

Report on the local ProfiCloud demonstrators

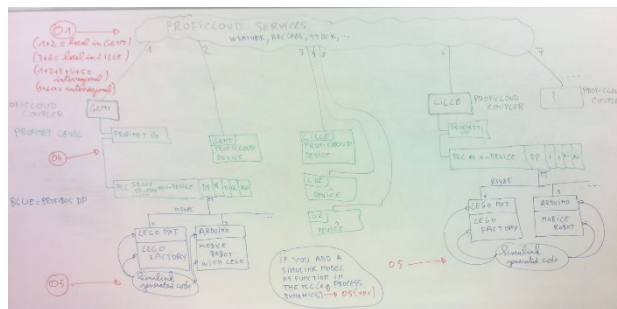
Description in AF
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Description in AF:

“Development and initial installation of small scale hardware and software locally at ICAM, UL1 & KU Leuven. OP1 MMU closely follows these tests. Testing of local performance: constraints, drawbacks, measuring local determinism, and integration in the local PROFINET industrial network backbone. PPs are initiated at high level during PP starting event on Industry 4.0 and ProfiCloud by OP11 in Germany.”

Short overview of the joint work

- The PPs and OP1 MMU attended in depth lectures on ProfiCloud technology during IC1, the starting event in Bad Pyrmont, Germany. This was hosted by OP11, Phoenix Contact.
- Joint design on TTM PROFINET/ProfiCloud day (December 2016, Gent), joint tests on 01/12/2017 where also the first interregional connection between KU Leuven and ICAM was tested. A BOM (Bill Of Materials) was listed, serving as a kind of reference for the PPs. Local work was done at the different PPs in the first phase of this Activity. Work was presented on Technical Day 2 by Univ-Lille 1 and KU Leuven (ICAM presented O 4/5 related work on that occasion).
- A demonstration tool has been developed (D3.1.4) and has been used several times already (D3.2.3).



– Impression of initial design December 2016 –

Small scale local demonstrators

In this phase – D1.1.1 – each PP connects 2 local parts via his own ProfiCloud.

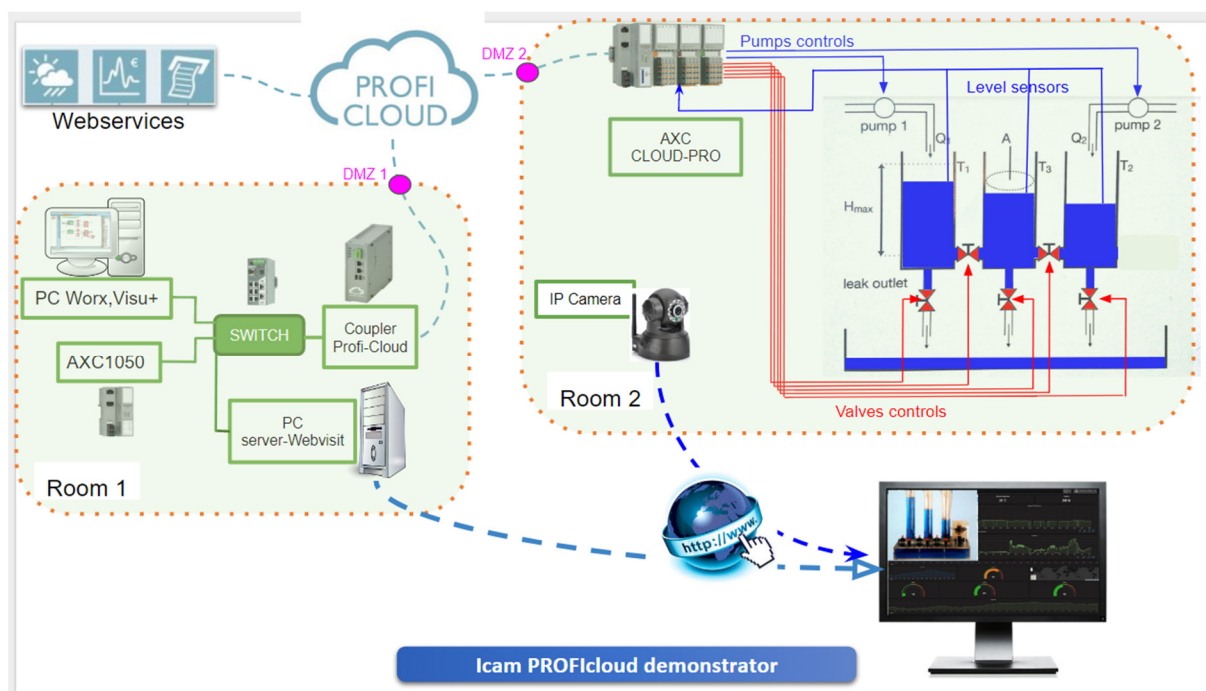
In the next phase (the large scale interregional pilot D1.1.2), every PP ProfiCloud will be connected to a central ProfiCloud (located in PP2 KU Leuven), in order to fully interact.

