

# *ELETRONICA TIRRITO SRL*

## *Street Lighting & Telemetry System*



UB. ES. and L.C.D.F. and Registered office:

Via San Leone 169 - 94100 Enna (EN)

Phone. +39 0935 1865109

E-mail: [info@elettronica-tirrito.it](mailto:info@elettronica-tirrito.it)

[progettazione@elettronica-tirrito.it](mailto:progettazione@elettronica-tirrito.it)

Pec: [elettronicatirritosrl@pec.it](mailto:elettronicatirritosrl@pec.it)

Web site: [www.elettronica-tirrito.it](http://www.elettronica-tirrito.it)

VAT 01228470868 Reg. imprese 69911

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## ZIGBEE TELEMETRY SYSTEM

In order to monitor real-time LED Street Lighting, it's possible to make a ZIGBEE 802.15.4 network architecture, at 2.4 GHz. The network topology in a street lighting system, it's characterized by 3 main modules:

- ✚ Central Host installed on the road network administrator PC or on an industrial raspberry card, consisting of a client and a server side;
- ✚ Master Controller, is on the street cabinet;
- ✚ Slave Controller, is on each lamp.

### See Figure 1 Network Architecture

Through this infrastructure is possible:

- Send ON/OFF commands, to tur-off and turn-on the lamps in certain time ranges and during maintenance;
- The dimming of each lamp, that is to reduce the luminous flux in certain time ranges and/or the passage of pedestrians or cars;
- Check the status of each lamp;

On request, you can view:

- Consumption and CO2 emissions graphs, useful for environmental protection;
- Manage up to 16 Digital Inputs of the Master Controller;
- Manage up to 8 Digital Outputs of the Master Controller;
- Manage up to 2 Analog Inputs of the Master Controller;
- Monitor the Temperature in RealTime with a DS18B20 sensor connected to the Master Controller;
- Detect environmental data such as speed and wind direction, humidity, temperature, illumination, etc

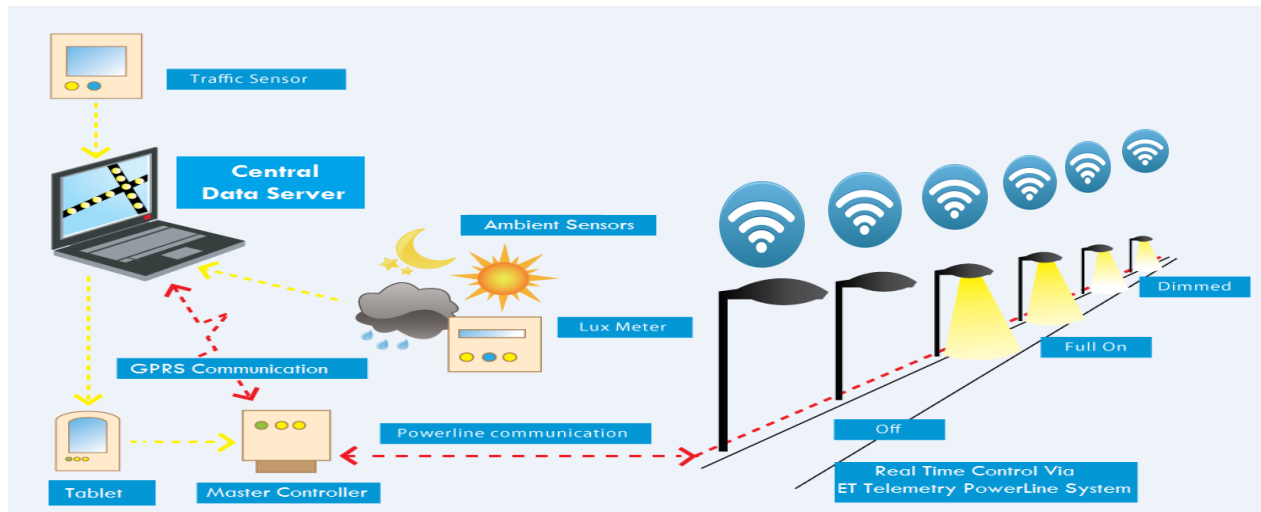


Figure 1 network Architecture

## HOST CENTRALE

The Central Host, it's characterized by a server and a client side, the first capable of processing, the second useful for parameter setting. The Central Host is developed in JAVA so multi platform it's possible installing it on a commercial raspberry card and on all PC.

