Adopting Theia: Insights from an Initial Contributor

EclipseCon 2022
Ludwigsburg, Germany

Paul Maréchal Ericsson Canada 2022-10-26

$ whoami

Paul Maréchal github.com/paul-marechal

Software Developer at **Ericsson Canada** in Montréal

Eclipse Theia committer/maintainer

Overview

- **Eclipse Theia** ramp-up tour
  - What is **Eclipse Theia**?
  - **Theia Extensions** and **VS Code Extensions**
  - Common pitfalls
- Usage/deployment examples and breakdown
  - **Docker** images (e.g., deprecated github.com/theia-ide/theia-apps)
  - **Eclipse Blueprint**
  - Proof of concept authentication portal

What is Eclipse Theia?

It' s a framework allowing developers to make browser and desktop IDE-like applications.

Eclipse Theia comes as a collection of NPM packages

- Lot of **Theia Extension** packages (45?)
- Few development packages such as the **Theia CLI**
- All under the **@theia/*** NPM namespace
- Cannot easily tell what's a **Theia Extension** or not from the name alone…

No Puns Monday

Products Pricing Documentation

npm

@theia

Search

Sign Up Sign In

71 packages found

1 2 3 4 »

Sort Packages

- Optimal
- Popularity
- Quality
- Maintenance

@theia/editor

Theia - Editor Extension

theia-extension

vince-fugnitto published 1.30.0 • 22 days ago

p q m

@theia/markers

Theia - Markers Extension

theia-extension

vince-fugnitto published 1.30.0 • 22 days ago

p q m

@theia/callhierarchy

Theia - Call Hierarchy Extension

theia-extension

vince-fugnitto published 1.30.0 • 22 days ago

p q m

@theia/file-search

Theia - File Search Extension

theia-extension

vince-fugnitto published 1.30.0 • 22 days ago

p q m

What is a Theia app?

It's an NPM application that's also a collection of **Theia Extensions**.

Install **@theia/cli** as dev dependency to bootstrap your applications:

- It will crawl your **node_modules** looking for **Theia Extensions** to include
- It will generate the frontend and backend scripts and assets
- You can check for dependency issues
- You can start your app quickly

What is a Theia Extension?

It's an NPM package that defines a "**theiaExtensions**" field in its **package.json**.

```
export interface Extension {
    frontend?: string;
    frontendElectron?: string;
    secondaryWindow?: string;
    backend?: string;
    backendElectron?: string;
    electronMain?: string;
}
```

```
  "theiaExtensions": [
    {
      "frontend": "lib/browser/terminal-
frontend-module",
      "secondaryWindow": "lib/browser/terminal-
frontend-module",
      "backend": "lib/node/terminal-backend-
module"
    }
  ],
```

What can a Theia Extension do?

Virtually anything: every feature is implemented through some **Theia Extension**.

```
bind(MonacoToProtocolConverter).toSelf().inSingletonScope();
bind(ProtocolToMonacoConverter).toSelf().inSingletonScope();

bind(MonacoLanguages).toSelf().inSingletonScope();
rebind(LanguageService).toService(MonacoLanguages);
bind(WorkspaceSymbolCommand).toSelf().inSingletonScope();
for (const identifier of [CommandContribution, KeybindingContribution,
MenuContribution, QuickAccessContribution]) {
    bind(identifier).toService(WorkspaceSymbolCommand);
}

bind(MonacoWorkspace).toSelf().inSingletonScope();
```

Example Theia app

```
{
  "private": true,
  "name": "my-theia-app",
  "version": "1.0.0",
  "main": "src-gen/backend/main.js",
  "dependencies": {
    "@theia/plugin-ext-vscode": "latest"
  },
  "devDependencies": {
    "@theia/cli": "latest"
  }
}
```

