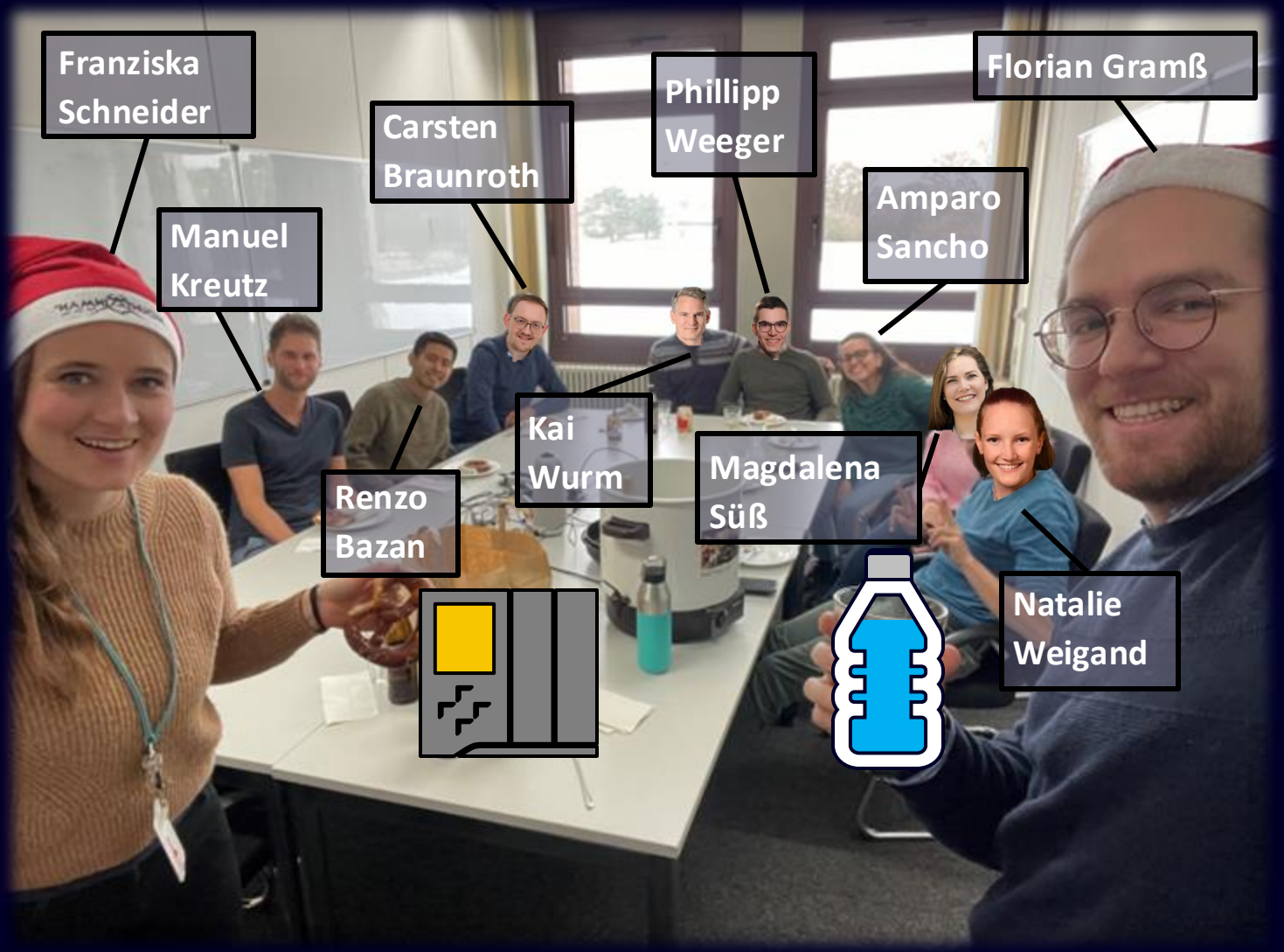
Empowering ROS Users in Industry and Research with Industrial Automation Equipment

presented by Florian Gramß

This communication is part of a project that has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement №101069732

SIEMENS

ROS @ SIEMENS - Who is behind that?



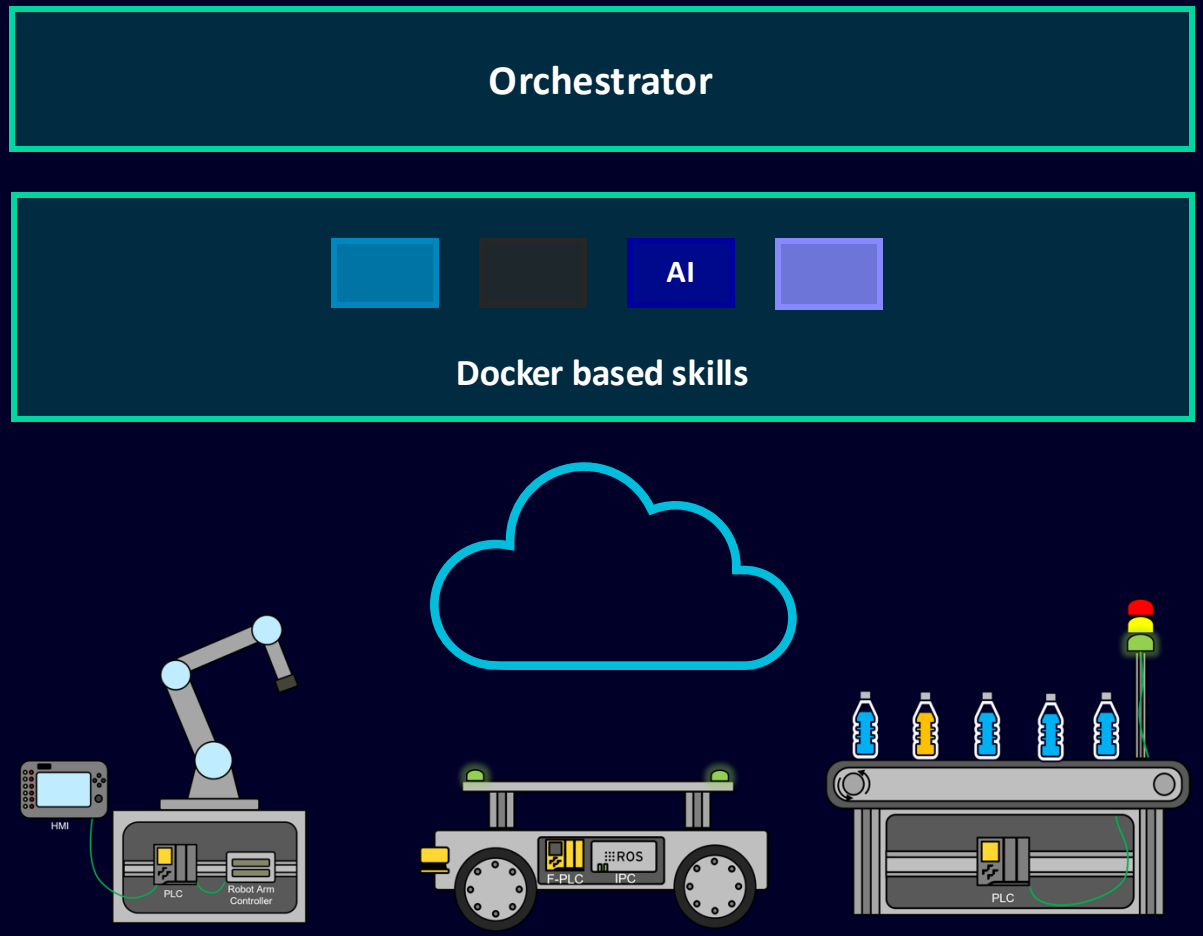
Project Team ROS @ SIEMENS

- Cross-functional team, focus on automation
- 100+ student theses: ROS + SIEMENS

