KU LEUVEN
TECHNOLOGIECAMPUS GENT

HEIn4.0

PROFI CLOUD

Proficloud: IoT framework for remote industrial applications

15/12/2020, HEIn4.0 Webinar

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- What is the goal?
- Some application scenarios
- How does it (really) look like?
- Security – Authentication – Software development
- Demonstrators
- Q & A - Movie

Boosting the role of HEIs in the industrial transformation towards the Industry 4.0 paradigm in Georgia and Ukraine
609939-EPP-1-2019-1-BE-EPPKA2-CBHE-JP

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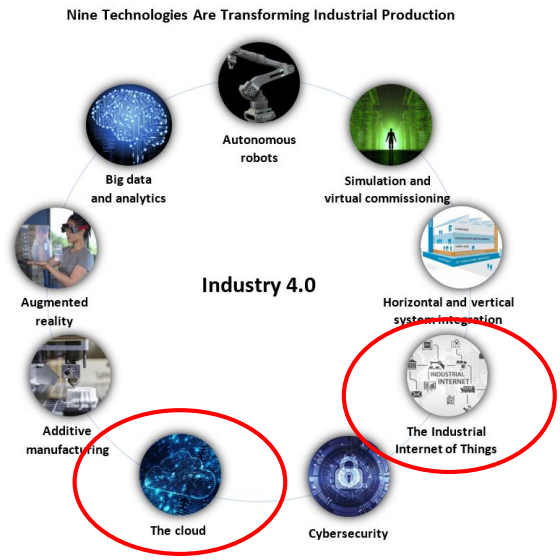

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What is the goal ?

We'd like a seamless secure connection to …

- Remote production machines or facilities
- Your products on your client's (production) location
- The "Cloud"
- …

Because we may wish to …

- Monitor the status of a remote production site, or even control/command parts of it
- Analyze KPIs of our remote machines, production, products, etc.
- Do long term quality control, or gather data for data mining, make some data available to your clients, e.g. for (their) predictive maintenance … in the cloud

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We want this for PROFINET industrial networks with IO Controllers and IO Devices

- Seamless: we'd like this in our standard programming software, and not set up firewalls, VPNs, import/export lists of variables, etc.
- Secure: TLS encrypted + authentication

TLS: Transport Layer Security (newer version of SSL (Secure Sockets Layer))

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- …

ProfiCloud can be the solution

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- Solution provided by Phoenix Contact

PHOENIX CONTACT INSPIRING INNOVATIONS

- Open to PROFINET equipment from other vendors
- "Open" Cloud, where you can host your own software applications

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What is the goal ?

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- Your products on your client's (production) location
- "The Cloud"
- …

Many clouds & solutions

- Microsoft, Google, Amazon, etc.
- Mindsphere (Siemens), ThingWorx (Rockwell Automation), MICA (Harting), Predix (GE), IoT-Cloud (Bosch), IoT-Gateway (DELL), etc.

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Some application scenarios

Typical use case: Ricola

- HQ in Laufen
- Production in Brislach
- Storage in Breitenbach
- Monitoring of the temperature in the storage in the HQ and production:
  - Quality management
  - FDA certification
- Add Cloud weather data

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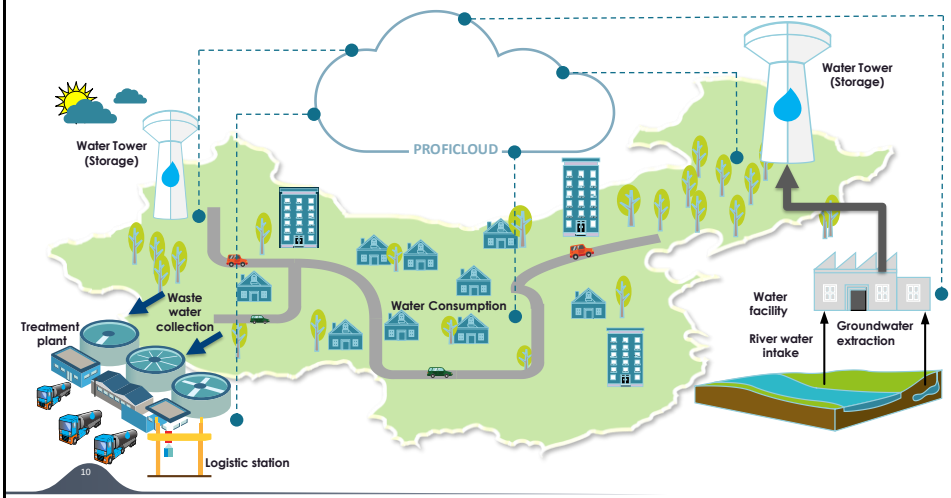
Some application scenarios

