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DISCLAIMER OF WARRANTIES

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Deliverable D4.2
frESCO Building Gateway & Extensions for integration with legacy equipment

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Deliverable name	frESCO Building Gateway & Extensions for integration with legacy equipment
Lead beneficiary	CIRCE
Description	Extension of CIRCE Energy Box and Voltalis smartbox communication protocols for compliance with open standards and the CIM
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ABBREVIATIONS

Abbreviation	Name
CIM	Common Information Model
D	Deliverable
EB	Energy Box
H2020	Horizon 2020
IoT	Internet of Things
JTAG	Joint Test Action Group
MQTT	Message Queuing Telemetry Transport
M2M	Machine to Machine
PCB	Printed Circuit Board
T	Task
Tx.y	Task x.y
WP	Work Package

TABLE OF CONTENT

EXECUTIVE SUMMARY

The deliverable aims to present in detail the design and development of the gateways used in the frESCO architecture, and its integration with the legacy and the new equipment to be installed. It is on of the prime outcomes of the work that has been carried out within Task 4.2 “Data acquisition devices and big data platform backbone infratsrtructure”, which is based on two devices, the EnergyBox from CIRCE and Voltalis SmartBox, both cutting-edge technology smart devices that will be used for monitoring and control of facilities in the different demo sites.

The document covers all hardware and software specifications of the aforementioned devices. Besides, a brief description of the metering devices selection process, and the interaction with the frESCO platform and its relationship with the CIM of the project has been included as relevant information to the deliverable. Both device selection and integration with CIM and frESCO platform are in the first stage of development, further advances will be reflected in further documentation.

Finally, an initial approach of the installation plan is depicted for all the demo sites. This plan is highly dependent on the definition of the demo sites and the devices finally selected; therefore the definitive course of action is still a work in progress.

1 INTRODUCTION AND OBJECTIVES

1.1 Scope and objectives of the deliverable

The aim of this document D4.2, “frESCO Building Gateway & Extensions for integration with legacy equipment”, is to present a general description of the devices that are going to be used in frESCO demo sites. This equipment has been developed or selected by CIRCE and VOLTALIS. The goal of the activities described in this deliverable is to deliver cutting edge technologies that allow the smartening of legacy devices and the integration of new ones, in order to obtain the necessary information to feed the big data platform.

To that purpose, the following deliverable is providing information of the hardware of the gateways developed by CIRCE and VOLTALIS, for a better understanding of the equipment to be installed in each demo site, including the metering and sensor equipment and describing the software functionalities that provide communication to the legacy devices and integrate the field information with the frESCO platform, giving an overview of the installation plan of the demo sites at this time of the project.

1.2 Structure of the deliverable

The following is the structure of this document.

Section 2 presents the hardware design of CIRCE and VOLTALIS gateways. It also includes the metering and sensor devices that are planned to be used to gather information from the demo sites.

Section 3 presents the software functionalities of the gateways to provide the necessary monitoring and management capabilities for the proper execution of the modules integrated in the big data platform. This section also relates the communication protocols with the Common Information Model (CIM) of the project.

Section 4 provides an initial overview of the installation plan for the frESCO demo sites, and the testing that is planned to ensure the correct integration in the system.

1.3 Relation to other tasks and deliverables

The present deliverable is strongly related to all the WP4 tasks, specially T4.1 “Open Standards, Interoperability and Common Information Model Adaptation”, where the data model of the project is being defined.

The information reported in this document will be the basis for the works carried out in the demonstration phase of WP6.

2 HARDWARE DESCRIPTION OF FRESCO BUILDING GATEWAYS

Two different hardware solutions are going to be used as gateways of the frESCO demo sites. VOLTALIS Smartbox is the solution for the French demo site, meanwhile CIRCE’s EnergyBox will be the gateway solution for the rest of the demo sites.

2.1 CIRCE’s Energy Box

CIRCE Energy Boxes (EB) are part of the range of next-generation smart controllers. The first version of this device was developed under the H2020 project “energy services demonstration of demand response, FLEXIbility and energy effiCIENCY based on metering data” (FLEXICIENCY). Since then, CIRCE has been working on new versions of PCB with new features and functionalities adapted to different purposes. In Figure 1 the latest version of the hardware is presented.

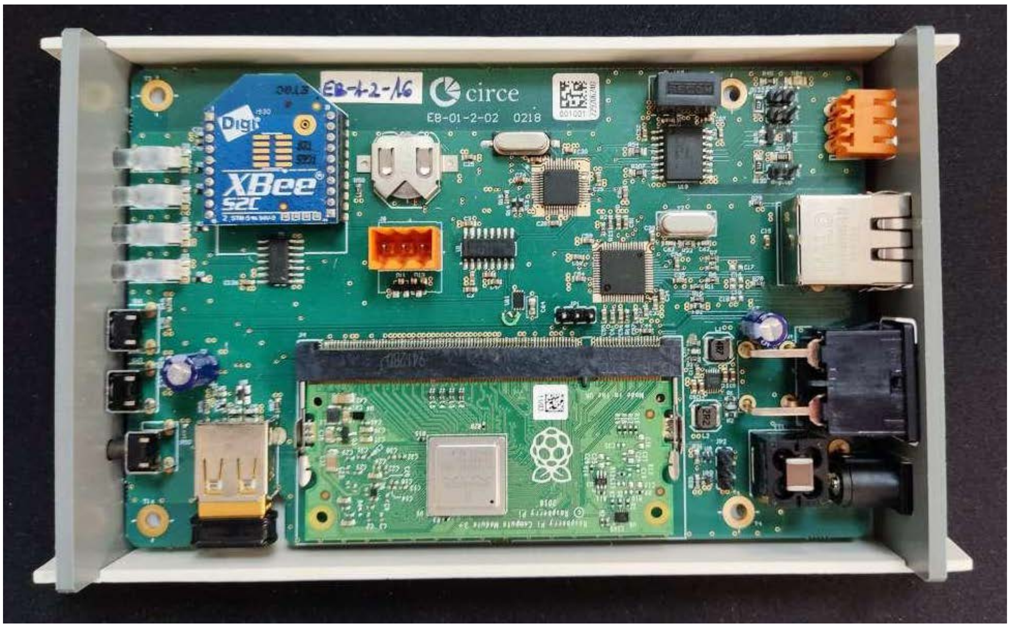


Figure 1.- PCB of the latest version of the Energy Box.

The EB integrates several of the most used communication technologies, reducing equipment and deployment costs. For a remarkable performance and to provide industry-leading system capabilities, it relies on a multi-core CPU architecture and non-blocking switching structure. This architecture helps meeting not only home requirements, but also other more complex control requirements needed for more demanding environments much closer to real time.