The functionalities implemented envisage:

- In the event that the Server receives an alarm message from the master node, because a lamp has been damaged, the server activates the Alarm Handling function. It'll allow updating the unique Database so that interested Clients, if online, can be view updated pole status; their web page will refreshed at regular intervals (5 seconds).
- the alert sending, e-mail to the mail addresses entered in the notification area.

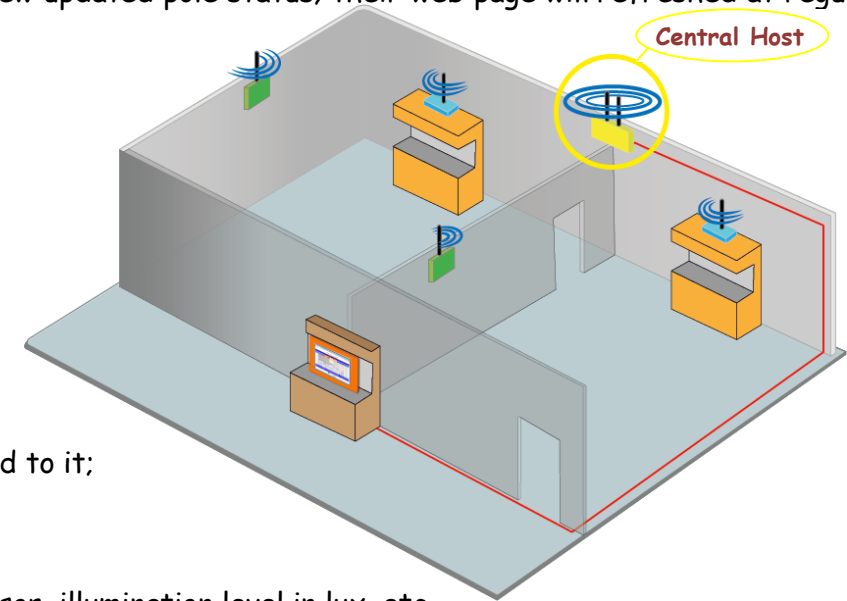
The Client allows monitoring, so the telemetry management of poles:

- the addition or removal of a lamp (that is a pole);
- the luminous flux setting for time ranges by tables;
- the turn-off or turn-on during maintenance of a single pole or a whole line;
- topographic map view (google MAPS) of the relocation of the Masters and the slaves attached to it;

If present:

- The displaying consumption graphs, CO2 emission, number of cars found near the sensing sensor, illumination level in lux, etc.
- The sending email alert when the measured temperature falls outside the set range.
- To monitor the Master Controller input;
- Manage the Master Controller outputs under programming or in mode

The Client side is just an application web, that is to say that having the right credentials can be accessed from anywhere in the world, at any time and with any device. So the maintainer, when it is necessary to replace or control a lamp, with his device (even in mobility) it can disable, enable, control each lamp in real time.





## LOGIN

To access at SW must insert Username and Password and press "LOGIN" button If you are already in Holding an account otherwise press "Registrati" button to receive another account.

The SW has three access level:

- Administration;
- Maintainer;
- Viewer.

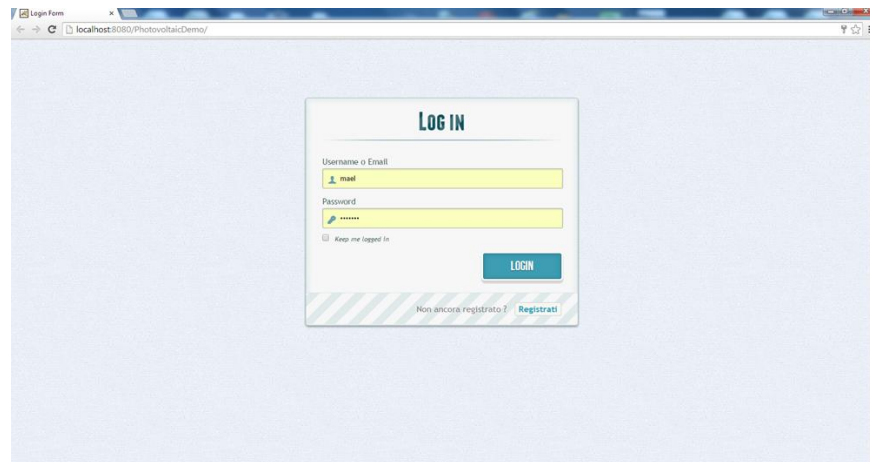


Figure 2 Login Page

When you logged in the Home page is displayed in the browser.

