REVOLUTIONIZING INDUSTRIAL IOT WITH APACHE PLC4X

APACHE PLC4X

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codecentric

WHO AM I?

- Christofer Dutz
- Senior IT Consultant
- codecentric AG
- Apache PLC4X & Apache Edgent
- Member of the Apache Foundation
- Open-Source Enthusiast
- Son of an electroengineer
- Twitter: @ChristoferDutz

AGENDA

- What we're doing
- What the industrial automation is/has been doing
- Histories compared
- Why should we change this?
- How could we change this?
- Apache PLC4X (Incubating)
- PLC4X Architecture
- CODE!!!

WHAT WE'RE DOING

WHAT THE INDUSTRIAL AUTOMATION IS/HAS BEEN DOING

- Logic initially hard-wired
- Connection based controllers (1950s)
- Programmable logic controllers (PLCs) (1960s/1970s)

HARD-WIRED LOGIC CONTROLLERS

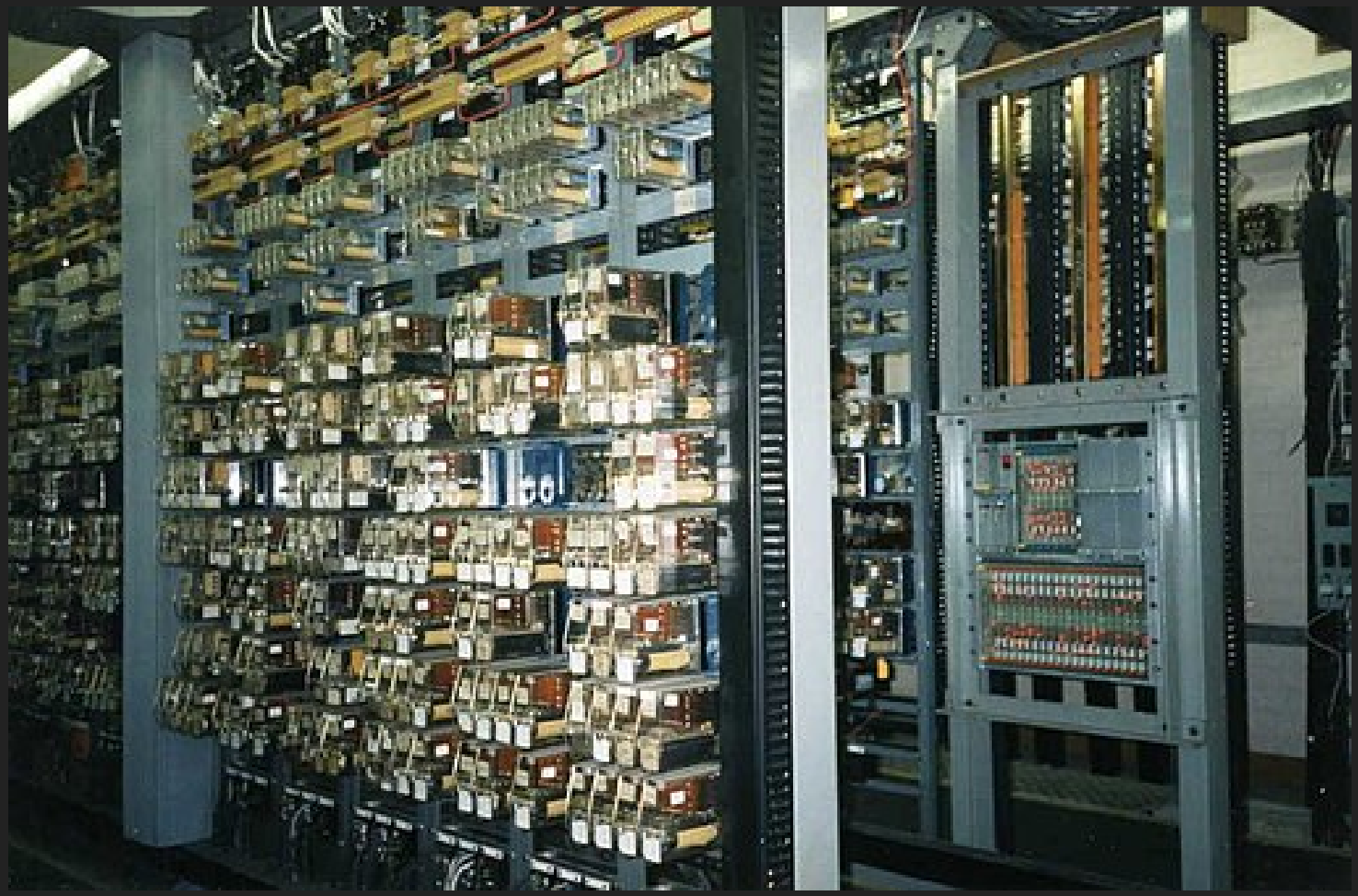


Figure 1. Courtesy of Signalhead via Wikimedia Commons

CONNECTION BASED LOGIC CONTROLLERS

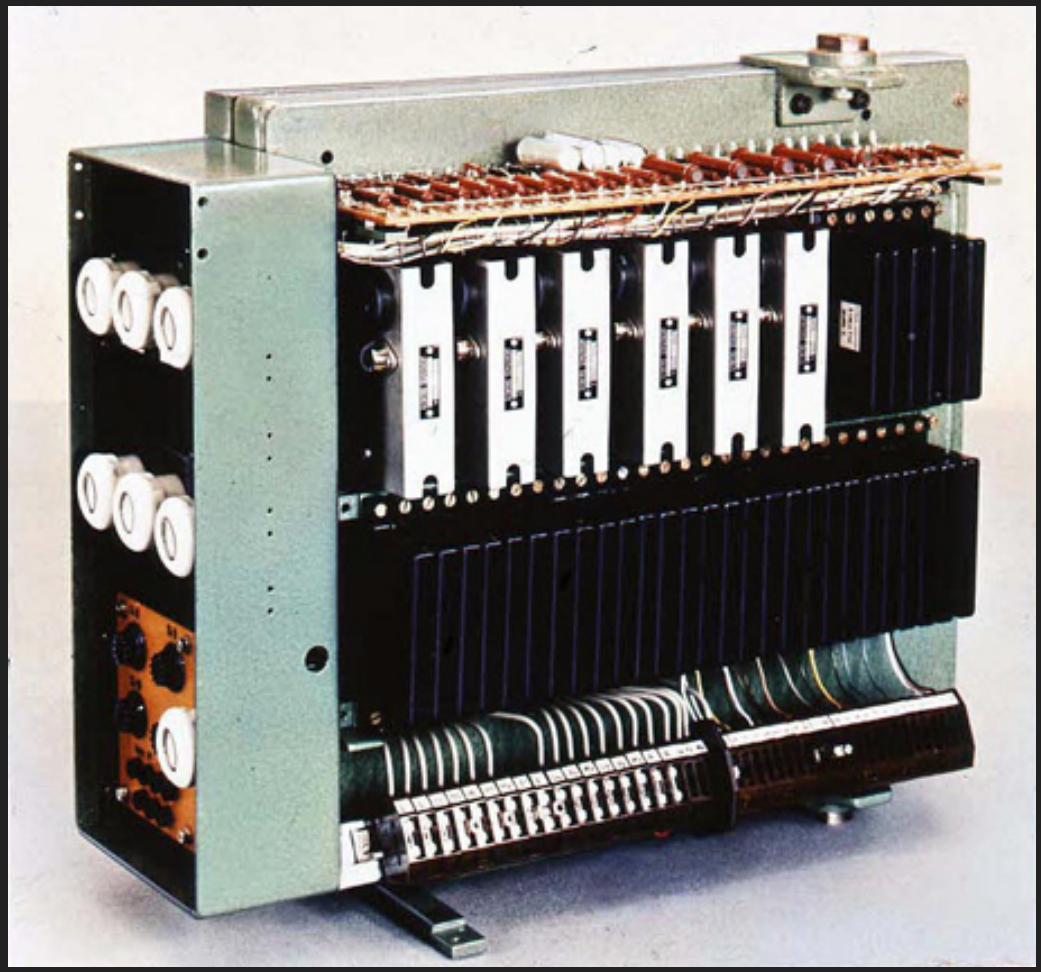


Figure 2. Courtesy of Siemens: SIMATIC-Controller for a turret lathe (Revolverdrehbank), 1959

PROGRAMMABLE LOGIC CONTROLLERS (PLCS)

Figure 3. Courtesy of https://www.automation.com PLC Pioneers, from left to right, Dick Morley, Tom Bossevain, George Schwenk,