Transitive dependencies

- **Theia Extensions** are deeply interdependent
- Installing one **Theia Extension** may pull several other **Theia Extensions** (as per its dependencies)
- @theia/cli sees it all 👀

```
return Promise.resolve()
    .then(function () { return import('@theia/core/lib/browser/i18n/i18n-frontend-module').then(load) })
    .then(function () { return import('@theia/core/lib/browser/menu/browser-menu-module').then(load) })
    .then(function () { return import('@theia/core/lib/browser/window/browser-window-module').then(load) })
    .then(function () { return import('@theia/core/lib/browser/keyboard/browser-keyboard-module').then(load) })
    .then(function () { return import('@theia/core/lib/browser/request/browser-request-module').then(load) })
    .then(function () { return import('@theia/variable-resolver/lib/browser/variable-resolver-frontend-
module').then(load) })
    .then(function () { return import('@theia/editor/lib/browser/editor-frontend-module').then(load) })
    .then(function () { return import('@theia/filesystem/lib/browser/filesystem-frontend-module').then(load) })
    .then(function () { return import('@theia/filesystem/lib/browser/download/file-download-frontend-
module').then(load) })
    .then(function () { return import('@theia/filesystem/lib/browser/file-dialog/file-dialog-module').then(load) })
    .then(function () { return import('@theia/process/lib/common/process-common-module').then(load) })
    .then(function () { return import('@theia/workspace/lib/browser/workspace-frontend-module').then(load) })
    .then(function () { return import('@theia/file-search/lib/browser/file-search-frontend-module').then(load) })
    .then(function () { return import('@theia/markers/lib/browser/problem/problem-frontend-module').then(load) })
    .then(function () { return import('@theia/outline-view/lib/browser/outline-view-frontend-module').then(load) })
    .then(function () { return import('@theia/monaco/lib/browser/monaco-frontend-module').then(load) })
    .then(function () { return import('@theia/output/lib/browser/output-frontend-module').then(load) })
    .then(function () { return import('@theia/navigator/lib/browser/navigator-frontend-module').then(load) })
    .then(function () { return import('@theia/search-in-workspace/lib/browser/search-in-workspace-frontend-
module').then(load) })
    .then(function () { return import('@theia/userstorage/lib/browser/user-storage-frontend-module').then(load) })
    .then(function () { return import('@theia/toolbar/lib/browser/toolbar-frontend-module').then(load) })
    .then(function () { return import('@theia/bulk-edit/lib/browser/bulk-edit-frontend-module').then(load) })
    .then(function () { return import('@theia/callhierarchy/lib/browser/callhierarchy-frontend-module').then(load) })
    .then(function () { return import('@theia/console/lib/browser/console-frontend-module').then(load) })
    .then(function () { return import('@theia/terminal/lib/browser/terminal-frontend-module').then(load) })
    .then(function () { return import('@theia/task/lib/browser/task-frontend-module').then(load) })
```

Bogus Theia app

```
{
  "private": true,
  "name": "my-theia-app",
  "version": "1.0.0",
  "main": "src-gen/backend/main.js",
  "dependencies": {
    "@theia/new-dependency": "latest"
    "@theia/plugin-ext-vscode": "latest"
  },
  "devDependencies": {
    "@theia/cli": "latest"
  }
}
```

Bogus Theia app

```
{
  "private": true,
  "name": "my-theia-app",
  "version": "1.0.0",
  "main": "src-gen/backend/main.js",
  "dependencies": {
    "@theia/new-dependency": "1.30.0"
    "@theia/plugin-ext-vscode": "1.29.0"
  },
  "devDependencies": {
    "@theia/cli": "1.29.0"
  }
}
```

Dependency mishaps

- First, be aware about your NPM dependencies
- Second, use @theia/cli to spot common issues with **Theia Extensions**
  - npx theia check:theia-version

Theia Extension or VS Code Extension?

- First try implementing your feature as a **VS Code Extension**
  - Make sure **Theia** supports the APIs you plan on using
- Otherwise consider writing a **Theia Extension**

Theia Extensions stability

- **Stable**
  - Contribution points (e.g., **FrontendApplicationContribution**)
- **Somewhat stable**
  - Some services (e.g., **RequestService**)
- **Not stable**
  - Arbitrary classes and protected methods (implementation details)
  - We still make a best effort to not break these, but it may hinder maintenance

VS Code Extensions

- **Theia**'s implementation of the **VS Code API**
- **Theia Community Release 1.29.1** supports **VS Code API 1.53.2**
  - See the **Theia Community Release**: theia-ide.org/releases/
    - Latest was released on **September 29th, 2022**
  - See the API comparator: eclipse-theia.github.io/vscode-theia-comparator/status.html
- Ongoing efforts to support more recent APIs