- First pilot software launched during ROSCon Denmark
- Also: funny LinkedIn videos

SIEMENS

Research context: EU project & my PhD



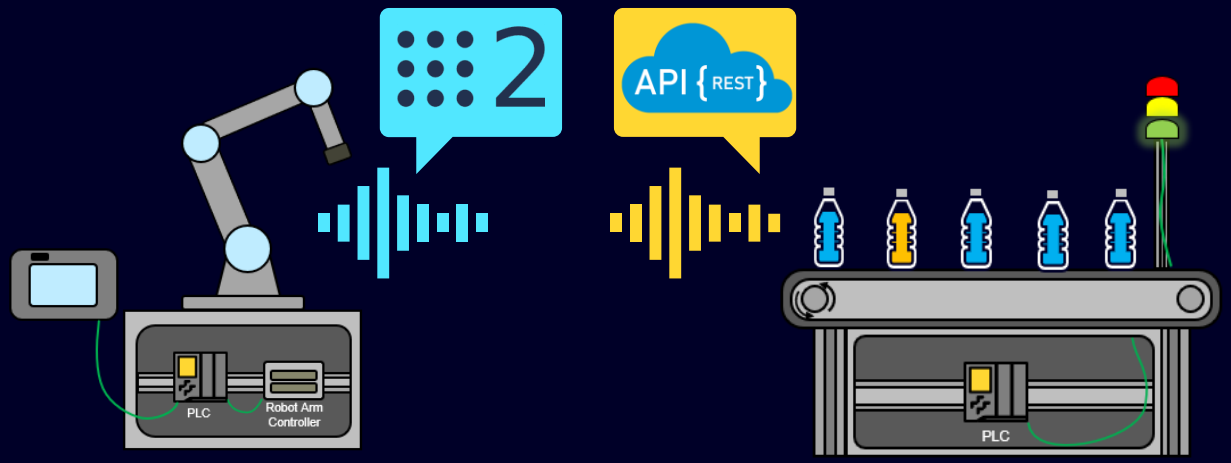
aerOS Project:

Next-generation meta operating system that enables intelligent, distributed data management across the IoT edge-cloud continuum.

It provides

- Efficient resource orchestration and hardware abstraction
- Decentralized decision-making
- Trusted data exchange frameworks

How to make integration more efficient



Our focus on the project:

Seamless communication between machines:

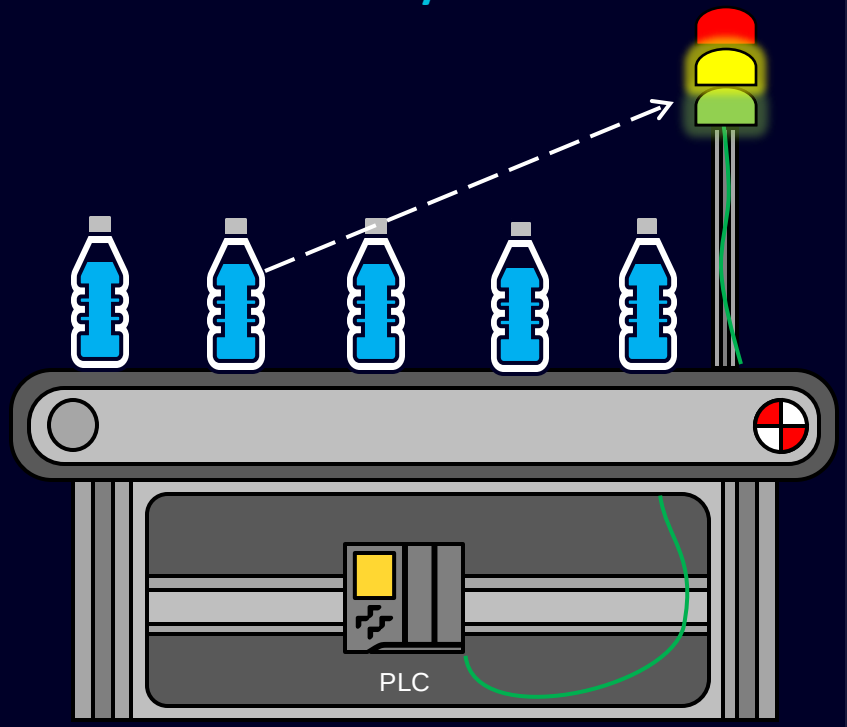
- Protocol representation
- API specifications
- Documentation

Opportunities:

