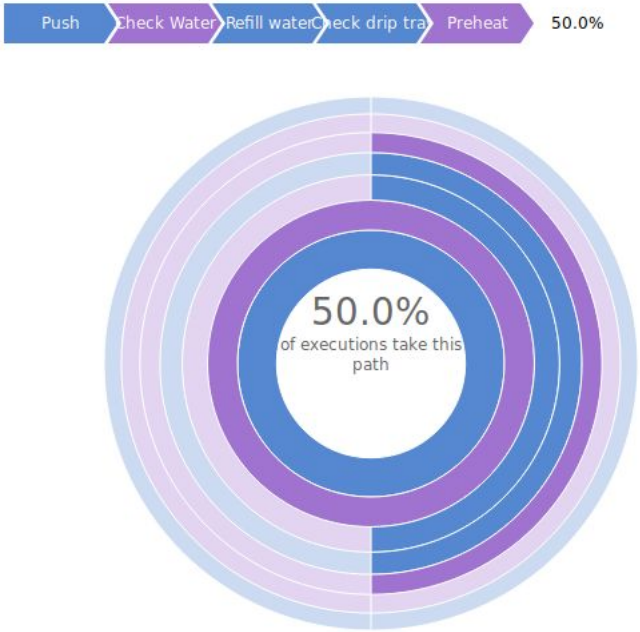
Textual Modeling

- Frontend: Theia Editor (Monaco)