Full	Filtered	Theia master	Theia v1.30.0	Theia v1.29.1-community	VSCode main	VSCode 1.72.2	VSCode 1.71.2	VSCode 1.70.2	VSCode 1.69.2	VSCode 1.55.2	VSCode 1.53.2	Note
onDidCollapseElement		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
onDidExpandElement		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
reveal		Supported	Supported	Partial	✓	✓	✓	✓	✓	✓	✓	
selection		Supported	Supported	Partial	✓	✓	✓	✓	✓	✓	✓	
title		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
visible		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
TreeViewExpansionEvent		Supported	Supported	Partial	✓	✓	✓	✓	✓	✓	✓	
element		Supported	Supported	Partial	✓	✓	✓	✓	✓	✓	✓	
TreeViewOptions		Partial	Partial	Partial	✓	✓	✓	✓	✓	✓	✓	
canSelectMany		Unsupported	Unsupported	Unsupported	✓	✓	✓	✓	✓	✓	✓	#10102
dragAndDropController		Unsupported	Unsupported	Unsupported	✓	✓	✓	✓	✓	-	-	
showCollapseAll		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
treeDataProvider		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
TreeViewSelectionChangeEvent		Supported	Supported	Partial	✓	✓	✓	✓	✓	✓	✓	
selection		Supported	Supported	Partial	✓	✓	✓	✓	✓	✓	✓	
TreeViewVisibilityChangeEvent		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
visible		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
TypeDefinitionProvider		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
provideTypeDefinition		Supported	Supported	Supported	✓	✓	✓	✓	✓	✓	✓	
TypeHierarchyItem		Supported	Unsupported	Unsupported	✓	✓	✓	✓	✓	✓	✓	#11516
constructor		Supported	Unsupported	Unsupported	✓	✓	✓	✓	✓	✓	✓	
detail		Supported	Unsupported	Unsupported	✓	✓	✓	✓	✓	✓	✓	

The different kinds of integration

Integrated Development Environment (IDE)

- Supports a variety of workflows OOTB
- Lots of views
- Wizards?
- May feel heavy or bloated?
- More things may still be contributed