- **Change existing machines**
- **Add open-source solutions**

Use Case: Change request for an existing machine

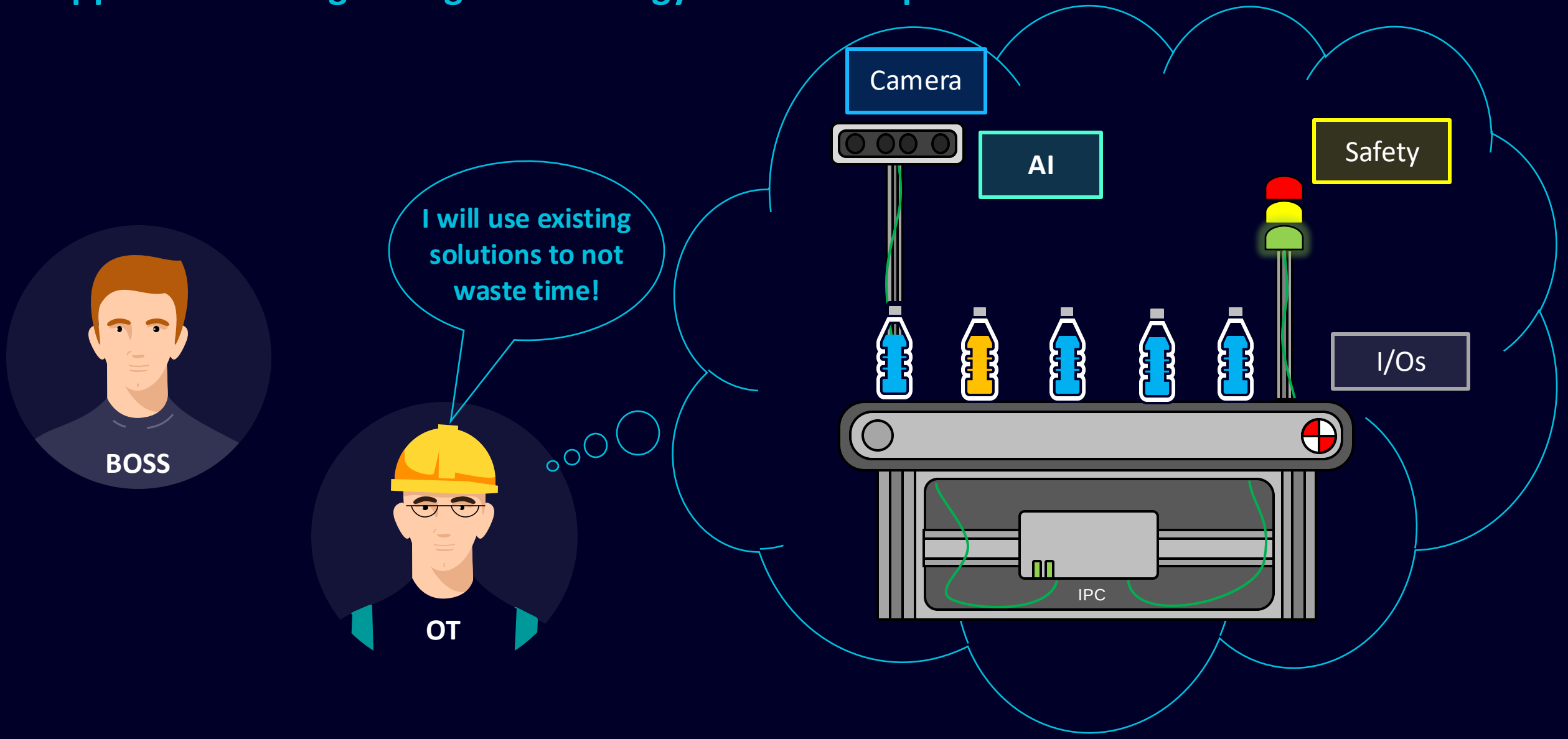
SIMATIC-based automation conveyor belt



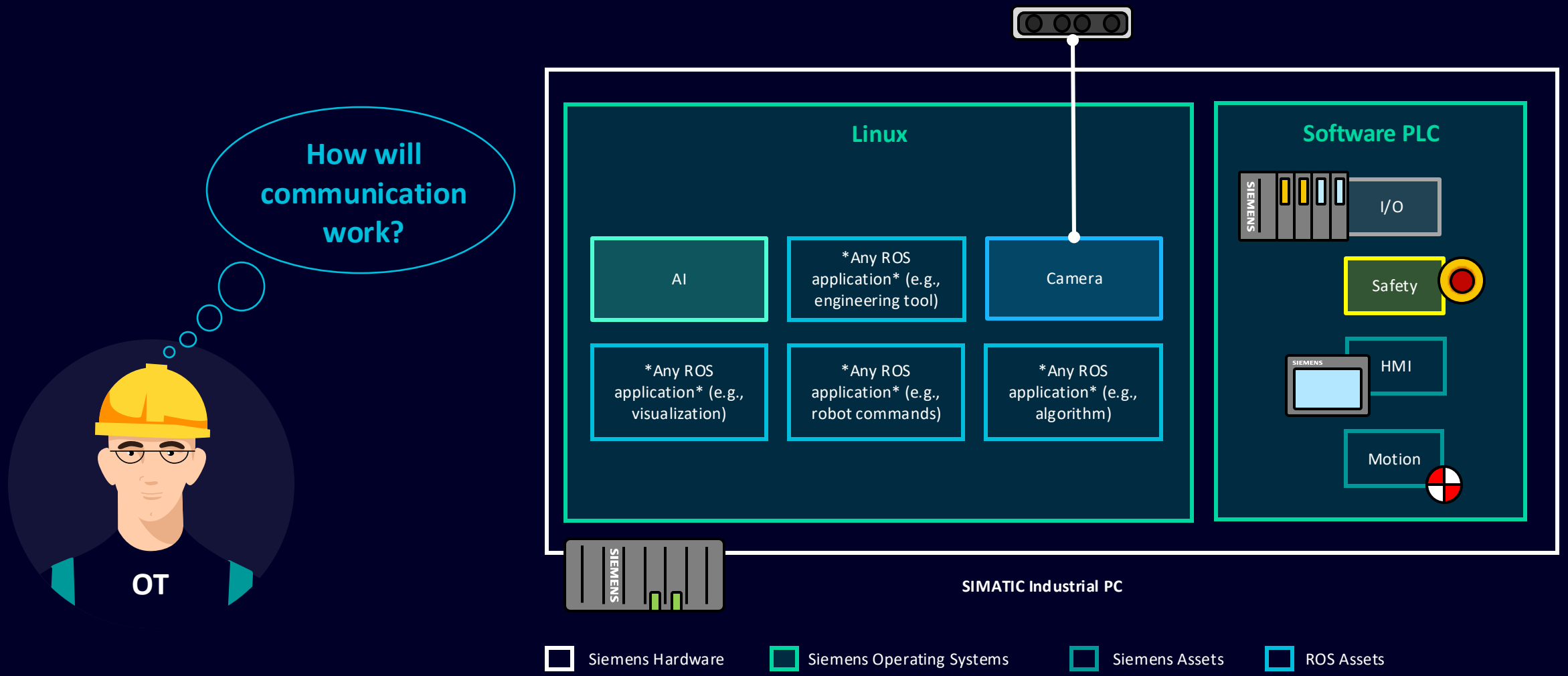
Research Context:

- Off-the-shelf research platform
- Pimp existing “old” demo

Approach: Finding the right technology to solve the problem

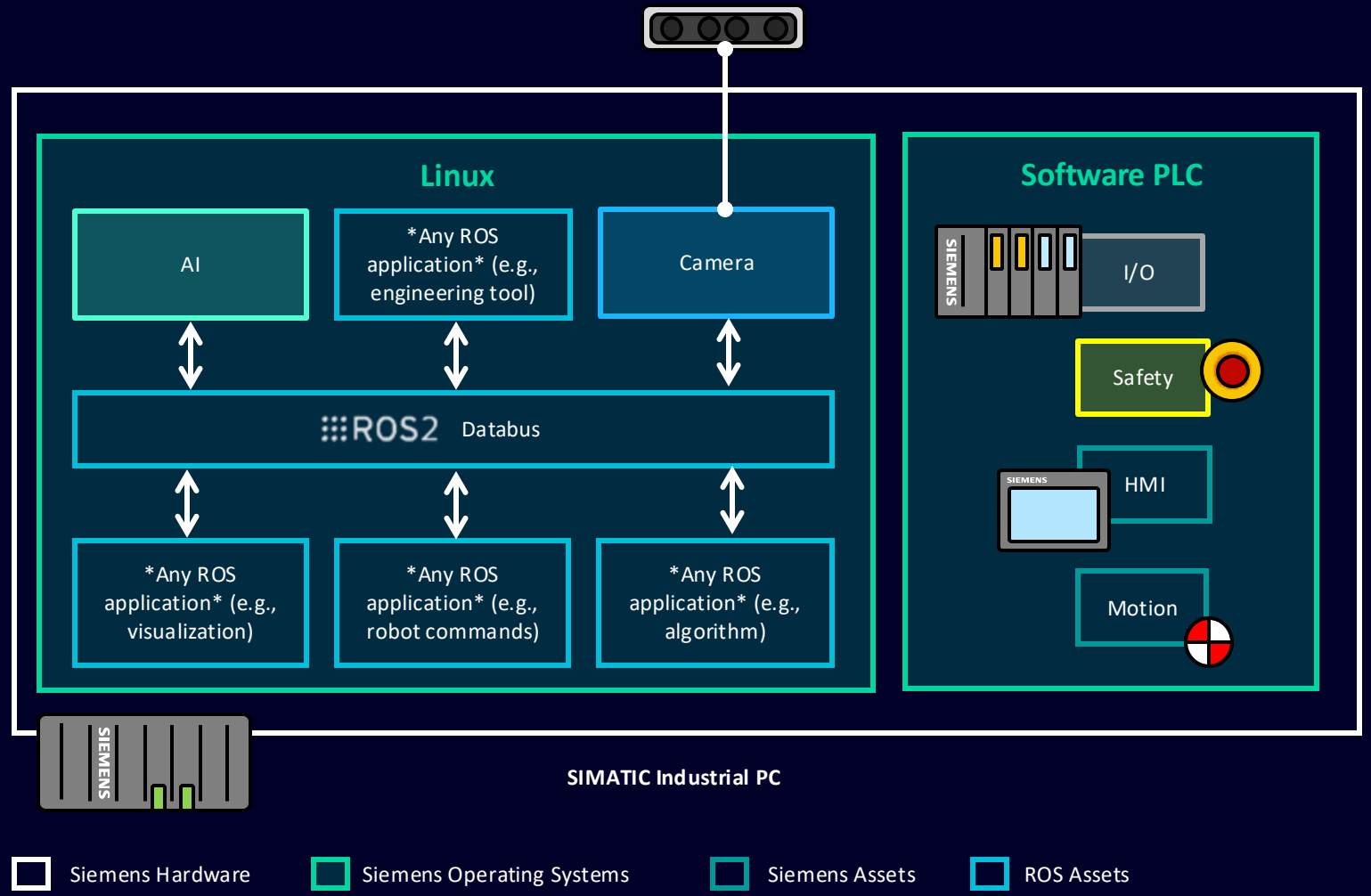


Embed solution in existing architecture



Open-Source to the rescue?