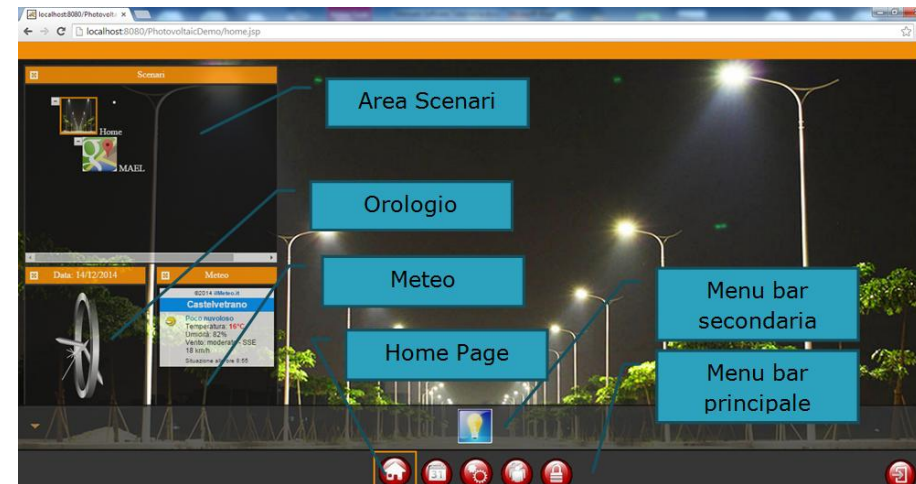


Figure 3 Home SW Management

- Scenario Area: there is they system structure. Selecting the map you can access at description of the LED Street Lighting location and the other available resources in the system.
- Menu bar principale: it's the access menu to the software various areas (Home, Programming, Configuration, Management account, Password change) and to exit from the same.

Menu bar secondaria is to:

- Open the luminaire's fluxe monitor/modification panel and the other system resources;
- Open scenary panels, clock, weather if previously closed by clicking on the "X" on each panel.

Clicking on scenary area and selecting the map icon you can access retail the arrangement of the lighting fixtures.

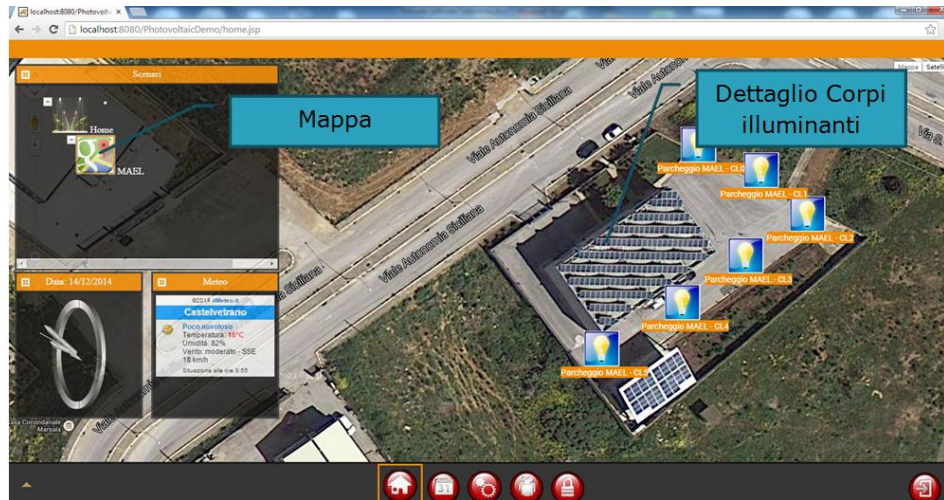


Figure 4 Luminaire's Fluxe Relocation

Clicking on "Lighting" icon (or available resources icon) you can see the detail.

