



# APACHE IOT



## A trip from the chip to the cloud

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# WHO AM I?

- Christofer Dutz
- Senior IT Consultant
- codecentric AG
- Open-Source Enthusiast
- Committer of 10 Apache projects
- Member of the Apache Foundation
- VP of Apache PLC4X
- Twitter: @ChristoferDutz



# FIRST STEPS IN IOT

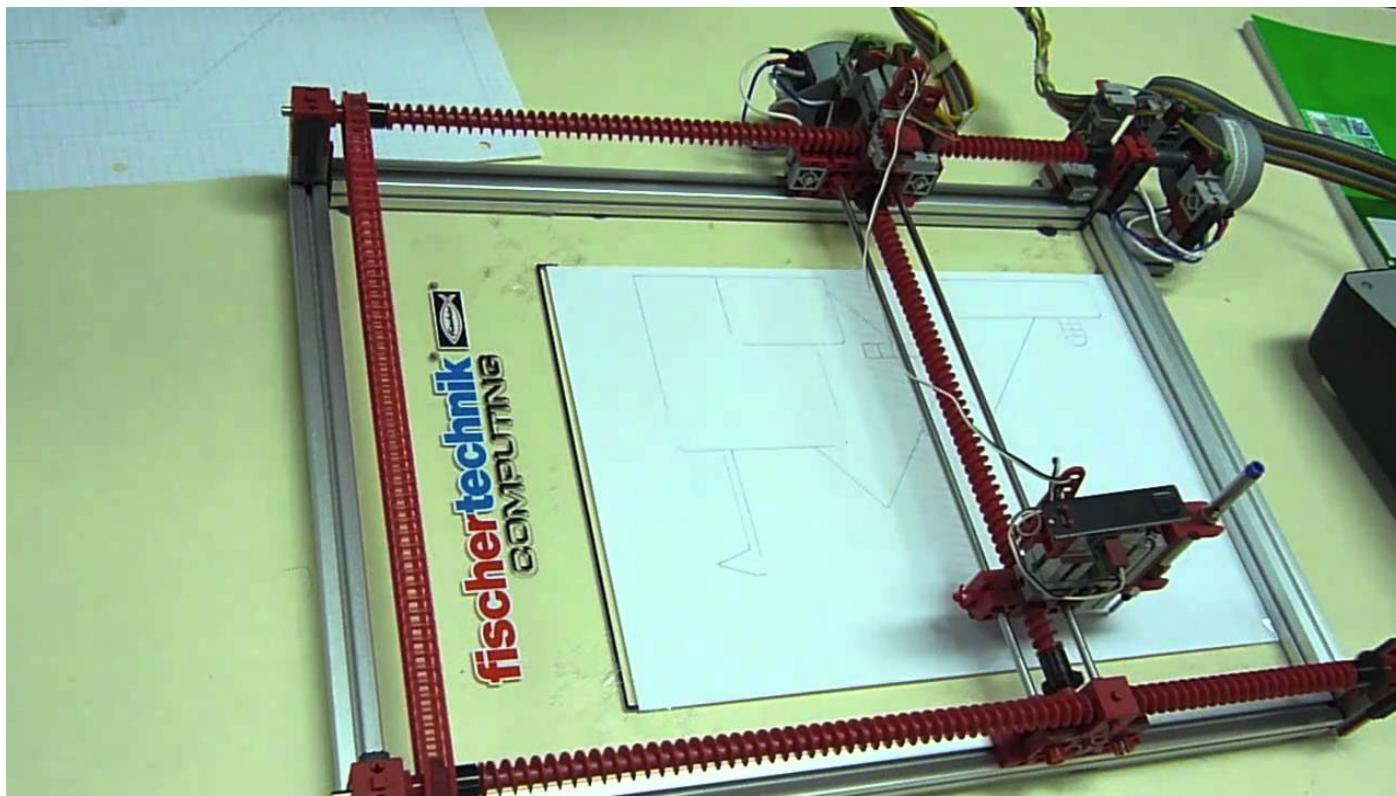


Figure 1. [https://www.youtube.com/watch?v=bF7\\_2FS3j1M](https://www.youtube.com/watch?v=bF7_2FS3j1M)