Therefore, the Energy Box provides a compact and embedded solution for controlling real smart devices. The key features of this system are:

- Compact and modern design.
- Fanless design that ensures quiet operation in small office spaces and living rooms.
- High level services and monitoring can be performed remotely whereas local services can be processed locally, which improves service quality, security and efficiency.
- Low power consumption.
- Debian based computer operating system.
- Reduced form factor and light weight.

The Energy Box hardware is formed by an ad hoc design intended to meet the project requirements regarding the communication capabilities, data processing, and the size and enclosure suitable for the smart home application. This versatile development includes 5 communication standards, as shown in Figure 2.

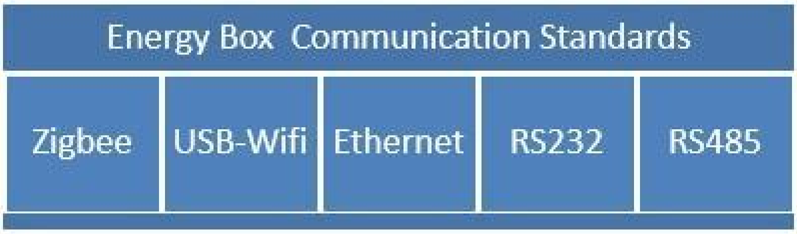


Figure 2.- Communication standards included in the EB.

The PCB can be divided in several blocks, each of them focusing on a different functionality. Each of them has different layout restrictions which are critical in order to get the hardware to operate correctly and in consequence their position on the layout is clearly defined. This approach prevents possible operational issues interferences.

The core processor where the main functionalities of the system are located is the RaspberryPi Compute Module 3. The rest of the modules provide the communication interfaces necessary to achieve the integration purposes of the different protocols. In Figure 3 there is a schematic view of the interactions of the modules, and Figure 4 shows a general view of the PCB, where the main elements are emphasized.

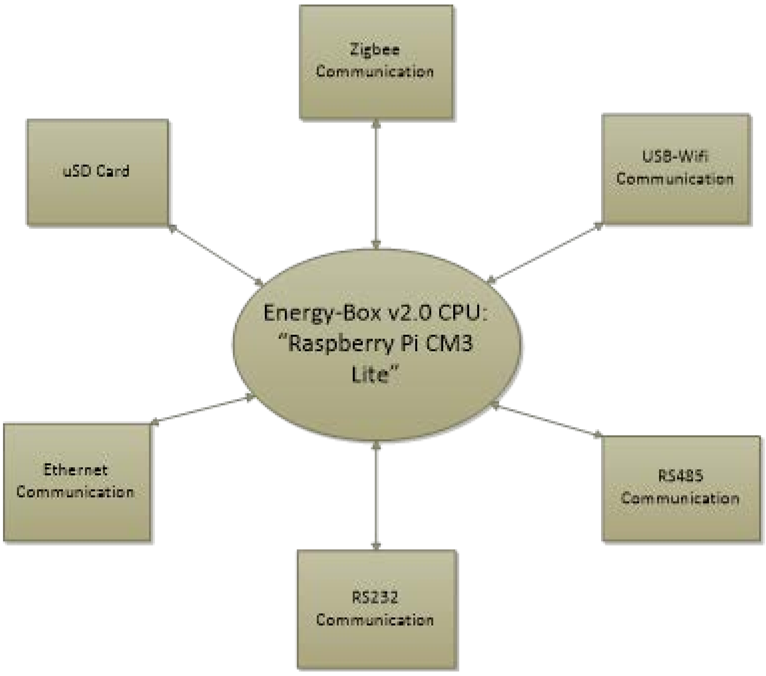


Figure 3.- Interactions between the modules of the PCB.

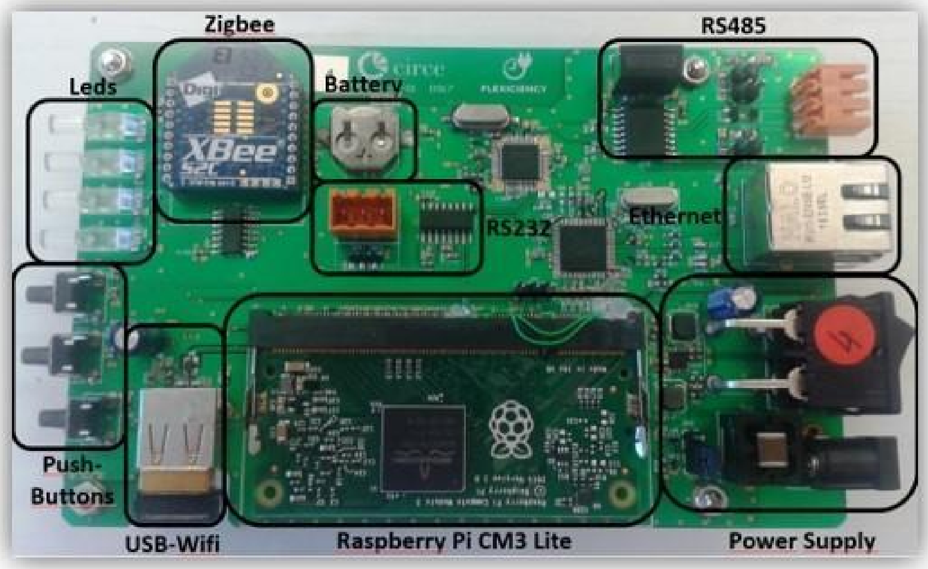


Figure 4.- PCB with the main blocks emphasized.

As a summary, Table 1 presents the most relevant hardware specifications of CIRCEs Energy Box development.

Table 1.- General hardware specifications of Energy Box.

Energy Box hardware specification	
External supply of 5V	The Energy-Box has an external power source with +5 V output to power-up the PCB. This voltage is adapted to +3.3 V and to +1.8 V to supply the power to the rest of the PCB components.
Raspberry Pi CM3 Lite	This plug-in card is the Energy Box CPU.
Battery	This battery of 3 V powers up the real time clock (RTC) DS1307, which keeps track of the current time. In this way, the RTC can continue to keep timing while the primary source of power of the Raspberry is off or unavailable.
uSD card	This card allows storage and loading of the operating system in the Raspberry Pi CM3 Lite.
External LEDs	Another design consideration are the LED indicators that show • WiFI connectivity • ZigBee connectivity • RS485 communication • Power indication These LEDs are shown in the exterior of the enclosure.

