Webinar

Freedom⁴ - Free Your Manufacturing Data with MQTT & PLC4X

WELCOME

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- Member of Apache Software Foundation
- Committer in 13 Apache Projects
- VP Apache PLC4X Project

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- 7 years of MQTT experience
- Blogger & Speaker
- Helped 130+ customers to go into production with IoT use cases

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Current Situation

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Current Situation in Manufacturing/Automation

- Most important components: **PLCs**
  - Little Computers that run machinery
  - Very limited resources (CPU & Memory)
  - Up to Real-Time operation
  - Actually never crash

- Currently the industry is all about **industry 4.0**
- industry 4.0 is all about **AI & Machine Learning**
- AI & Machine Learning is all about **data**
  - It's actually about **lots of data**
- Data is everywhere

- Accessing Data is easy (on new PLCs)
  - Using **OPC UA** or **MQTT**

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What is OPC UA?

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Introducing OPC UA

- **OPC U**nified **A**rchitecture
- Standard & Protocol for
  - Platform independent **data exchange**
  - Service-Oriented **architecture**
- Also defines the **semantics** of data
- Created by the **OPC Foundation**
- Development time: about **10 years**
- Sort of final version released **2 years ago**

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Problems with OPC UA?

- A highly **complex** standard
- **Incompatible** Asset Administration Shells
- Need to add **application-server** to PLC
- Great for accessing small amounts of data (for Dashboards, Logging, etc.)
- **Inacceptable performance** when accessing large amounts of data - especially at high frequencies (for AI & Machine learning)

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What is MQTT?

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Introducing MQTT

- IoT messaging protocol
- Publish/subscribe
- Minimal overhead for client and bandwidth
- Lightweight client implementations
- Designed for reliable communications over unreliable channels
- 3 Quality of Service (QoS) levels
- MQTT 5 is required for IIoT

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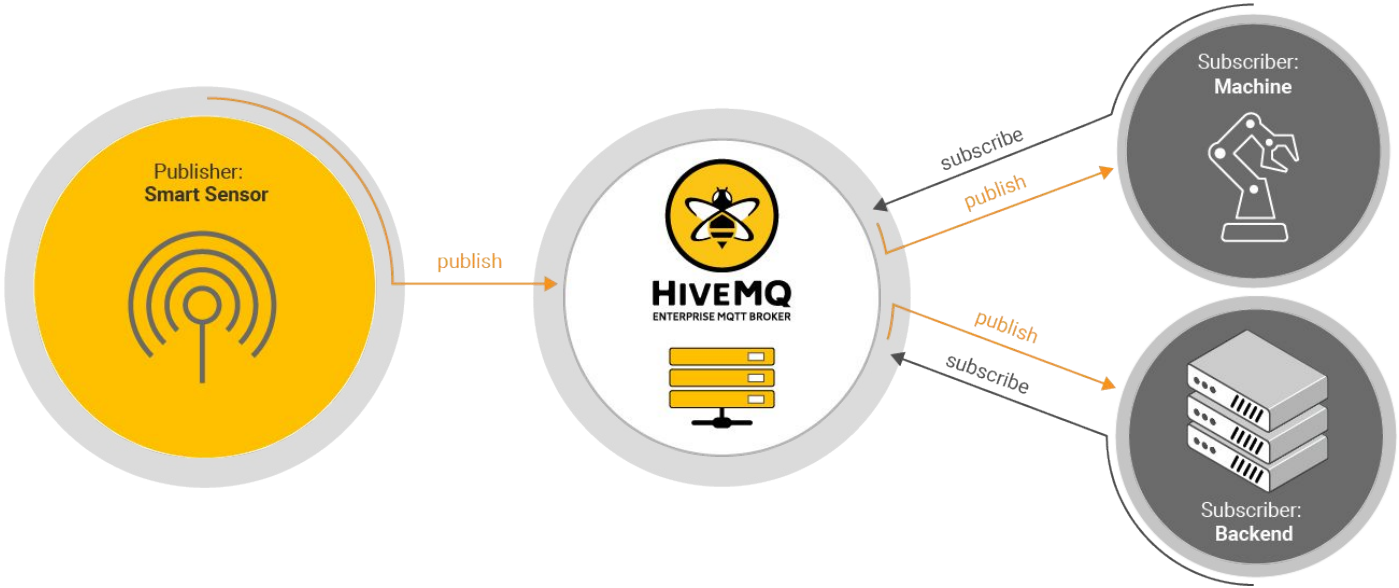
Publish / Subscribe Pattern