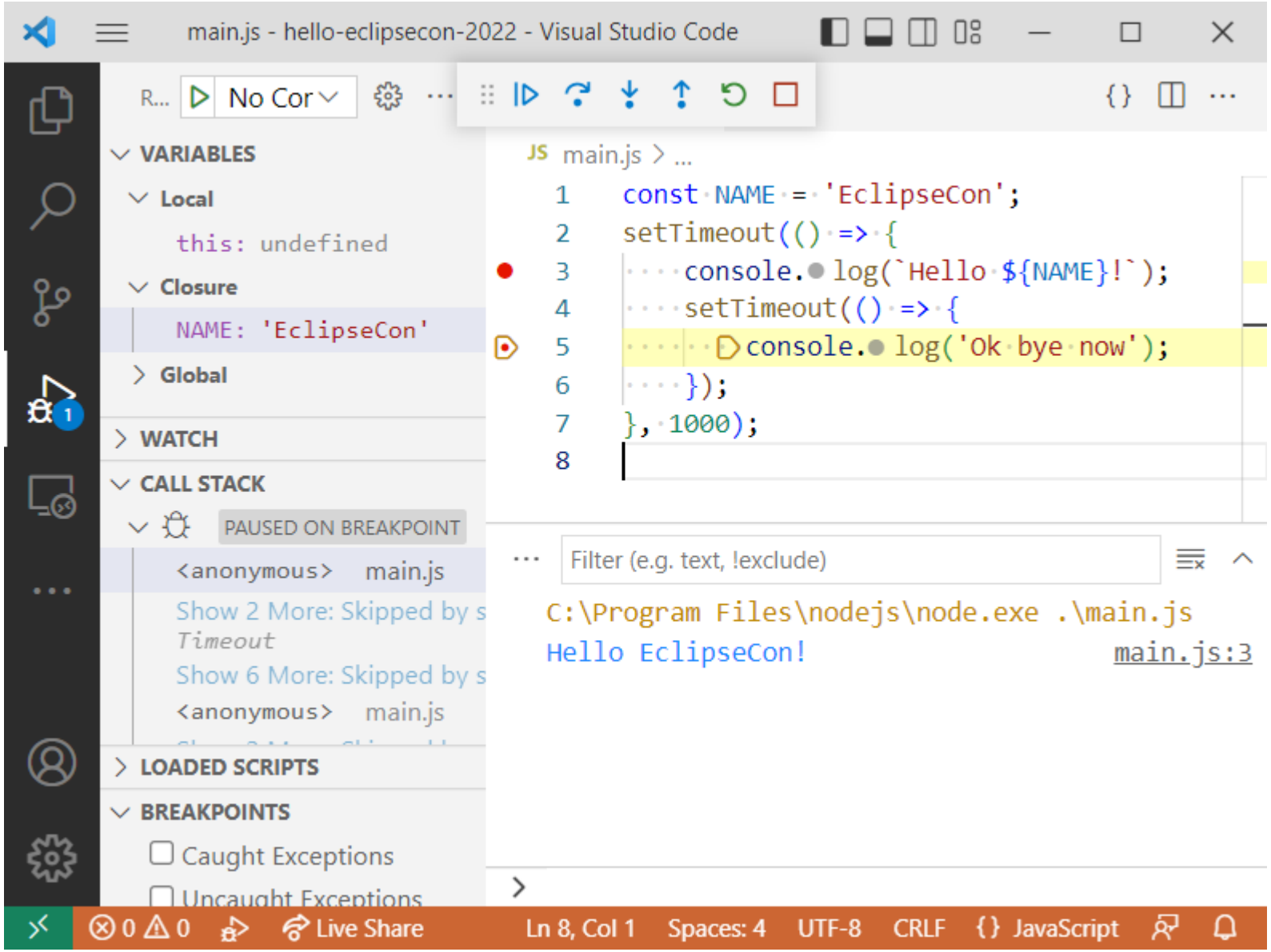
(Smart) Editors

- Main purpose: Work on code
- Somewhat dumb OOTB
- Smartness is contributed
- Tools are used, not often embedded

The VS Code way

Support common denominators:

- Code navigation
- Code completion
- Live static analysis
- In-editor debug
- Tasks
- Tests
- …



The VS Code way: LSP

- **Technical feat**
  - Specify a reliable **Language Server Protocol** (**LSP**) to transmit language information in real time
  - Ensures the **Language Server** (**LS**) logic is isolated from the main process
  - The protocol can run on a variety of transports (streams: pipes, TCP sockets, WebSocket, etc)
- **Collaboration feat**
  - **VS Code** can focus on implementing **editor core features**
  - The “communities“ will happily develop language servers thanks to their **expert knowledge**
  - Servers can be implemented in any language, **not just JavaScript**