- Position: Scenary where the light fixture is present;
- Name: Light fixture name;
- Phase: avabile just on multi-phase installations;
- Actual value:
  - Last detected value or;
  - Fail typology or;
  - ND if the resource isn't reachable;
- New value: Value to which you want to set the resource;
- Selecting: The new value can be applied to the single resource or simultaneously to multiple / all resources;
- Modification Value: set the new value button;
- Back to normal programming: Once the value has been changed, this value remains until midnight or by pressing this button you can return to the default values set in the programming page.

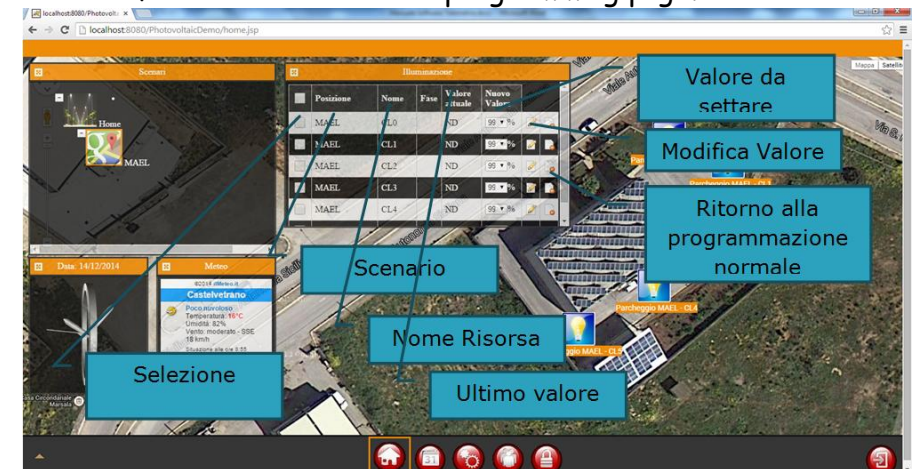


Figure 5 Light Fixture Detail



## Programming

This section allows to set the default value for the resources and planning their value in the time.

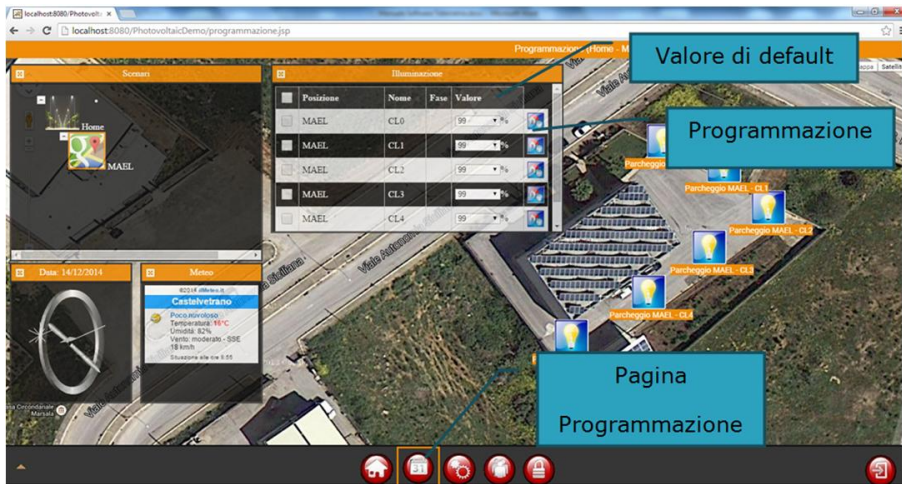


Figure 6 Programming

- **Valore di default:** The value at which the resource is set when no time zone is programmed, or outside of the programmed time zone, and no value has been set in the Home Page.
- **Programmazione:** Access to programming area for the resource/s selected.

**WARNING:** You can create a new programming range on multiple resources at the same time, while editing or deleting a previously created programming band must be done individually for each resource.