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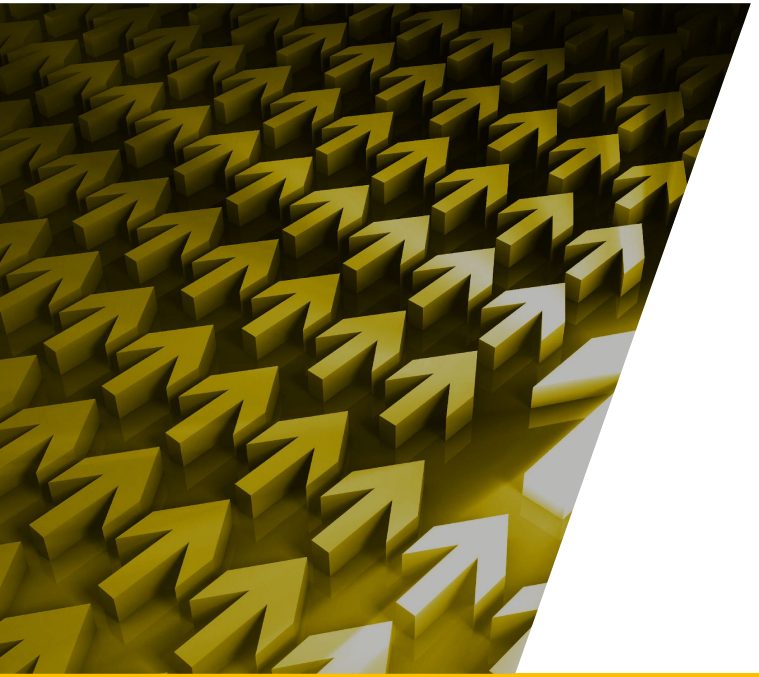
MQTT Pub/Sub Advantages



- Space Decoupling
- Time Decoupling
- Synchronization Decoupling
- Message filtering based on subjects topics
- Push Communication
- Dynamic Topics

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So why not just concentrate on MQTT?

- Industrial Hardware usually built for lifespans of **20 years**
- MQTT enabled PLCs available for **1-2 years**
- Assuming that every PLC built into machinery in the last 2 years supports MQTT:
  - 5% of machinery replaced per year
  - -> **Max. 10% availability**
- What to do with the remaining **>90%**?

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MQTT Open Standard - Freedom[1]

- Free and open ISO standard
- OASIS standard
- Technical committee of users
- Periodic improvements

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Current Situation in Manufacturing/Automation

- Accessing data on PLCs older than 1-2 years is difficult
  - Hundreds (if not even thousands) of **protocols**
  - **Incompatibilities** between manufacturers
  - Most have absolutely **no security**
  - Those with security features mostly implemented in a **useless** fashion
- Especially when using OPC UA mostly **performance is unacceptable** for:
  - Lots of data
  - In high frequencies

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Current Solutions

- Usage of **integration platforms**
  - Extremely expensive
  - Usually Monoliths -> Don’t scale well
- Usage of commercial or open-source **drivers**
  - Commercial usually == Expensive
  - Open-Source mostly:
    - Very old projects
    - Badly maintained
    - Bady licensed
- Usage of (hardware) **gateways**
  - Gateway PLCs
  - Protocol Adapters/Gateways

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Introducing Apache PLC4X

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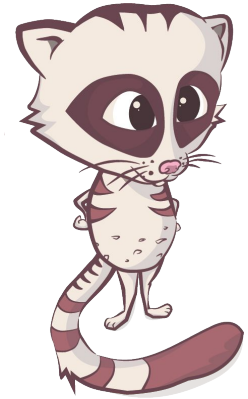
Apache PLC4X Open Source - Freedom²



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"

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Apache PLC4X Implementation

APACHE PLC4X

Supported Operations:

- Read ✓
- Write ✓
- Subscribe ✓
  - On value change
  - Cyclic
  - Events
- Browse ✗
- Execute ✗

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Apache PLC4X Implementation - Freedom³

APACHE PLC4X

Supported Protocols:

- Siemens S7 ✓
- Beckhoff ADS ✓
- Modbus ✓
- EtherNet/IP ✓
- OPC-UA ✓
- Firmata ✓
- KnxNet/IP ✓
- CAN ✓

- Allen-Bradley AB-ETH ✗
- Allen-Bradley DF1 ✗
- BacNet ✗
- Emerson DeltaV ✗
- Luxtronic ✗
- Siemens S7 (TIA) ✗
- ProfiNet ✗
- …

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Apache PLC4X Implementation - Freedom³

APACHE PLC4X

Supported Languages:

- Java ✓
- Go ✓
- C ✗
- Python ✗
- C# ✗
- C++ ✗
- ...

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Apache PLC4X USPs - Freedom⁴

APACHE PLC4X

- One API for all drivers
- One software can handle any type of machinery
  - Different Vendors in different Plants
  - Upgrading / Replacing machinery
- No need to retrofit existing machinery
- No license costs
- **Passive-Mode drivers**

