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logi.CAD3 → logi.CLOUD

An experience report on migrating an industrial-grade IDE to the Cloud using the Eclipse ecosystem

WE EMPOWER AUTOMATION

Agenda of this Talk

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- **Introduction (7 Minutes)**
  - Goal
  - Company focus (products, technical)
  - High-level goal
- **Experience report (20 Minutes)**
  - Architectural decisions
  - Challenges
- **Outlook (3 Minutes)**
  - Future steps
- **Q&A (5 Minutes)**

Goals of this Talk

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- **Usage scenario of Eclipse technologies**
  - Industrial Automation
- **Sharing experiences: Make Fat Desktop App usable in Cloud Environment**
  - Overview of frameworks and projects
  - Challenges, Pitfalls
  - How we got started

About
logi.cals

logi.cals

1987
FOUNDED

35
EMPLOYEES

2
OFFICES

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Overview: Our (Original) Goal

IDE for Programmable Logic Controllers

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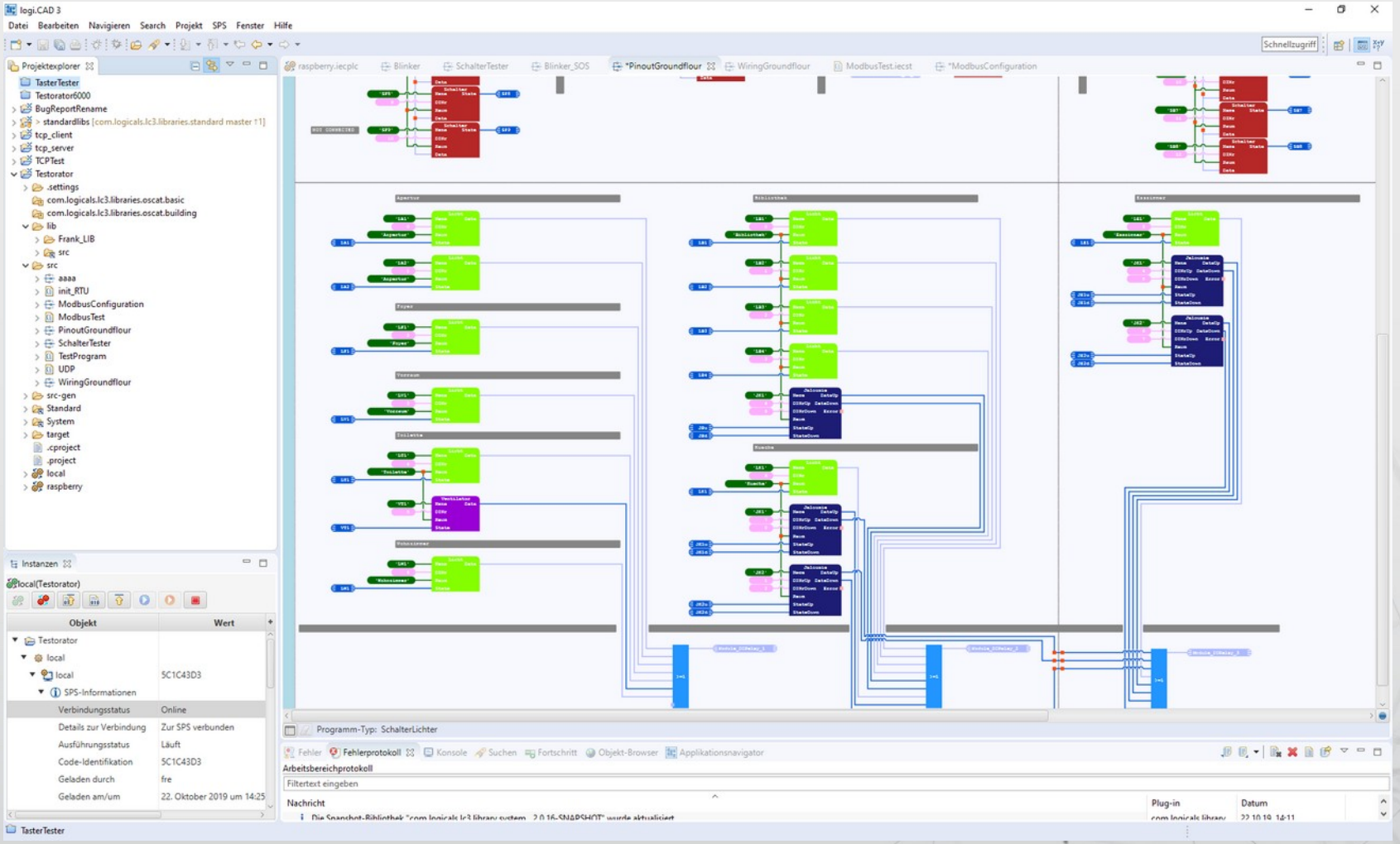