What about using ROS?



ROS is great, but now starts the real work…

Camera

ROS 2 interface

AI

ROS 2 interface

Extract interface description for different scenarios

ROS 2 interface

EXAMPLE

ROS 2 interface

ROS 2 interface

ASYNCAPI

THE LINUX FOUNDATION

OPENAPI AsyncAPI

ROS 2 interface

100 001 100 001

ROS 2 Jazzy only

Credits, master thesis: Jakob Retman

SIEMENS

What does AsyncAPI feels like?

agv.yaml

agv.yaml > {} channels > {} AnsOrderActionReply > {} messages > {} AnsO

```yaml
asyncapi: 3.0.0
info:
  title: AsyncAPI example for ROS 2
  version: 1.0.0
  description: |-
    AsyncAPI example for ROS 2
  license:
    name: Apache 2.0
    url: https://www.apache.org/licenses/LICENS

servers:
  ros2:
    host: localhost
    protocol: ros2
    protocolVersion: humble
    bindings:
      x-ros2:
        rmwImplementation: rmw_cyclonedds_cpp
        domainId: 0

operations:
  receiveECLift:
    action: receive
    channel:
      $ref: "#/channels/ECLiftActionRequest"
    reply:
      channel:
        $ref: "#/channels/ECLiftActionReply"
```

agv.yaml

AsyncAPI example for ROS 2 1.0.0

APACHE 2.0

AsyncAPI example for ROS 2

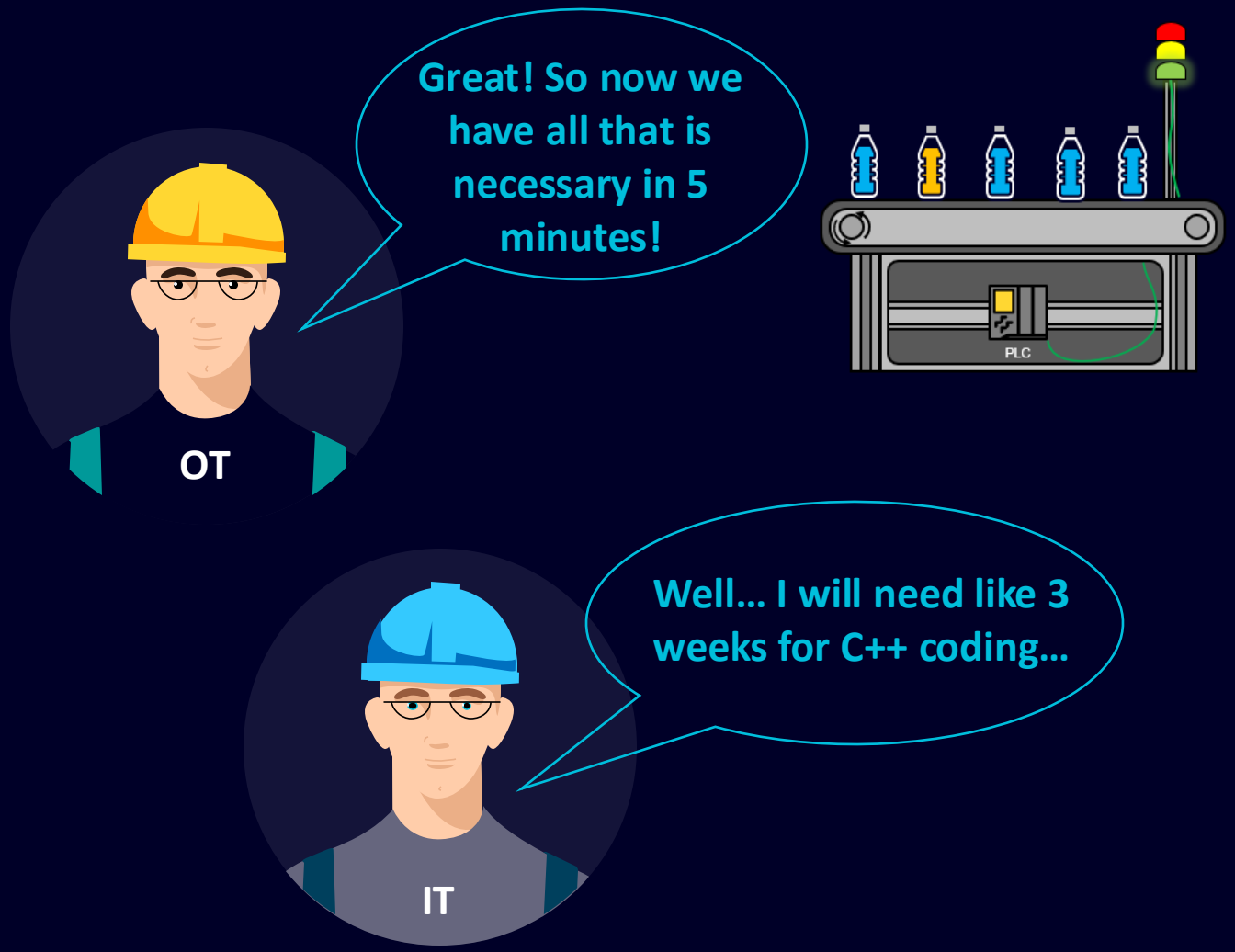
Servers

ros2://localhost/ ROS2 HUMBLE ROS2

Server specific information X-ROS2 › Object

Expand all

Recap, what does work now and what is still missing?