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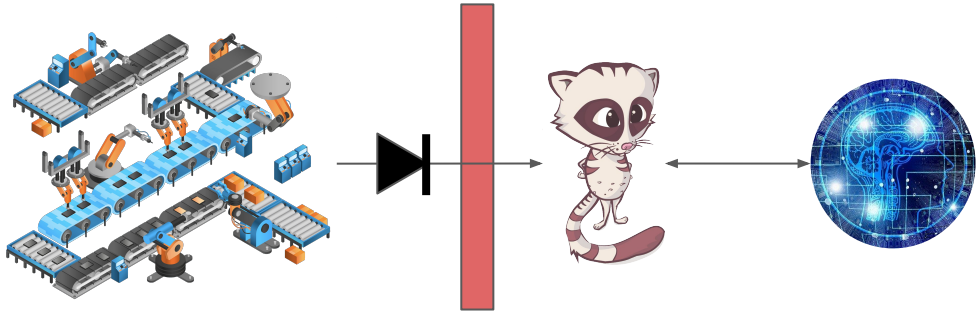
Apache PLC4X Passive - Mode Drivers

APACHE PLC4X

- **Secure by design**
- **Only listen** to network traffic
- Make data in production network available **100% secure**
- No need to validate/certify drivers
- Support **subscription** API



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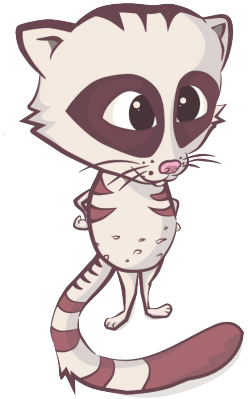
Apache PLC4X Passive-Mode Drivers



APACHE PLC4X

- **Wiesemann & Theis GmbH** built “Data-Diode”
- Explicitly built for usage with Apache PLC4X passive-mode drivers
- Product name: **Fix Defined Firewall**
- https://www.wut.de/e-55312-ww-dade-000.php

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Apache PLC4X Commercial Support

APACHE PLC4X

- https://industrial-opensource.com
- 14 Businesses around Apache PLC4X and other Apache IoT project
- Formed alliance for providing support for IoT Open-Source projects
- Services:
  - Trainings & Workshops
  - Consulting Services
  - Implementation (assistance)
  - Technical Support
  - Legal Consulting

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Apache PLC4X for all the existing & old Machines

MQTT for the new and upcoming devices

Perfect Match

APACHE PLC4X ❤ HIVEMQ

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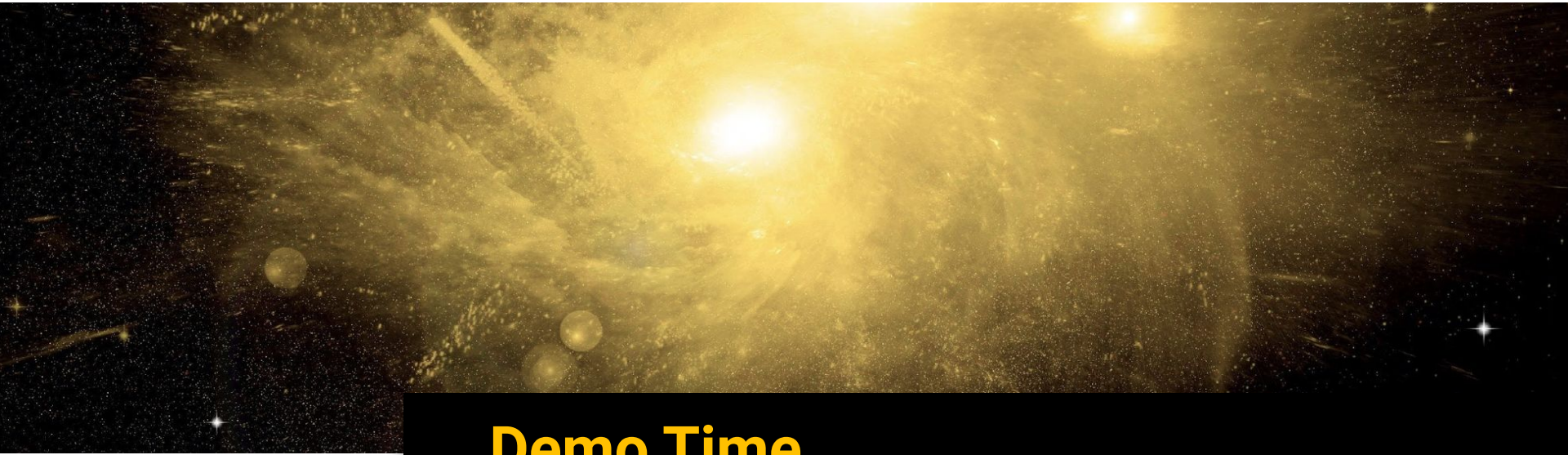

Demo Time

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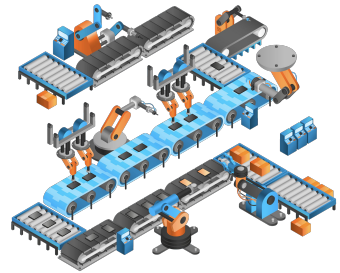
Demo Setup



HIVEMQ

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Demo Client

- Go to: **http://www.hivemq.com/demos/websocket-client/**
- connect to Host: **broker.hivemq.com** with Port: **8000**
- Subscribe to topic **plc4x/sorting-line-topic**

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Questions?

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