- Backend:
  - DSL modeled as XText grammar
  - XText LSP Server for DSL

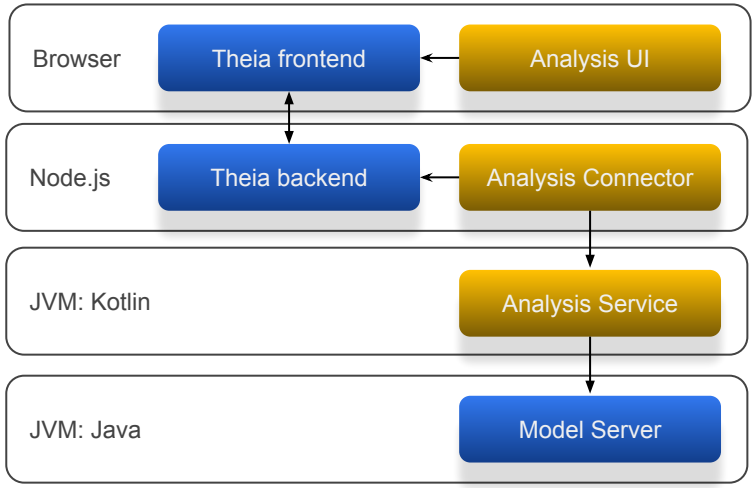


Demo: Model Analysis

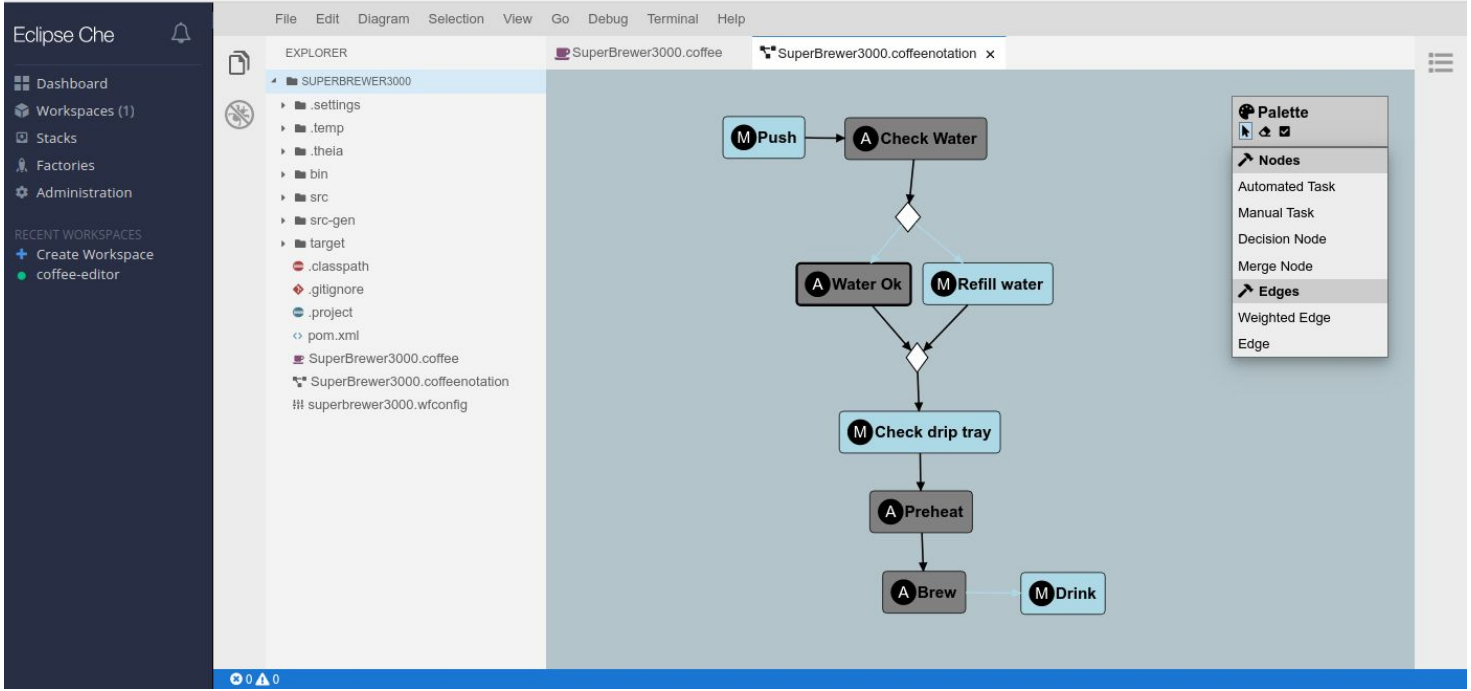


Model Analysis

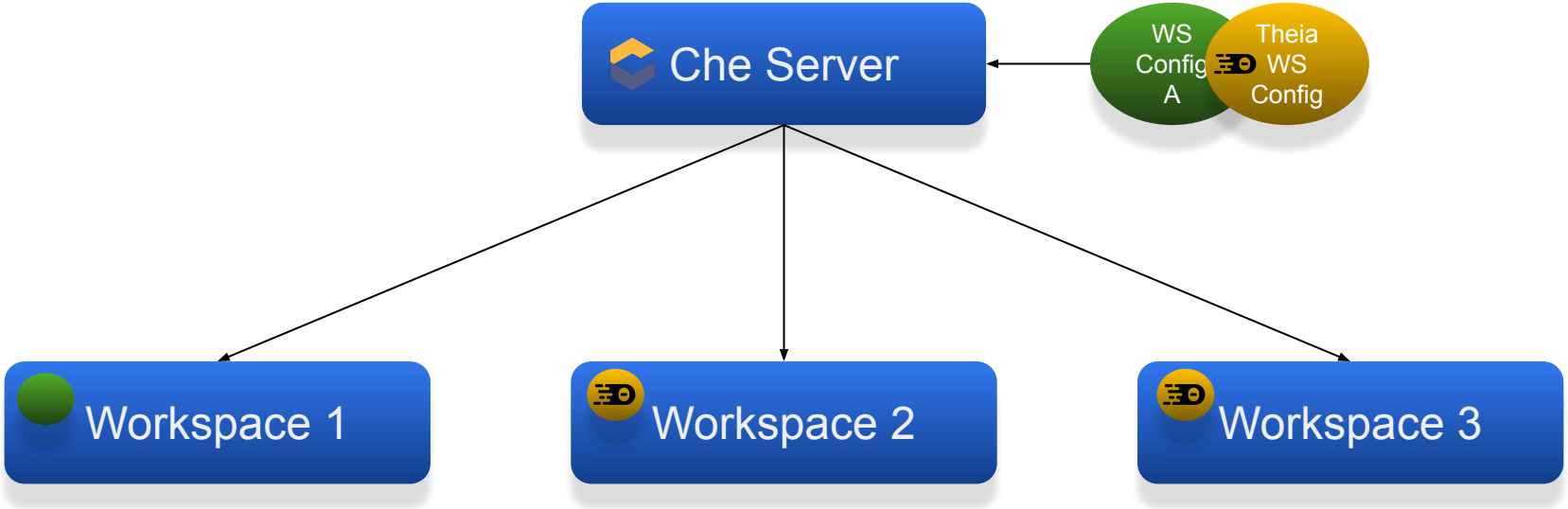
- Frontend:
  - Uses D3 to visualize analysis results
- Backend:
  - Fetches data from model server
  - Calculates analysis result from data



