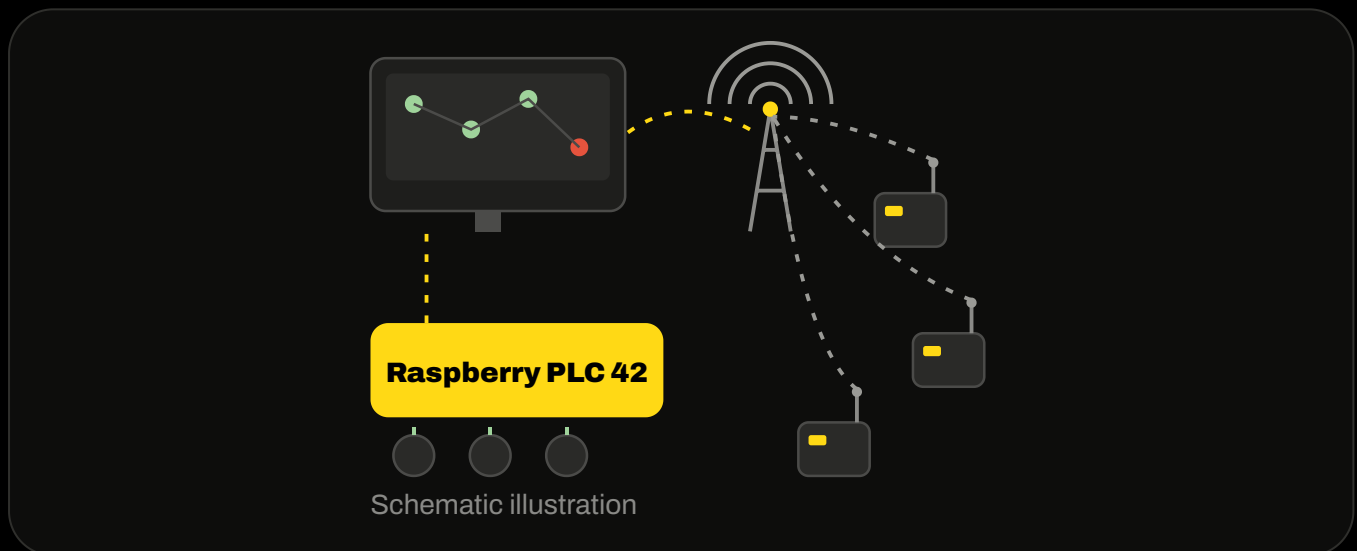


WATER NETWORK · LORAWAN

Many sites. One control room.

Linux PLCs at the plant, ESP32 PLCs in the field, LoRaWAN between them.

[Read the interactive case study online ›](#)

26 / 16

inputs / outputs of the Raspberry PLC 42 at the plant

13 / 8

inputs / outputs of each ESP32 PLC 21 in the field

EU868

LoRaWAN band of the radio boards

500 Ω

turns a 4-20 mA loop into 2-10 V for the PLC input

THE CHALLENGE

Many sites, few people, long distances.

A municipal water network is spread out. The treatment plant, the pumping stations, the tanks and the wells are often kilometres apart, and many have no fixed network line. The operator must see every site, get the alarm when a pump fails, and act before a wet well overflows. The control room must also know when a site stops talking.

01

Local control first

A pumping station starts and stops its pumps on its own level. The radio link must never be part of that loop.

02

Small data, long range

A remote point sends a few values: a level, the pump states, an alarm. LoRaWAN carries that far, with no SIM card per site.

03

Many signals at the plant

The treatment plant has 4-20 mA transmitters and devices that already speak Modbus. One controller must read both.

04

Silence is a state

If a site stops reporting, the control room must show it. No news must not look like good news.



One view for the operator

A panel at each site cabinet, a large screen in the control room, and the alarm on the phone of the person on call. The same data, with the same timestamp, whatever the path it took.

HOW IT WORKS

Three stages: the station, the radio, the plant.

Stage 1 · The pumping station

The level starts the pumps. The radio sends the news.

An ESP32 PLC 21 reads the wet well level from a 4-20 mA transmitter. It starts the duty pump at the start level and stops the pumps at the stop level. If the level keeps rising, the second pump helps. The pumps alternate, and a pump fault moves the work to the other pump. The PLC sends a short LoRaWAN frame on a fixed period, and at once on an event: a fault or a high level.

- Wet well level: 4-20 mA through a 500 Ω shunt
- Duty and assist pumps with alternation

Stage 2 · The radio network

Any gateway can hear a site. Silence has a timer.