Typical use case: water production facility, with small remote sites some tens of kilometers away



"Industrial Cloud automation for interconnected factories" L. Chalal, A. Saadane, A. Rhiad, FTC 2019.

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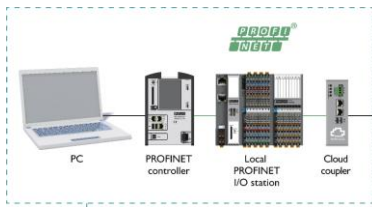
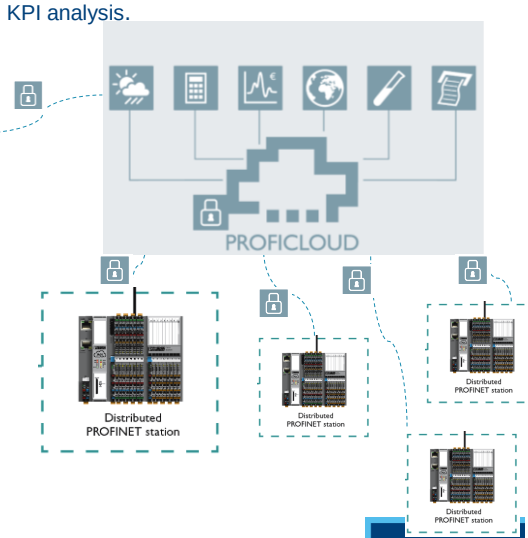
How does it look like?

Remote production machines, automation headquarters in Belgium. We want to monitor the status of the machines, get warnings on our smart watch, and send some measurements to the Cloud (or local servers) for KPI analysis.





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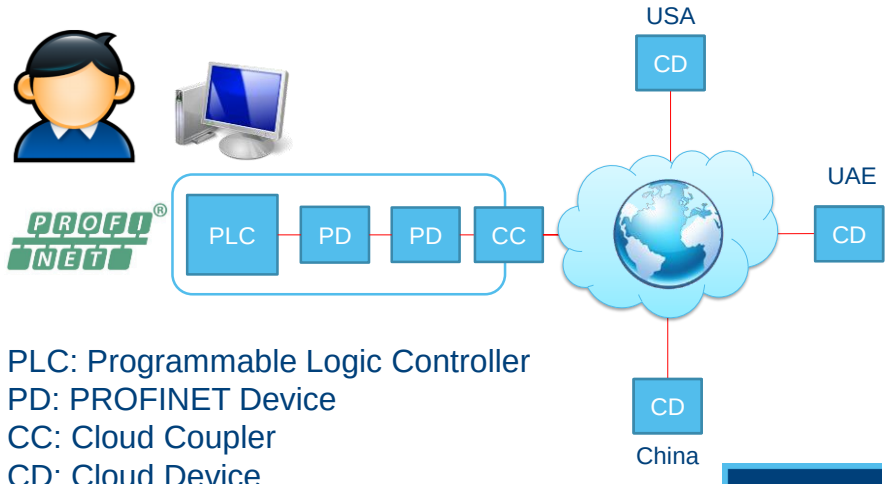
How does it look like?

Remote production machines, automation headquarters in Belgium.