and Jonas Landau

MODERN PLCS

Figure 4. Courtesy of https://www.automationdirect.com

PROGRAMMING PROGRAMMABLE LOGIC CONTROLLERS

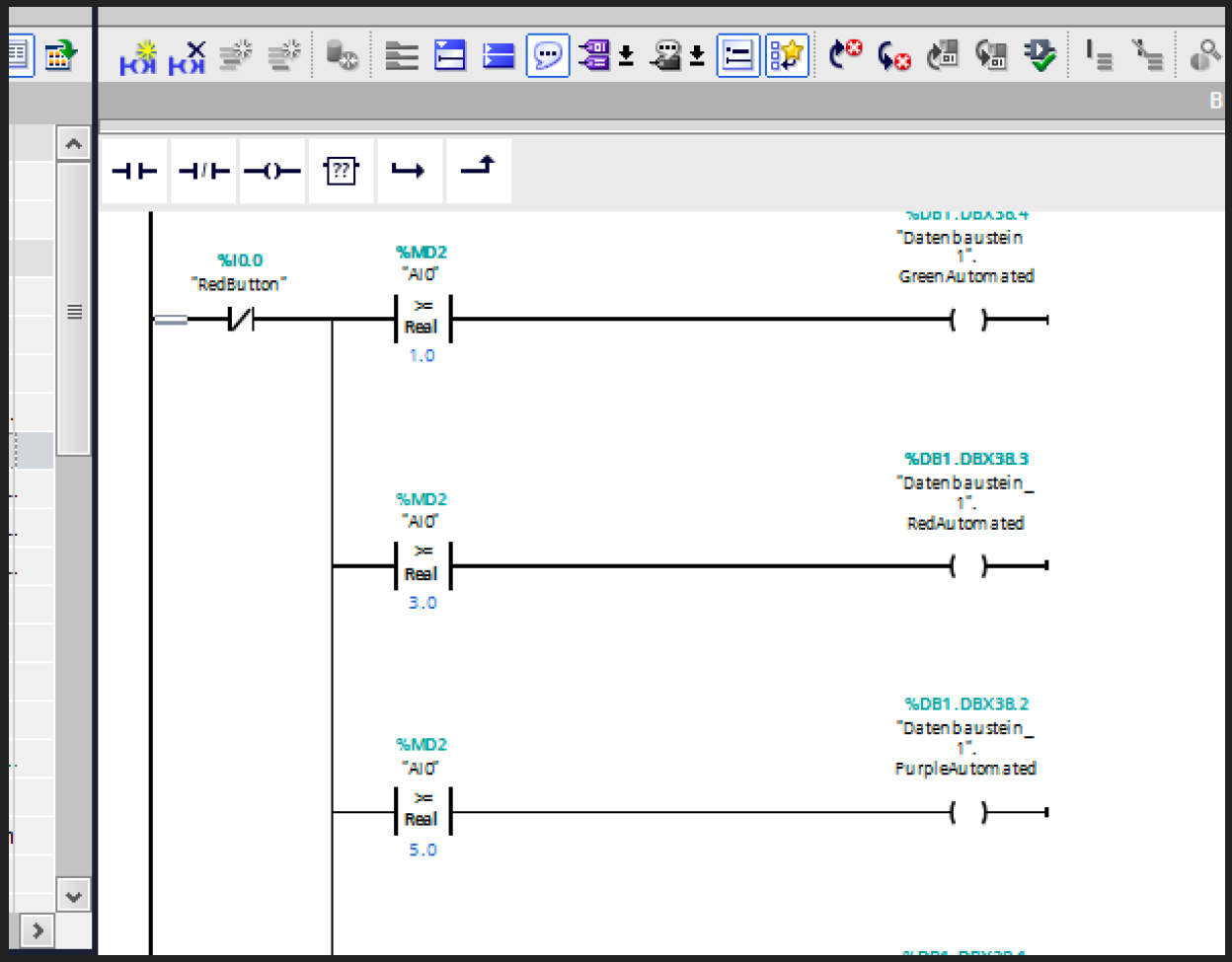


Figure 5. 'Code' for my IoTree Application

HISTORIES COMPARED

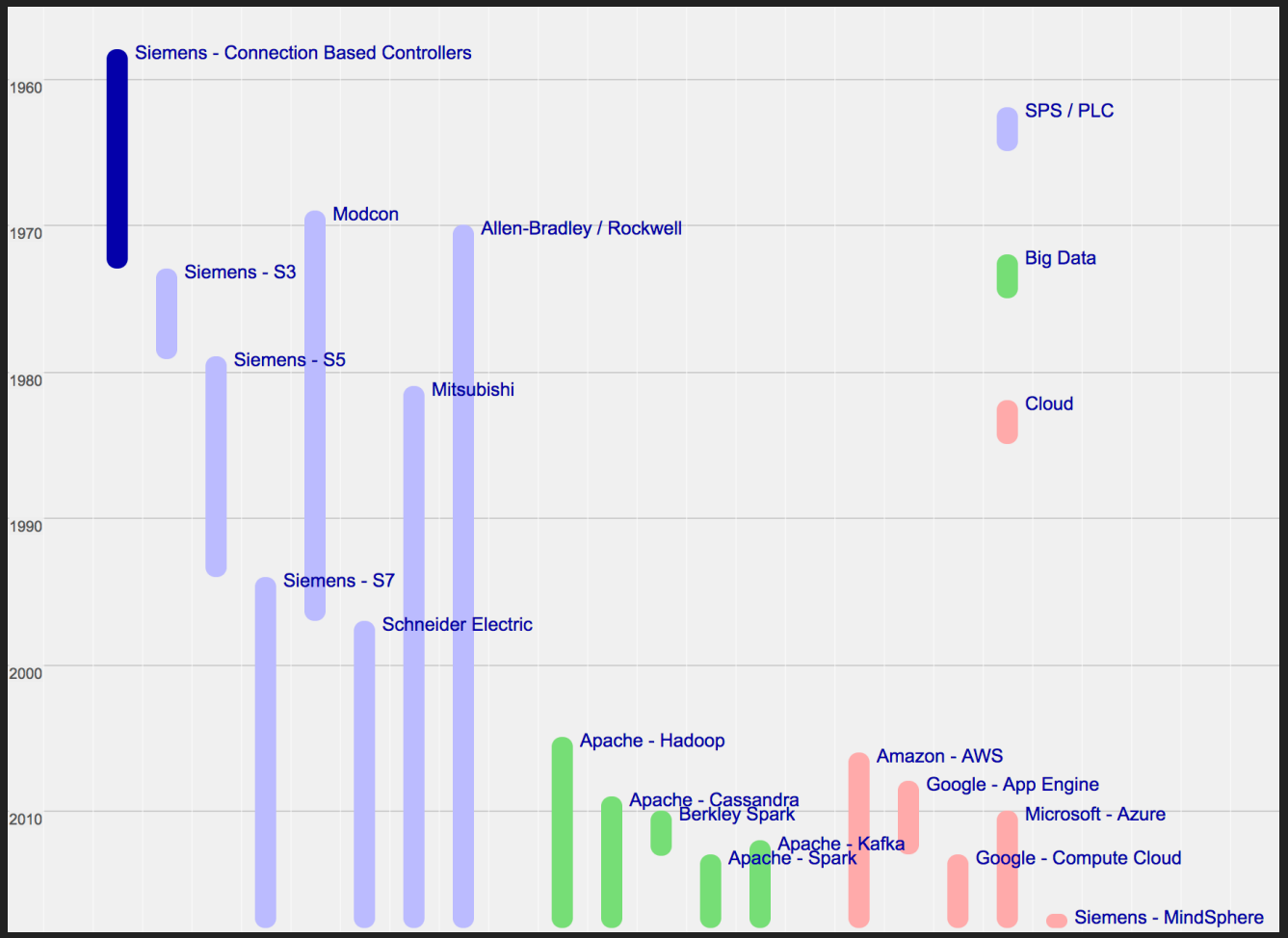
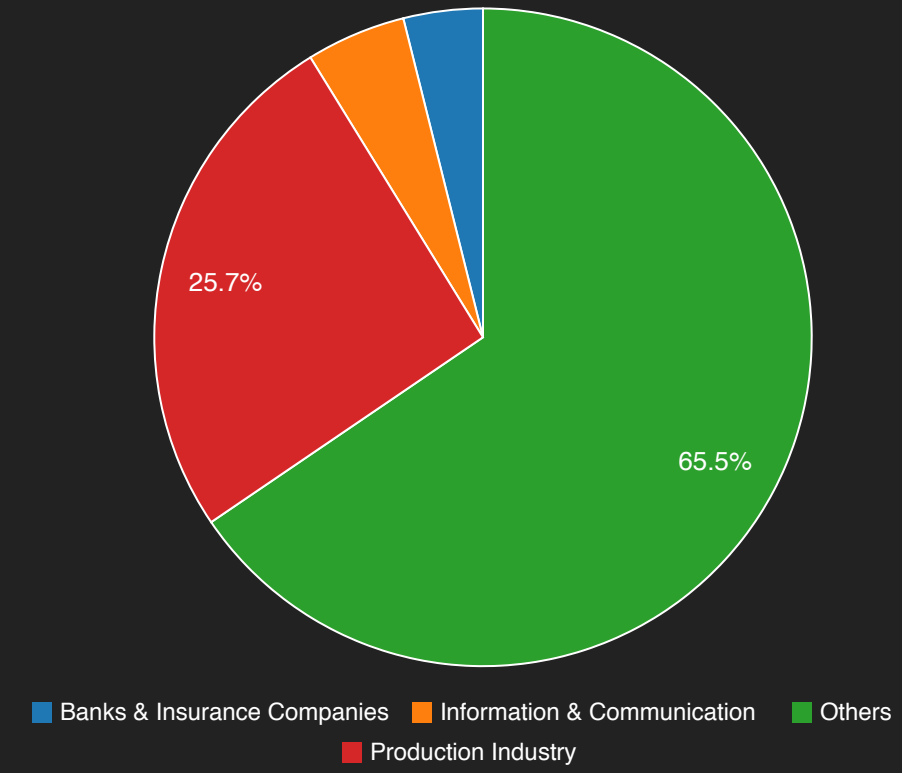


Figure 6. Release Dates of major products in the areas: PLC, BigData and Cloud

BUILDING WALLS

- Automation industry have been doing their thing since ... forever
- Long cycle times in the production industry
- Automation industry **didn't have the time to react**
- Customers have become used to consume only what their supplier offers
- First proprietary Cloud & BigData solutions by the large automation vendors

WHY SHOULD WE WANT CHANGE THIS?



