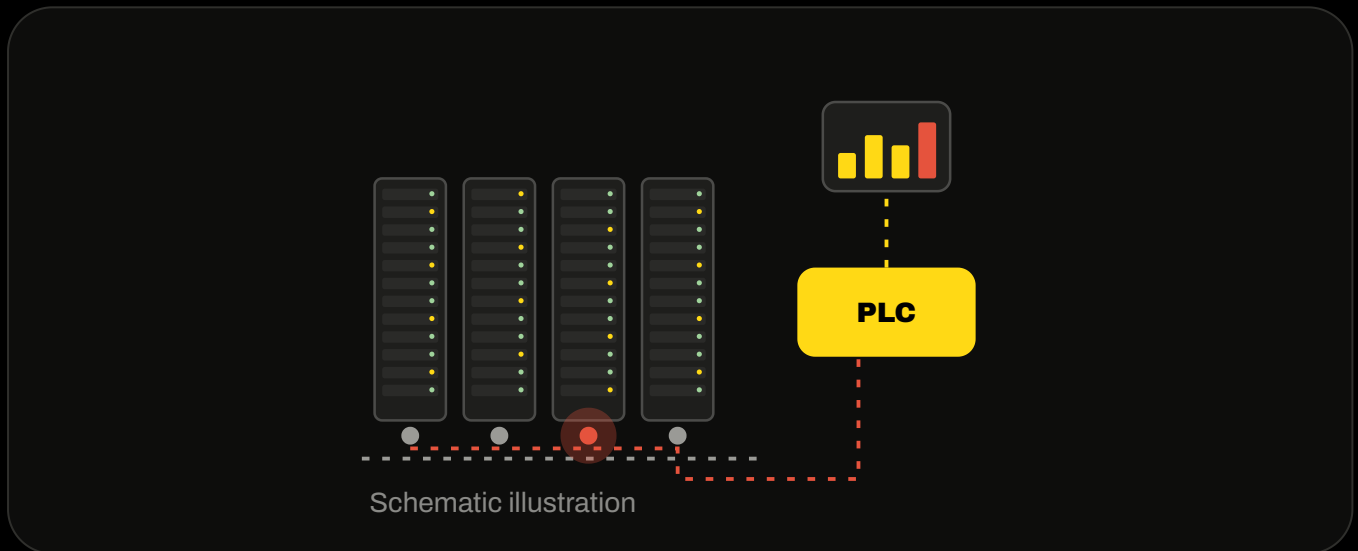


DATA CENTER · M-DUINO 19R+

# Measure at the rack. Cool only where it is needed.

PLCs measure each rack, so the HVAC acts on the hot spots.

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

**~2x**

almost twice the equipment, in rooms sized before

**65-80 °F**

temperature band that the case quotes from ASHRAE

**40-60 %**

relative humidity band quoted by the case

**30-35 %**

humidity floor used by the case

## THE CHALLENGE

# More servers in the same rooms. A higher energy bill.

The data center almost doubled its equipment after new contracts. The growth went into rooms that were sized before, and the energy cost grew fast. The facility was modern, with a powerful and versatile HVAC and environmental sensors in each room. The operator wanted to know where the energy was lost, and how to use less of it without risk for the servers.

01

### Air at the right temperature

The case quotes ASHRAE: 65 to 80 °F (18.3 to 26.7 °C), and close to 22 °C for safe humidity levels. Current ASHRAE guidance: 18 to 27 °C at the server inlet.

02

### Humidity in a band

40 to 60 % relative humidity. The case keeps it above 30 to 35 % against electrostatic discharges. An adequate humidity also protects the equipment against corrosion.

03

### Hot spots

One critical point can heat the whole room and lower its relative humidity. A sensor on the wall of the room does not show where it is.

04

### Energy for the cooling

PUE compares the total energy of the data center with the energy that reaches the IT equipment. To cool the whole room for a few hot racks raises the PUE.



### Complete the HVAC, do not replace it

The PLCs complement and improve the existing installation. The operator chose them for their versatility and for the freedom of programming of open source hardware.

## HOW IT WORKS

### Three stages: find, measure, act.

#### Stage 1 · Find

#### The history shows where the energy goes.

First, the historical data of the facility was analysed to find patterns: places and moments where the facility does not work at an adequate level and uses too much energy. After the analysis, with the HVAC correctly sized, a more detailed measurement was chosen. A typical way to look at it: the cooling energy for each kWh that reaches the IT equipment, hour by hour. Move the threshold, then switch to a hot week.

#### Stage 2 · Measure

#### Sensors at the foot of the rack find the hot spot.

A more detailed measurement at the foot of the racks found critical points that heated the whole room and lowered its relative humidity, with a risk of electrostatic discharges. More sensors then gave a complete view: the whole room, each rack and parts of a rack. The PLC checks each point against its band and raises an alarm when a value is out of range. Create the hot spot, then switch the rack sensors off.