A LoRaWAN device is not paired with one gateway. Every gateway in range receives its frame, and the network server removes the copies. A site covered by two gateways keeps reporting when one gateway fails. A site covered by one gateway goes silent. The control room knows the period of each site: after three missed frames, it marks the site as stale. When the link comes back, the frame counter shows how many frames were lost. Switch a gateway off.

- Each frame is heard by every gateway in range
- The network server removes the copies

Stage 3 · The treatment plant

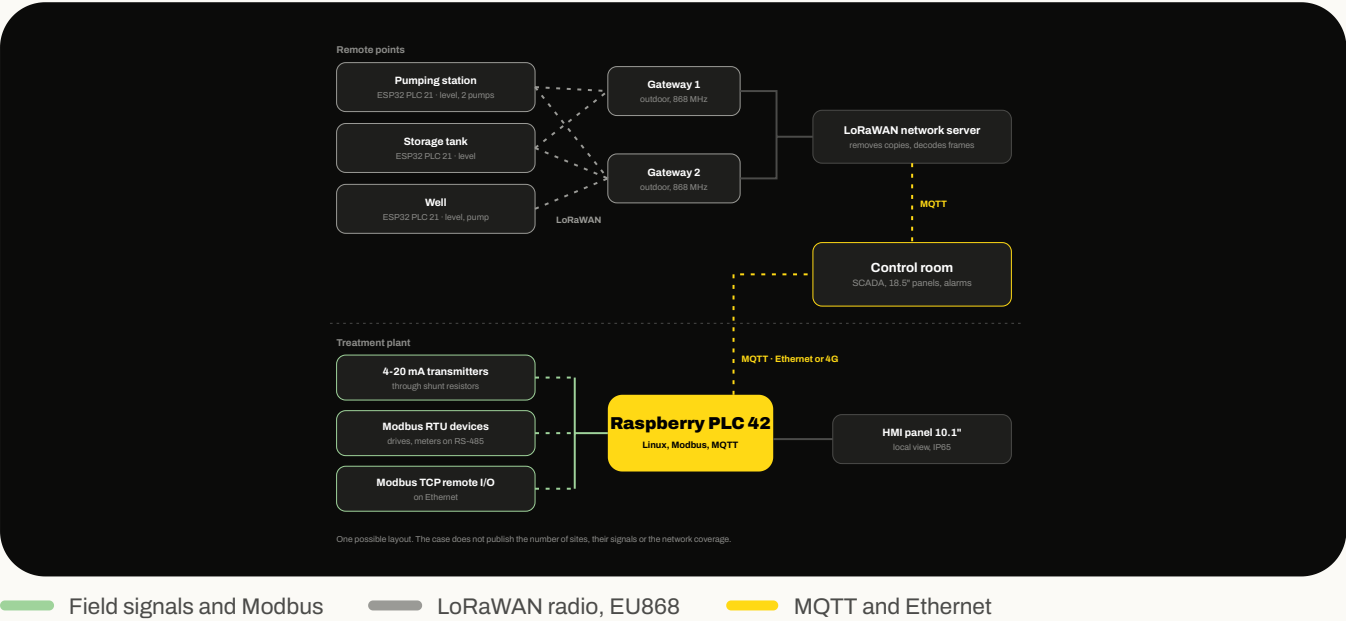
Milliamps, volts, units. A broken wire is not a zero.

At the plant, a Raspberry PLC 42 reads the 4-20 mA transmitters, the devices that already speak Modbus, and a local HMI panel. Its analog inputs measure 0-10 V, so each 4-20 mA loop goes through a shunt resistor. 4 mA is the zero of the scale. A reading of 3.6 mA or less is a fault, such as a broken wire or a failed transmitter, not a zero flow. The PLC sends each value to the control room over MQTT, with a quality flag.

- 4-20 mA to 0-10 V with a shunt resistor
- Fault limits from NAMUR NE 43

How does telecontrol of a water network fit together?

Two kinds of PLC, two paths. In the field, an ESP32 PLC 21 with a LoRa board runs each remote point: it controls the pumps on site and sends short LoRaWAN frames. Outdoor gateways receive the frames and pass them to a LoRaWAN network server, which sends the decoded data to the control room. At the treatment plant, a Raspberry PLC 42 reads the 4-20 mA transmitters, the Modbus RTU devices on RS-485 and the Modbus TCP remote I/O, shows the plant on a local HMI panel and publishes its values over MQTT. The control room puts both paths on one screen.