Quelle: Deutschland in Zahlen 2016

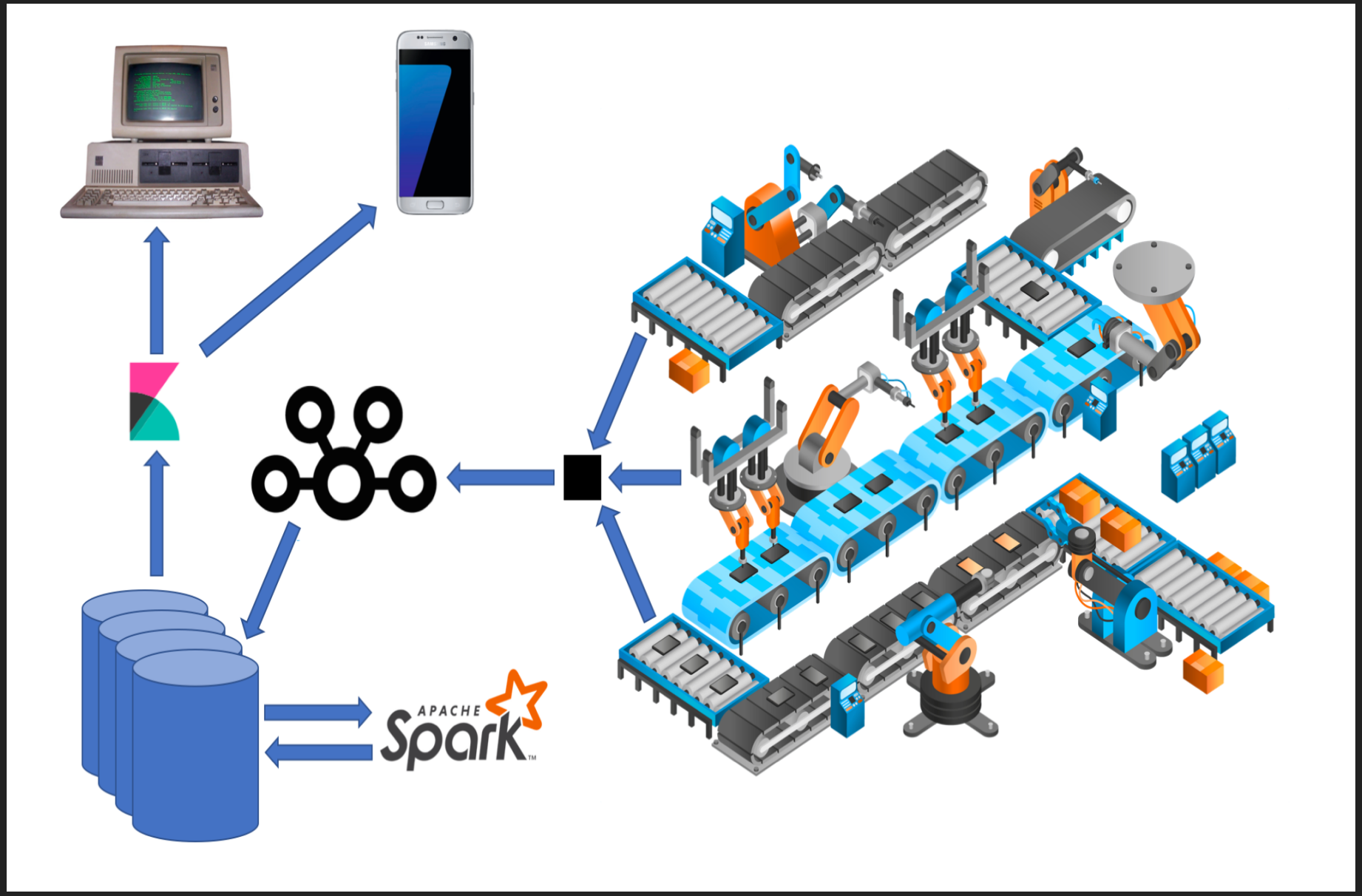
WHY SHOULD WE WANT TO CHANGE THIS?

- Huge market
- Great part of it not served yet
- Need of market matches our haves
- Industry 4.0 is all about:
  - Cloud
  - Big Data
  - Machine Learning
  - ...