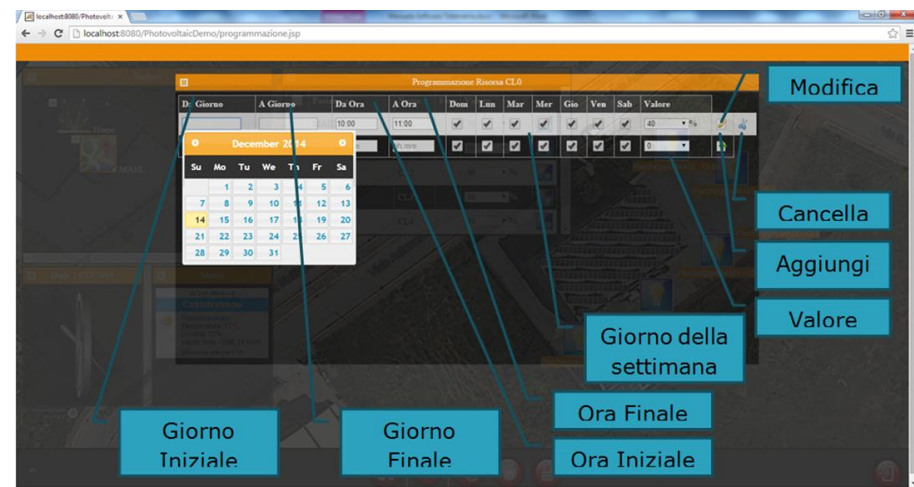


Figure 7 Daily Programming

- **Giorno Iniziale:** Start programming date. It can be left blank if you do not want to specify.
- **Giorno Finale:** Finish programming date. It can be left blank if you do not want to specify.
- **Ora Iniziale:** Start programming hour. It can be left blank if you do not want to specify.
- **Ora Finale:** Finish programming hour. It can be left blank if you do not want to specify.
- **Giorno della settimana:** Days that you want to apply the programming.
- **Valore:** Resource value.
- **Aggiungi:** It adds a new programming range at selected resource.
- **Modifica:** Modification of programming range of selected resource.
- **Cancella:** Delete the programming range for the selected resource.

## Configuration

In the configuration area you can:

- Add/Change/Delete a scenery;
- Add/Change/Delete a control card;
- Add/Change/Delete a resource.

The following window appears:

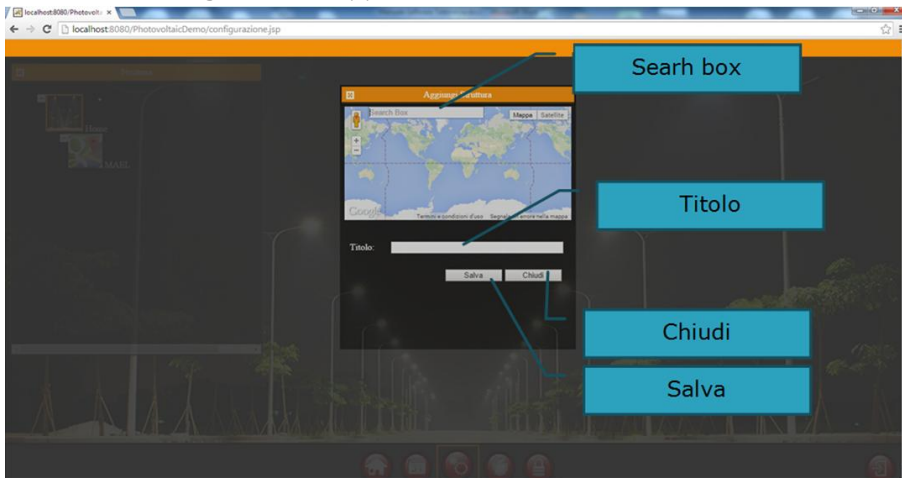


Figure 8 Cabinet Added

- Search Box: indicate the address of the area where you want to insert the resources;
- Titolo: insert the scenery name;
- Salva: save the new scenery.

By clicking the left mouse button on a resource icon, the following window appears.

## Master Controller

The Master Controller shown in Figure 9, to be installed in the street picture, has the role of network administrator to which it's connected, has the ability to communicate with the Central Host through GPRS and directly or indirectly with the slave nodes (the lamps) through ZigBee. The particular routing algorithm implemented causes the possibility that all nodes have the option of routing the packets by addressing them to the appropriate nodes. The Master node is able to manage more than 100 LED Street Lighting.

It also has the ability to run on request, environmental measures, which: wind direction and speed, relative humidity, temperature etc.

Communication with the Central Host can take place through:

-GSM/GPRS module with Tim, Vodafone or Wind card, (default configuration);

-802.11g WiFi if the cabinet is near a WiFi area, on request;

The communication to the street lighting is through ZigBee transceiver;

Integral environmental sensors on request are:

Photodiode, to detect the present illuminance;

PIR/ ultrasound sensors to detect traffic intensity;

Anemometer, to detect wind speed;

Weathervane, to detect the wind direction;

Humidity sensor;

Temperature sensor.

