



CERN
openlab

SIEMENS

Data Analytics and IoT for Industrial Control Systems

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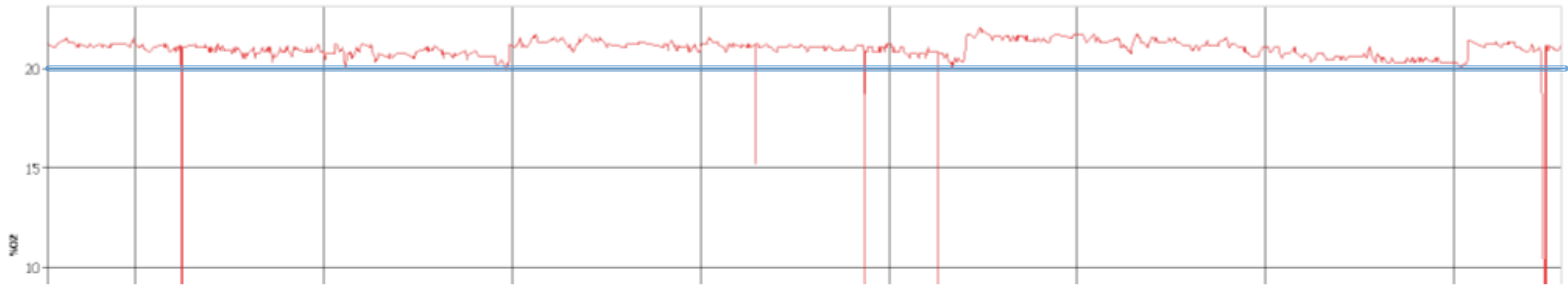
22 / 01 / 2020

Outlook

- Retrospective:
 - ELVis – a web-based platform for handling multiple streams of data from sensors
 - Tighter integration between ELVis and Smart IIoT technologies
- Using distributed complex event processing for oxygen level monitoring
- Other projects:
 - Linac3 ion source optimization with machine learning
 - Room occupancy detection via IoT infrared sensors

Oxygen level monitoring in the LHC tunnel

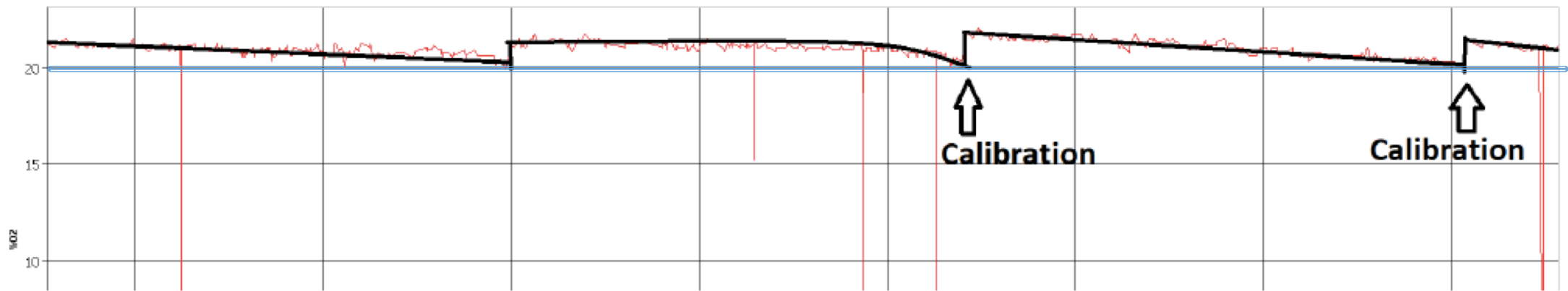
- 320 oxygen sensors are spread across LHC tunnel
- Periodically sensors get clogged
- We want to avoid false alarms



— Alarm threshold

Oxygen level monitoring in the LHC tunnel

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- Periodically sensors get clogged
- We want to avoid false alarms