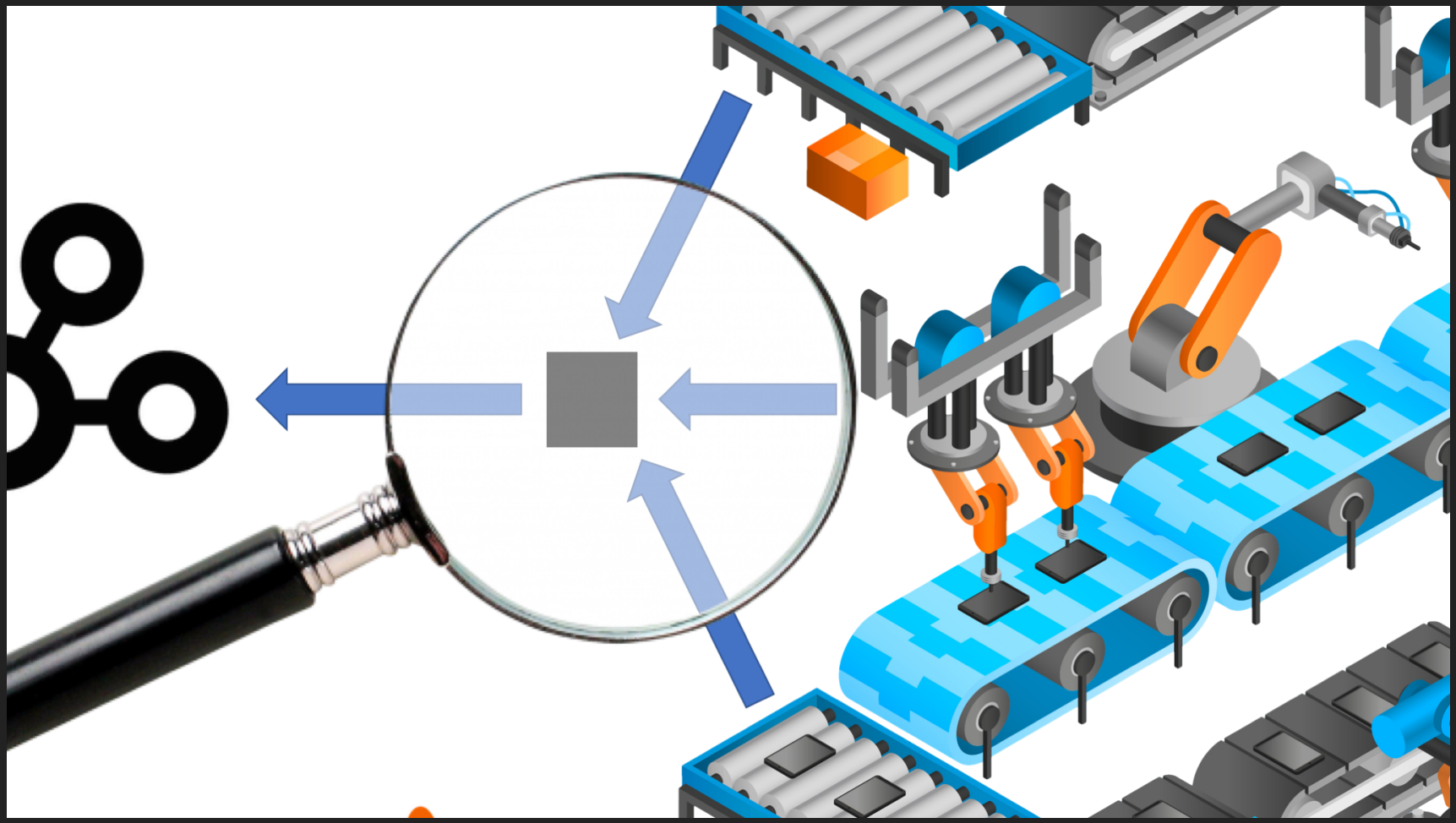
WHY SHOULD THEY WANT US TO CHANGE THIS?

- Drastic cost reduction
- Freedom of choice
- Small & mid-sized companies cut off from innovation
- On-Premise solutions don’t scale / Not extensible
- Security
- Automation industry cloud solutions not as mature as ours
  - Only few professionals available

HOW COULD WE CHANGE THIS?



WHAT'S WRONG WITH THAT?



WHAT'S WRONG WITH THAT?

APACHE PLC4X (INCUBATING)