The VS Code way: DAP

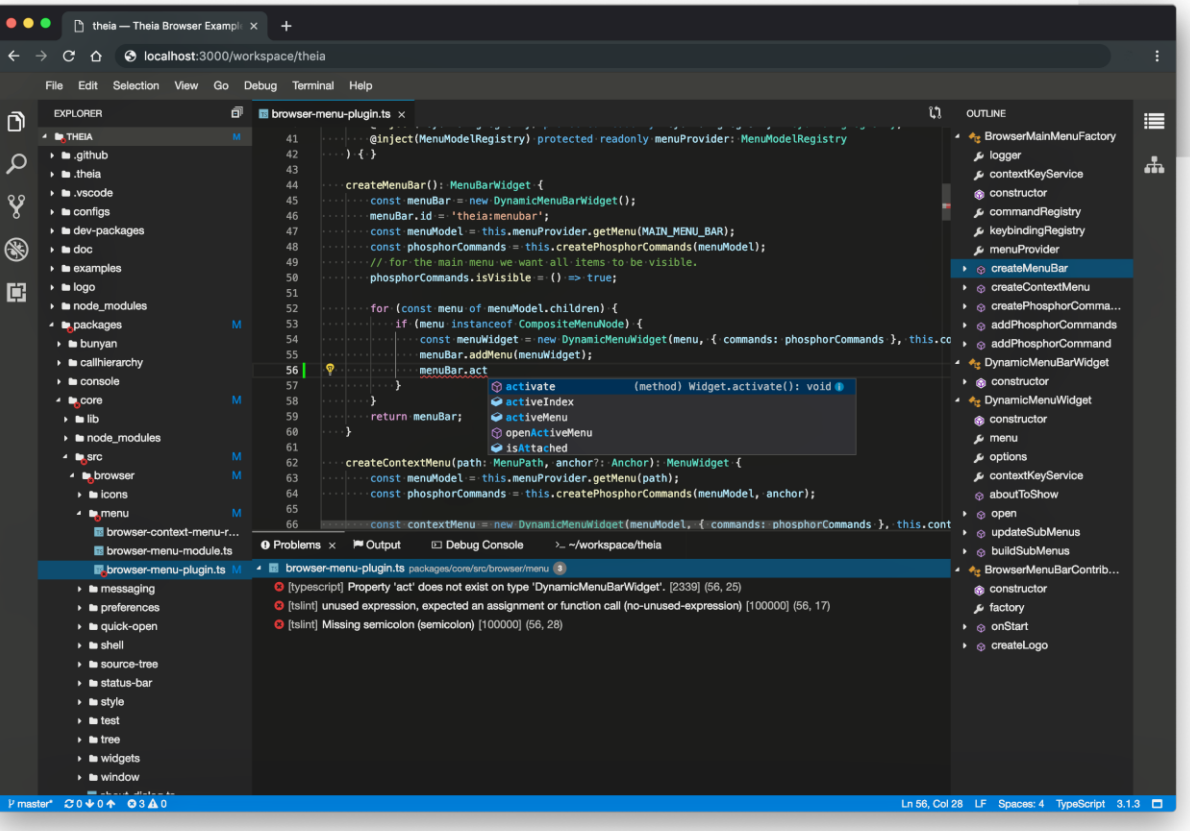
- **Technical feat**
  - Just like the LSP, the Debug Adapter Protocol (DAP) is well specified and versatile
- **Collaboration feat**
  - Debuggers come in all shapes and sizes
  - Some can be remote controlled
  - Others must be driven from the command-line
  - Debugger developers not always keen on supporting this protocol
  - Instead, people may implement wrappers called **Debug Adapters** (**DA**)