- **IEC 61131-3**
  - Structure Text (ST)
  - Function Block Diagram (FBD)
  - Sequential Function Chart (SFC)

Overview: Our (Original) Goal

IDE for Programmable Logic Controllers

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Solutions
Overview

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AUTOMOTIVE

80% of all buses in Europe

BUILDING

Thousands of controllers for security and comfort in modern ships

ENERGY

30% of all hydro-electric power plants

MOBILE AUTOMATION

Controllers for off-highway and agricultural machines

SYSTEM

Projects with 6 million I/O and communication data points

Continental

SIEMENS Building Technologies

ANDRITZ Hydro

STW

SMS group

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logi.cals Live Demo: logi.CAD3

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Overview: Current State
High-Level Architecture

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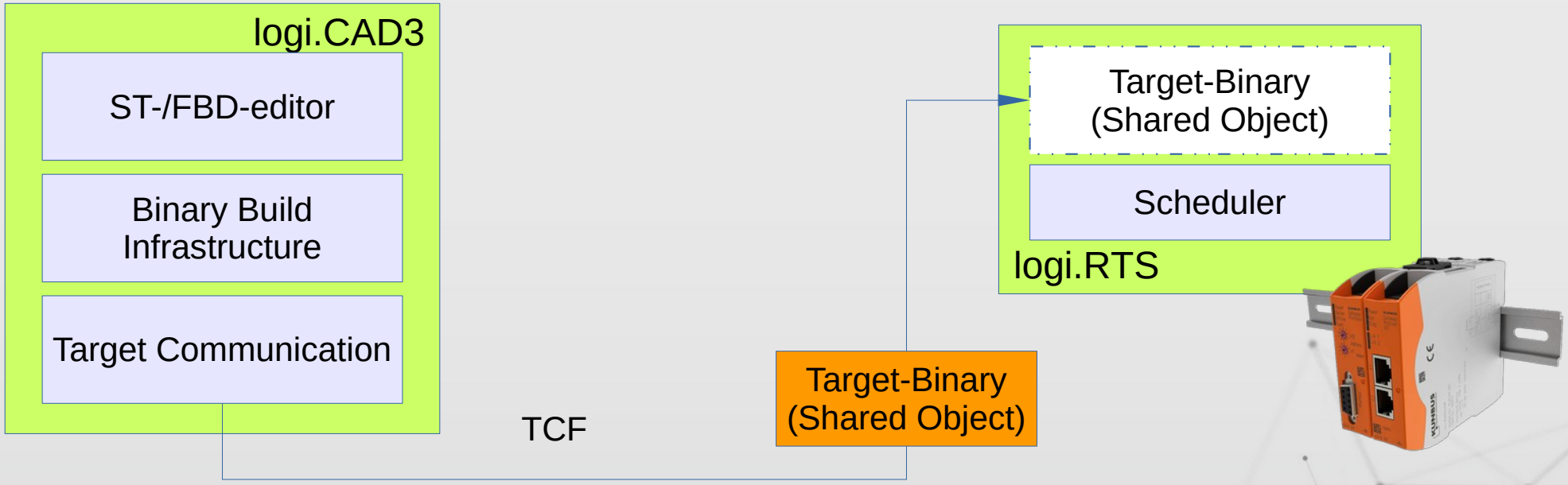
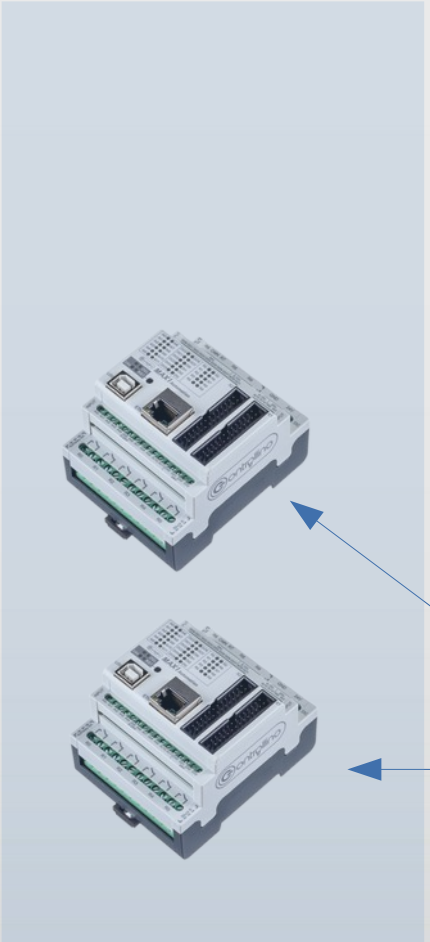