# FIRST STEPS IN IOT

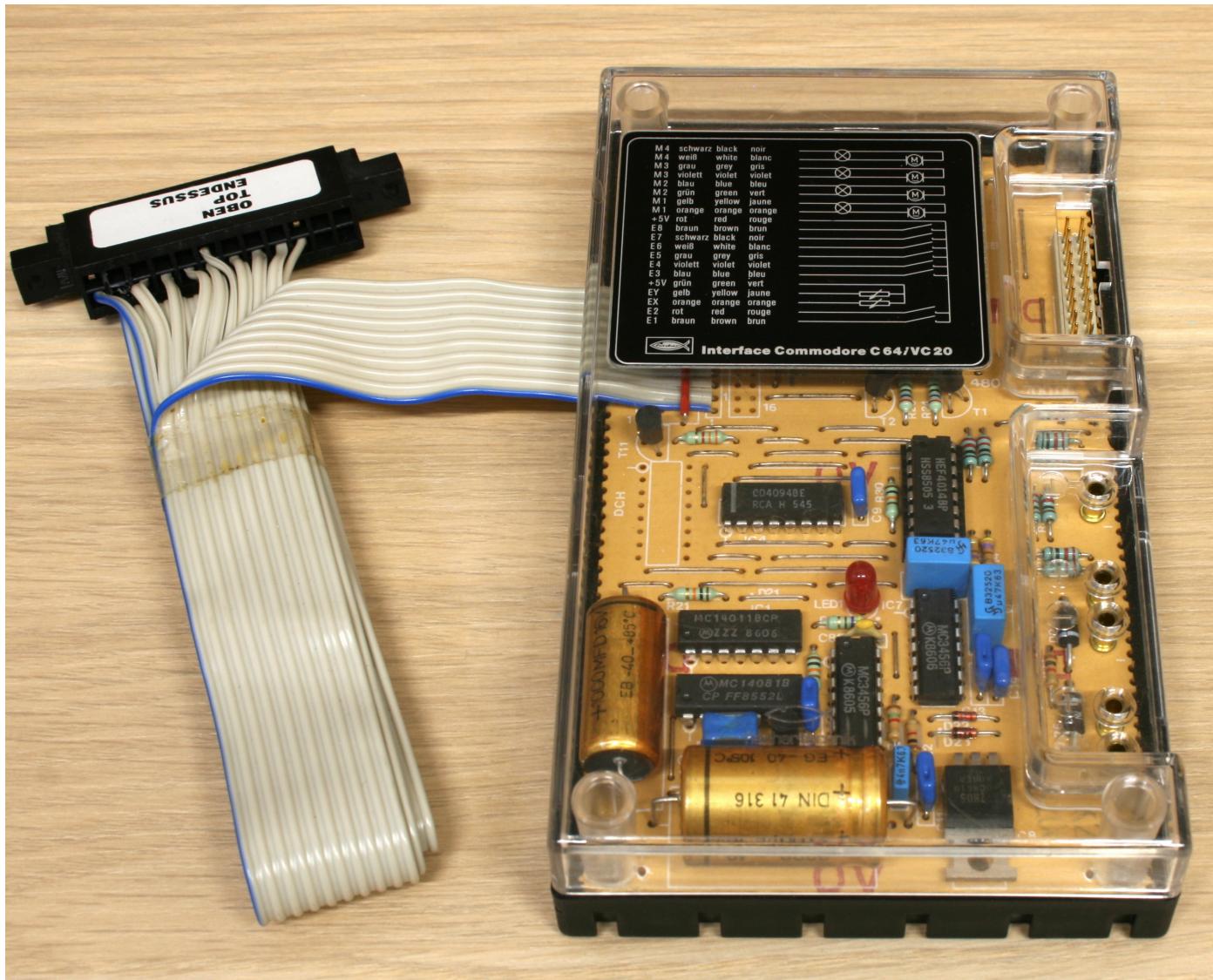


Figure 2. <https://klaus.merkert.info/computer/ft/>

# FIRST STEPS IN IOT

```

55176 REM
56000 REM *** -X/+Y-DIAGONALE ***
56010 REM
56020 LET XJ=XJ-1:LET YJ=YJ+1
56030 GOSUB 61000:REM *** OUT? ***
56040 IF XOUT THEN GOTO 52840
56050 IF YOUT THEN GOTO 51040
*56060 SYS M1,REISYS M2,L1SYS M3,RE
56070 GOSUB 60000:REM *** ET ??? ***
*56080 SYS M1,L1SYS M2,RE:SYS M3,RE
56090 GOSUB 60000:REM *** ET ??? ***
*56100 SYS M1,L1SYS M2,RE:SYS M3,L1
56110 GOSUB 60000:REM *** ET ??? ***
*56120 SYS M1,REISYS M2,RE:REISYS M3,RE
56130 GOSUB 60000:REM *** ET ??? ***
*56140 SYS M1,REISYS M2,RE:REISYS M3,RE
56150 GOSUB 60000:REM *** ET ??? ***
56160 RETURN
56170 REM
57000 REM *** -X/-Y-DIAGONALE ***
57010 REM
57020 LET XJ=XJ-1:LET YJ=YJ-1
57030 GOSUB 61000:REM *** OUT? ***
57040 IF XOUT THEN GOTO 53040
57050 IF YOUT THEN GOTO 51040
*57060 SYS M1,REISYS M2,L1SYS M3,L1
57070 GOSUB 60000:REM *** ET ??? ***
*57080 SYS M1,L1SYS M2,L1SYS M3,L1
57090 GOSUB 60000:REM *** ET ??? ***
*57100 SYS M1,L1SYS M2,RE:REISYS M3,RE
57110 GOSUB 60000:REM *** ET ??? ***
*57120 SYS M1,REISYS M2,RE:REISYS M3,RE
57130 GOSUB 60000:REM *** ET ??? ***
57140 RETURN
57150 REM
58000 REM *** MG-EIN ***
58010 REM
58020 LET MG=="EIN"
58030 IF (XOUT) OR YOUT THEN RETURN
*58040 SYS INIT
58050 FOR Z=1 TO 100:NEXT
*58060 SYS M4,EIN