External push buttons	The PCB includincludedes 3 external push buttons to allow the user to set up the communication and to reset, • the system. • Wifi connection. • ZigBee connection. • Raspberry reset and setting of default values.
External connectors	RS485 port Ethernet connector 5V power supply jack
Jumpers	There are 3 types of jumpers: JP1: It enables and disables “auto-MDIX” mode for Ethernet wire. When this characteristic is enabled, the type of connection of required wire is detected, and if not, direct wires must be used. The installer can manage it according to their needs. JP2: It is for Raspberry boost. The installer does not need to move it from default position. JP5, JP6 and JP7: They offer the possibility of putting a pull-up line or pull-down resistor depending on the RS485 connection. The installer can manage them according to their needs.

2.2 Voltalis’ Smartbox

Voltalis platform aggregates hundreds of thousands of flexible electricity appliances, focusing on thermal usage such as heaters and water boilers. These appliances are measured and controlled in real time by Smartswitches, which are connected locally to an IoT gateway named Pilot. The Pilot embeds computing capacity to collect and store data from its connected Smartswitches. It handles remote communication with the central platform through mobile M2M (embedded SIM card).

I. A general power consumption sensor to monitor the housing power consumption, named “vX General Consumption”
II. An IoT gateway, named the vX Pilot, which provides local intelligence. This product runs algorithms and allows the communication between Voltalis platform and other devices.
III. A heater and hot water tank equipment, named Smartswitch with two different products

a. A specific product for heaters: Can power the plugged product on and off or in specific state as described below.
b. Another product for other appliances (eg: hot water tank): Can power the appliance on and off (relay).

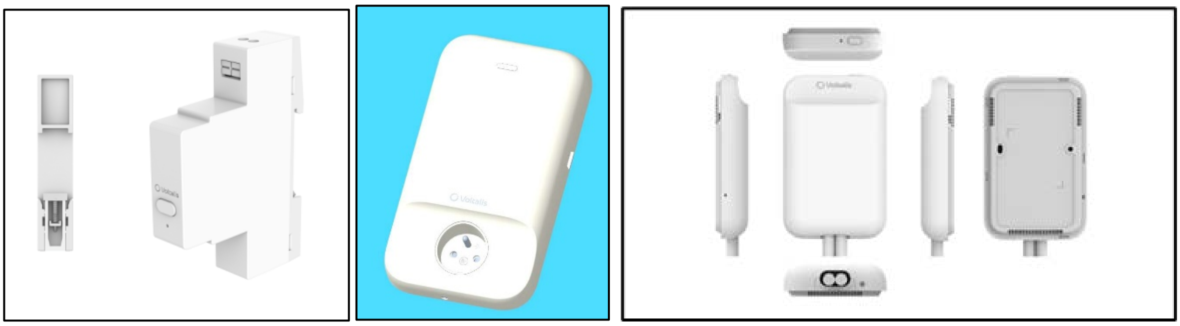


Figure 5.- a) vX General Consumption; b) vX Pilot; c) SmatSwitch

Both product types need to be able to measure the power consumption of the appliances they are linked to. Here we can see how it is installed in a household (Figure 6).

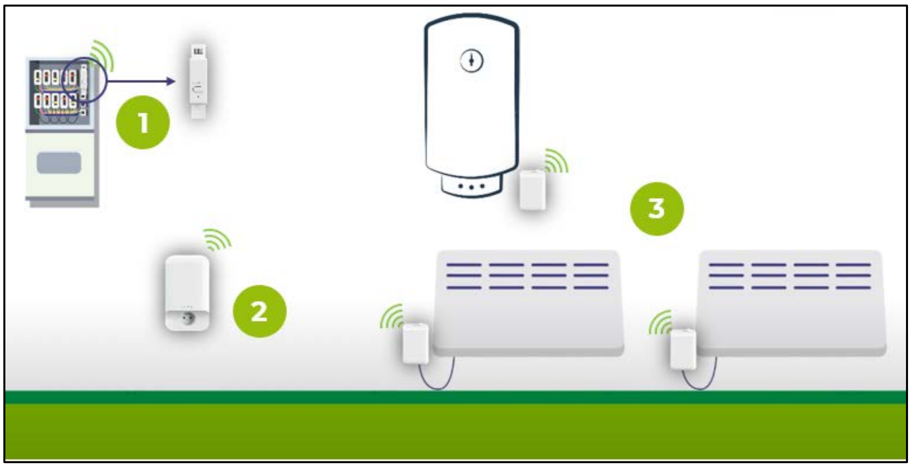


Figure 6.- Main components of the Voltalis SmartBox solution.

2.2.1 General consumption

The vX General Consumption is a power measurement device. It is installed directly in the switchboard (DIN rail). The device communicates with a vX Pilot and other vX Smartswitches through a ZigBee 3.0 network.

The hardware architecture of the vX General Consumption comprises:

- An internal power-supply

- Computation capacities and storage capacities
- ZigBee communication
- Basic human interfaces (LED and buttons)
- An electrical power measurement function

Below is the overview of the architecture of the device (Figure 7).

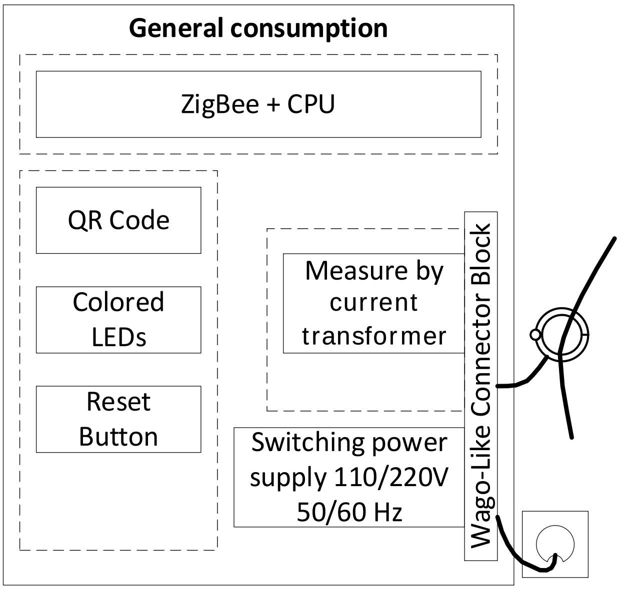


Figure 7.-Overview General consumption.

Electric diagram block

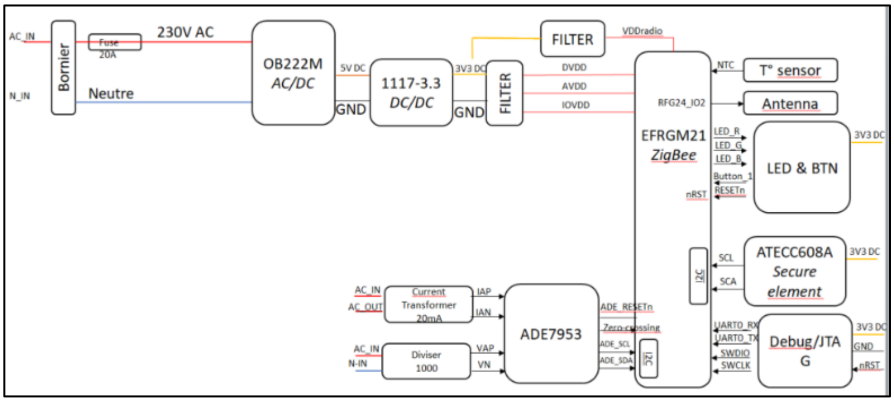


Figure 8.- Electric diagram block of General consumption.