PLC: Programmable Logic Controller
PD: PROFINET Device
CC: Cloud Coupler
CD: Cloud Device

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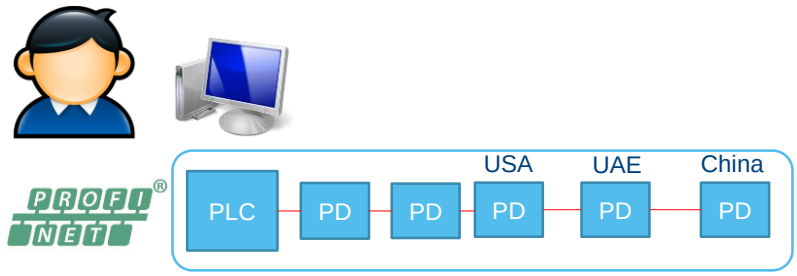
How does it look like?

Remote production machines, automation headquarters in Belgium.



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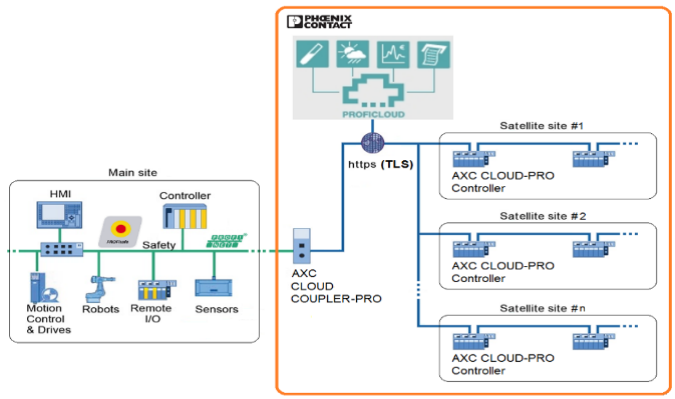

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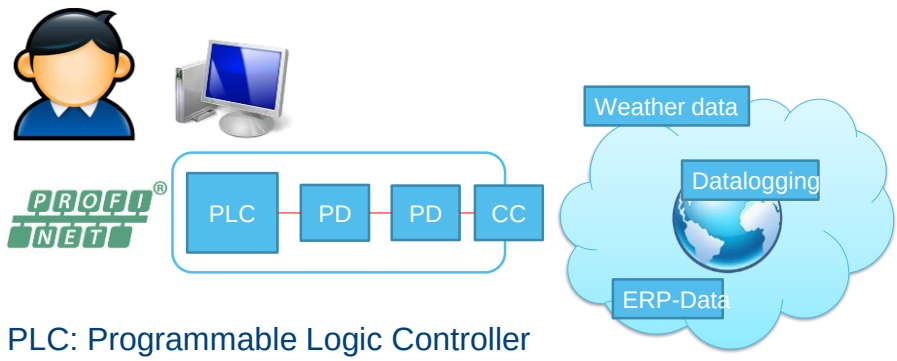

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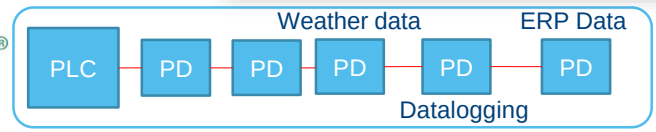

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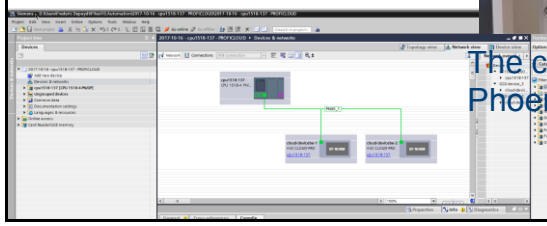
How does it really look like?