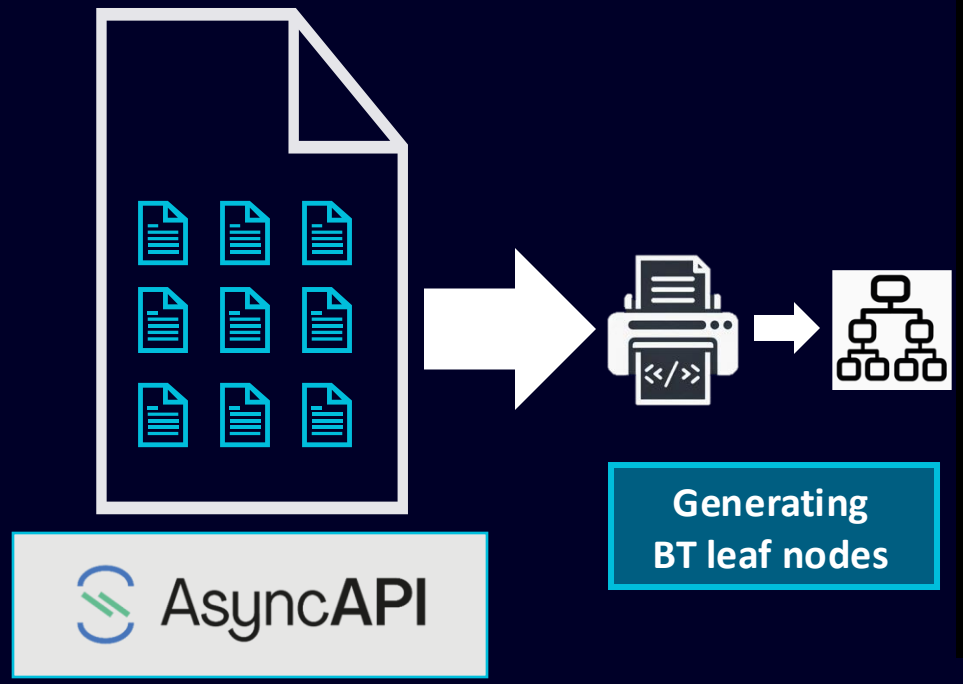
Already achieved:

- Selected existing solutions for the use case
- Extracted interface definitions automatically

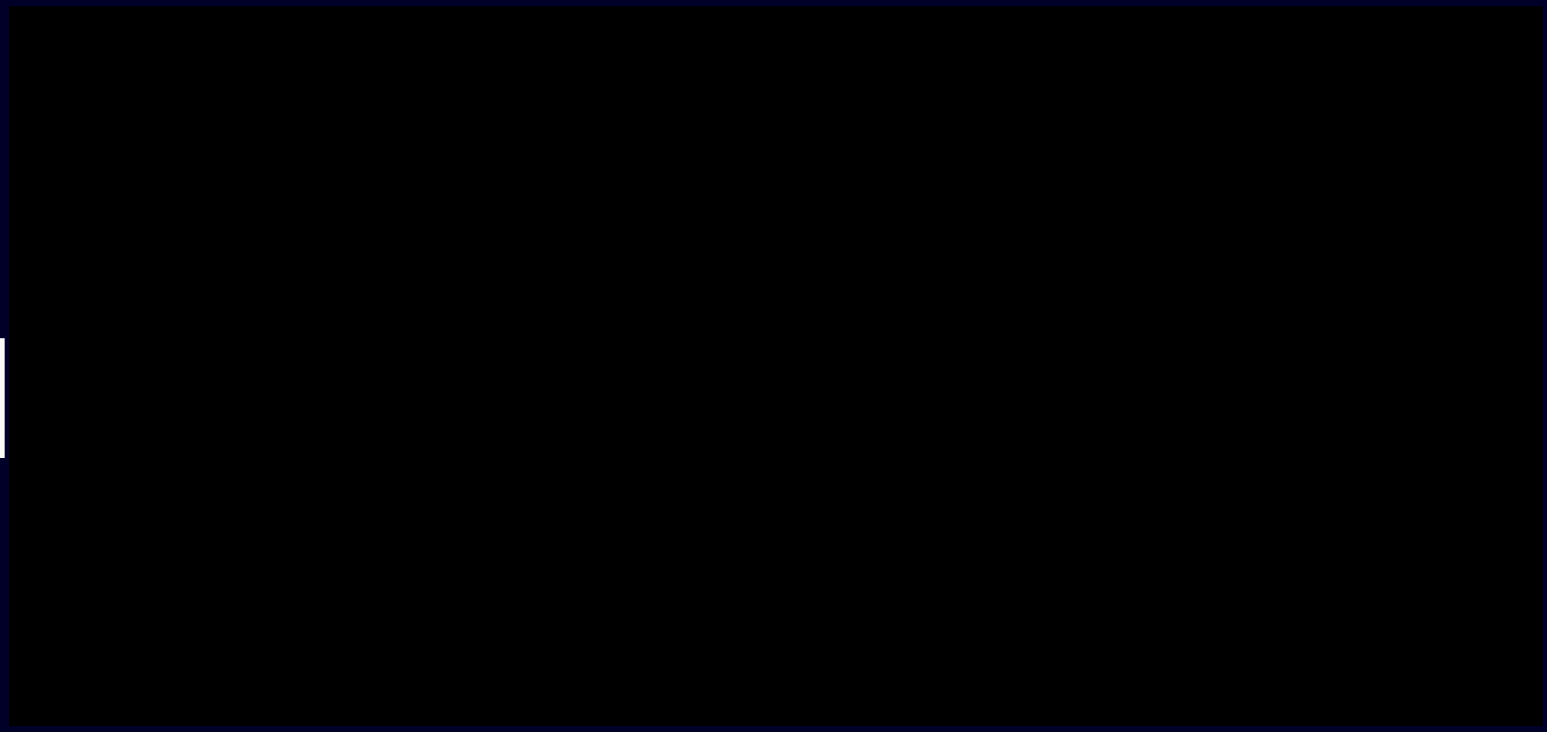
Still missing:

- To program the machine to interact with the different existing solutions

Is AsyncAPI only useful for documentation?