Local demonstrator 1 – ICAM

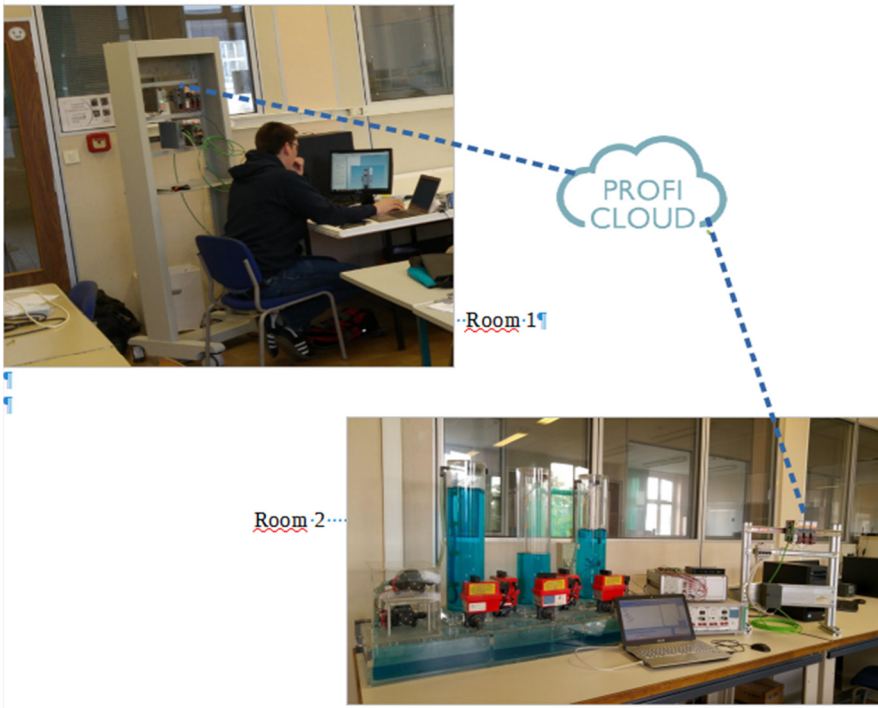
At ICAM, a local demonstrator is set up in order to technically test a complete ProfiCloud solution from pumping to distribution of water. The local demonstrator is composed of equipment located in two separated rooms in ICAM (Fig. 1a, b, c):

- room 1: equipped with ProfiCloud coupler connected to the DMZ#1 + AXC 1050 PLC (from Phoenix Contact)
- room 2: equipped with AXC PRO PLC connected to the DMZ#2 +I/O modules which are plugged on an experimental test bench emulating a water station (3 tanks + 2 pumps + fives valves with power amplifier and level sensors). Two webcams with pan-tilt remote control facilities are added to get “almost real time” streaming video from the process.
- A PC server with Web Visit software from Phoenix Contact is included allowing the distant user to get informations more precisely from the process status, thanks to an appropriate HMI.