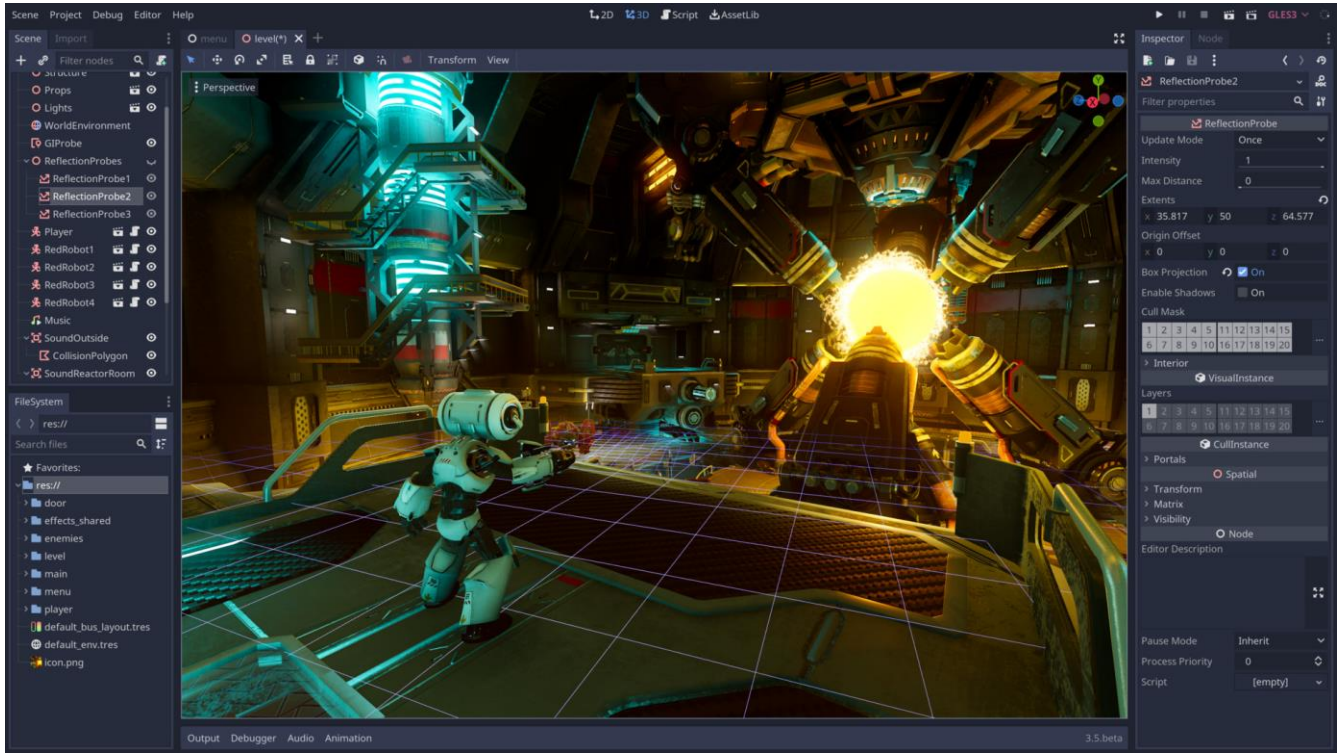
The VS Code way: Plugins

- The editor provides common features
- **VS Code Extensions** (**Plugins**) leverage these features by providing actual intelligence
- **Plugins** may contribute “meta workflows”, but I would argue this is not the norm
  - Most plugins are just UI integrations of command-line tools

Modularity = Independence

- If you implement complex workflow as part of extensions, how do you execute it on CI?
- **Modularity** comes from **re-usable components**
- **Re-usable components** come with **minimal dependencies**
- Avoid dependence on your editor, or anything else really





Eclipse Theia

Image from github.com/eclipse-theia/theia

Godot Editor

Image from github.com/godotengine/godot

Examples

Theia app breakdown

- **Theia CLI** will generate multiple artifacts
  - src-gen/
    - Entry points referencing each **Theia Extension** module statically
      - backend/main.js
      - frontend/index.js
  - webpack.config.js
    - Required boilerplate configuration to bundle the frontend
  - lib/
    - The bundled frontend from the src-gen/frontend/index.js entry point

BackendApplicationServer mechanism

If you bind something to the **BackendApplicationServer** symbol from @theia/core in one of your **Theia Extension**, then the **Theia backend** won't try to serve the default **Theia frontend** generated next to it.

This means you can have a **Theia backend** that only acts as a dedicated server to a **Theia frontend** served from a **Content Delivery Network** (**CDN**), for example.

Docker images

- Pros
  - Easy to consume*
- Cons
  - Images prone to become monolithic
  - Hard to compose use cases as you need a new image for new combinations

**or is it?*

Monolithic Docker images

Required when building a **Docker** image that embeds a **Theia** app:

- Build tools for **Theia**
  - These can be removed from the final image (pkg-config, libx11-dev, libxkbfile-dev, etc.)
  - E.g., use a multi-stage build to build **Theia** and get rid of the build tools
- Runtime binaries for **Theia**
  - **Node.js**
- Development tools to be used by/with **Theia**
  - Want to develop **Java** applications? Add **Java**
  - Want to develop **Python** applications too? Add **Python**
  - Want to develop **X**? Add **Y**. 🤔

Theia in Docker

- Let users create their own development environment
- Somehow get a **Theia app** to run and have access to this container
  - Build the **Theia app** in the image?
  - Inject a pre-built **Theia app** in the container?
  - Run multiple containers for one workspace?

