EPFL, LAMS
« Industrial Automation » course

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Exercise Sheet 3

1. What is the purpose and what are the main parts of an architecture?
2. The CERN data center hosts all computing, administrative and scientific infrastructure of CERN, which includes more than 10,000 servers hosted in three rooms running 24/7. A remote extension of the data center is hosted at the Wigner Research Center for Physics in Hungary, which is connected to the main CERN campus through two independent and dedicated 100Gb/s fibre optic lines. The LHC experiment alone produces over 30 petabytes of data per year, and the center has more than 130 petabytes of stored data currently. To have such a massive computing center running, two main technical infrastructures are critical: power distribution and cooling and ventilation. The cooling and ventilation of the computing rooms is done through cold air introduced in the building via big pipes coming from the roof and going down to the floor. Three chillers on the building roof are responsible for pushing down the air into the building. The supervision is critical, since the servers will be stopped if the supervision system fails, to avoid overheating and fires.

   Consider yourself an employee of a system integrators bidding for the cooling automation system. Your colleague asks you for help with the following high-level architecture.

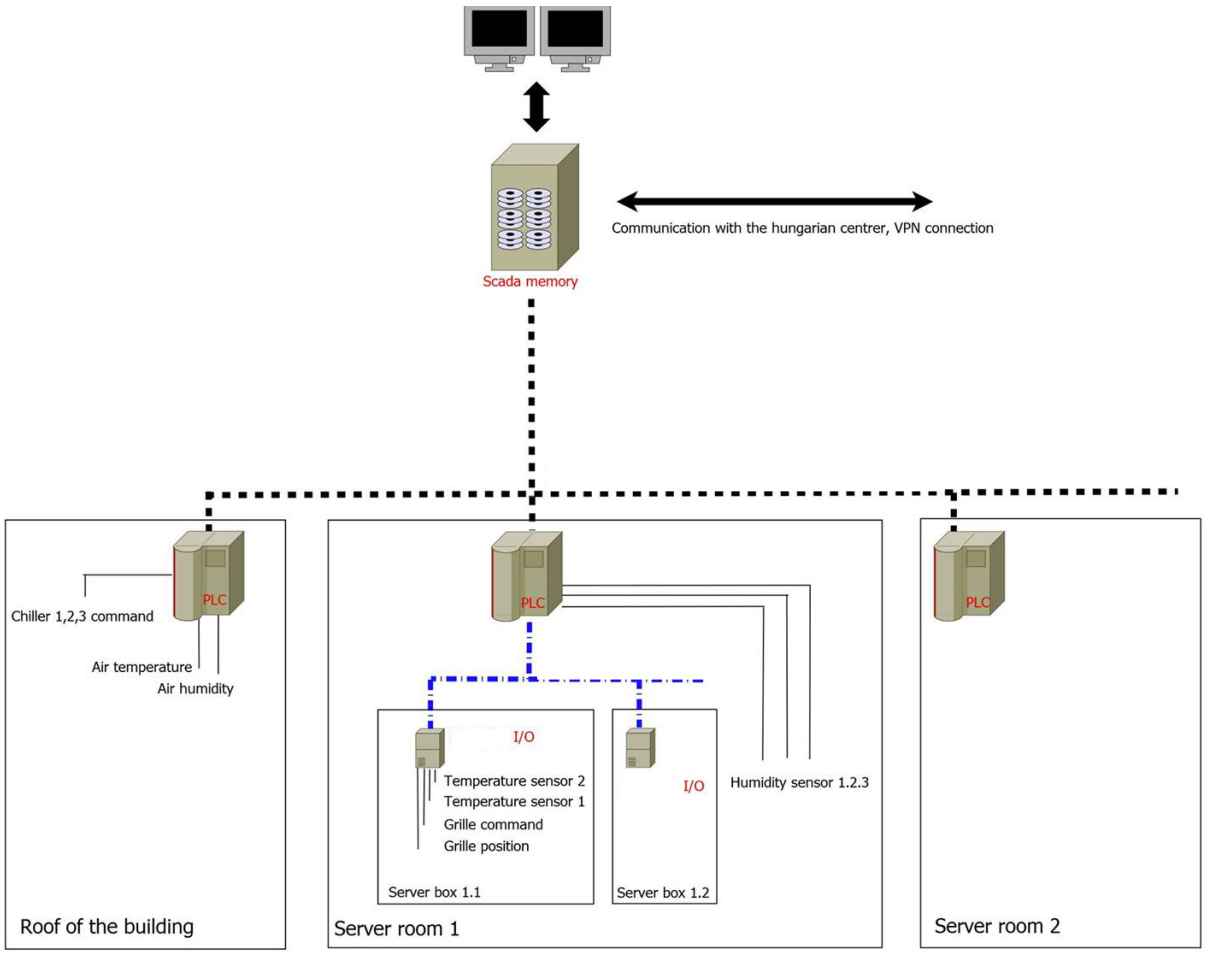
   The system is distributed, with one PLC assigned to each room, and another one for the chillers. Server room PLCs communicate directly with the SCADA system and with the remote I/O deployed locally at each server box. We use CAN fieldbus connections. Each remote I/O (one per server box) regroup temperature sensors, the command and position of the grille. Room PLCs also receive data directly from the humidity sensor. The PLC dedicated to chillers could command the air flow, the air temperature and humidity. It also verifies that the air is at the desired temperature and the humidity level at the output of chillers.

   To be able to give your colleague constructive feedback, answer the following questions

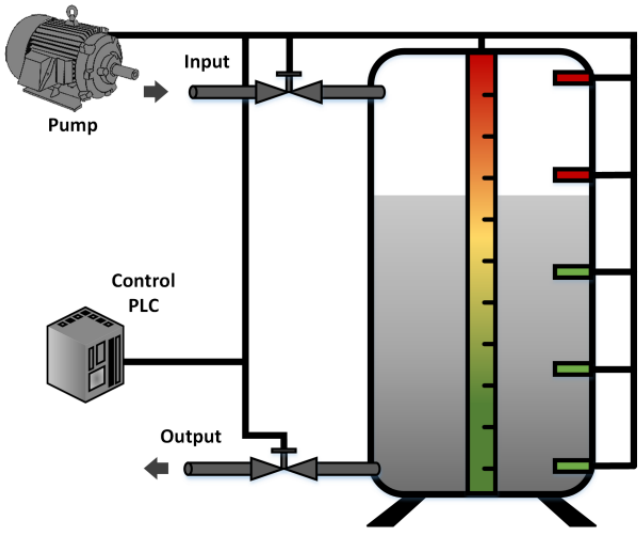
   a) Is the architecture complete with respect to your answer of question 1? If not, what is missing?

   b) Which parts of the architecture figure and the description do you understand? Where do you have questions? What additional information on assumptions and justifications is necessary?

   c) Improve the figure and the description based on your answers a) and b).



3. Industrial storage tanks are used in many industries to hold liquids or compressed gases for short or long term. Consider a simple installation of oil tanks, each instrumented by a controllable input valve, a controllable output valve, one sensor indicating the current oil level in the tank, five sensors indicating different threshold levels (very low, low, high, very high, spilling).



a) Does the instrumentation make sense? Is something missing or superfluous? Why?

b) Do we need real-time communication for this plant? What assumptions are necessary to answer this? If yes, what is the maximum latency the automation system should depend on?

c) Where in this plant would you use cyclic or event-driven communication?

e) Estimate the communication bandwidth requirements in this plant (make assumptions, give back on the envelope calculation).

d) Is PROFIBUS a good solution for the field level network?

e) Could it make sense to use wireless communication for this installation?