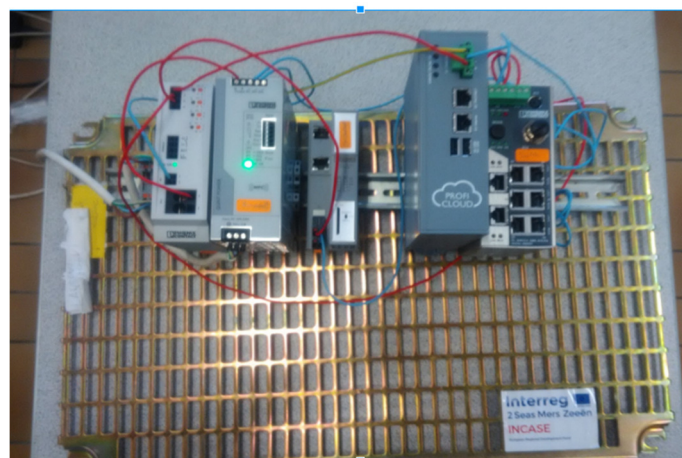
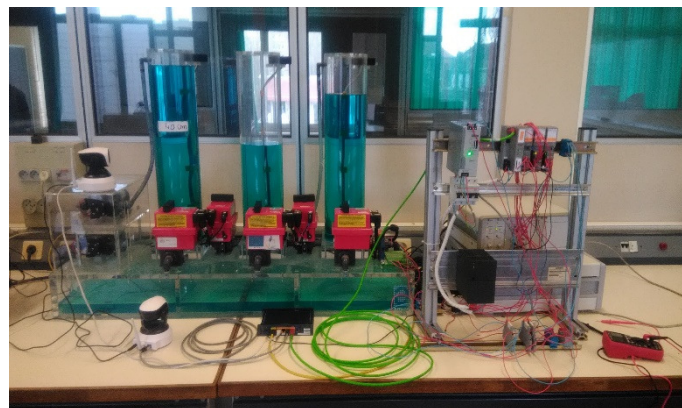
In each room, there is a local PROFINET communication backbone. All ProfiCloud components are configured and work correctly.



– Figure 1a: Overview of the local ProfiCloud demonstrator at ICAM –



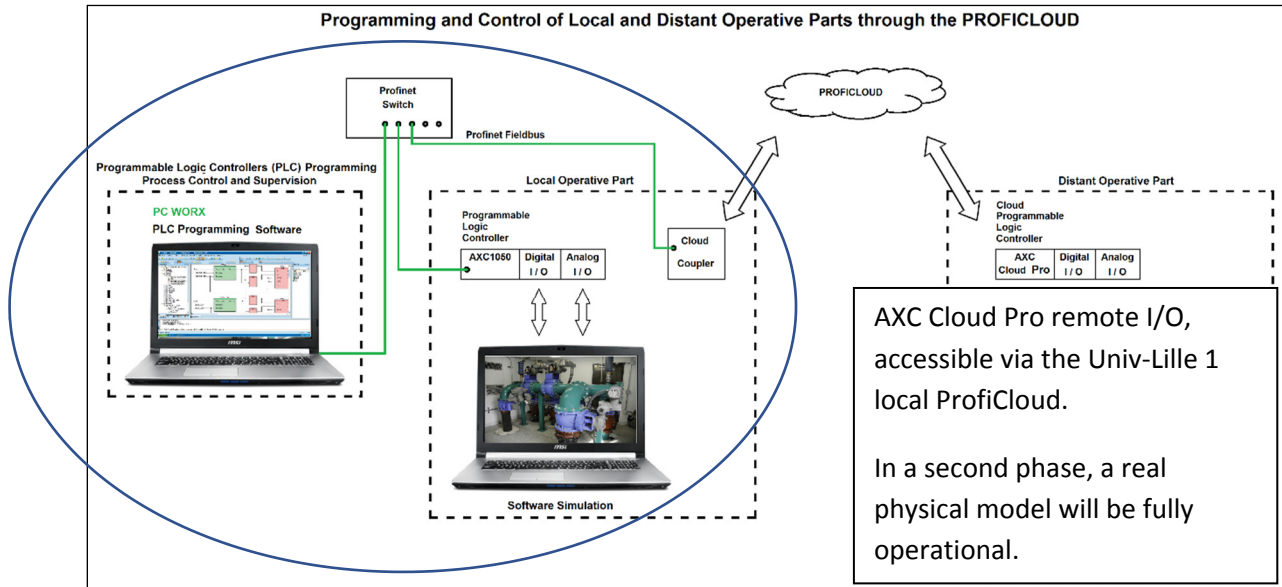
– Figure 1b: intermediate result, work in progress at ICAM –