Zigbee Communication

The vX General Consumption shall communicate with other products through Zigbee 3.0, 2.4 GHz. This device must be able to act as a Zigbee router.

Basic Human interfaces (LED and buttons)

vX General Consumption must have multicolor light signal: red, blue and green.

vX General Consumption must have two buttons:

- A subminiature push-button for reset with difficult access. This button must not be accessible by hand only. Pressing it must require the use of a tool.
- A push-button for ZigBee pairing and to stop ongoing action, easy access.

Global power measurement functions

The vX General Consumption is intended to measure the power directly by ADE7953, with an internal measurement circuit (power, energy active and reactive, current…). The measurement applies in a mono-phased environment), especially with current transformer. vX General Consumption measurement shall meet IEC 62052-11, IEC 62053-21, IEC 62053-22 class 0,5S; IEC 62053-23 class 0,5S French recommendations.

The current transformer should be up to 60A.

The voltage will be measured directly on the line.

Terminals

Terminals shall be grouped together by function.

Moreover, input and output order shall be identical (inputs must be numbered in the same way as outputs).

An automatic connector is present and easily accessible on the device.

2.2.2 vX Pilot

The vX Pilot is a device communicating with one or several vX Smartswitches and vX General Consumption devices, storing real time consumption information and sending related data to a centralized server platform through the Internet.

The hardware architecture of the vX Pilot comprises:

- Internal power-supply.
- Computation and storage capacities.
- Hardware security features.
- Basic human interfaces (LED and buttons).
- ZigBee communication.
- WiFi communication.

- Mobile network communication.
- USB ports.

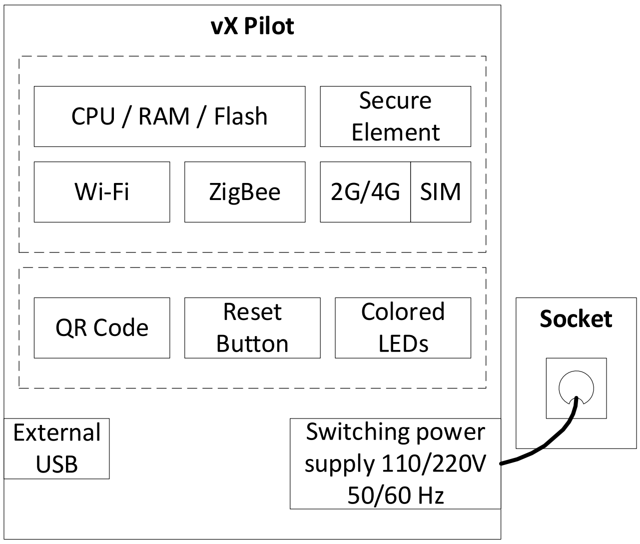


Figure 9.- vX pilot general architecture.

vX pilot functions

There are two possibilities for the installation of the vX pilot: with or without a general accessible plug.

- **Scenario 1: recessed socket**

The pilot is plugged on a special socket that replaces an electrical recessed outlet. Users must not be able to unplug the Pilot without a tool. The function “electrical outlet” needs to be offered on this new system (French format, 16A). It will be powered on standard electrical wires (L, N, G). Each wire entry must be duplicated (i.e. double Wago).

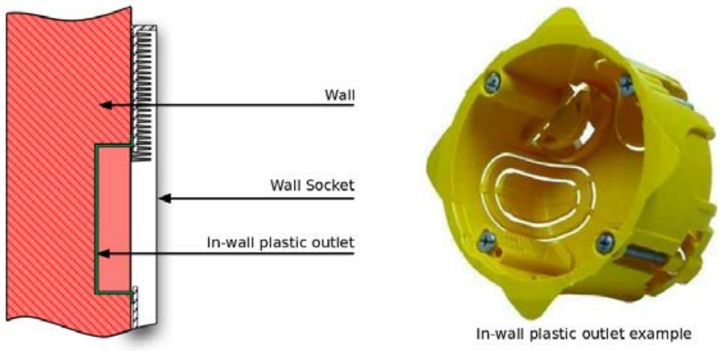


Figure 10.- To ensure the wall socket proper installation, it is necessary to include a 2 mm empty space on the wall side.

- **Scenario 2: Flat wall**

The pilot is installed on the flat wall, it will be powered on standard electrical wires (L and N), users must not be able to unplug the Pilot without a tool.

In order to allow the insertion of a potential surface electrical conduit into the wall socket, some parts of the wall socket are rendered detachable on each side.

The minimum width of the wall socket is w= 2 cm.

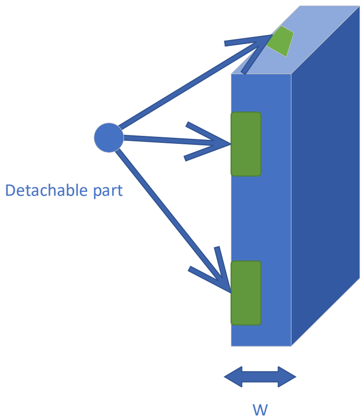


Figure 11.- Examples of insertion of wall socket.

Basic human interfaces (LED and buttons)

The vX Pilot must have 3 different LEDs: red, blue and green.

The Pilot must also have 2 buttons:

- A subminiature push-button for reset with difficult access. This button must not be accessible by hand only. Pressing it must require the use of a tool.

* A push-button for ZigBee pairing and to stop ongoing actions, easy access.

ZigBee communication

vX Pilot shall communicate with other products through Zigbee 3.0, 2.4GHz. This device is a Zigbee coordinator. The range is large enough to communicate with objects located in a standard house.

WiFi communication

vX Pilot has an embeded WiFi b/g/n module, allowing it to be a client and a hotspot. The range is large enough to communicate with objects located in a standard house. WiFi module implements Packet Traffic Arbitration (PTA).

Mobile network communication

vX Pilot has an embedded worldwide 4G (Cat-M) with 2G fallback modem with embedded antenna and SIM.

USB ports, other ports and other functions

vX Pilot includes a USB host port, at least USB 2.0 with a type A female connector. This connector is accessible from the outside of the product. It allows the plugging in of any dongle type.

It has a JTAG and UART debug port on the PCB for the devlopment development phase.