Architecture of logi.Cloud

Architecture and Components

logi.cals



logi.CAD
Build Server

logi.CAD
LC3 Server

logi.CAD
Target Comm Server

THEIA

Targets

Engineering

Theia IDE Backend

Theia IDE Frontend

logi.cals Live Demo: logi.CLOUD

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Structure of logi.CAD3
Architecture and Components

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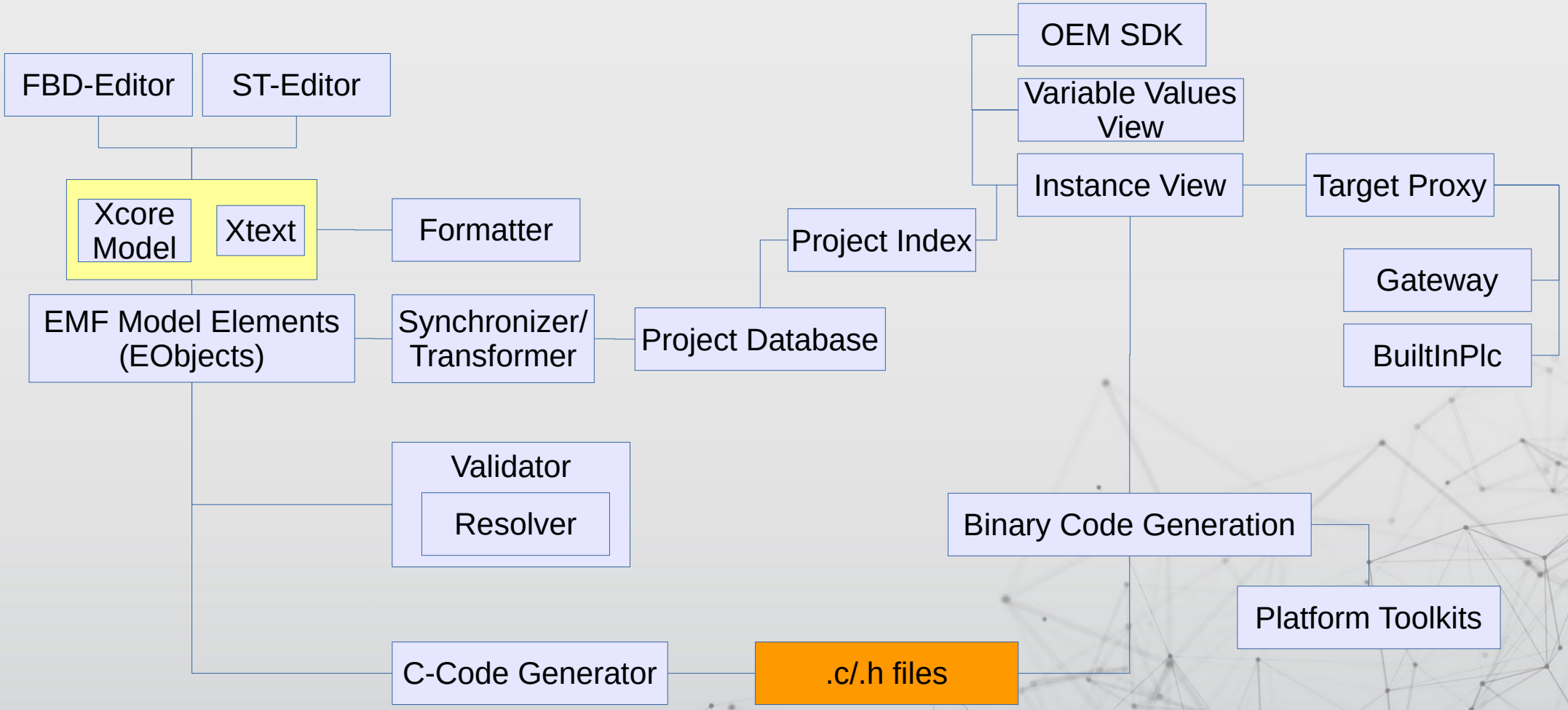
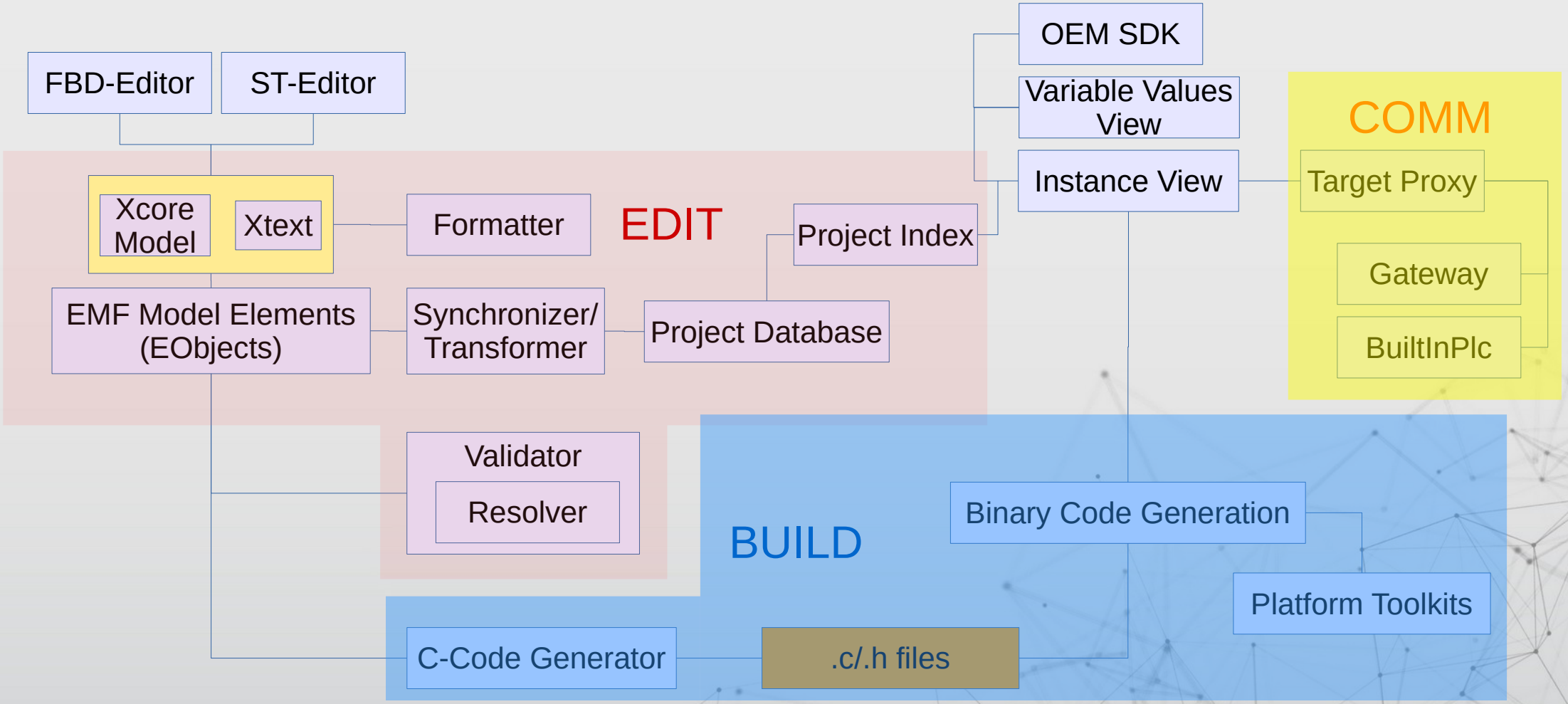


Structure of logi.CAD3

What will be re-used for the Cloud?