Nor does your programming software …



The controller does not need to be Phoenix Contact …

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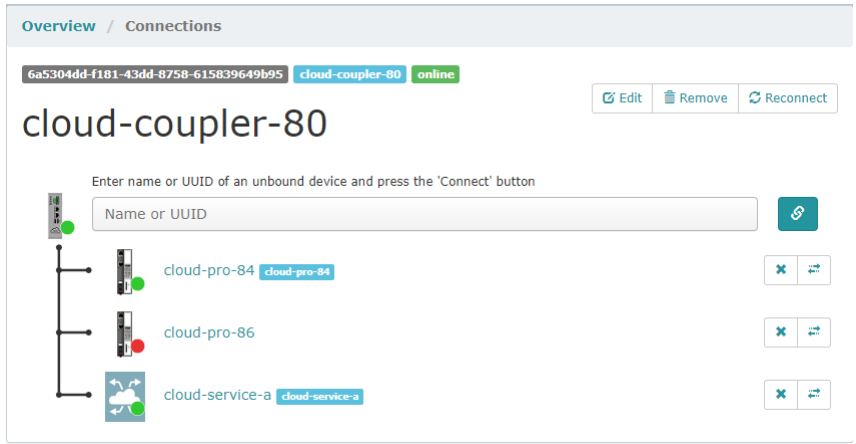
How does it really look like?

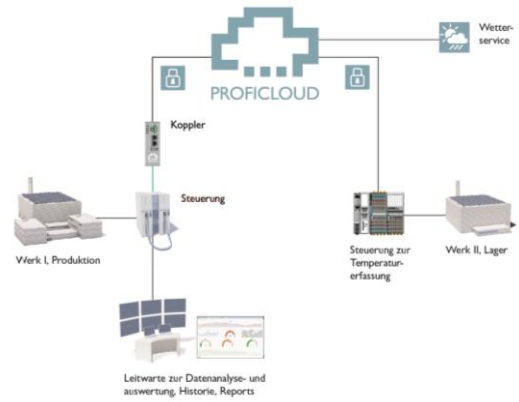


CC, 2 CDs, cloud-cloud coupler service

How does it really look like?

Typical use case: Ricola

- Installed S7 PLC extended with a PROFINET controller
- Cloud Coupler installed at the PLC
- AXC Cloud-Pro with AXL F RTD 4 for measurement
- Service Weather for monitoring of the temperature outside the storage



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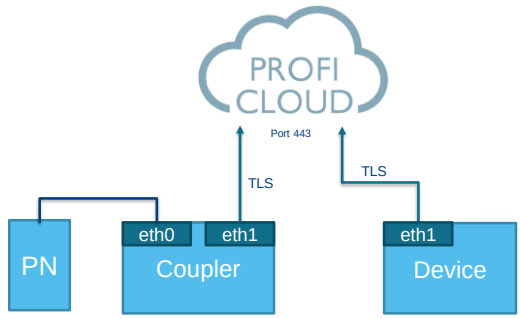
TLS – Transport Layer Security

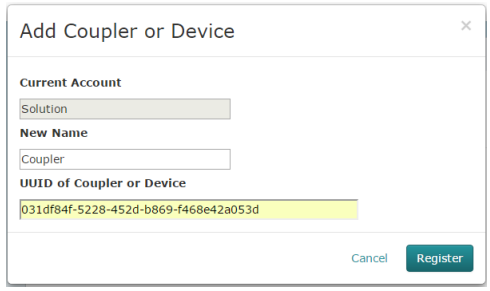


- All connections TLS encrypted
- Root certificate from GeoTrust®
- Devices establish connections (no open ports on the operator side)

Port 443 is https: http protocol over TLS/SSL

TLS – Transport Layer Security

Authentication



- Initially, each device is identified and authenticated using a UUID (Universally Unique Identifier (128 bit number))
- Only "manufactured" UUIDs are allowed
- The first login / registration is used to exchange a new key (API key)
- For all other interactions, only this API key is allowed

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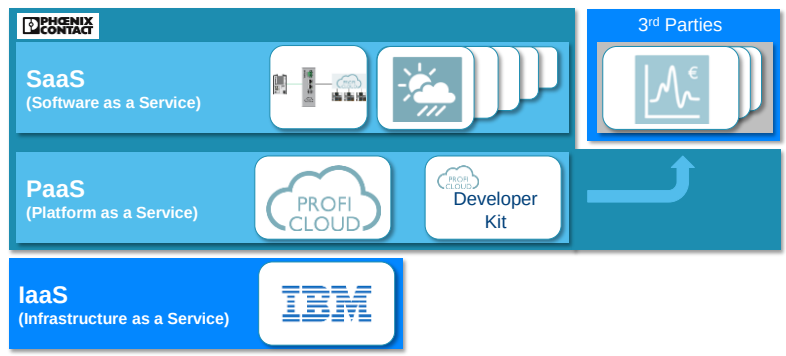
Open control platform: devices, software development