A temperature sensor.

Terminals

Output High Voltage terminal blocks can handle at least two 2.5 square millimetre wires.

It has an automatic connector like Wago.

Housing

The device size has been minimised and is aesthetically OK for a product that may be visible.

2.2.3 Smartswitch vX

The vX Smartswitch is a power adjustment and measurement device installed close to the equipment it controls. The device communicates with a vX Pilot, other vX Smartswitches and vX General Consumption devices through a ZigBee 3.0 network.

The difference between the heater Smartswitch and the hot water tank Smartswitch is the control function.

The hardware architecture of the Smartswitch comprises:

- An internal power-supply.
- Computation capacities and storage capacity.
- A ZigBee communication.
- Basic human interfaces (LED and buttons).
- A control function.
- An electrical power measurement function.

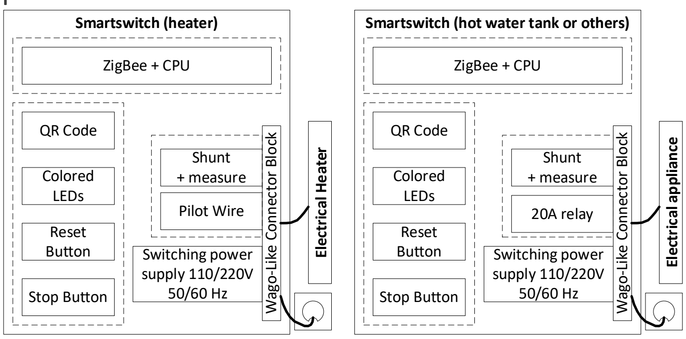


Figure 12.- General architecture of smartswitches.

Electrical diagram blocks

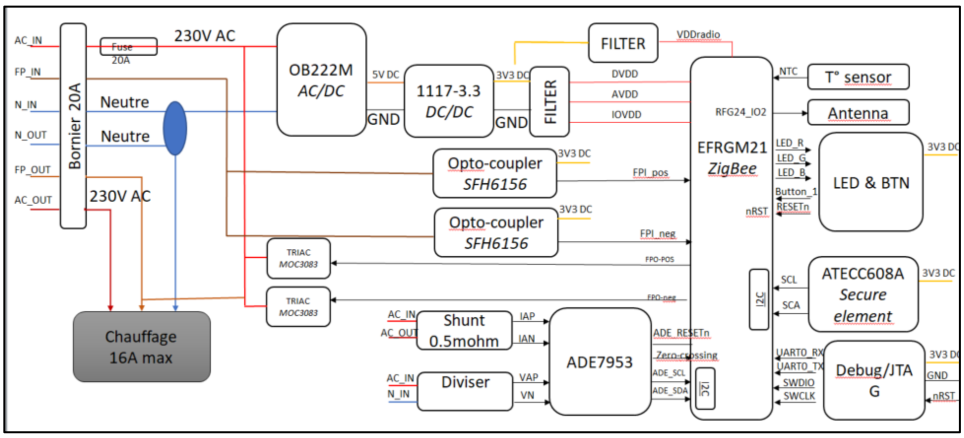


Figure 13.-Smartswitch "Fil-pilote" wire pilot Electrical diagram Bloc.

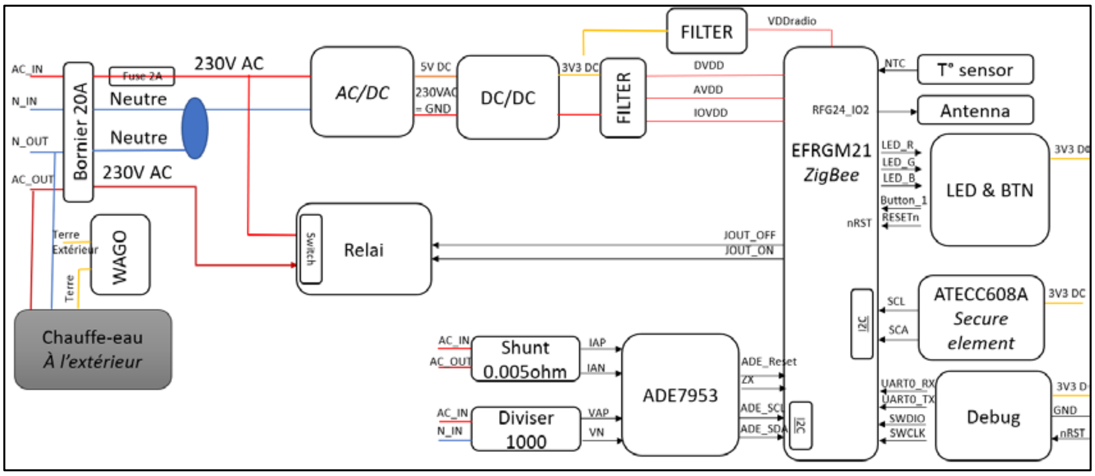


Figure 14.- Smartswitch relay Electrical diagram Bloc.

Zigbee communication

vX Smartswitch communicates with other products through Zigbee 3.0, 2.4GHz. This device can act as a Zigbee router.

Basic human interfaces (LED and buttons)

vX Smartswitch has a multicolor light signal: red, blue and green.

vX Smartswitch has two buttons:

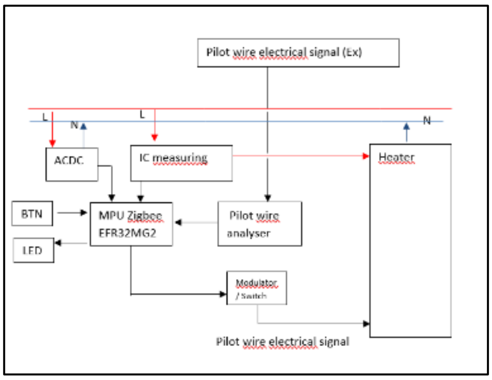
- A subminiature push-button for reset with difficult access. This button is not accessible by hand only. Pressing it requires the use of a tool.
- A push-button for ZigBee pairing and to stop ongoing actions, easy access.

Control functions

The vX Smartswitch contains:

<u>Heater type:</u>

- Fil-pilote (pilot wire) which is a French protocol used to control heaters. There are six orders: comfort, comfort -1°C, comfort -2°C, eco, frost-free and switched off.
- The vX Smartswitch has a “Fil Pilote” input and an output and can encode and decode the signals.
- The modulator switch is used to select the pilot wire given to the heater (external pilot wire or internal pilot wire)



Orders	"Fil-pilote" (Pilot wire) electrical signal	
Comfort	No signal	
Eco	220V	
Frost-free	220V – negative signal	
Off	220V – positive signal	
Comfort -1°C	Timed signal	
Comfort -2°C	Timed signal	

Figure 15.- "Fil-pilote" electrical signals.