APACHE PLC4X

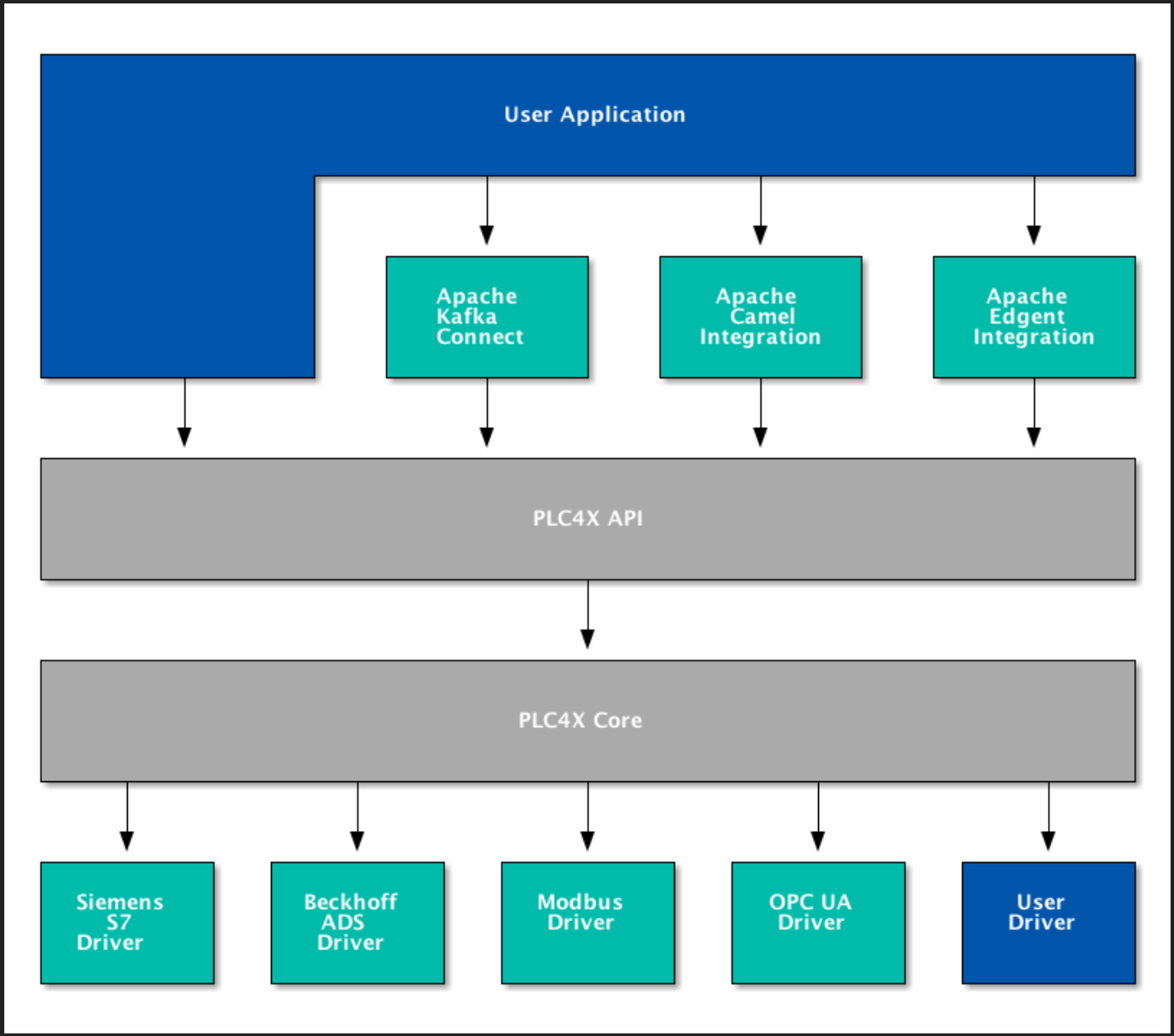
PLC4X is a set of libraries for communicating with industrial programmable logic controllers (PLCs) using a variety of protocols but with a shared API.

— Apache PLC4X Project Statement

APACHE PLC4X (INCUBATING)

- Applications only use API module
- Integration modules available for multiple frameworks
- Currently plain Java, but Scala, C, C++, C#, JavaScript, ... planned
- Driver implementations implement the functionality
  - Native
  - Simulated where needed & where possible
- Ability to write software (almost) independent of the actual PLC used

PLC4X ARCHITECTURE

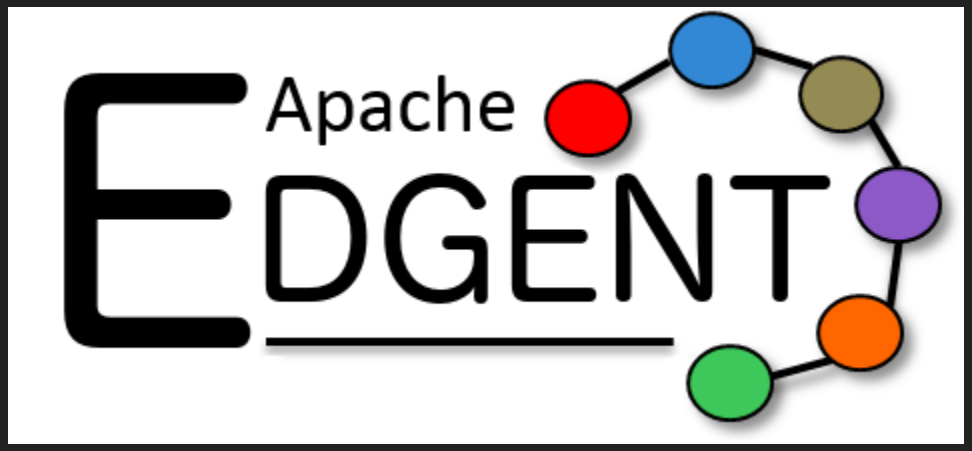


CODE EXAMPLE (DIRECT API)

- Asynchronous example:

```
try (PlcConnection plcConnection =
        new PlcDriverManager().getConnection("s7://10.10.64.20/1/1")) {

    Optional<PlcReader> reader = plcConnection.getReader();
    if (reader.isPresent()) {
        PlcReader plcReader = reader.get();

        Address inputs = plcConnection.parseAddress("INPUTS/0");

        CompletableFuture<TypeSafePlcReadResponse<Byte>> asyncResponse =
            plcReader.read(new TypeSafePlcReadRequest(Byte.class, inputs));

        asyncResponse.thenAccept(bytePlcReadResponse -> {
            Byte dataAsync = bytePlcReadResponse.getResponseItem()
                .orElseThrow(() -> new IllegalStateException("No response"))
                .getValues().get(0);
            System.out.println("Inputs: " + dataAsync);
        });
```