*58070 FOR Z=1 TO 100:SYS M4,EIN:NEXT
58080 RETURN
58090 REM
59000 REM *** MG-AUS ***
59010 REM
59020 LET MG=="AUS"
*59030 SYS M4,LINKS
*59040 SYS M4,AUS
59050 FOR Z=1 TO 100:NEXT
59060 RETURN
59070 REM
60000 REM *** ET-GEDRUECKT ***
60010 REM
*60020 IF (SER(E7)=0) AND (XJ < 0) OR (USER(E8)=0)
AND YJ < 0) THEN GOTO 50040

```

Figure 3. From the official manual.

# INTRODUCTION

- IoT is everywhere
- Things have become quite a bit easier
- Open-Source, but also Open-Hardware
- New Projects being started every day
- All the major foundation have "IoT Sections"
- Hard to keep track of everything that's happening

# AGENDA

- Take you on a journey
  - from the chip
  - via the edge
  - through the fog
  - into the cloud
- Focus on Apache projects
- Outreach to Other projects and foundations
- Discussion

# PROJECTS WE'LL BE TALKING ABOUT

- Apache MyNewt
- Apache PLC4X
- Apache Edgent
- Apache Camel
- Apache NiFi
- Apache Spark
- Apache Flink
- Apache Beam
- Apache Hadoop
- Apache Cassandra
- **Apache IoTDB**
- Apache Kafka
- **Apache StreamPipes**

# APACHE MYNEWT



# APACHE MYNEWT

- First Apache (Rt)OS
- "Linux for platforms too small to run Linux"
- Multiple layers of abstraction
  - Allows developing software for a wide range of chips
- Built for Wireless
  - Bluetooth (Mesh), LoRaWan, ...
- Modular Drivers
- Built with security as main principle
- Secure Bootloader