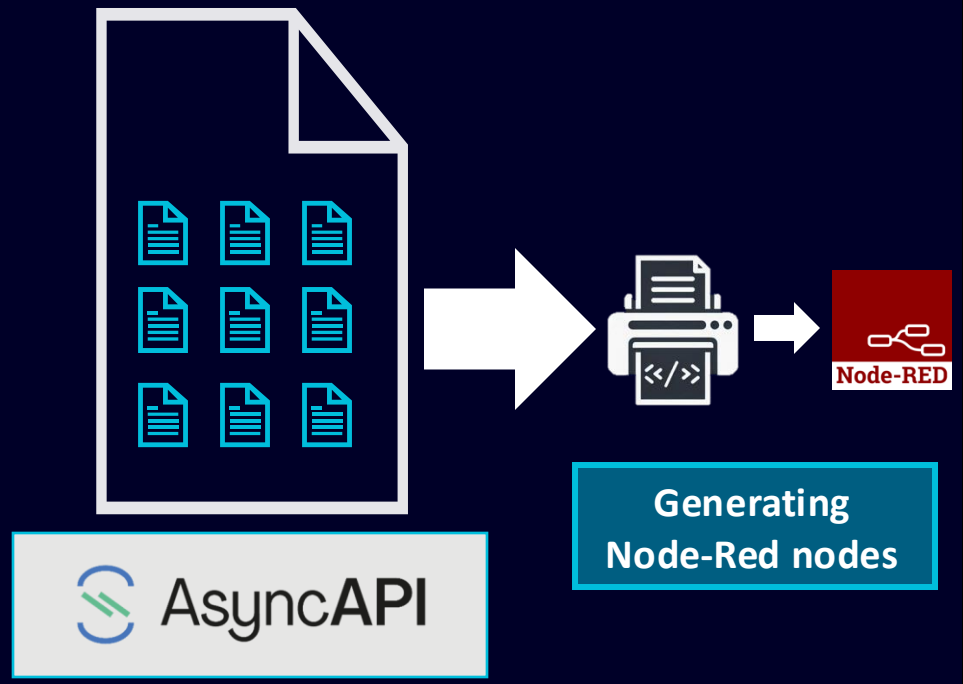


Generating
BT leaf nodes

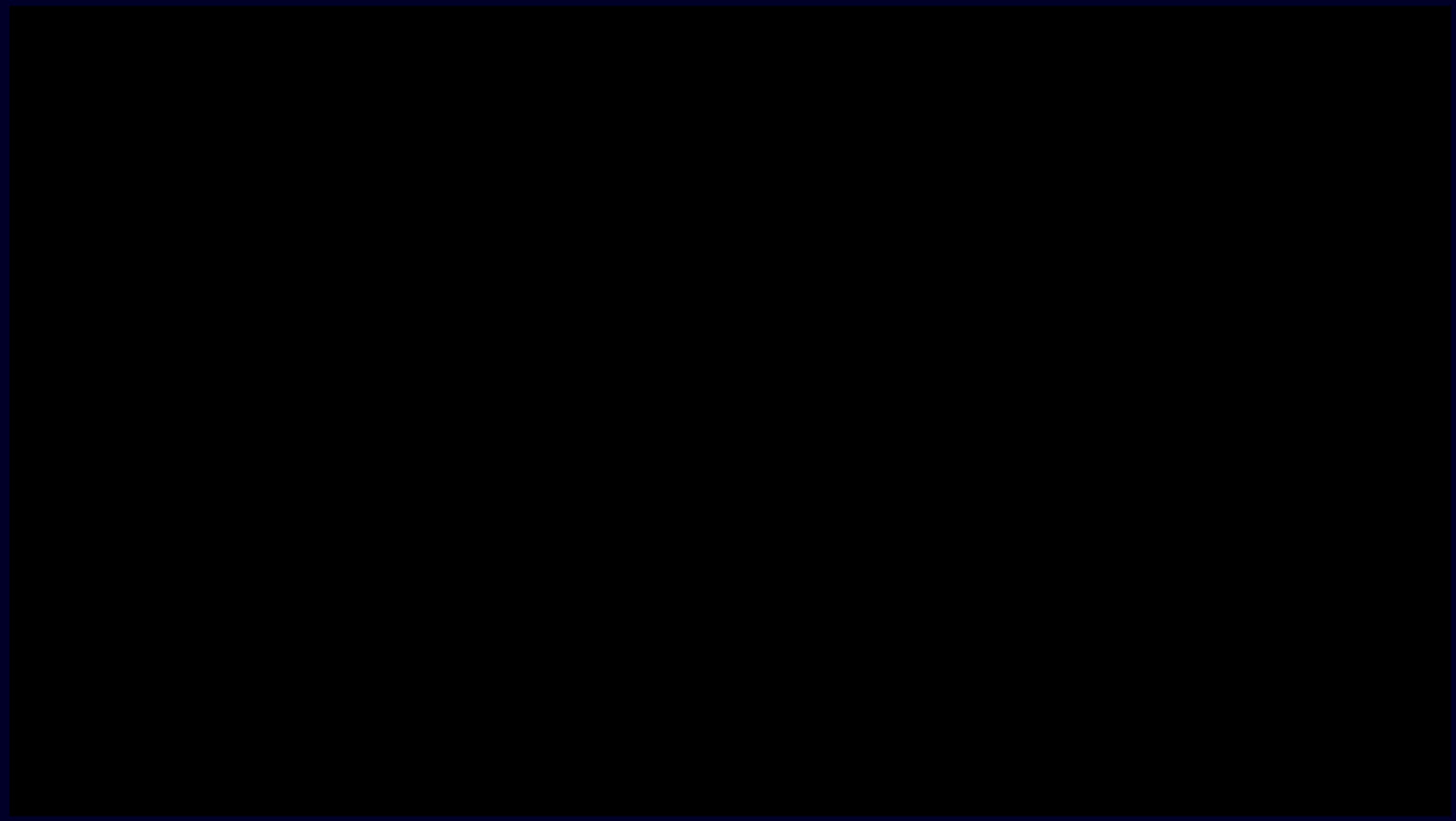


Credits, master thesis:
Raffael Pöggel

But what if you don’t like Behavior Trees?

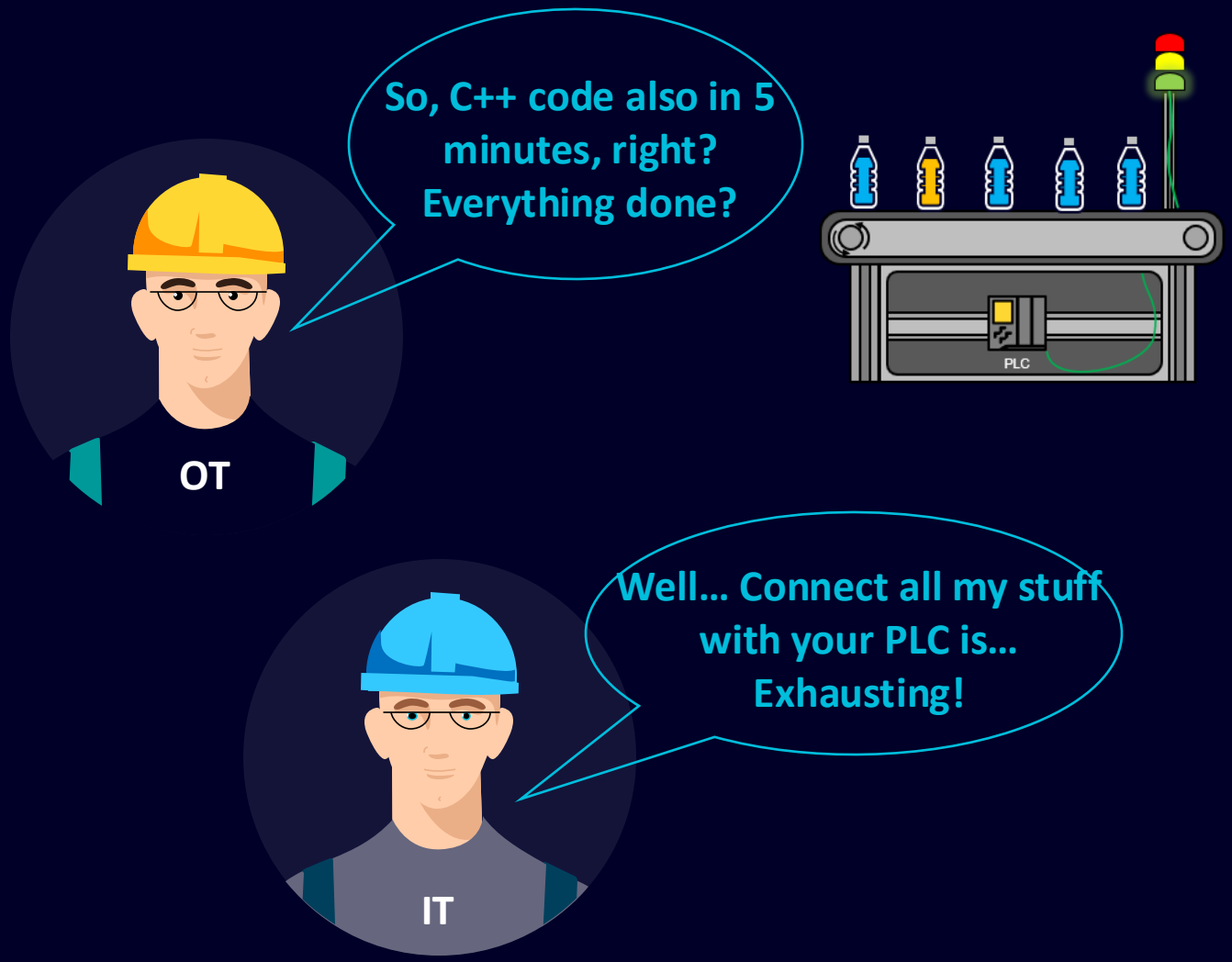


Generating Node-Red nodes



Credits, master thesis: Apostolos Zacharis

Recap, what does work now and what is still missing?