Eclipse Theia Blueprint

github.com/eclipse-theia/theia-blueprint

Eclipse Theia Blueprint browser

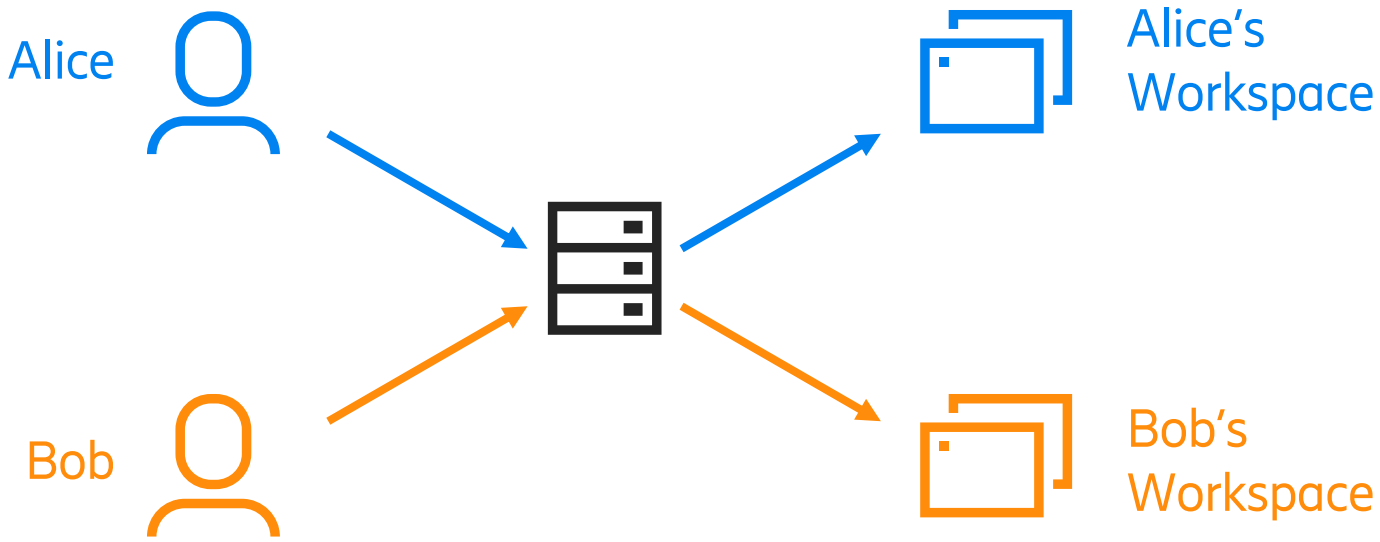
- Goal was to create an executable server ready to download
- Draft: github.com/eclipse-theia/theia-blueprint/pull/168

Eclipse Theia Blueprint browser

It is difficult to create executables from complex **Node.js** applications (hello **Theia backend**):

- While the **Theia frontend** is designed with bundling in mind, the **Theia backend** is not…
- Dynamic imports are problematic
- Sub-processes are problematic
  - Need to create a bundle for each spawned sub-process
- vercel/pkg is amazing but has an issue with "execArgv" when forking scripts
  - **VS Code Extensions** very often fork scripts (**LS**, **DA**, etc), and hence sometime fail

A simple coding interview portal?



A simple coding interview portal...

I want to see how interviewees fare when in front of code relevant to the expected role:

- I have an Ubuntu 20.04 virtual machine running at home
- I configured my home NAT to redirect a TCP port to this VM

Problems:

- If I run one Theia instance, what user should it have? Good ol' www-data?
- If using the same user, do I need to manually clean up between interviews?
- If interviewees remember the hostname I gave them, can they interfere with future interviews?

A simple coding interview portal...

Interviewees should not be able to access anything outside of the allocated time for the interview

When they do have access it should be limited to a one-time user's privileges

A simple coding interview portal...

- Register a session in advance
  - Must be privileged to create users
  - Required: **username** + interview **date/time** + connection **token**
  - Note that I decided to prepare the workspace files in the user's home at registration time...
- Run the portal
  - Must be privileged to impersonate users
  - Check authentication token validity based on time
  - Act as a **reverse proxy to local services** when authenticated
  - Respond with `401` Unauthorized otherwise

A simple coding interview portal!

- GET /portal/auth/:userToken
  - Moves <userToken> into a cookie
  - Redirects to /portal/loading
- GET /portal/loading
  - Displays a simple html page with JavaScript code waiting for the workspace to boot
  - A button appears to open the workspace once ready (querying /portal/wait)
- GET /portal/wait
  - Responds with 200 when workspace is ready
- ALL /
  - The Theia application and workspace for <user-token>

A simple coding interview portal!

- Already used in a couple of interviews with great success
- Repository: github.com/paul-marechal/theia-local-portal