# APACHE MYNEWT



Figure 4. Source Amazon

# APACHE MYNEWT



Figure 5. Source Ruuvi

# APACHE PLC4X



# APACHE PLC4X

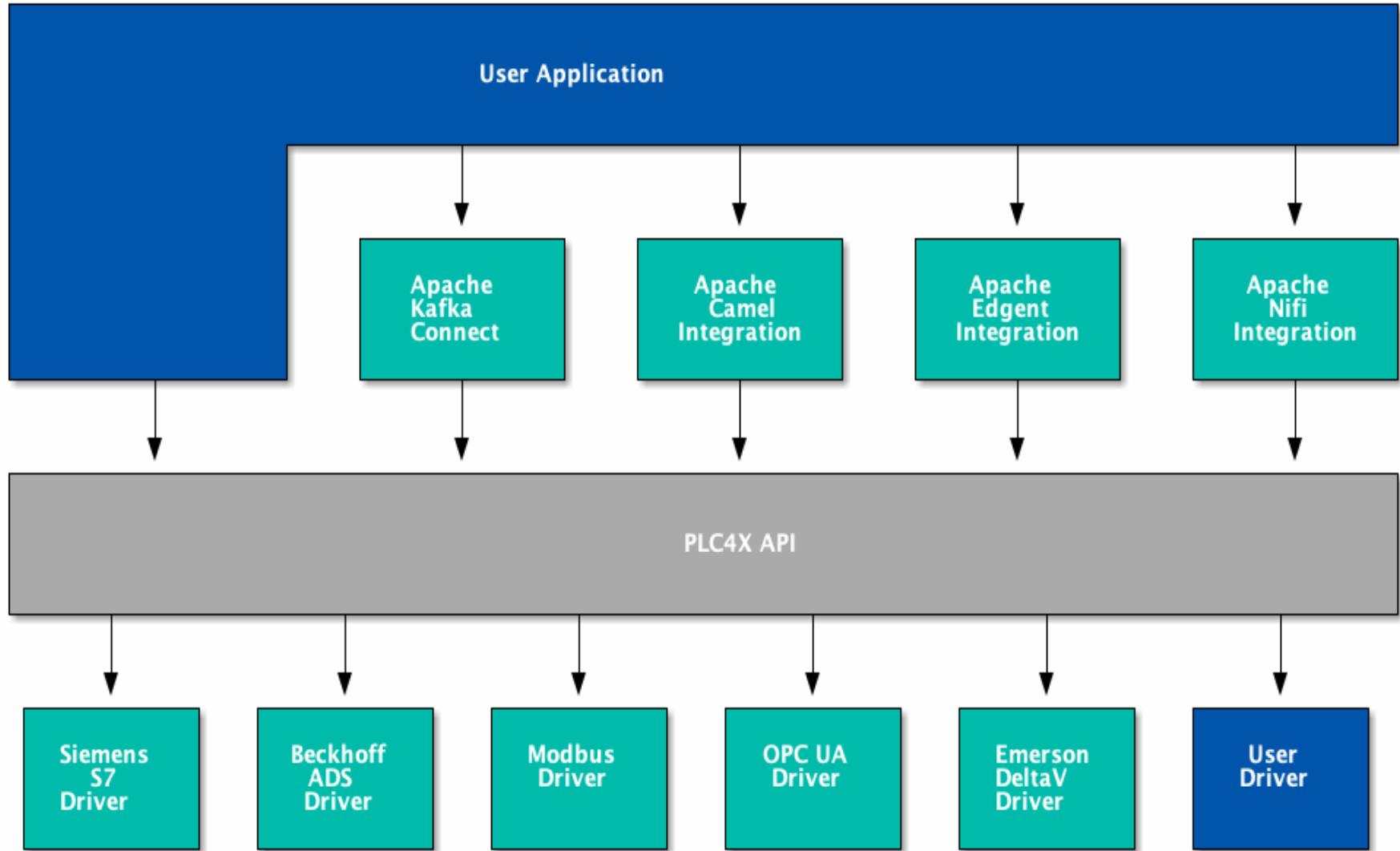
*PLC4X is a set of libraries for communicating with industrial programmable logic controllers (PLCs) using a variety of protocols but with a shared API.*