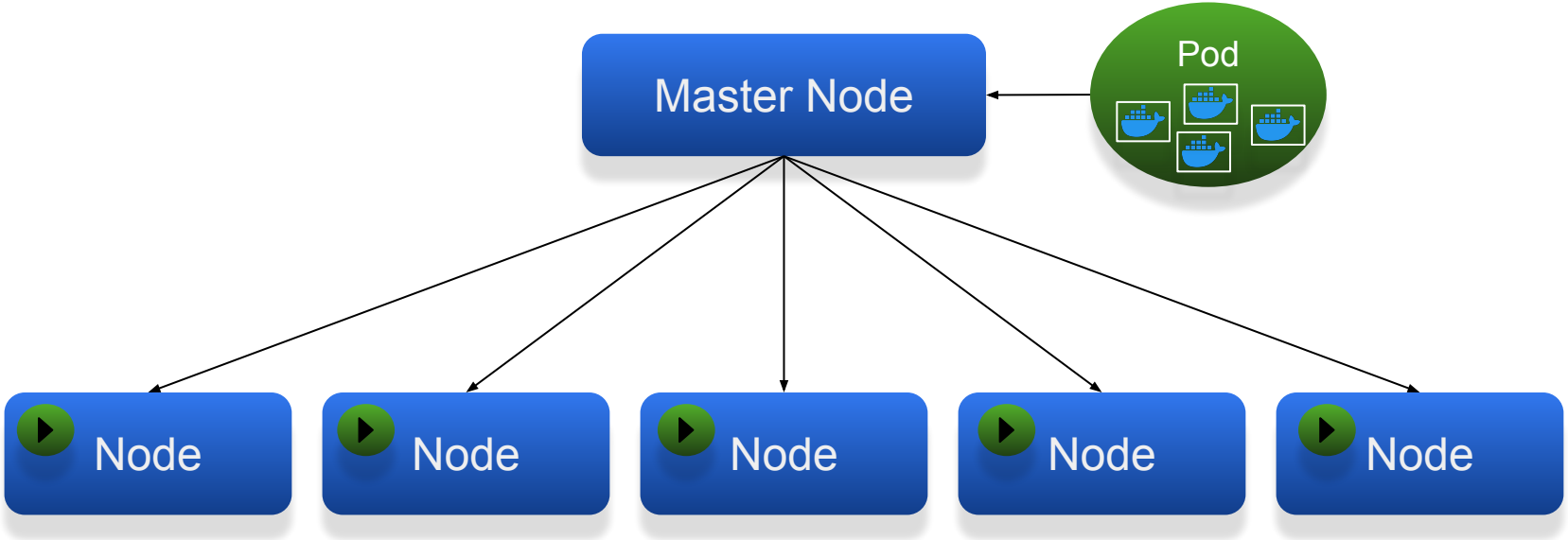
Multi-User Support



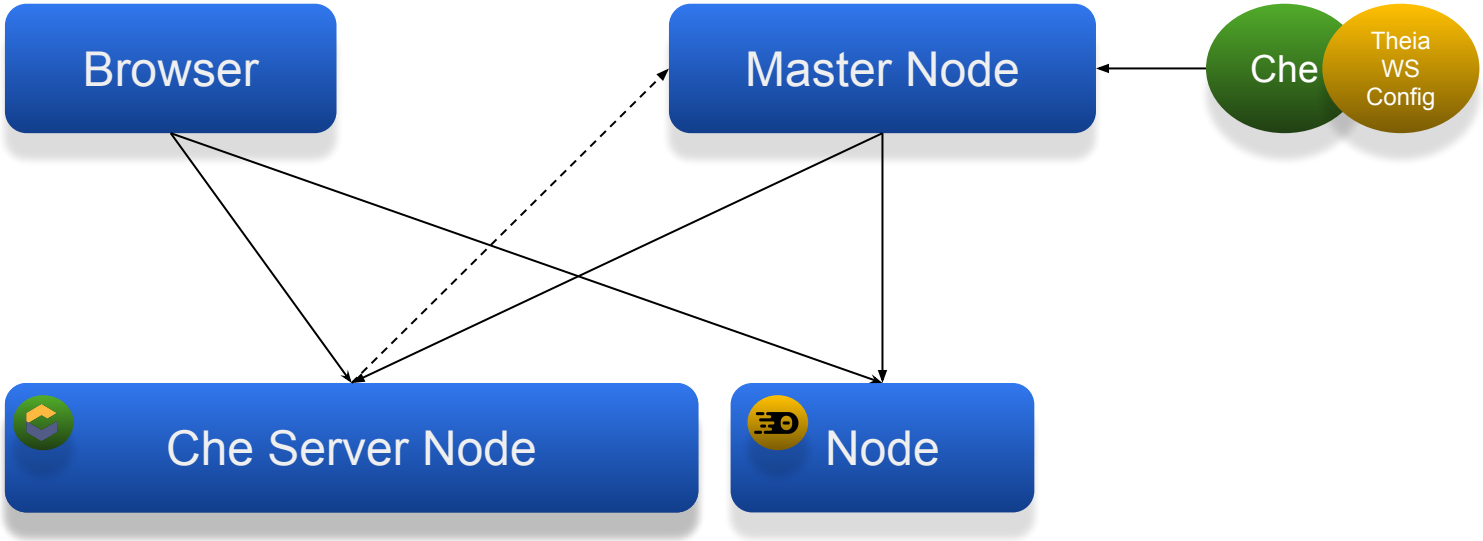
Running Theia on Che



Excursion: Running applications on Kubernetes



Excursion: Running Che and Theia on Kubernetes



Summary

- Web-based modeling tools are feasible today
- Reuse and migration easier than expected
- Web technology can leverage unique advantages
  - Modern UI and styling
  - Zero installation for users
  - Enables “cloud” business models
- There is open-source components
  - Eclipse Theia and Eclipse Che
  - EMF.cloud, LSP, GLSP, JSON Forms, XText, Sprotty and D3
  - Existing business logic can often be reused
- Demo code available: https://github.com/eclipsesource/coffee-editor

→ **Important now:** Define strategy and timeplan, build POC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Please