— Alarm threshold

Signal Event Processing Toolbox

Infer information from events about system states and fail modes

Calculate failure / degradation **indicators**

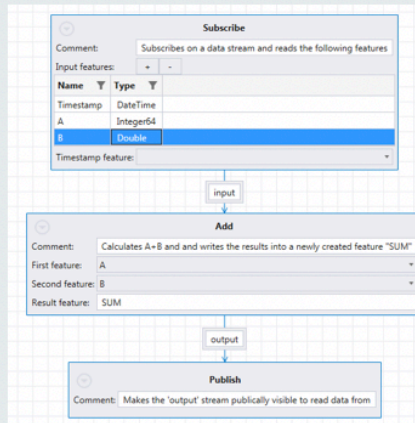
Intuitive for engineers and programmers

The **same model** for stream and batch processing

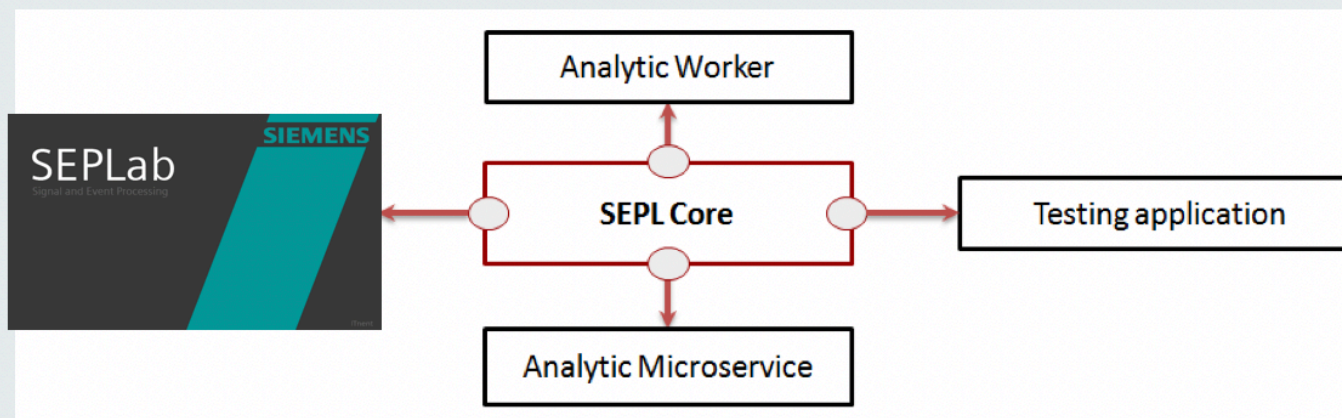
Extendable and reusable

Deployable on all device ranges

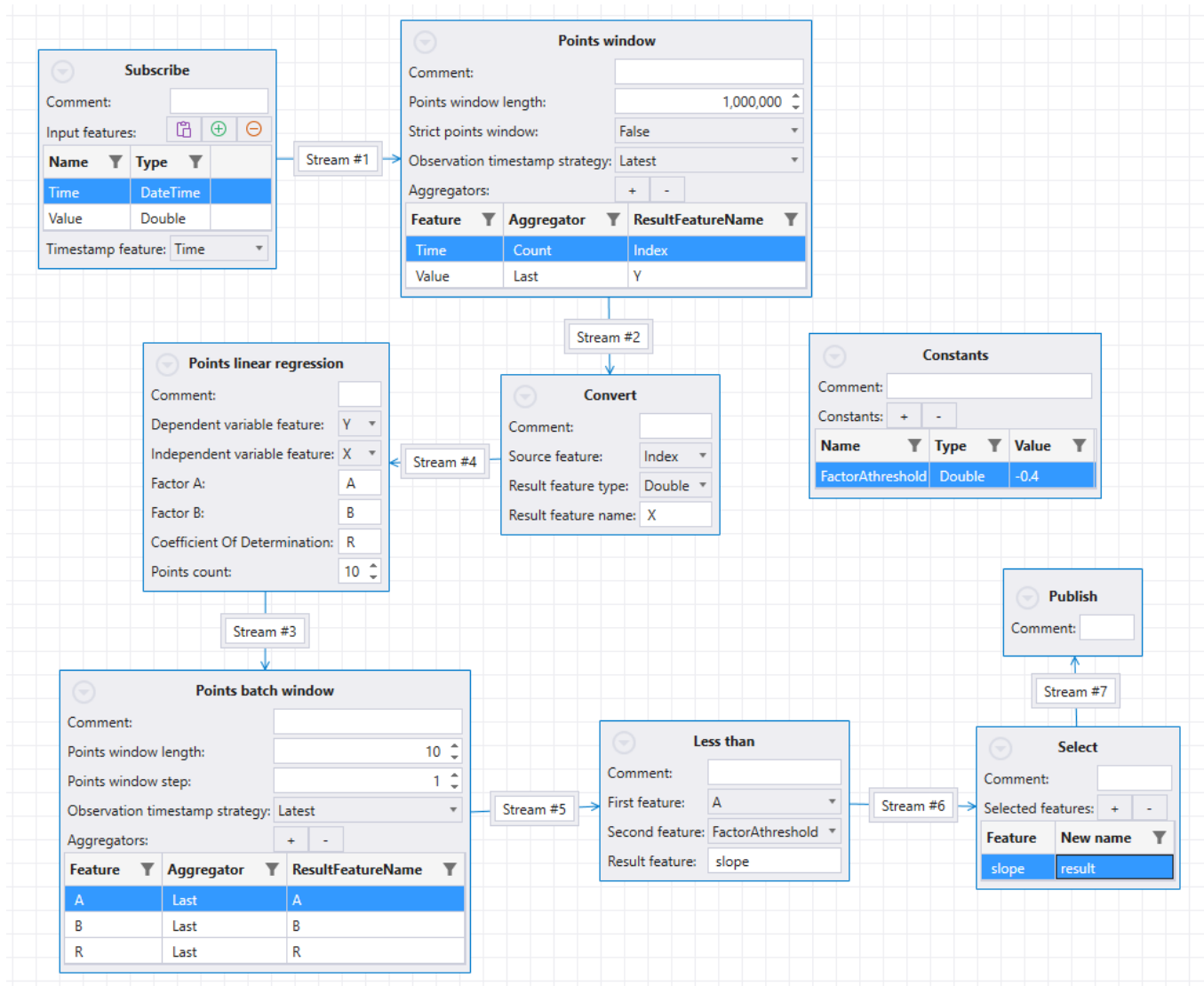
Graph processing



Features			
Timestamp	ENC1_POS_Z	TORQUE_SP	
2017-12-04 17:17:34.566	-11.5158395767212	0.0	
2017-12-04 17:17:34.57	-11.5800151824951	0.214110001921654	