- Apache PLC4X Project Statement

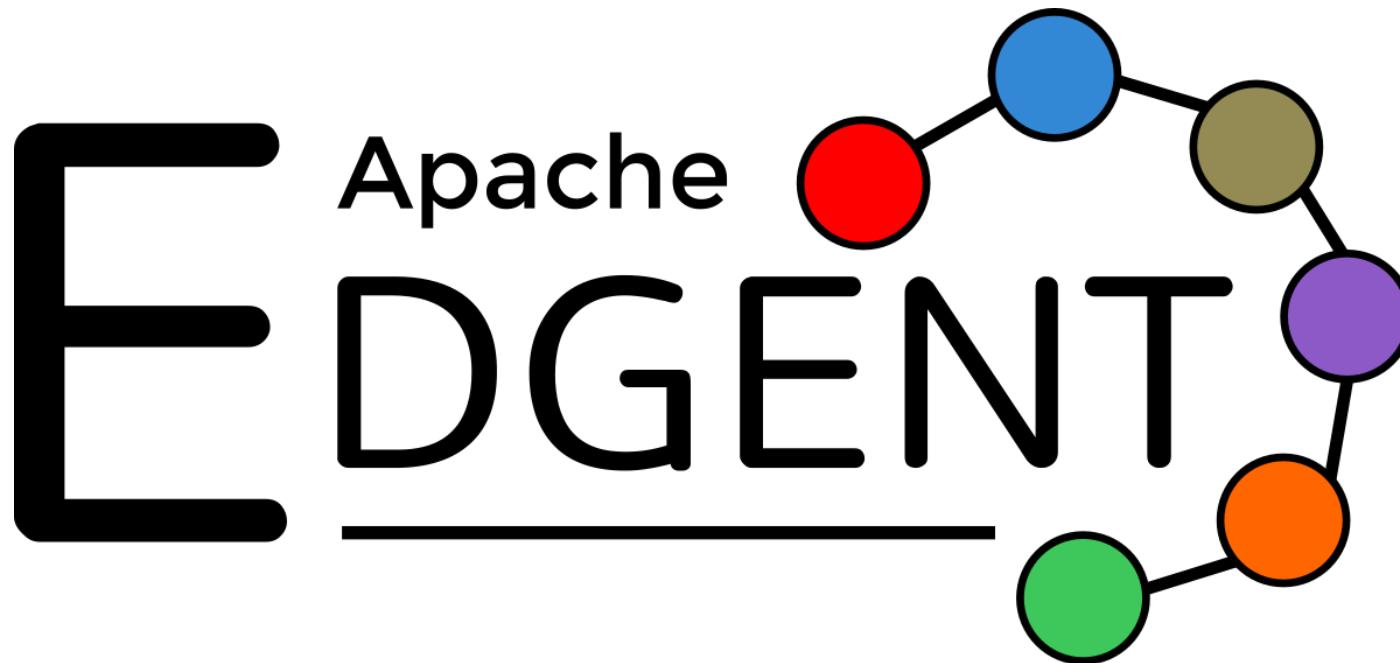
# APACHE PLC4X

- Develop only using the API module
- Develop software for any type of PLC
- Highly inspired by JDBC
- Integration modules to other open-source SW
- Strongly growing number of supported protocols
- Soon also non Java drivers

# APACHE PLC4X



# APACHE EDGENT



# APACHE EDGENT

- Programming model and micro-kernel style runtime
- Can be embedded in gateways and small footprint edge devices
- Enabling local, real-time, analytics on the edge
- Sources and Sinks for all sorts of targets
- "Kafka Streams for systems too small to run Kafka Streams"

# APACHE EDGENT (RIP)

- Mainly driven by IBM
- IBM pulled the plug in 2018
- No knowledge transfer before leaving
- I was the first non-IBM PPMC
- Managed to vote in one new PPMC
- We decided to retire Edgent 10.2019

# APACHE CAMEL



APACHE®  
Camel

# APACHE CAMEL

- Integration framework
- Message oriented middleware
- Based on "Enterprise Integration Patterns" Book
- Integration into all major component frameworks
- Build pipelines
  - Producers
  - Transformations
  - Consumers