<u>Hot water tank or other types:</u>

- Appliance power control through a 20A relay
- The relay can cut the power supply of the maximum associated load at least 100,000 times (one hundred thousand). A 20A certification must be provided for the chosen relay.
- Zero-crossing detection is used to cut the power supply.

Electrical power measurement functions

The vX Smartswitch is intended to measure the power directly, with an internal measurement circuit (active and reactive power, energy, current, frequency…). The measurement only applies in a mono-phased environment with capacity of 20A.

vX Smartswitch measurement meets IEC 62052-11, IEC 62053-22 class 0,5S, IEC 62053-23 class 0,5S French recommendations.

The voltage is measured directly on the line.

The current is measured with a shunt. The shunt resistivity is small to ensure a small consumption.

Terminals

Terminals are grouped together by function.

Moreover, input and output order are identical (inputs are numbered in the same way as outputs).

Output High Voltage terminal blocks can handle at least two 1.5 square millimetres wires for Smartswitch Fil pilote (wire pilot) and two 2.5 square millimetres wires for Smartswitch relay. Smartswitch uses the automatic connector Wago.

The terminals:

Wire pilot Heater type (front left to right): Wire Pilot in / L in / N in / N out / L out / Wire Pilot Out

Relay type (frond left to right): L in / N in / N out / L out

Figure 16.- Smartswitch a) wire pilot terminal; b) relay types.

3 SOFTWARE FUNCTIONALITIES OF FRESCO BUILDING GATEWAYS

3.1 CIRCE's Energy Box

The Energy Box provides communication functionalities in two levels of communications, downwards (with the field devices) and upwards (with the cloud Energy Management Systems, in our case the frESCO Big Data Management Platform), as shown in Figure 17.

Downward communications include the connection between the auxiliary modules exposed in the hardware section, interfacing with the Raspberry Pi 3 module that contains the main operative system and the main functionalities. The modules selected are among the most used standards in the industry, which are: as wired solutions, serial communications via

Ethernet and RS485/RS232 modules; as wireless solutions, ZigBee and WiFi modules. Each of these modules use a dedicated port of the Raspberry to avoid problems derived from sharing ports. For each one of the modules a development of their protocols has been performed between the core and the drivers.

With the connection possibilities that the explained modules provide, the variety of field devices compatible with the Energy Box comprise:

- ZigBee devices using the Home Automation profile.
- Power analyzers connected using Modbus/RTU or Modbus/TCP.
- DER equipment such as solar and wind converters or electric vehicle chargers.

Their respective modules implement ZigBee and WiFi protocols, but the rest of the protocols needed, like Modbus and the specific protocols of the rest of the equipment, have been programmed in the core module of the Energy Box.

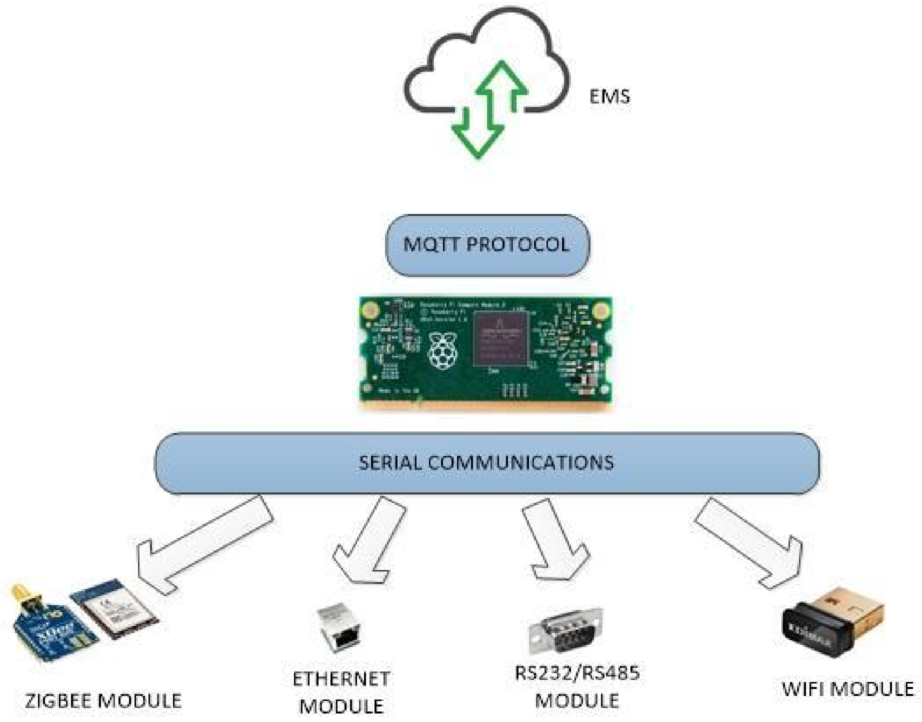


Figure 17.- Schematic of the downward (with field devices) and upward (with Energy Management Systems) communications of the EB.

For the upstream communications, The EB presents several possibilities, and being adaptable to the necessities of the project, but the most used nowadays is MQTT.

The MQTT protocol is based on the principle of publishing messages and subscribing to topics, or "pub/sub". Multiple clients could connect to a broker and subscribe to topics that they are interested in. Clients also connect to the broker and publish messages to topics, to be read by other clients inside the network. Clients are free to subscribe to whatever topic they are interested in, and many may subscribe to the same topics without limitation. The broker and MQTT act as a simple common interface for everything to connect to.

As a summary of this section, the EB is also a modular software solution that provides communication capabilities, both upstream and downstream, with a wide variety of field devices supporting the main standard communication protocols, but also with different cloud platforms where advanced functionalities are implemented. Taking advantage of these advanced communication capabilities, it is able to perform device control policies and provide flexibility and scalability for the control architecture. It also provides a database and GUI layers for SCADA capabilities. The orchestration of the operative system (OS) with the backend software, using Yocto technology and repositories for OS deployment and VPN remote access, allows an easy deployment of third-parties software solutions to take advantage of their functionalities.

3.2 Voltalis's Smartbox

Listed below are the functionalities embedded in the Voltalis's Smartbox:

i. Real-time:
- **a.** Time response < 1sec
- **b.** Parallel computing
- **c.** Algorithms can be hosted on the devices for better resilience
- **d.** Continuous processing (e.g. for frequency regulation)

ii. Field-proven at very large scale
- a. 1 million appliances connected
- b. Over 200bn entries in the database, and up to 100m data collected daily
- c. Scalable

iii. Secured
- a. Critical servers separated
- b. Encryption
- c. Private key in vault chip
- d. M2M tunnel through dedicated VPN

iv. "Privacy" ready
- a. Private cloud, local hosting

b. Anonymized data
c. Opt-in (volunteers)
d. On-premises algorithms
e. No access to past data of home for new tenant

Figure 18 shows the general method of communication between the different devices and the Voltalis' platform. All vX pilot have a SIM embedded for communication through GPRS with the platform. This way, no dependency with household WiFi exists (that would decrease overall reliability of the system).