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Summary

Proficloud offers …

- Remote control and maintenance using the Internet as a network
- Very easy engineering, Cloud components are simply used in your local PROFINET network
- No VPN tunnels to set up, …
- Freedom to use equipment and software from other vendors, own or third party cloud services, own apps
- …

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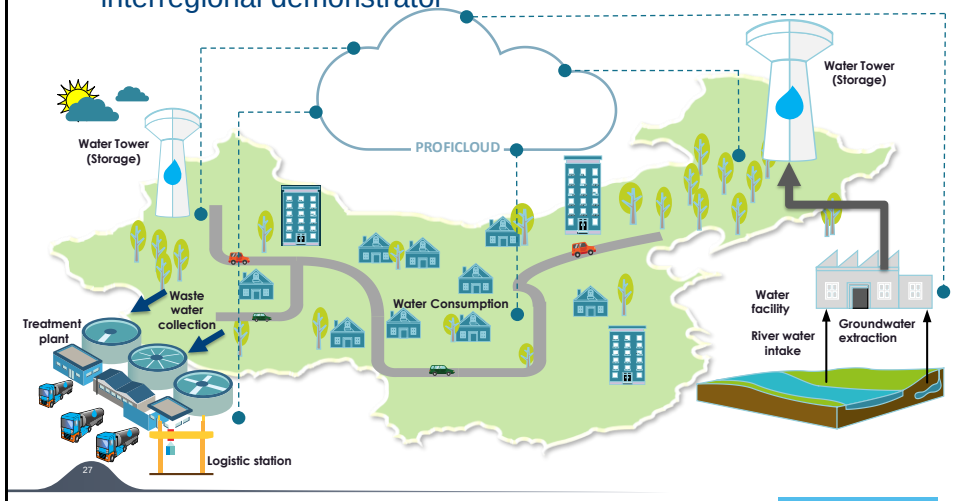
INCASE: demonstrators

- ICAM, Univ-Lille 1 and KU Leuven have developed lab set-ups to 1) demonstrate the working principle 2) install a large interregional demonstrator



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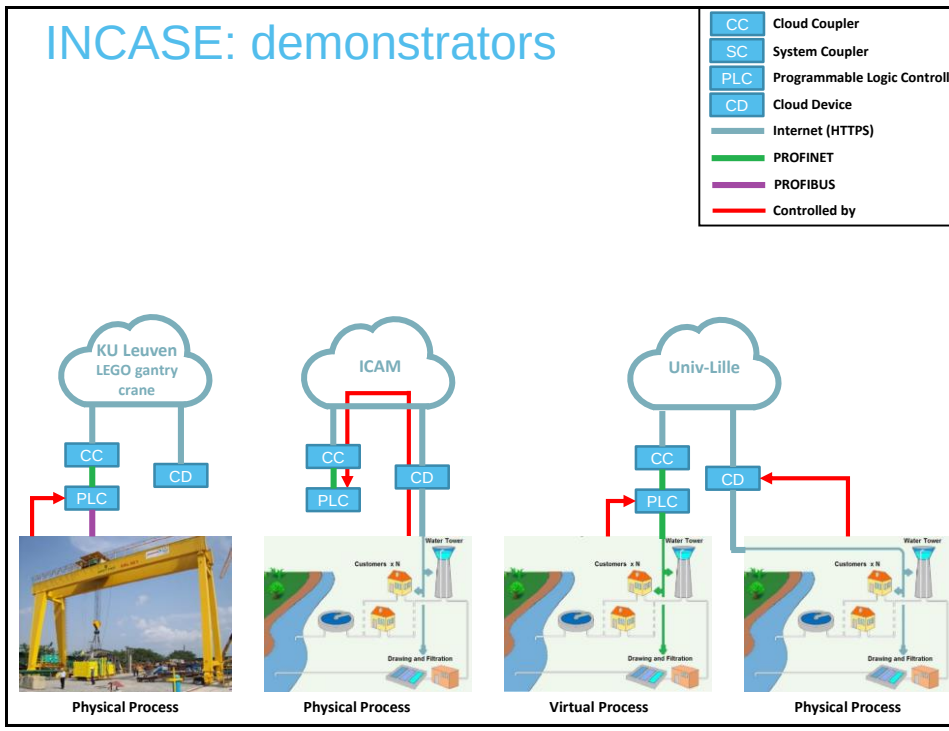
INCASE: demonstrators