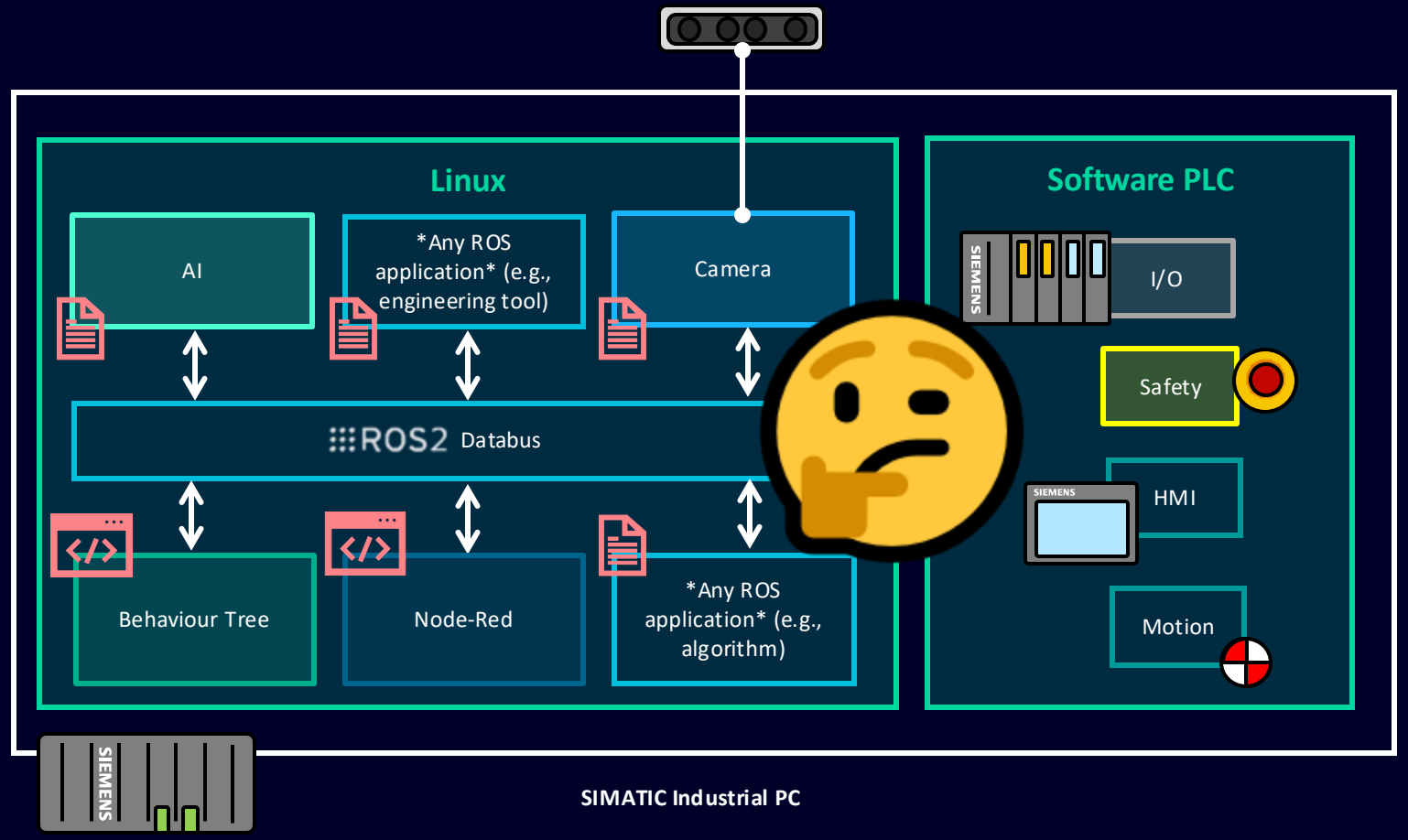
Already achieved:

- Selected existing solutions for the use case
- Extracted interface definitions **automatically**
- Generated code **automatically**

Still missing:

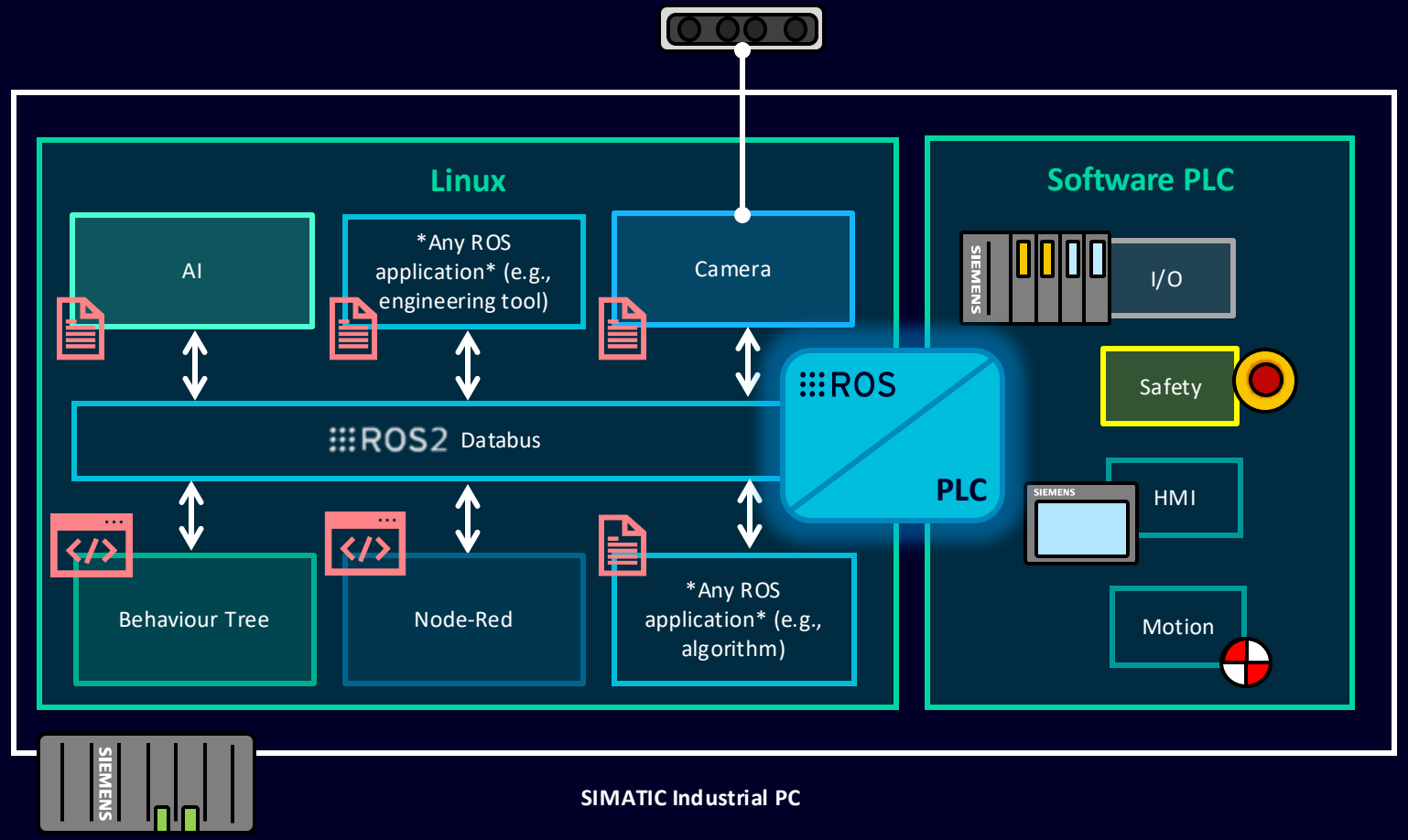
- To connect IT with OT

How to connect the OT part?