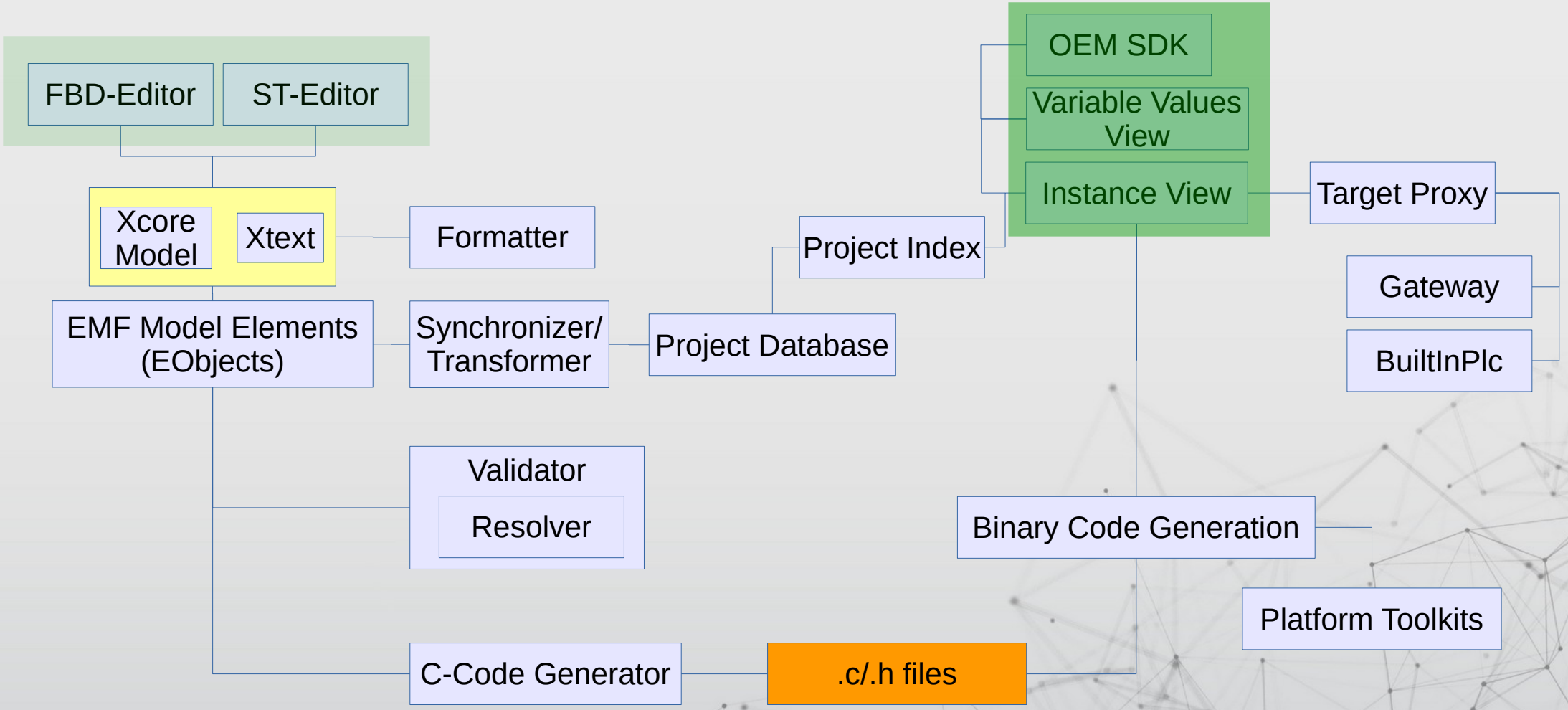
logi.cals



Structure of logi.CAD3

What will be re-used for the Cloud?

logi.cals



Architecture of logi.Cloud

Architecture and Components

- **logi.CAD3 offers public API**
  - logi.CAD3 is a tool integrated by OEMs
  - API is pretty comprehensive
- **Makes it quite simple to**
  - Extend logi.CAD3 itself
  - Create stand-alone applications (with extensions)