2017-12-04 17:17:34.574	-11.6185874938965	0.330444425344467	
2017-12-04 17:17:34.578	-11.6588401794434	0.404419988393784	
2017-12-04 17:17:34.582	-11.7001419067383	0.523370027542114	
2017-12-04 17:17:34.586	-11.7422857284546	0.570949971675873	
2017-12-04 17:17:34.59	-11.7847862243652	0.642319977283478	
2017-12-04 17:17:34.594	-11.8283023834229	0.666109979152679	



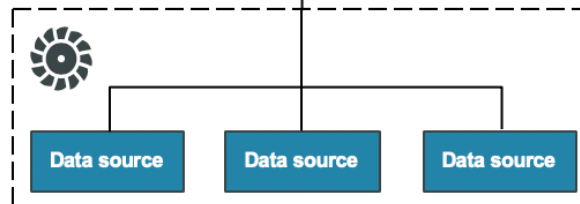
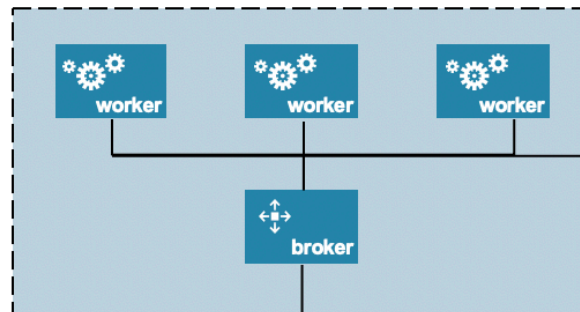
Signal Event Processing Lab



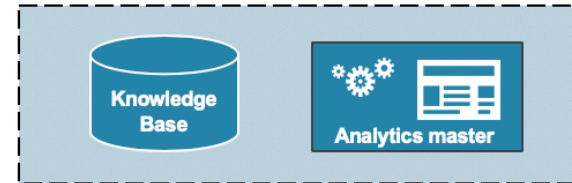
Distributed Complex Event Processing (DCEP)