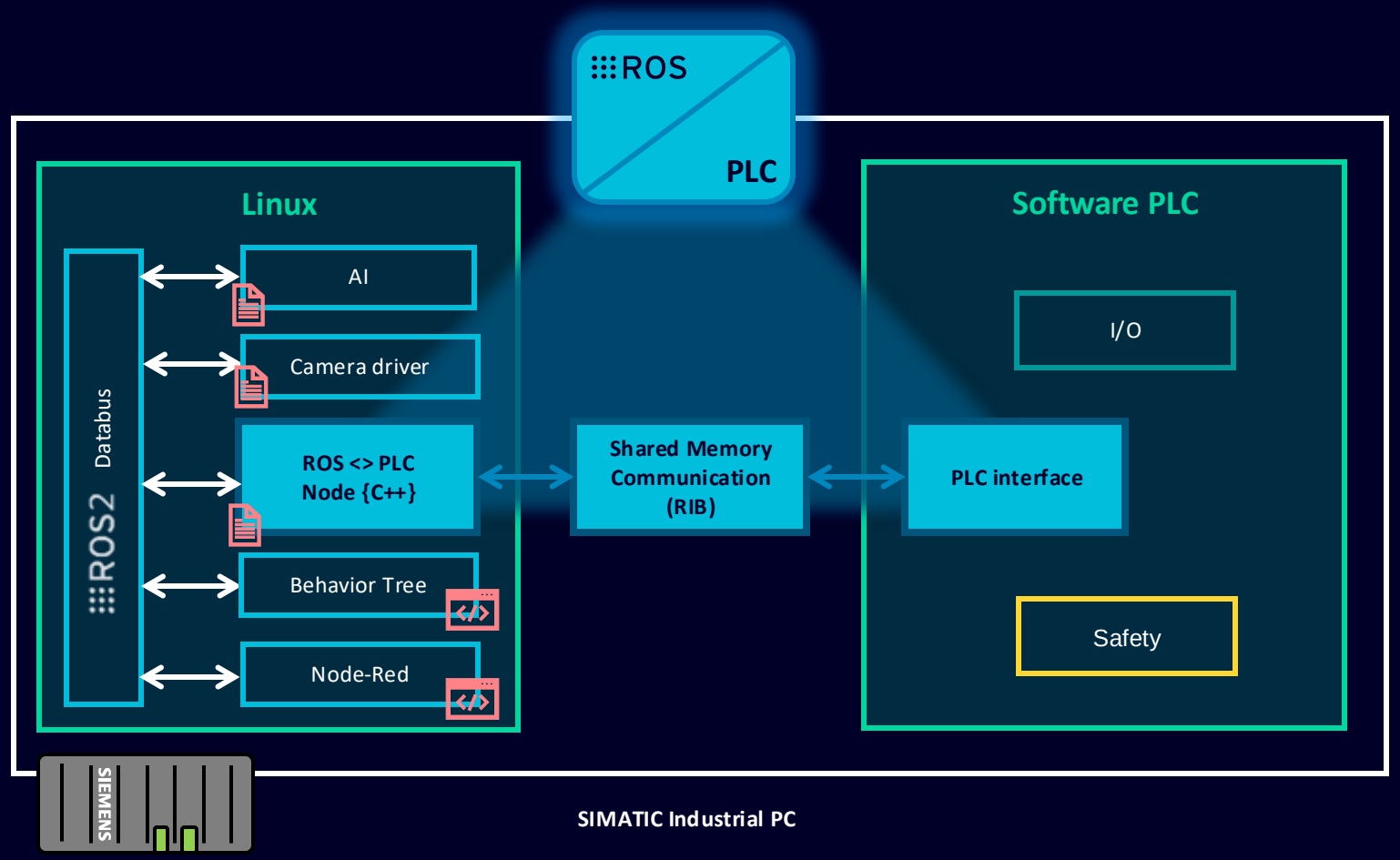
Siemens Hardware | Siemens Operating Systems | Siemens Assets | ROS Assets | AsyncAPI Doc | AsyncAPI Code

Test our pilot software today!



Siemens Hardware | Siemens Operating Systems | Siemens Assets | ROS Assets | AsyncAPI Doc | AsyncAPI Code

What is inside the box?



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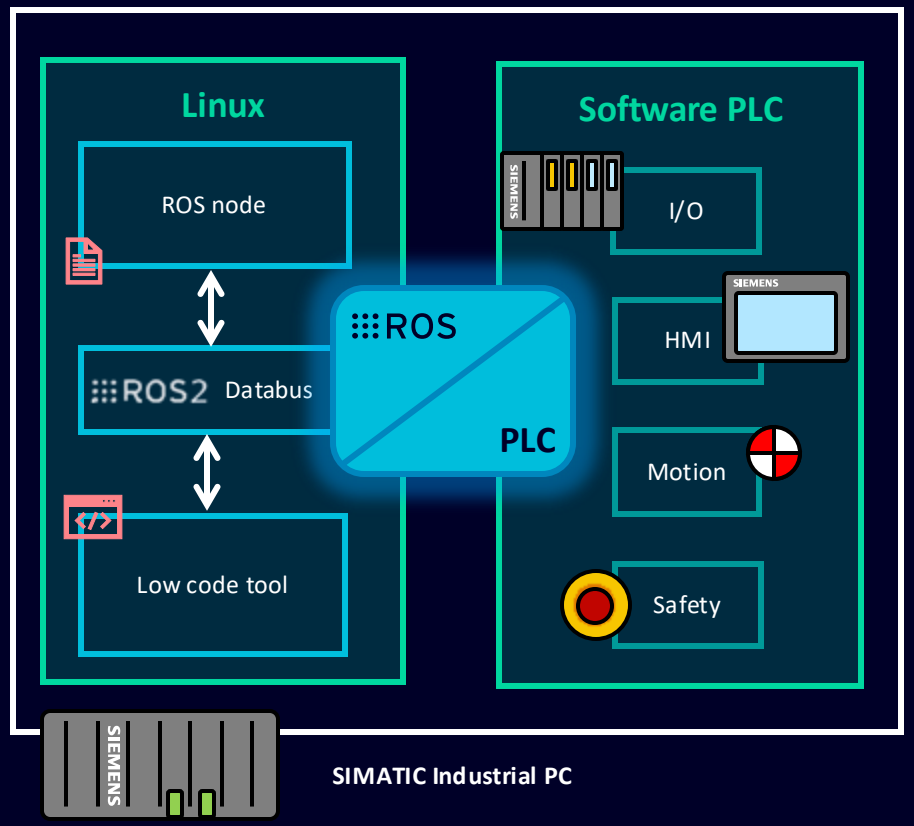
Recap in a nutshell



What you can test today:

SIEMENS <> ROS Connector:

- Up to 1 kHz speed
- Generate your interface in 5 mins
- **Talk to us** today or LinkedIn

Research:

- **AsyncAPI** spec -> soon on **GitHub**
- **AsyncAPI Generators -> Paper:**
  - Documentation
    - Static Code & Introspection
  - BehaviorTree.CPP V3
  - Node-Red
  - Scratch

“Siemens 

Open Source“

For more information:

Siemens ♥ Open Source

ROS2 AsyncAPI

ROSSharp

aerOS

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