Architecture of logi.Cloud

Architecture and Components

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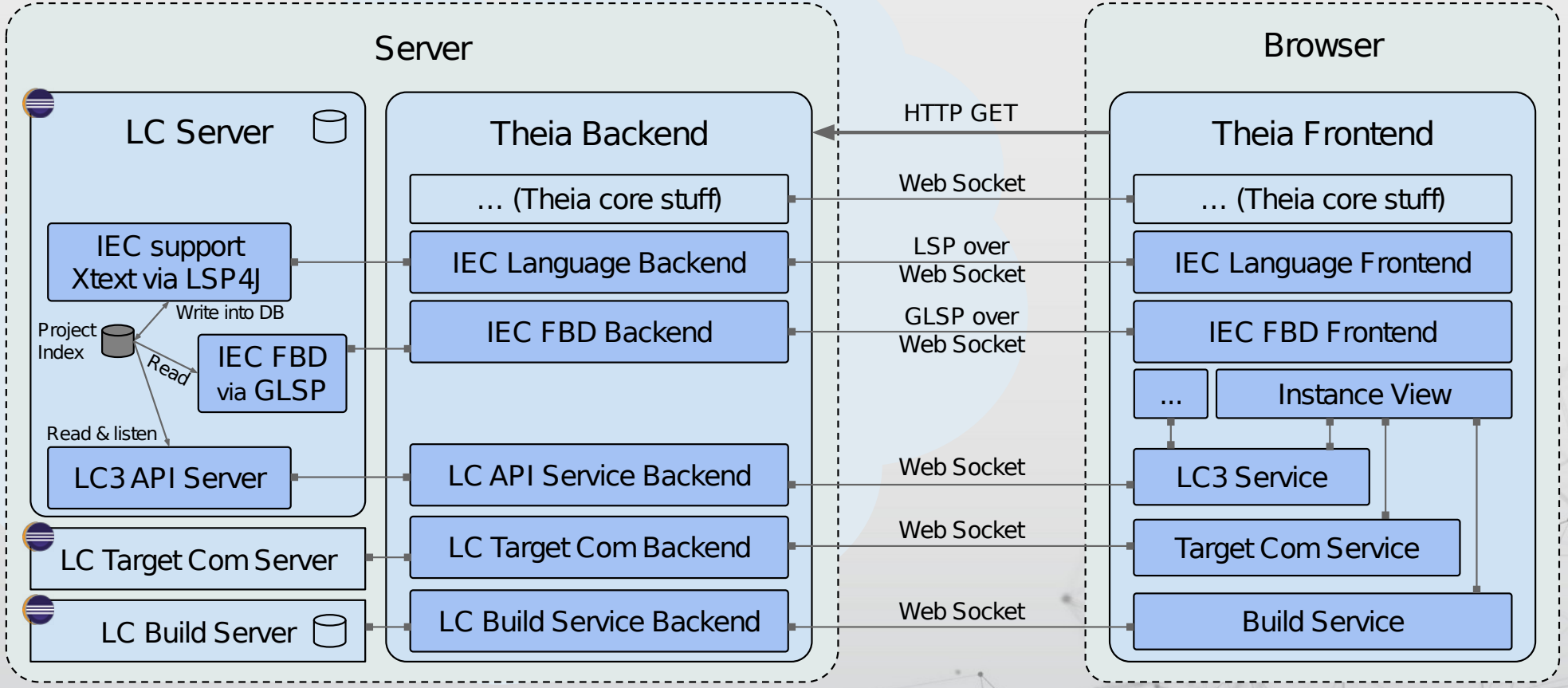

Key Enablers

Making logi.CAD3 ready for the Cloud

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- **Eclipse projects**
  - Xtext: language mechanisms
  - LSP4J: JSON RPC over WebSockets (incl. support for LSP)
  - Eclipse Theia: Frontend/Backend framework
  - Eclipse GLSP: Graphical Language Server Protocol
  - Eclipse Che: future execution context of logi.CLOUD

Challenges: Dependency Categorization

Making logi.CAD3 ready for the Cloud

logi.cals

- **UI dependencies**
  - Rely on Eclipse UI to work
  - Example: custom editors
- **Eclipse dependencies**
  - Rely on common Eclipse functionality (but no UI)
  - Example: Eclipse builders, Workspace
- **OSGi**
  - Low-level Eclipse functionality
  - Example: Service access
- **OK**
  - Functionality that works in any Java environment
  - Example: (Generated) Xtext parsers