Flexible and generalized rule definition
Performant distributed DB
Multi-user front end

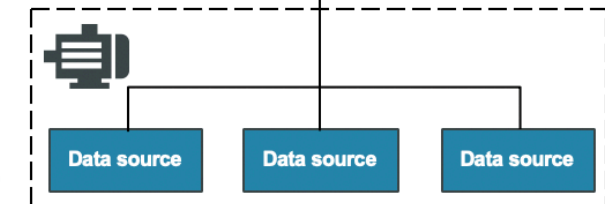
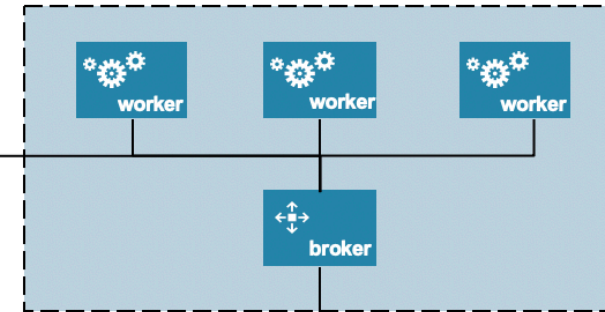
Scalable distributed architecture



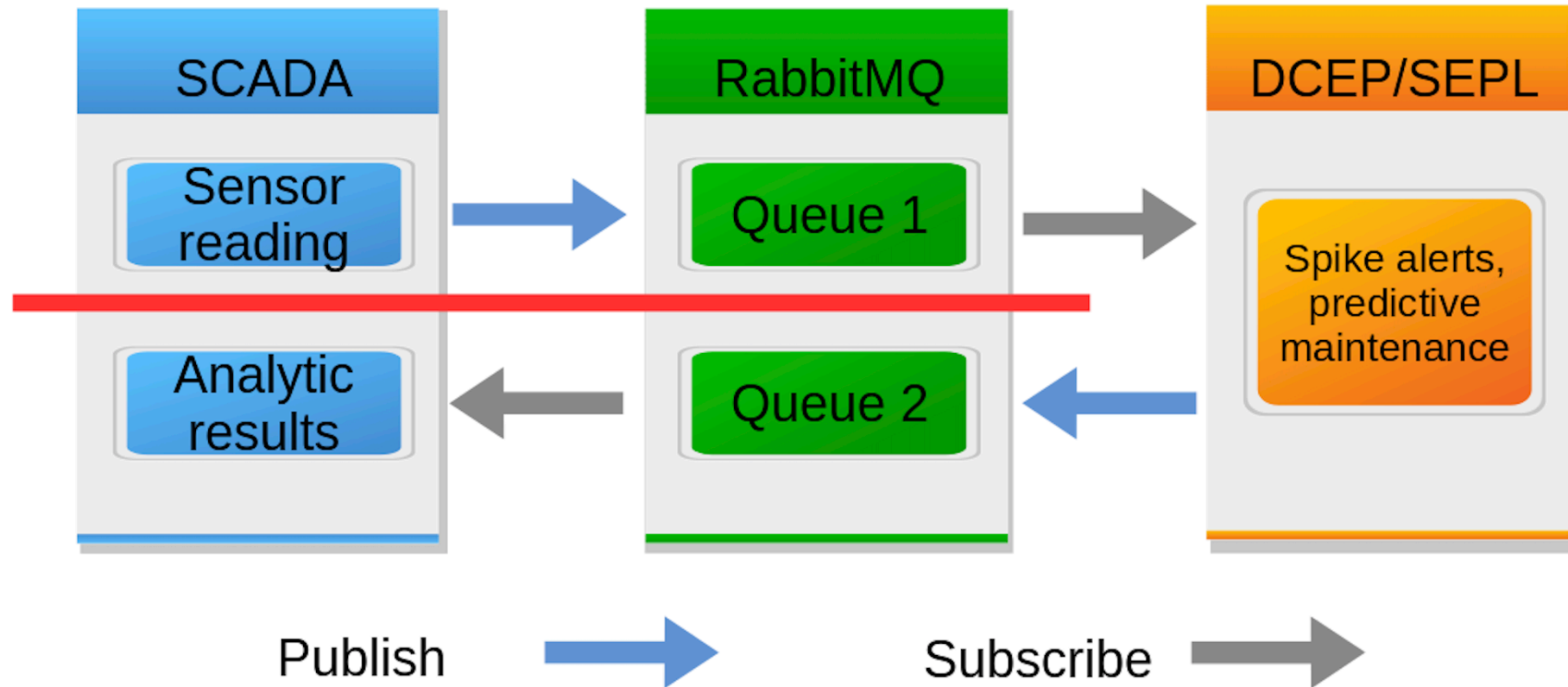
Simple integration of new components



Continuous analysis
Reduced network traffic



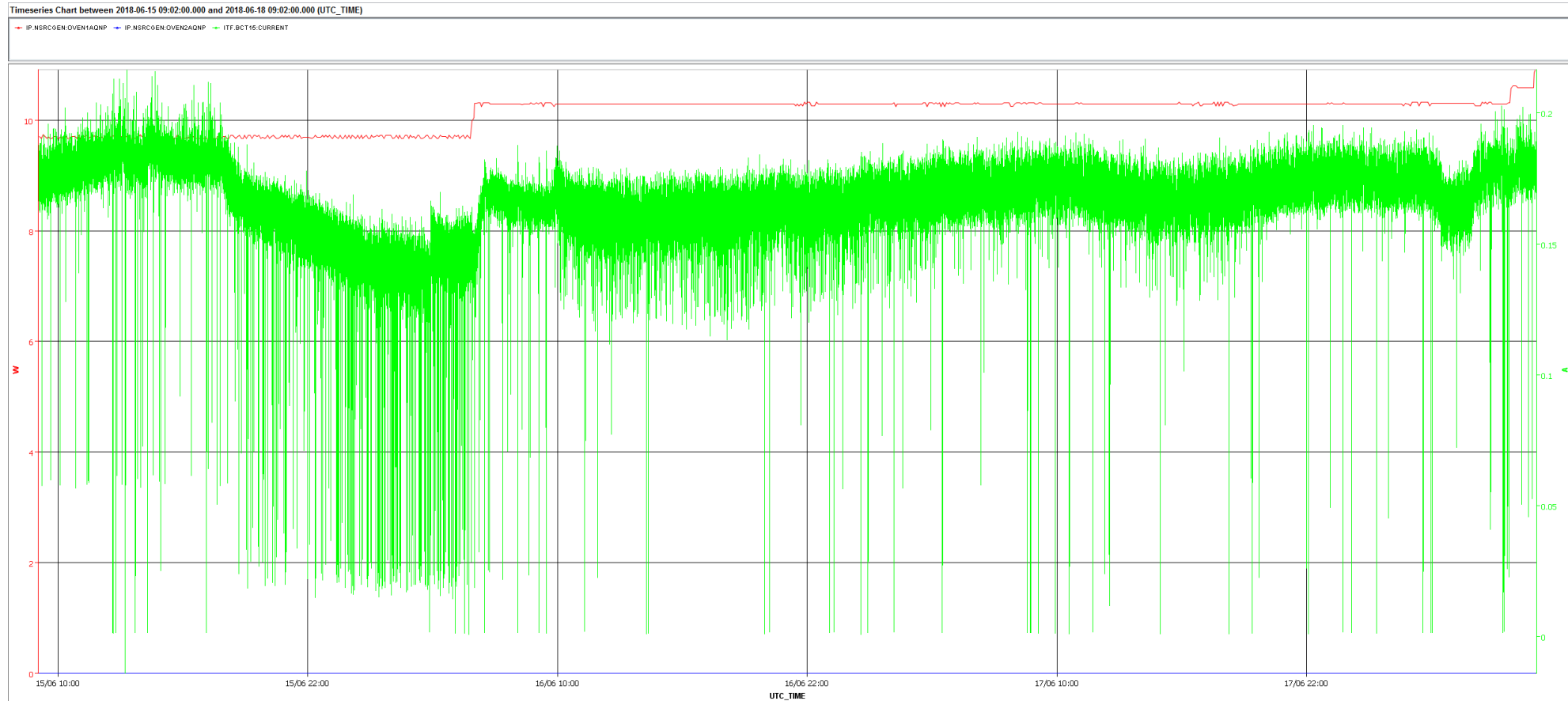
Distributed data analytics workflow for ODH