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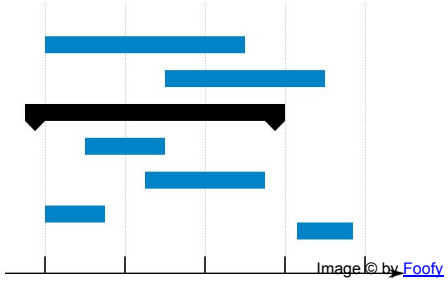
Thank you!

Towards a migration strategy

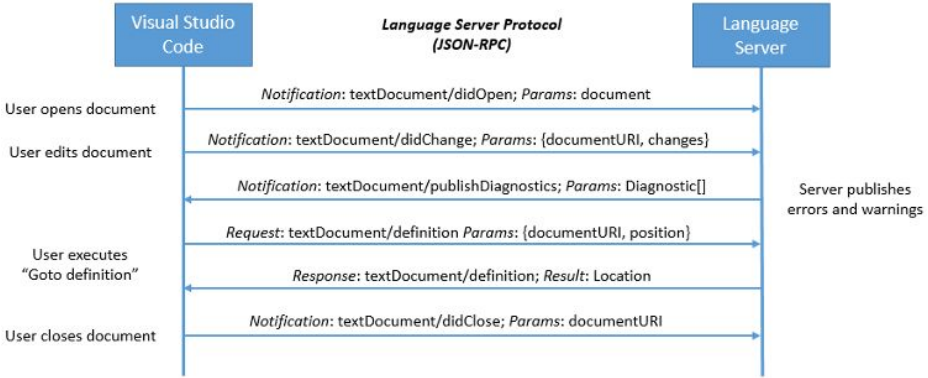
- Now: Define a strategy and timeplan, build POC
- Short-term: Consider for architectural decisions
- Mid-term:
  - Prepare architecture for migration iteratively
  - Migrate high-value use cases iteratively
  - Single-source components, enable reuse
- Long-term:
  - Migrate use-case by use-case iteratively
  - Deprecate desktop-based solution



Excursion: Language Server Protocol

- Separation of concerns
  - Tooling for editing code and textual DSLs
  - Language smarts: auto-completion, refactoring support

- Advantages
  - LSP-Client is language-agnostic
  - LSP-Server is tool-agnostic



Excursion: Separation of Concerns with GLSP