Challenges: Dependencies

Making logi.CAD3 ready for the Cloud

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- **Dependency Analysis of Java Code using CDA**
  - **C**lass **D**ependency **A**nalyzer
    http://www.dependency-analyzer.org/
  - Handles class, package, and plug-in level dependencies
  - Can visualize dependency hierarchies
- **Dependencies exported to CSV format**
- **Categorization and aggregation in Spreadsheet Software**
  - Identification of (potentially) problematic dependencies

Challenges: Dependency Categorization

Making logi.CAD3 ready for the Cloud

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			Direct dependency types (plugin)					Direct dependency types (class)			
14	Plugin	Included in headless	Eclipse	UI	OSGi	?		Eclipse	UI	OSGi	?
17	com.logicals.buildservice_2.6.0.201909060757.jar	Yes	2	1	2	0		12	2	7	0
18	com.logicals.common_2.6.0.201909060757.jar	Yes	2	2	4	5	wip	18	3	21	22
26	com.logicals.debug.common_2.6.0.201909060757.jar	Yes	4	4	4	2		16	8	14	26
37	com.logicals.iec.fbd_2.6.0.201909060757.jar	Yes	1	0	0	1		1	0	7	5
38	com.logicals.iec.model_2.6.0.201909060757.jar	Yes	2	1	3	1		9	4	10	1
39	com.logicals.iec.st_2.6.0.201909060757.jar	Yes	2	0	3	1		7	0	8	2
49	com.logicals.iec.st.ide_2.6.0.201909060757.jar	Yes	2	2	2	0		26	9	12	0
58	com.logicals.lc3.api_2.6.0.201909060757.jar	Yes	2	2	4	0	wip	5	3	17	0
52	com.logicals.lc3.api.model.st.impl_2.6.0.201909060757.jar	Yes	0	0	2	1	wip	0	0	2	1
53	com.logicals.lc3.api.mrc_2.6.0.201909060757.jar	Yes	1	0	2	1		4	0	4	1
54	com.logicals.lc3.help_2.6.0.201909060757.jar	Yes	1	2	2	3		1	7	5	9
70	com.logicals.library_2.6.0.201909060757.jar	Yes	1	0	3	1		9	0	13	4
77	com.logicals.mrc_2.6.0.201909060757.jar	Yes	2	4	4	1	wip	9	18	10	1
82	com.logicals.projectindex_2.6.0.201909060757.jar	Yes	2	1	3	1		11	2	18	7
84	com.logicals.targetproxy_2.6.0.201909060757.jar	Yes	1	2	3	1		1	3	8	10
87	com.logicals.uploader.lc3uploader_2.6.0.201909060757.jar	Yes	1	1	2	0		4	2	6	0

Challenges: Workspace handling

Making logi.CAD3 ready for the Cloud

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- **Challenge:**
  - Eclipse Workspace depending functionality (Project Index; H2-based)
  - Theia IDE does not know Eclipse Workspaces
- **Solution:**
  - Custom “Cloud-aware” Workspace implementation
  - Will behave differently to Eclipse file system
  - Limits possibility of shared code with logi.CAD3

Challenges: Workspace handling

Making logi.CAD3 ready for the Cloud

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- **Workspace types being used**
  - Theia Backend: FS/TS-based workspace
  - logi.CAD3 Server: Cloud-aware workspace
  - logi.CAD3 Build Server: Eclipse workspace (generated; snapshot)
  - logi.CAD3 Target Comm Server: none needed

Outlook
The (near) Future

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- **Full support for C/C++ editing**
  - Based on clangd
- **Diagnostic Features**
  - View variable values
- **Continue FBD support**
  - Variable table
  - Context menus
  - Full editing, e. g. routing for connections
  - Copy-paste
  - ...

Outlook
The (far) Future

logi.cals

- **Integration of new platforms**
  - Licensing issues/challenges
- **Workspace management**
- Based on Eclipse Che
- **Decision on the execution platform for logi.CLOUD**
  - RedHat OpenShift, MS Azure, ...