Other projects

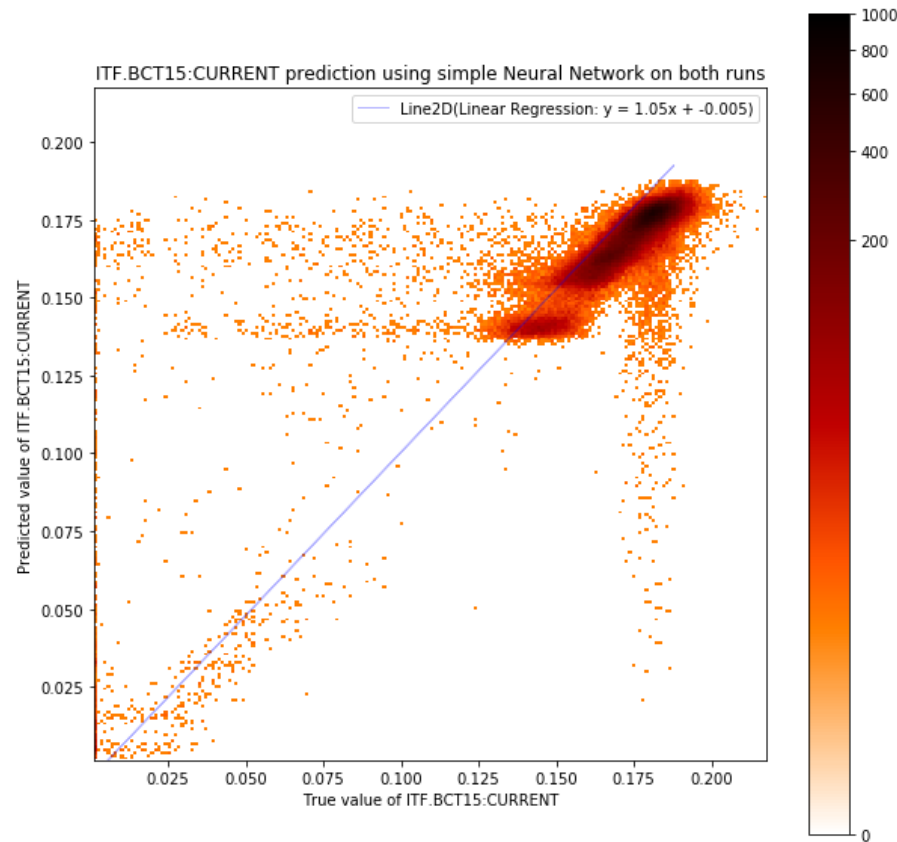
- Linac3 ion source optimization with machine learning
- Room occupancy detection via IoT infrared sensors