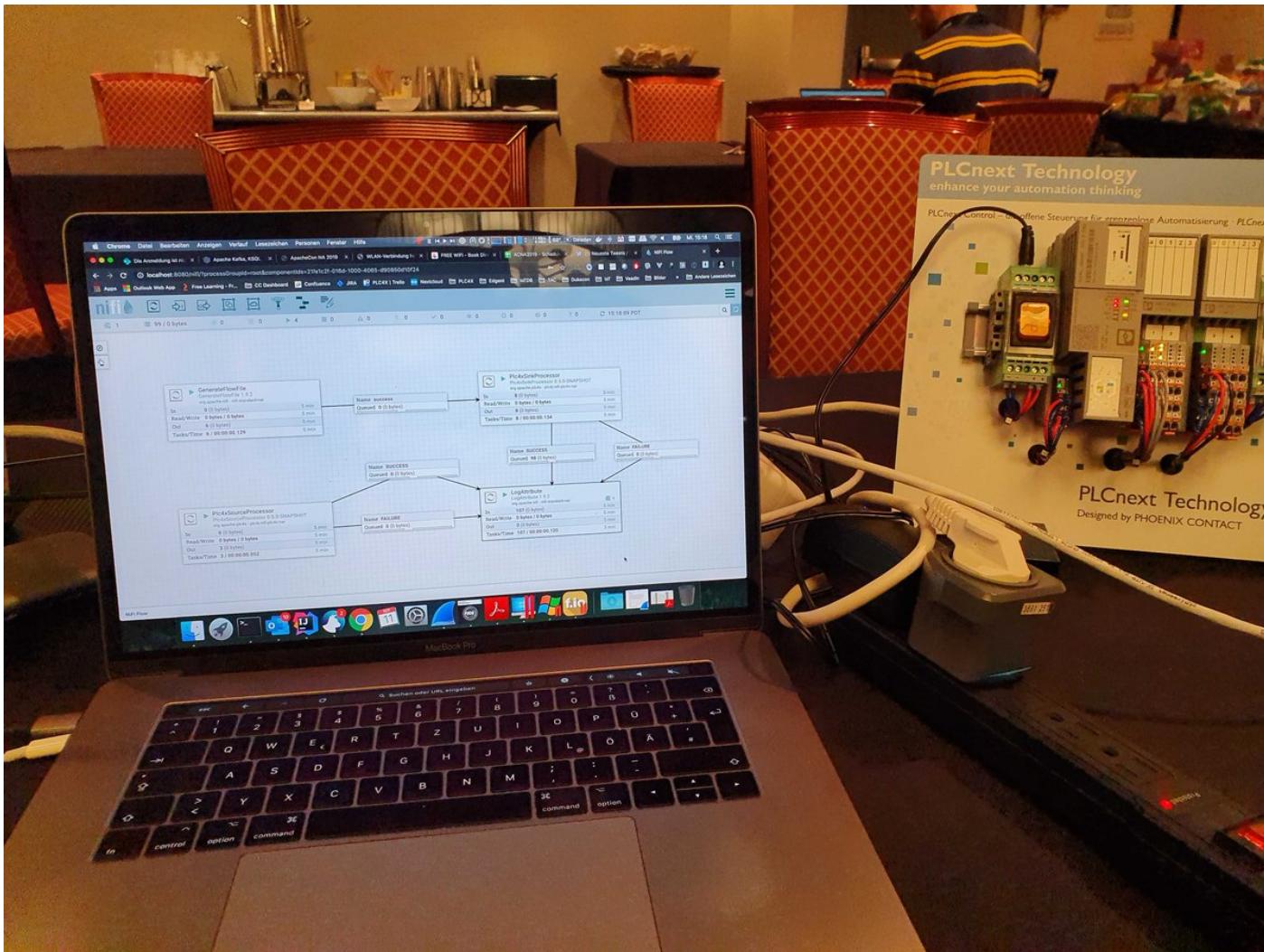
# APACHE NIFI



# APACHE NIFI

- System for routing and processing streams of data
- Web-UI for modeling data streams
- Tracking of data through the pipelines
- Handling of back pressure
- Secure