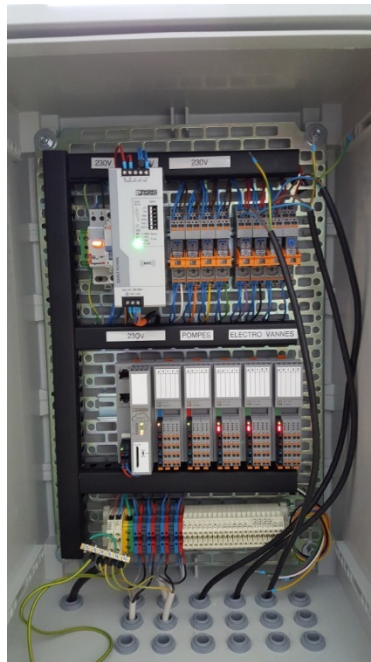
– Figure 1c: detailed look at ICAM components –

Demonstrator 2 – Univ-Lille 1

Univ-Lille 1 has developed a local demonstrator connecting a local AXC 1050 PLC (Programmable Logic Controller) via their ProfiCloud to a local remote I/O station (Fig. 2, right). The set-up is programmed via PC Worx programming software, and also holds a software simulation of a real plant. The latter components and the AXC 1050 PLC are connected in a local PROFINET backbone via the PROFINET switch (indicated in blue). Part of the system was presented at Technical Day 2 (July 2017).



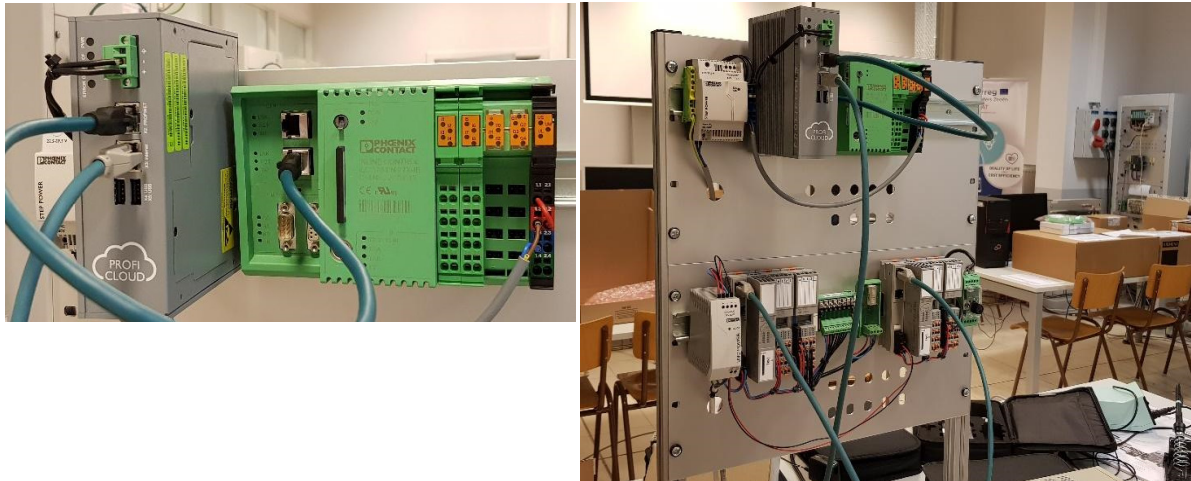
– Figure 2: Overview of the local ProfiCloud demonstrator at Univ-Lille 1 –