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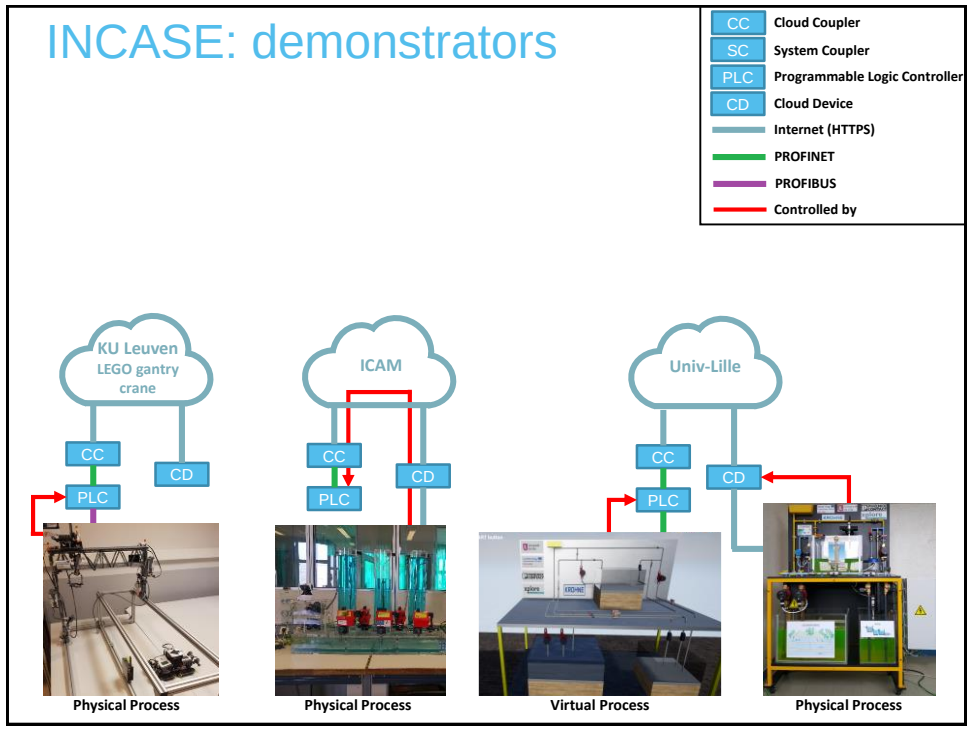
INCASE: demonstrators
CC Cloud Coupler
SC System Coupler
PLC Programmable Logic Controller
CD Cloud Device
Internet (HTTPS)
PROFINET
PROFIBUS
Controlled by
KU Leuven LEGO gantry crane
CC
CD
PLC
ICAM
CC
CD
PLC
Univ-Lille
CC
CD
PLC
Physical Process
Physical Process
Virtual Process
Physical Process