# APACHE NIFI



# APACHE MINIFI

- Runtime for running parts of NiFi streams on small edge devices
- Operations on edge devices
  - Aggregation
  - Filtering
  - Translation
  - ...
- Secure communication with NiFi cluster
- No UI

# APACHE SPARK

- Batch processing
- Stream processing
- Runs in almost all cluster environments

# APACHE FLINK

- Stateful stream analytics
- Bounded and unbounded data streams
- Runs in almost all cluster environments

# APACHE BEAM

- Framework for running batch jobs
- Framework for running streaming "jobs"
- Abstracts from the actual runtime
- Runs "jobs" in:
  - Spark
  - Flink
  - Hadoop
  - Google Cloud
  - ...

# APACHE HADOOP

- Big Data storage
- Distributed storage and processing
- Processing of huge datasets
- MapReduce

# APACHE CASSANDRA

- Big Data storage
- Linear scalability
- Distributed storage
- Managing of huge datasets
- Decentralized

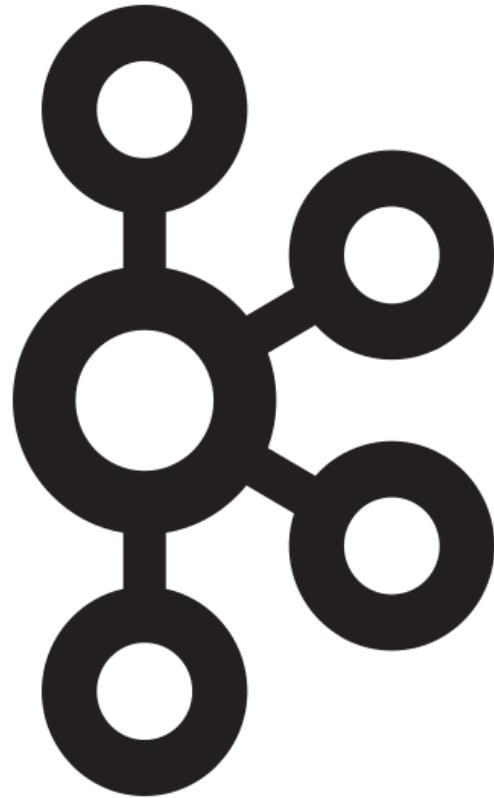
# APACHE IOTDB (INCUBATING)



# APACHE IOTDB (INCUBATING)

- Time series DB
- Lightweight
- High performance
- Compressed data
- Ability to deal with IoT data
  - Ingest data out of sequence
  - Ingest data while being offline
  - Ingest data on extremely small devices
- Integration with Hadoop & Spark

# APACHE KAFKA



kafka

# APACHE KAFKA

- Streaming Framework
- Able to route enormous amounts of data
- Fault tolerant
- Kafka Streams
  - Processing of data
- Kafka Connect
  - Ingestion of massive amounts of data
  - (Output massive amounts of data)

# APACHE KAFKA

- However doesn't like:
  - Bad networks
  - Small (Edge) devices
- Solution
  - Use MQTT on Edge devices
  - Ingest MQTT data into Kafka cluster