APACHE EDGENT (INCUBATING)



- Programmingmodel and Micro-Kernel Runtime
- Runs on very limited hardware
- Developed around the concept of streams
- Realtime analysis of datastreams
- Connectors to many diferent datasources

CODE EXAMPLE (PLC4X MIT EDGENT)

- Data collection on Siemens S7 PLCs

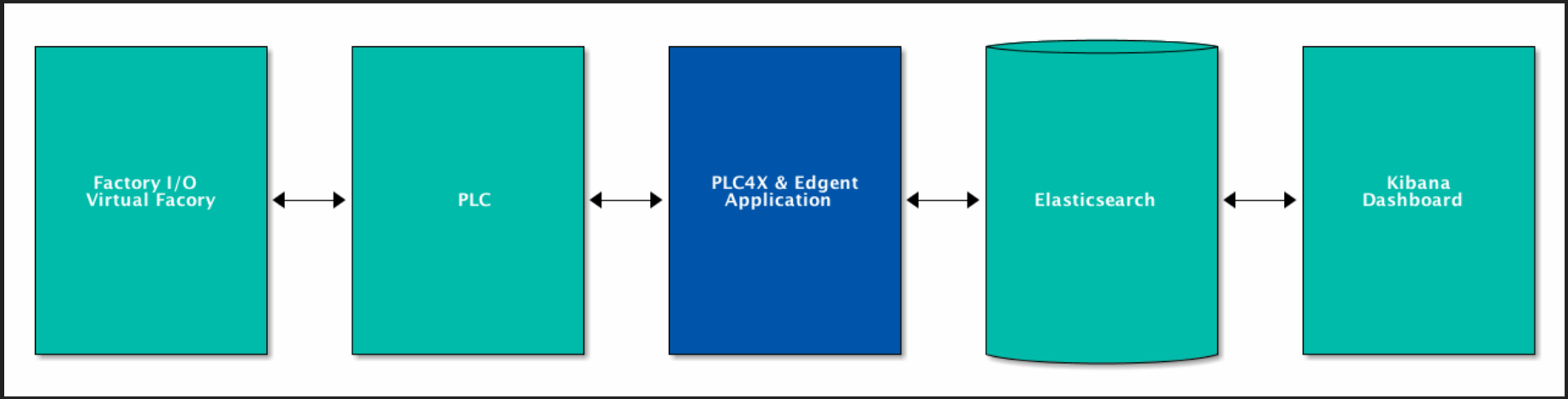
```
try (PlcConnectionAdapter plcAdapter =
        new PlcConnectionAdapter("s7://10.10.64.20/1/1")) {

    DirectProvider dp = new DirectProvider();

    Topology top = dp.newTopology();

    TStream<Byte> internalVariableStream = top.poll(
        PlcFunctions.byteSupplier(plcAdapter, "INPUT/0"),
        10, TimeUnit.MILLISECONDS);

    internalVariableStream.sink((Consumer<Byte>) inputs -> {
        System.out.println("Inputs: " + inputs);
    });

    dp.submit(top);
}
```

CODE EXAMPLE (PLC4X MIT EDGENT)

- Data collection on Beckhoff PLCs

```
try (PlcConnectionAdapter plcAdapter =
        new PlcConnectionAdapter("ads:tcp://10.10.64.10.1.1")) {

    DirectProvider dp = new DirectProvider();

    Topology top = dp.newTopology();

    TStream<Byte> internalVariableStream = top.poll(
        PlcFunctions.byteSupplier(plcAdapter, "Allgemein.Eingaenge"),
        10, TimeUnit.MILLISECONDS);

    internalVariableStream.sink((Consumer<Byte>) inputs -> {
        System.out.println("Inputs: " + inputs);
    });

    dp.submit(top);
}
```

LIVE DEMO (EXTENDED EXAMPLE)



- Application based on PLC4X & Edgent
- PLC: SPS S7-1200
- Virtual Factory (Sorting of boxes)
- Datastorage in Elasticsearch
- Dashboard with Kibana

WHAT'S TO COME (PLC4X)?

- Implementation of additional protokolls:
  - Modbus, OPC-DA, OPC-UA, Ethernet/IP, ...
- Extending the features of some drivers
- Publish & Subscribe for Siemens
- Building the community

WHAT'S TO COME (EDGENT)?

- Implementation of additional connectors
  - AWS IoT Cloud
  - Google IoT Cloud
  - Azure IO
  - Siemens Mindsphere
  - MQTT5 (MQTT Bee Integration)
- Building the community

THANKS FOR LISTENING

- Questions?
- Suggestions?
- Want to join us??
- Want to try it out?