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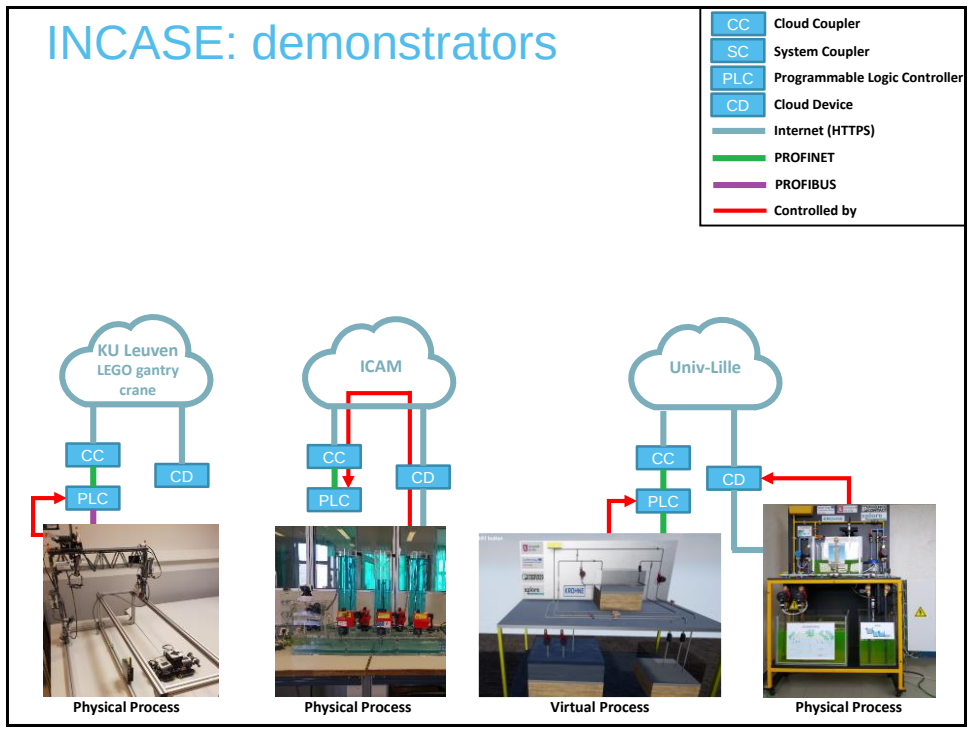
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Physical Process
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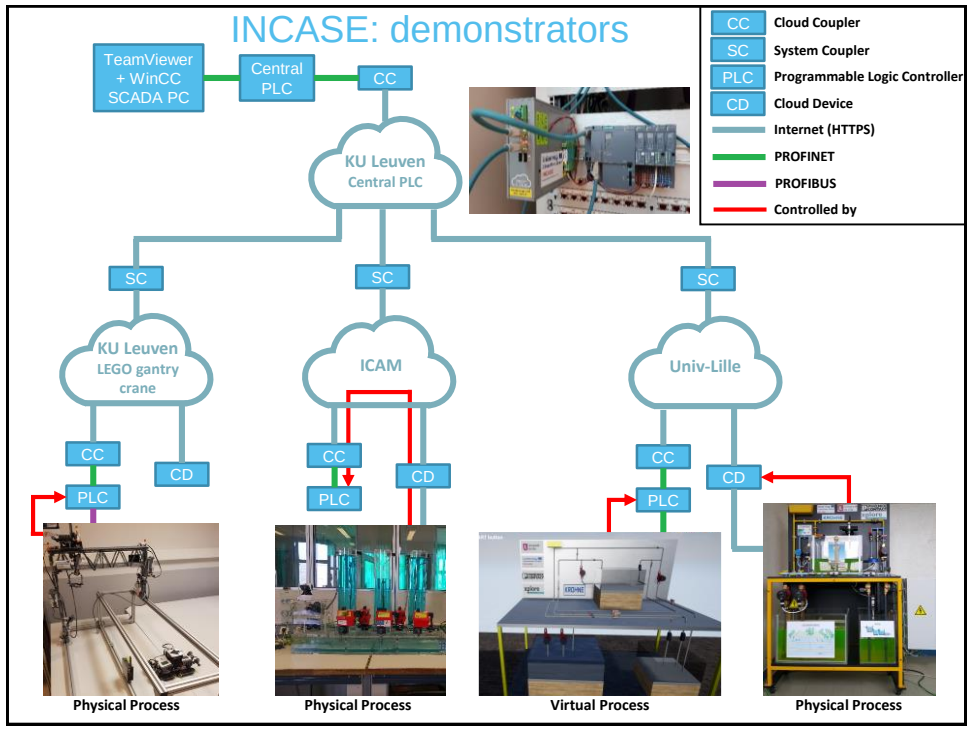
INCASE: demonstrators
TeamViewer + WinCC SCADA PC
Central PLC
CC
KU Leuven Central PLC
SC
SC
SC
KU Leuven LEGO gantry crane
ICAM
Univ-Lille
CC
CD
PLC
CC
CD
PLC
CC
CD
PLC
Physical Process
Physical Process
Virtual Process
Physical Process
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CD Cloud Device
Internet (HTTPS)
PROFINET
PROFIBUS
Controlled by