Outlook
The (far) Future

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- **Offering logi.CLOUD as an integrable solution**
  - logi.cals products typically sold as integrable framework
  - OEMs use our product and add branding
  - OEMs expect a plugin infrastructure

Summary
Findings, Recommendations

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- **Build Proof-of-Concept Prototypes**
  - Based on well-defined use-cases
  - Getting to know new technologies and frameworks
  - Helps to estimate the time frame for developing the actual product

Bibliography
Further reading

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- **Overall Architecture**
  - (Initial) Eclipse Theia Design Document:

    https://docs.google.com/document/d/1aodR1LJEF_zu7xBis2MjpHRyv7JKJzW7EWI9XRYCt48/
  - EclipseSource Documents on Eclipse Theia and Eclipse Che:

    https://eclipsesource.com/blogs
- **Getting Started (Motivational example)**
  - https://theia-ide.org/docs/

logi.cals Thank you for your attention!

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Challenges: Additional concerns

Making logi.CAD3 ready for the Cloud

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LC3/logi.CLOUD: General interface of LC3 projects:

```
public interface Lc3Project extends Comparable<Lc3Project> {
  [...]
  File getFile(String name);
}
```

Challenges: Additional concerns

Making logi.CAD3 ready for the Cloud

logi.cals

LC3: Using Eclipse `IProject` to retrieve files

```
@Override
public File getFile(final String name) {
  final IFile eclipseFile = this.eclipseProject.getFile(name);
  return new File(eclipseFile.getLocation().toOSString());
}
```

logi.CLOUD: Using Language Server Project Manager to retrieve files (LC3 Server; JAVA)

```
@Override
public File getFile(final String name) {
  final URI baseDir = this.projectManager.getBaseDir();
  return new File(baseDir.toFileString() + name);
}
```

Challenges: Additional concerns

Making logi.CAD3 ready for the Cloud

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LC3: Using Eclipse Workspace and Projects to initialize Project Index

```
private void initializeProjects() {
  final IProject[] iProjects = ResourcesPlugin.getWorkspace().getRoot().getProjects();
  for (final IProject iProject : iProjects) {
    if (iProject.isOpen() && IECProjectNature.isIECProject(iProject)) {
      final Lc3Project project = new Lc3ProjectImpl(iProject);
      projects.put(project.getName(), project);
    }
  }
}
```

Challenges: Additional concerns

Making logi.CAD3 ready for the Cloud

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logi.CLOUD: Use Language Server Workspace Manager and Project Manager

to initialize Project Index (LC3 Server; JAVA)

```
private void initializeProjects() {
  for (final ProjectManager projectManager : workspaceManager.getProjectManagers()) {
    if (projectManager.getBaseDir() != null) {
      final Lc3Project project = new LC3CloudProject(projectManager);
      projects.put(project.getName(), project);
    }
  }
}
```

Challenges: Additional concerns

Making logi.CAD3 ready for the Cloud

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LC3: Build and Upload Program triggered by client

```
protected void buildAndLoadApplication(final ActionEvent event) {
  TargetSession targetSession = TargetProxy.getTargetSessionForUI(resource);
  new BuildProgramJob(targetSession.getResource(), new BuildOptions()).schedule();
  new UploadProgramJob(targetSession).schedule();
}

public static NormalizedFile getTargetOutputDirectory(IProject project) {
  return new NormalizedFile(project.getLocation().toFile()).append("target");
}
```

Challenges: Additional concerns

Making logi.CAD3 ready for the Cloud

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logi.CLOUD: Build and Upload Program triggered by client (Theia Backend; TypeScript)

```
async buildAndLoadApplication(connectionInfo: Lc3ResourceConnectionInfo): Promise<void> {
  const jobId = await this.buildService.buildWithProgress(connectionInfo.resource.instancePath);
  await this.buildService.onJobFinished(jobId);
  const buildLocation = await this.buildService.getBuildLocation();
  return this.targetService.upload(connectionInfo, buildLocation);
}
```

logi.CLOUD: Determining the actual build location (LC3 Build Server; JAVA)

```
public NormalizedFile getTargetOutputDirectory(String buildLocation, String projectName) {
  return new NormalizedFile(buildLocation).append(projectName).append("target");
}
```

Overview: PLC-Programming

Programming Languages: ST (IEC61131-3)

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