– Figure 3: The cabinet of the local ProfiCloud demonstrator at Univ-Lille 1 –

Demonstrator 3 – KU Leuven

KU Leuven used in its first design for a local demonstrator two types of controllers. In close co-operation with OP11 (Phoenix Contact), a first demonstrator was set up and tested for operation together with engineers from Phoenix Contact Belgium, as some issues appeared (see “Some observations”). Please refer to Fig. 4.



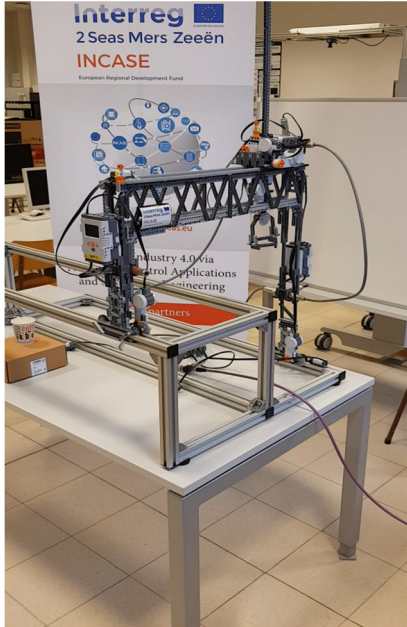
– Figure 4: First version of the local ProfiCloud demonstrator at KU Leuven –

After this experiment, tests have been done to realize a multivendor set-up, as this is quite common in industrial applications. As PLC (Programmable Logic Controller) a Siemens S7-15xx PLC has been used, with configuration of the local PROFINET backbone and programming of the PLC in TIA Portal. Please refer to Fig. 5.



– Figure 5: Second version of the local ProfiCloud demonstrator at KU Leuven –

This second version has been extended with initial tests on a gantry crane at KU Leuven; it will later be a part of the large interregional ProfiCloud pilot. In a joint design, ISEN and KU Leuven use rapid prototyping (“integrated design” Output 5) techniques for the control of the crane (Fig. 6). An ISEN trainee student (Guillaume Halloy) worked on the topic in KU Leuven campus Gent; the system was demonstrated at Technical Day 2 (July 2017).



– Figure 6: First tests on a gantry crane, later to be integrated via ProfiCloud in the large scale interregional pilot –

Some observations

- After extended analysis by KU Leuven and OP11 Phoenix Contact Belgium, this early product evaluation showed that the Google DNS server needs to be reachable for the remote I/O stations. As this is often blocked by companies (e.g. also on KU Leuven campus Gent, Un. of Essex, UGent campus Kortrijk), this was reported to Phoenix Contact Germany and a patch was obtained.
- Initial measurements show that the current update time is 500 ms for the ProfiCloud connection itself. On the local ProfiCloud backbone, this is not a real constraint, as the devices answer in time. For a connection to other remote stations via the ProfiCloud, this means that data exchange is logically limited to commands, results (of e.g. local fast calculations), etc. This is the expected behavior of cloud services in general; faster connections would require what is now sometimes called the “Tactile Internet”, requiring e.g. new ethernet/internet technologies and 5G wireless connections. The local communication backbone and control form the fast first layer of the control.
- Not all ProfiCloud diagnostics are visible in TIA Portal, nor are they well documented as far as we know now. During the 2nd phase – working towards the large interregional pilot – there will be extra work on this.