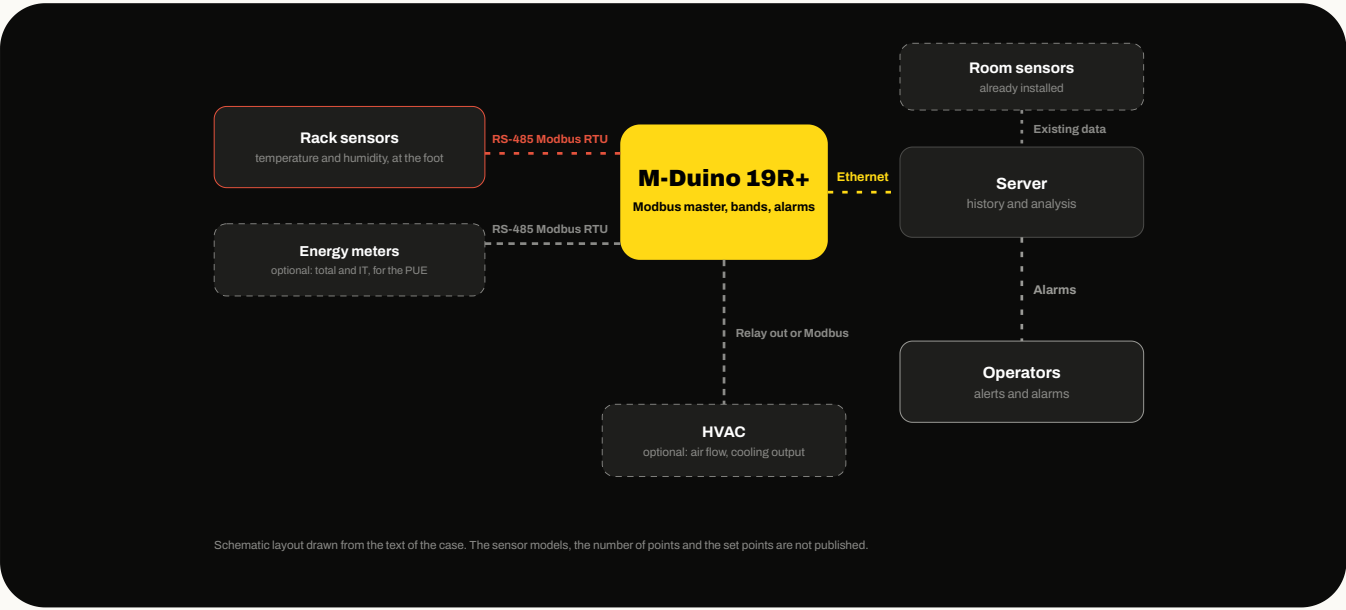
#### Stage 3 · Act

#### Cool the hot zone, not the whole room.

With the new data, some parameters of the HVAC changed. The air flow and the control of the cooling output were adapted to manage temperature and humidity better. The HVAC acts on each area, instead of cooling the whole room to protect a few critical racks. Compare the two modes and change the size of the hot spot.

# How do you find the hot spots of a data center with a PLC?

Temperature and humidity sensors sit at the foot of each rack. The M-Duino PLC reads them, checks each value against its band and raises the alarms. It sends the data over Ethernet to a server, where the history is stored and analysed. The room sensors that were already in place give the room view. As an option, the PLC sends enable signals or set points to the HVAC, and reads energy meters for the PUE.



— RS-485 (Modbus RTU)    — Ethernet    — Alerts and alarms    — Optional or existing

## Signals and data

| Signal                        | Between                              | Type                         | Purpose                                            |
|-------------------------------|--------------------------------------|------------------------------|----------------------------------------------------|
| Rack inlet temperature        | Sensor at the foot of the rack → PLC | RS-485, Modbus RTU (typical) | Find the hot spots, rack by rack                   |
| Rack relative humidity        | Sensor at the foot of the rack → PLC | RS-485, Modbus RTU (typical) | Find dry air and the risk of discharges            |
| Room temperature and humidity | Room sensors, already installed      | Existing                     | The room view, before the rack sensors             |
| Data and history              | PLC → server                         | Ethernet                     | Store the values and find the patterns             |
| Alerts and alarms             | Server → operators                   | Ethernet                     | Values out of range                                |
| HVAC action (option)          | PLC → HVAC                           | Relay out or Modbus          | Automations on the air flow and the cooling output |
| Energy (option)               | Energy meters → PLC                  | RS-485, Modbus RTU           | Total energy and IT energy for the PUE             |

# A PLC on the rack row. Data for every point.



## M-DUINO ETHERNET PLC ARDUINO 19R

An industrial PLC built around an original Arduino Mega 2560, with Ethernet, RS-485 and 8 relay outputs. Here it reads the sensors of the racks, checks each band, raises the alarms and sends the data to the server. You program it with the Arduino IDE.

**Inputs**      **6: 4 analog/digital (0-10 Vdc), 2 digital optoisolated with interrupts (5-24 Vdc)**

**Outputs**      **11: 8 relays (230 Vac 4 A / 24 Vdc 2 A, resistive load), 3 analog/digital/PWM (0-10 V)**

**Comms**      **Ethernet, RS-485, RS-232, I2C, SPI, TTL serial**

The case says "Arduino PLC" and does not publish the exact model or the number of units. The old page of the case shows an M-Duino 19R. The image and the link show its current version, the M-Duino 19R+ (IS.MDuino.19R+). The RS-485 port uses a MAX485 transceiver referenced to the PLC ground: on a long sensor line, keep a common reference or add an isolated RS-485 repeater.

[See the M-Duino 19R+ ›](#)

### History first

The analysis of the historical data came before any new sensor. It showed where the facility used too much energy.

### Temperature and humidity together

When a hot spot heats the air, its relative humidity falls. Both values come from the same point, so the PLC sees the risk of discharges too.

### Act on the area

The HVAC was already powerful and versatile. With data for each area, it cools the hot zone and does not overcool the stable ones.

#### SIMILAR DATA CENTER?

**Tell us your rooms and your racks. An engineer will answer.**

Tell us how many rooms and racks you have, which sensors and HVAC are installed, which limits matter and who must see the alarms. We will tell you which controller fits and how to connect it.

#### READ IT ONLINE

[industrialshields.com/case-study-data-center-rack-monitoring-m-duino](https://industrialshields.com/case-study-data-center-rack-monitoring-m-duino)

#### EMAIL

[info@industrialshields.com](mailto:info@industrialshields.com)

#### PHONE

[\(+34\) 938 760 191](tel:+34938760191)