Linac3 ion source optimization with machine learning

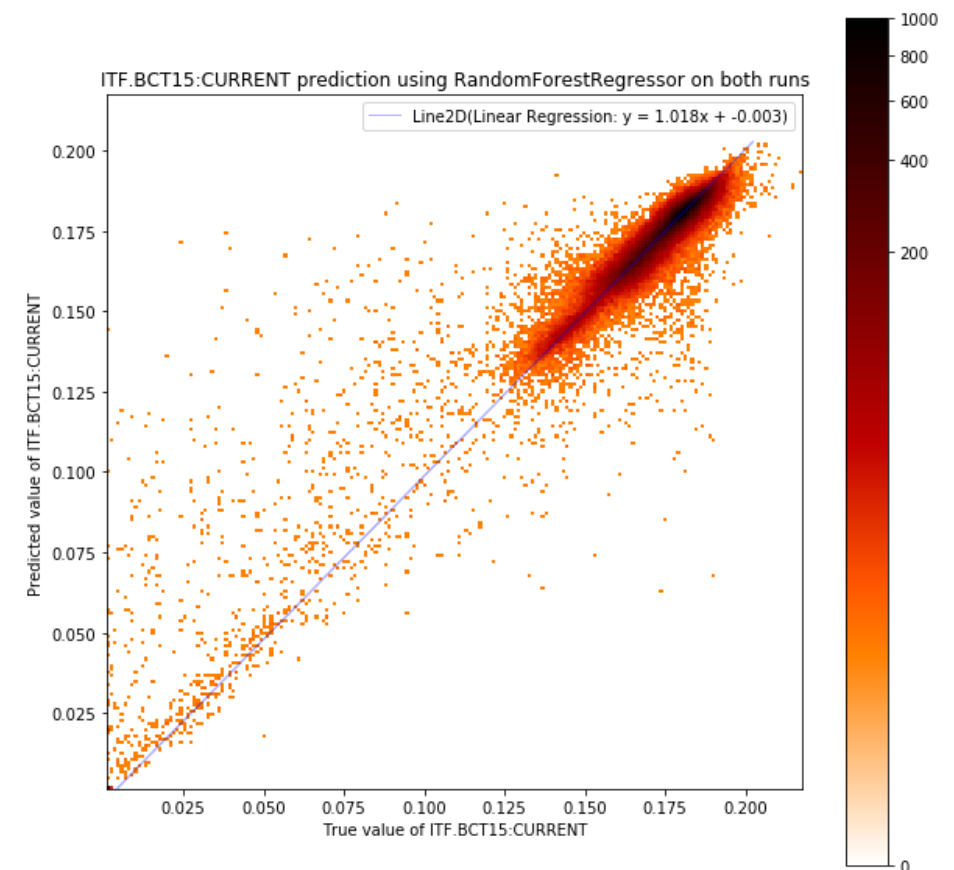


Linac3 ion source optimization with machine learning

Pearson correlation squared: 0.69
MSE of NN: 0.000139



Pearson correlation squared: 0.92
MSE of NN: 3.2e-05



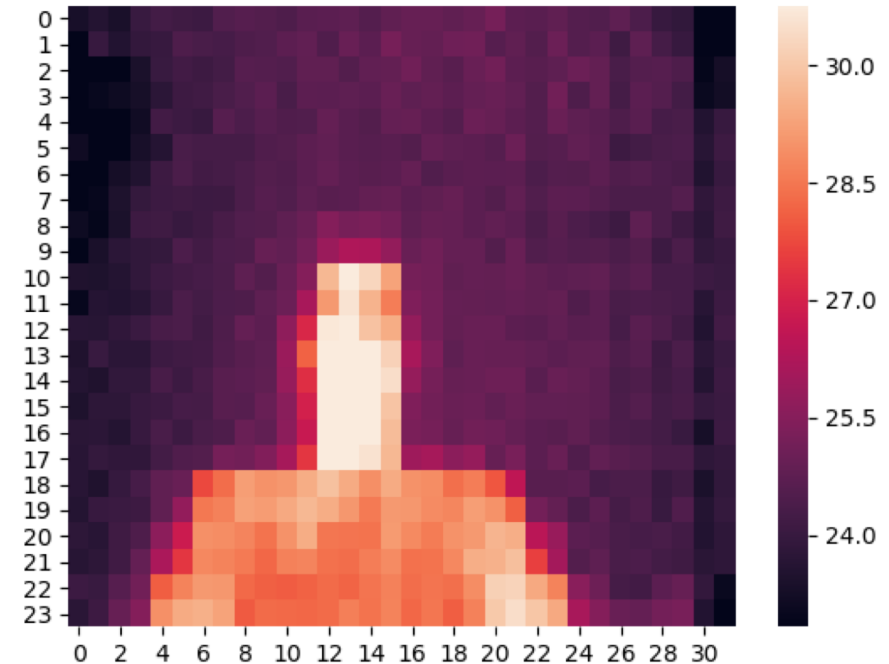
MindDoT – Siemens IoT sensors

The MindDoT sensors can provide:

- infrared image
- temperature
- relative humidity
- atmospheric pressure

Used for room occupancy detection.

To be integrated with room booking system.



Conclusions

- Pilot deployment of Siemens technologies to real-life problems at CERN by end of Q1 2020
- Ongoing R&D on Linac3 ion source optimization
- Preparations for the deployment of Siemens IoT sensors in selected meeting rooms

The end

Thank you for your attention!