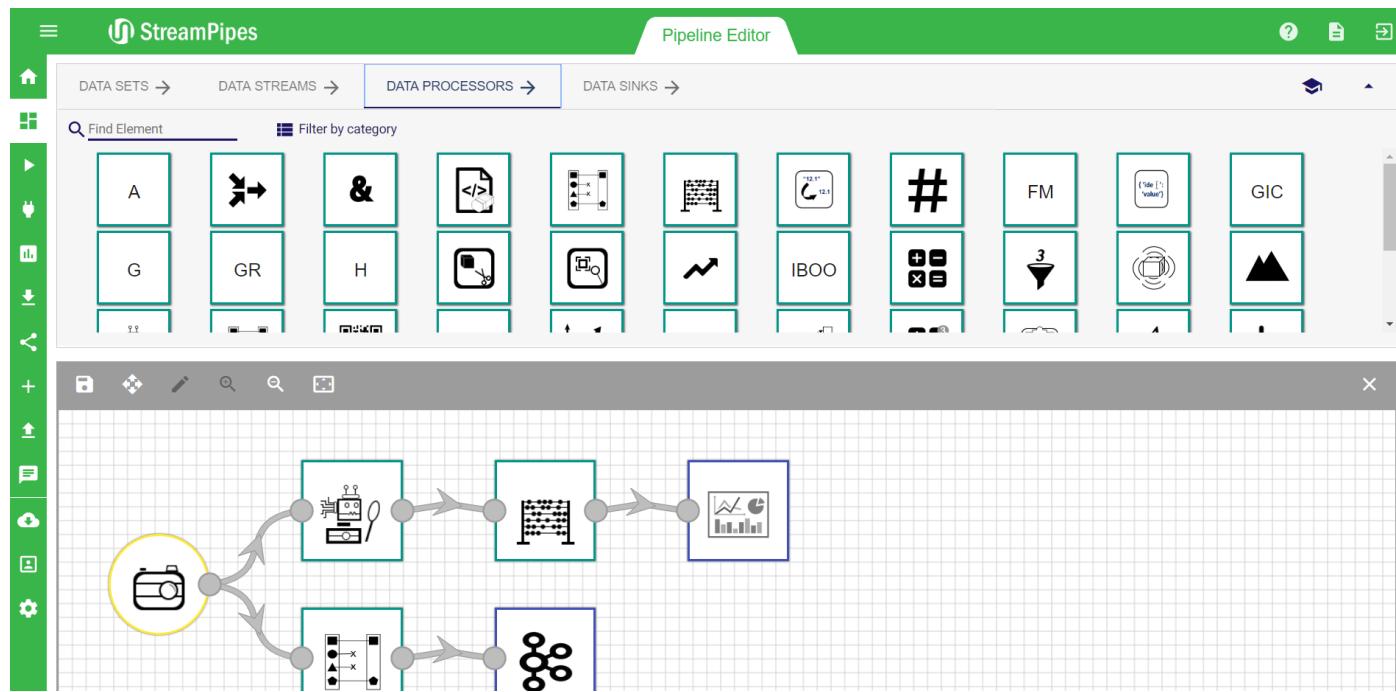
# APACHE STREAMPIPES



# APACHE STREAMPIPES

- Self-Service IoT Data Analytics Platform
- Focus on data streams
- Similar to Apache NiFi
- Focus on (production) Industry
- Focus on being run by OT
- Focus on non-technical users (domain experts)
- Hides the complexity of modern IT solutions
- Uses Machine-learning to guess semantics of data

# APACHE STREAMPIPES



# APACHE STREAMPIPES

StreamPipes

Live Dashboard

MANAGE LAYOUTS LAYOUT 1

ADD VISUALIZATION

Monitor Water Level[verticalbar]

Monitor Pressure[gauge]

Monitor Flow Rate[line]

Monitor Pressure[table]

Monitor Water Level[trafficlight]

Monitor Flow Rate[number]

The screenshot shows a live dashboard interface for StreamPipes. On the left, a sidebar contains icons for home, layouts, add visualization, refresh, save, delete, and settings. The main area displays six visualizations arranged in two rows of three:

- Monitor Water Level[verticalbar]:** A vertical bar chart showing a value of 74.09.
- Monitor Pressure[gauge]:** A gauge chart showing a value of 14.71.
- Monitor Flow Rate[line]:** A line chart showing flow rate over time from 09:07:11 PM to 09:07:41 PM.
- Monitor Pressure[table]:** A table showing pressure data for sensorid pressure01 at various timestamps.
- Monitor Water Level[trafficlight]:** A traffic light indicator showing red.
- Monitor Flow Rate[number]:** A large number card showing 3.52.

# OUTREACH TO OTHER FOUNDATIONS

- Eclipse Foundation
  - Appears rather unstructured
  - 36 projects in total
- Linux Foundation
  - LF-Edge Initiative
  - 7 Projects in total
  - EdgeX Foundry
  - EvE
- HiveMQ

# THANKS FOR LISTENING

- Questions?
- Suggestions?
- Discussions!
- For news:
  - Subscribe to mailing list: [iot@apache.org](mailto:iot@apache.org)
  - Follow me on Twitter: **@ChristoferDutz**