Signals and data

Signal	Between	Type	Purpose
Wet well level	Transmitter → ESP32 PLC 21	4-20 mA, 500 Ω	Starts and stops the pumps on site
Pump running, pump fault	Contacteur, thermal relay → ESP32 PLC 21	Digital in	Confirms each pump. A fault moves the work to the other pump
Pump command	ESP32 PLC 21 → contacteur	Digital out	Through an interposing relay to the contacteur coil
Site status	ESP32 PLC 21 → gateways	LoRaWAN	A few bytes: level, pump states, alarms. On each period and on each event
Decoded frames	Network server → control room	MQTT or HTTP	Data of all the remote points, without copies
Plant process values	Transmitters → Raspberry PLC 42	4-20 mA, shunt	Flows and levels of the plant (example)
Installed devices	Drives, meters → Raspberry PLC 42	Modbus RTU	Values the devices already compute, on RS-485
Remote I/O	I/O modules → Raspberry PLC 42	Modbus TCP	More digital signals without new cables to the cabinet
Local view	HMI panel ↔ Raspberry PLC 42	Display and touch	Plant view and local commands. The case does not publish how the panel connects
Plant data	Raspberry PLC 42 → control room	MQTT	Each value with its timestamp and quality, over Ethernet or 4G

Linux at the plant. ESP32 in the field. Screens for people.



Raspberry PLC 42

An industrial PLC built around a Raspberry Pi 4, with Debian 64-bit. At the plant it reads the 4-20 mA transmitters through shunts, talks Modbus RTU on its two RS-485 ports and Modbus TCP on Ethernet, shows the plant on the local HMI panel and publishes the values over MQTT. You program it in Python, Node-RED or C/C++.

Role	Plant controller: analog signals, Modbus, local HMI, MQTT
Computer	Raspberry Pi 4, quad core 64-bit, 1.8 GHz, 2, 4 or 8 GB RAM
Inputs	26: 12 analog/digital (0-10 V, 12-bit), 14 digital optoisolated (5-24 Vdc)
Outputs	16: 6 analog/digital/PWM (0-10 V), 10 digital optoisolated (5-24 Vdc)

In the project behind this case, the plant controllers are Raspberry PLC 42 units. They send their data over Ethernet, or over a 4G board where a site has no wired network.

[See the Raspberry PLC 42 >](#)



ESP32 PLC 21 FLEX

An industrial controller built on the dual-core ESP32, programmed with the Arduino IDE. The FLEX version takes one communication board: here, LoRa for the EU868 band. At a pumping station it reads the level and the pump signals, drives the pump contactors through interposing relays, and sends the LoRaWAN frames.

Role	Remote point: local pump control, LoRaWAN frames
Inputs	13: 6 analog/digital (0-10 V, 11-bit), 7 digital optoisolated (5-24 Vdc)
Outputs	8: 3 analog/digital/PWM (0-10 V), 5 digital optoisolated (5-24 Vdc)
Comms	Ethernet, Wi-Fi, Bluetooth LE, RS-485, RS-232

In the project behind this case, the remote points use the ESP32 PLC 21 with the LoRa (EU868) board. A two-pump station like the one in stage 1 needs about 6 of its 13 inputs: the level, two run signals, two fault signals and a high level float. The outputs have no relays: drive the contactor coils through interposing relays.

[See the ESP32 PLC 21 >](#)



Panel HMI Touch Screen

The screens for the operators: a capacitive touch panel at the site cabinet, and a large one in the control room.

Role	Local plant view, control room screen
Sizes	7", 10.1" or 18.5"
Touch	Capacitive

In the project behind this case: 10.1" panels with an IP65 front at the sites, and 18.5" panels in the control room.

[See the HMI panel >](#)

Control stays on site

The pumps react to the level inside the PLC, every scan. A lost frame changes what the control room sees, not what the pump does.

Few bytes, on purpose

Short frames use less airtime. In EU868, the main channels allow 1 % of airtime per device. Pack the bits: see [LoRaWAN payload bit packing](#).

A broken wire is not a zero

With 4 mA as the zero of the scale, a dead loop reads near 0 mA and the PLC flags it. The control room gets a bad quality flag, not a false zero flow.

SIMILAR NETWORK?

Tell us your sites and your signals. An engineer will answer.

Tell us what kind of sites you have, what each one measures and controls, the distances, and which network reaches them today. We will tell you which controller fits each site and how to bring the data to one control room.

FULL CASE STUDY ONLINE

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