It allows, on request:

- The reading of 7 digital inputs, default NA configuration (logic 1);
- The writing of digital outputs 7, driven through a DRIVER with  $I_{max} = 700mA$  or Relay

The Master Controller, it's incorporated in 9 modules DIN box.

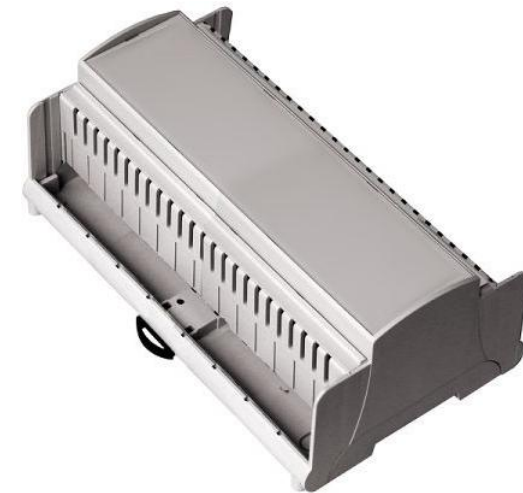


Figure 9 Master Controller



### Slave Controller

The Slave Controller (Figure 10) is on each street-lamp allows load piloting depending on the ZigBee and Master Controller commands received.

It can be requested in three different versions:

- With DALI output;
- With 1-10V output;
- With PWM output;

It allows real-time monitoring of the lamp status, sending to the Master Controller alert in the event of a fault.

It comes in ABS black box with three 0.22 mm<sup>2</sup> cables for +- 12 V, and given dimming, of 6x9x2.5 cm or similar size.



Figure 10 Slave Controller

### FRER Module Interface

The Remote control system Is able to interface with the FRAN NANO 63H Module through RS-485 interface with MODBUS Protocol. Through it you can view the following network parameters:

V L1-N	1mV
V L2-N	1mV
V L3-N	1mV
V L1-L2	1mV

V L2-L3	1mV
V L3-L1	1mV
I L1	1mA
I L2	1mA
I L3	1mA
F	1mHz
P Sys (P for C/Q15/96UCL and Q52/72C3L)	1W
Q Sys	1VAr
P.F. Sys	0.001
kWh+ Sys	1Wh
kVArh+ Sys	1VArh
Energy multiplier	1

V L-L Sys	1mV
V L-N Sys (V for C/Q15/96UCL and Q52/72C3L)	1mV
I Sys (I for C/Q15/96UCL and Q52/72C3L)	1mA
Delta V L-L	%
Delta V L-N	%
Delta I	%
I Neutral	1mA
Cos Phi Sys	0.001
P.F. Avg Sys	0.001
THD V L1	0.1 %
THD V L2	0.1 %
THD V L3	0.1 %

THD I L1	0.1 %
THD I L2	0.1 %

THD I L3	0.1 %
kWh- Sys	1Wh
kVArh- Sys	1VArh
S Sys	1VA
P L1	1W
P L2	1W
P L3	1W
Q L1	1VAr
Q L2	1VAr
Q L3	1VAr
S L1	1VA
S L2	1VA



S L3	1VA
P.F. L1	0.001
P.F. L2	0.001
P.F. L3	0.001
Cos Phi L1	0.001
Cos Phi L2	0.001
Cos Phi L3	0.001
P max Sys	1W
P avg Sys	1W
I max L1 (I max Sys for Q52/72C3L)	1mA
I max L2	1mA
I max L3	1mA
I avg L1 (I avg Sys for Q52/72C3L)	1mA

I avg L2	1mA
I avg L3	1mA

### Possible extensions

Regarding th SW part, it's possible:

integrate video surveillance features, using TCP / IP cameras;  
view graphs of average lighting and traffic flow for a given street;

Manage brightness programming in a completely automatic and transparent manner to the user by defining only the type of road. The SW in its extended version, independently implements the appropriate flow in order to reach the level of lighting required by road regulations by type of road.

Regarding the HW network architcture, if the cabinet is reached by xDSL connection, it is possible to equip the lamps of a HOTSPOT repeater to distribute WiFi along the way.