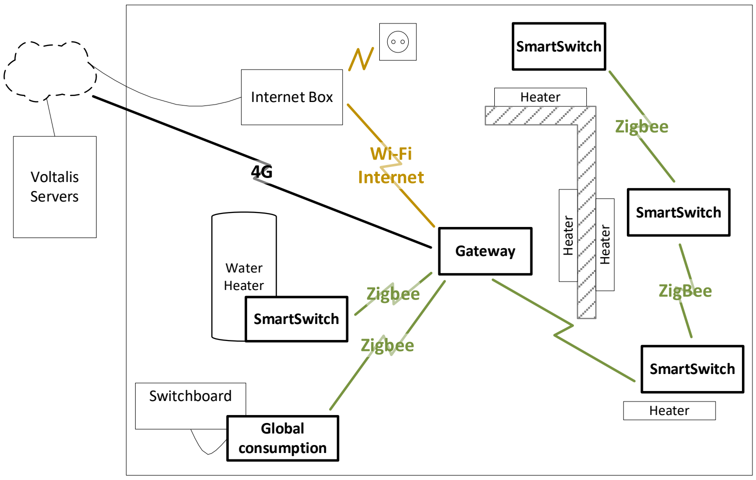


Figure 18.- Wireless communications of Smartbox system.

Computation and storage capacities

The vX Pilot has a minimum of A5 or A7 micro-processor with 512MB of Flash and 512 MB of RAM. The chosen MPU embeds a Real Time Clock (RTC) and a watchdog.

Embedded software for the application level will be developed and provided by Voltalis, this software runs under Linux, thus, the processor is supported by Linux Kernel (>= 4.X). The design center will provide any needed driver to use internal board peripherals (all sources are provided with the software), including the boot loader.

Therefore, the Voltalis' Smartbox can offer the following services to the end-users: smart & connected thermostat, detailed and real-time consumption, budget management, heat-up only if at home, smart advice, alerts, comparison, notifications, … All this through a standard application.

3.3 Communication protocols compliance with open standards and frESCO CIM

D4.1 "frESCO Common Information Model" explains the work carried out so far to determine the information necessary for the cloud platform, and the format to be used in the upstream communication. This model does not affect the downstream communications, because it uses standard protocols with their corresponding formats.

The state-of-the-art carried out in D4.1 focuses on semantic standards, not communication ones. That means the output obtained in that task will provide the data model in terms of entities and attributes, not the way of sending information between the agents of the architecture.

Both Voltalis and CIRCE will have to establish the most suitable communication protocol in collaboration with the Big Data platform, owned by Suite5. This process will be finalized when demo sites define their field devices, and could be one of the solutions already developed by the gateways, such as MQTT, or another solution that fits the data format better.

Even though the definition is in process, an example of an MQTT message is shown below with JSON format. In the example, apart from the relevant variables of a photovoltaic panel and some batteries, there is also metadata about the name of the different devices to identify them in the system, along with the timestamp to keep track of the historical information.


```
{"timestamp":"1602682054",
"nameEB":"eb_microrred",
"devices":[
    {"nameDevice":"pv",
     "idDevice":"pv_1",
     "nameDER":"generation",
     "idDER":"pv",
     "values":[{"magnitude":"active_power", "unit":"kWIII", "payload":"5.234"},
         { "magnitude":"reactive_power", "unit":"kVArIII","payload":"5.234"},
         { "magnitude":"apparent_power", "unit":"kVA","payload":"5.234"},
         { "magnitude":"voltage", "unit":"VIII","payload":"230"},
         { "magnitude":"current", "unit":"AIII","payload":"20.234"},
```

{ "magnitude":"power_factor", "unit":"na","payload":"5.234"},
{ "magnitude":"active_energy", "unit":"kWh","payload":"5.234"},
{ "magnitude":"reactive_energy ", "unit":"kVArh","payload":"5.234"},
{ "magnitude":"status", "unit":"na","payload":"0"},
{ "magnitude":"operation_mode", "unit":"na","payload":"1"}]
},
{"nameDevice":"batteries",
"idDevice":"02",
"nameDER":"storage",
"idDER":"batteries",
"values":[{"magnitude":"active_power", "unit":"kWIII", "payload":"5.234"},
{ "magnitude":"reactive_power", "unit":"kVArIII","payload":"5.234"},
{ "magnitude":"apparent_power", "unit":"kVA","payload":"5.234"},
{ "magnitude":"voltage", "unit":"VIII","payload":"230"},
{ "magnitude":"current", "unit":"AIII","payload":"20.234"},
{ "magnitude":"power_factor", "unit":"na","payload":"5.234"},
{ "magnitude":"active_energy", "unit":"kWh","payload":"5.234"},
{ "magnitude":"reactive_energy ", "unit":"kVArh","payload":"5.234"},
{ "magnitude":"status", "unit":"na","payload":"0"},
{ "magnitude":"charge_status", "unit":"%","payload":"0"},
{ "magnitude":"operation_mode", "unit":"na","payload":"1"}]
}
]
}

Using MQTT as the communication protocol also allows to perform the enhancements needed to make the solution compatible with OneM2M, as referred in the DoA. Figure 19 shows the architecture of OneM2M, where MQTT could support the messages exchanged between entities (Mca, Mcc and Mcn). In fact, inside the OneM2M technical specification there are specific documents to define the binding of OneM2M protocols with the MQTT transport layer.

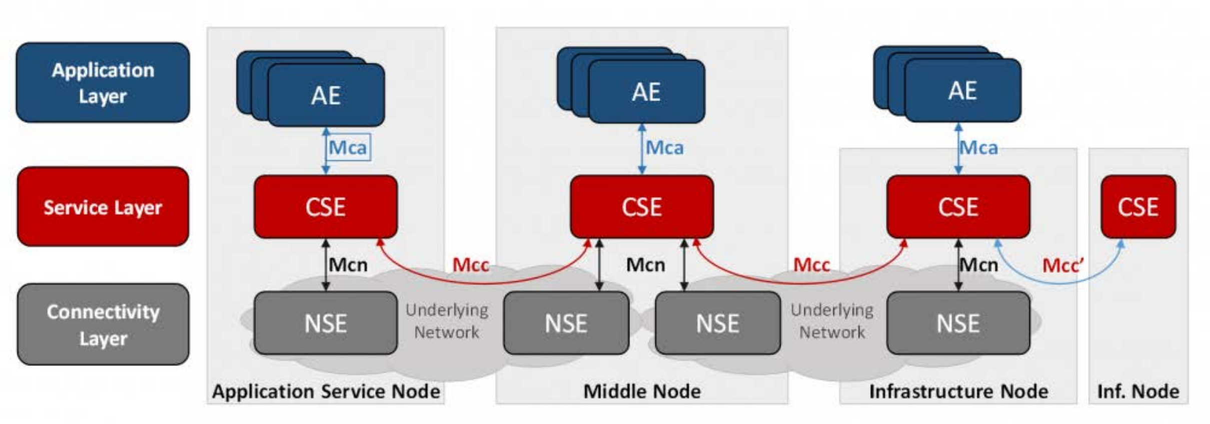


Figure 19.- OneM2M architecture.