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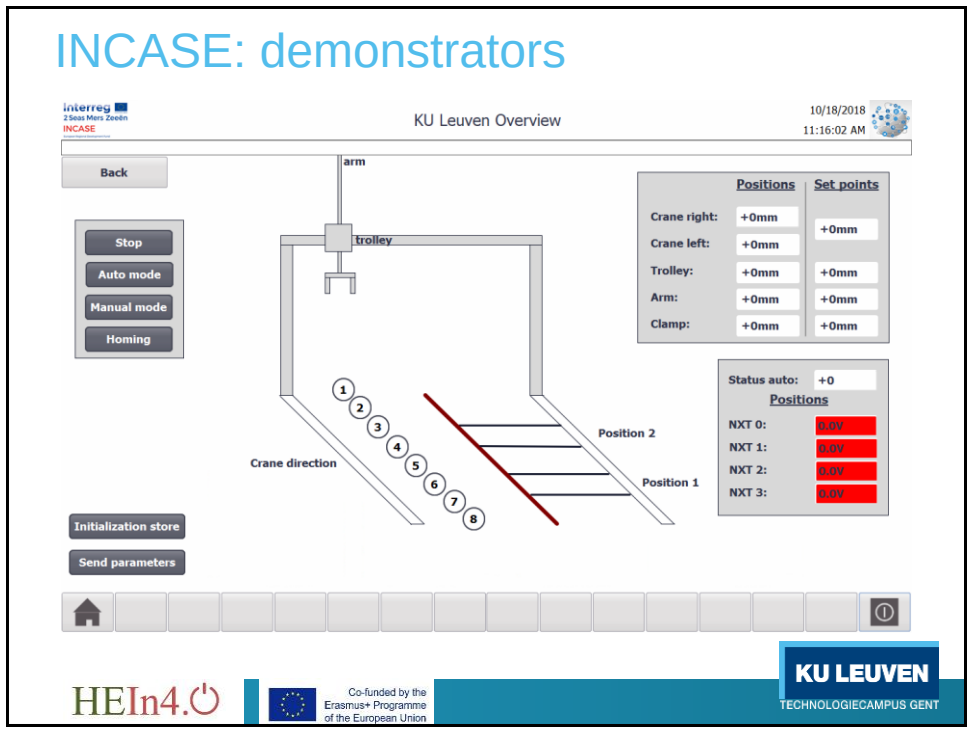
INCASE: demonstrators
KU Leuven Overview
10/18/2018
11:16:02 AM
Back
Stop
Auto mode
Manual mode
Homing
arm
trolley
Positions
Set points
Crane right: +0mm +0mm
Crane left: +0mm
Trolley: +0mm +0mm
Arm: +0mm +0mm
Clamp: +0mm +0mm
Status auto: +0
Positions
NXT 0: 0.0V
NXT 1: 0.0V
NXT 2: 0.0V
NXT 3: 0.0V
Crane direction
Position 2
Position 1
Initialization store
Send parameters
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INCASE: demonstrators - Conclusions

Proficloud application / analysis

- Part of the demonstrator is shown in the movie
  - HMI via central PLC and cloud, 3 sites
  - Analog and discrete variables, commands: about 150 in total
  - Parts of the PLC code are be generated from MATLAB/Simulink (e.g. in the crane control)
- First version of latency measurements:
  - (1) typically 3100 ms roundtrip
  - (2) 770 ms one direction (mean) 2200 ms (maximum response time)
- Cost: 1 hour x 1 connection = 1 credit. 87600 credits ~ € 439.

(1) PN/CC/SC/SC/CC/PN roundtrip; ping Gent-Frankfurt = 18 ms.
(2) Forsström/Jennehag ("A Performance and Cost Evaluation of Combining OPC-UA and Microsoft Azure IoT Hub into an Industrial Internet-of-Things System", GIoTS 2017 conference)

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