4 INSTALLATION PLAN AND TESTING IN FRESCO DEMOSITES

The definition of the demosite installations and monitoring necessities is a work in progress, in different stages depending on the demosite. Despite this, the installation plan will be similar in each case, including the following steps:

- Definition of the physical installations: number of dwellings, infrastructure already on site, and any limitations encountered.
- Selection of field devices that fit the previous specifications and comply with the monitoring requirements.
- Purchase of the devices and testing in controlled environments, i.e. CIRCEs laboratory.
- Shipment of the tested devices to the demosite and installation.
- Verification of the installation and the extraction of the demosite information. In the case of any problems being detected, demosite leaders and gateway providers will work together on a solution.

Once the previous steps have been fulfilled, the demosite will be in a position to move to operation phase inside the project, which is under task 6.1.

4.1 Metering and sensor integration within frESCO data gathering system.

Regarding the French demo site, Voltalis' Smartbox presented in previous section, shows all the components that are going to be installed to measure the required information. Further deployments will be considered when the definition of this demo site is advanced.

In the rest of the frESCO demo sites, selection of metering devices is being carried out between CIRCE and the demo site managers, in order to find the most suitable ones for each of them. Greek demo site is running one step ahead of the Croatian and Spanish demo sites, hence the experience obtained in its device selection will be the basis for the other demonstrators when it comes to define the equipment requirements.

Putting together CIRCE teams experience with several brands and technologies, with the field knowledge and options presented by VERD and IOSA as demo site managers, a set of devices was selected considering that the devices should require minimum installation effort. In order to ease this process, promoting wireless solutions before wired ones. If wired installation is required, current on site infrastructures will be taken into account, i.e. Ethernet infrastructure, as a resource to avoid duplicating equipment.

The result of the process is shown in Figure 20, and the set of devices is currently (January 2022) at CIRCEs facilities to be tested before installation. When correct functioning is assured, it will be sent back to Greece, and presented to the other demo sites as a starting point for their monitoring necessities inside the project.

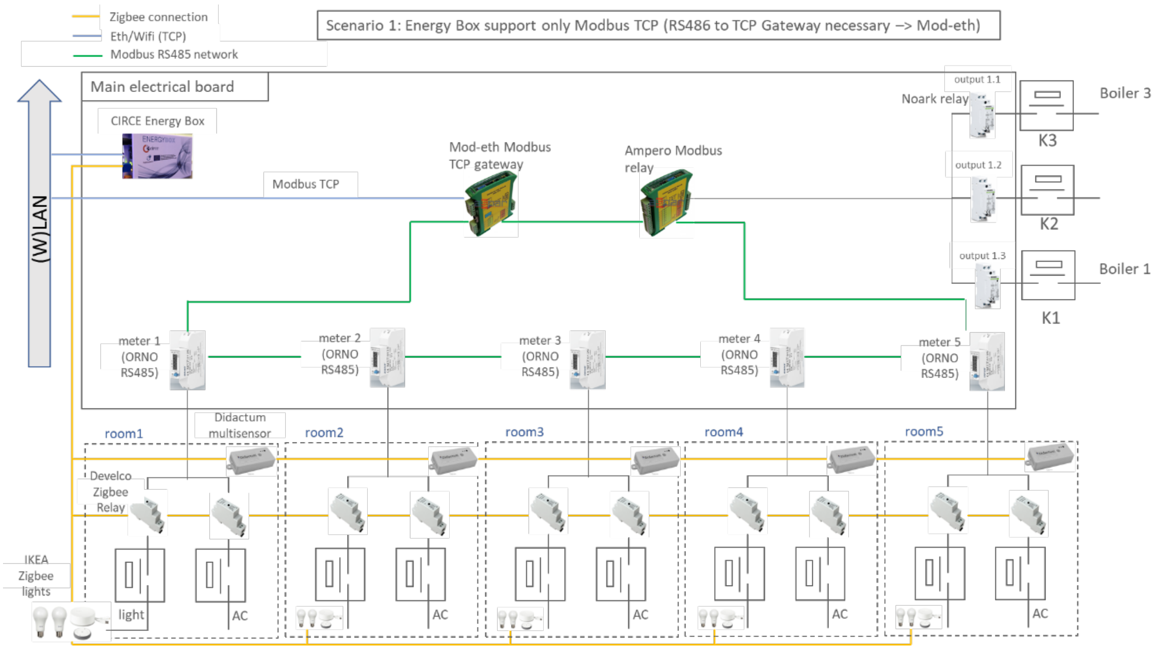


Figure 20.- General scheme of the Greek demosite.

5 CONCLUSIONS

The design and development of frESCO Gateways is documented in this deliverable. The key features of each device are exhaustively introduced, including the main hardware and software functionalities, and their application in the overall frESCO architecture.

As the deployment of smart devices increases, along with the necessity of the efficient management of produced and consumed energy, usage of tools that provide monitoring and control and empower grid stability is becoming of high importance. These powerful, yet compact hardware solutions and their communications potentials, become strong assets towards a more sustainable future, providing the necessary infrastructure for the deployment of novel services and innovative business models.

Considering the current state of progress of the project, only a first outline of the interaction of these solutions with the rest of frESCO architecture have been illustrated. The solution will continue to develop until the final field deployment and problem solving in each of the frESCO demosites.

6 ANEXES

6.1 Installation advice

As shown in Table 1 on page 11., the Energy Box only requires a 5 V power supply. These are very common and will be supplied to each demo site along with the device itself. Only a Schuko socket is necessary to install the equipment.

In terms of size, the Energy Box is equivalent to a regular Internet router present in every house, and does not have special needs in terms of position, therefore its allocation is very versatile and adaptable to the characteristics of the site.

About the communications, for the Energy Box it will be mandatory to provide an Internet connection. The desirable way would be an Ethernet cable, but if not possible, WiFi connection could be an option also. Communications with meter devices will depend on the final solution installed in each demo site.