

enControl™

EnControl™ is a white label B2B product by Sensing & Control Systems providing a smart home solution. At a glance, EnControl has four main functions: (i) Comfort, (ii) Security (iii) Energy Management and (iv) automation. Users of EnControl are able to monitor and control remotely their homes & business using smartphones or any device running internet browsers like tablets or PCs. EnControl can be divided into three main components, (i) home devices, (ii) IoT Platform and (iii) graphical user interfaces (as shown in next figure~~Error! Reference source not found.~~).

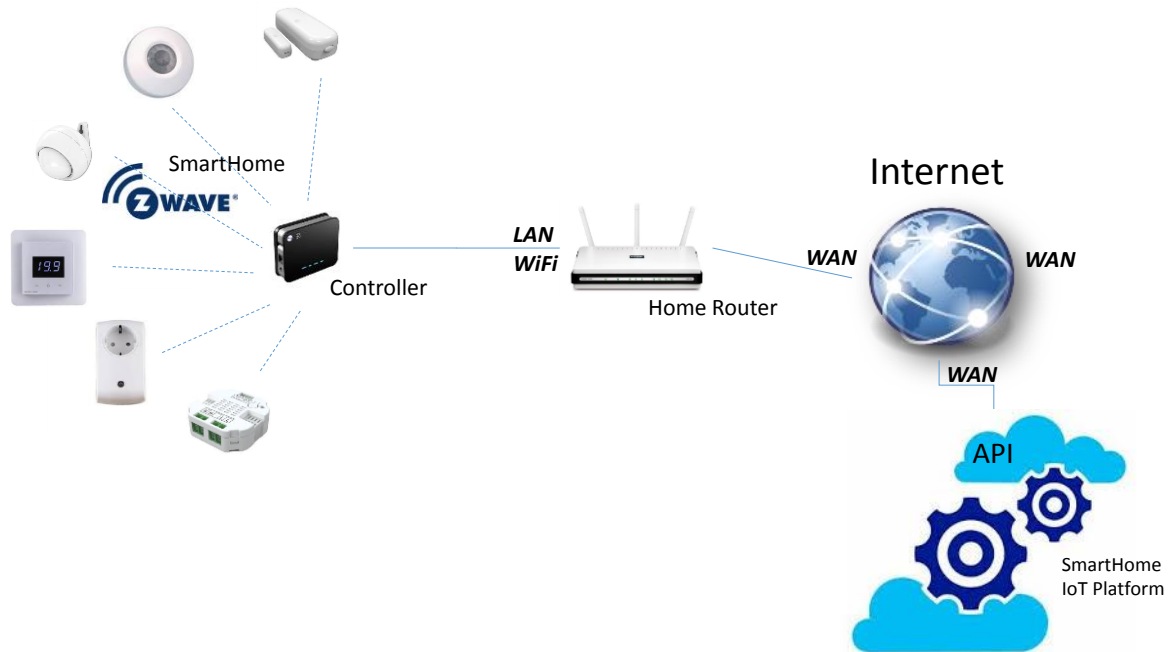


Figure 1: Smart home architecture

At home level, EnControl is composed by (i) end devices (sensors and actuators) and (ii) home controller (Gateway). The gateway supports communication using different protocols, but mostly uses ZWAVE radio technology for the communication of off-the-shelf end devices and home controller.

There are more than 300+ companies providing ZWAVE more than 1300 products¹ which enables encontrol to deliver the four main functionalities highlighted above, which are extended in following short list² (from the point of view of the information being triggered by the end devices):

- 1) Comfort
 - a. Climate monitoring
 - b. Climate control
 - c. Temperature, Humidity, CO2 (etc...) levels
- 2) Security
 - a. Detection of door/window opening

¹ According to <http://z-wavealliance.org>

² The list does not pretend to cover all possibilities, the Reader should understand that the smart home solution can integrate any ZWAVE standard product, thus enabling the functionality delivered by a particular product. For full list of product, please visit ZWAVE alliance web page.

- b. Detection of movement
- c. Detection of Smoke
- d. Detection of CO
- e. Detection of water basement
- 3) Energy Management
 - a. Energy consumption
 - b. Energy control (switch on/off electricity, water, gas, etc...)
- 4) Automation
 - a. Switch on/off appliances
 - b. Switch on/off lights
 - c. Open/Close doors, curtains, shutters

The IoT platform contains the core of the smart home solution. It provides an open REST API enabling the home controllers to exchange information bidirectionally, based on synchronous or asynchronous actions triggered by home devices, IoT or end users through EnControl interfaces. The IoT platform serves as well as main repository of information, keeps historical information about end devices data (information and status) as well as basic actions triggered by different actors, so users of the smart home solution knows in real time who-when-what of actions monitored. The current smart home solution provides an intuitive and friendly user interface, which is similar for tablets and PCs (web interface) and smart phones. Figure 2, shows the look and feel of the dashboard, (a) for web browser and (b) for smart phone.



Figure 2: enControl™ Dashboard

Smart phone apps allow users to get real time push notifications about important events at home. Events from devices can be combined within its native rule engine to trigger actuations like start ventilation if the air quality is poor and generate personalised notifications to home or business owners too aware about events that matters.

The following shows an architectural picture of the data flow related to the integration of Ateknea's LEO devices and CITISENSE SEDS Platform, within S&C's Smart Home solution.

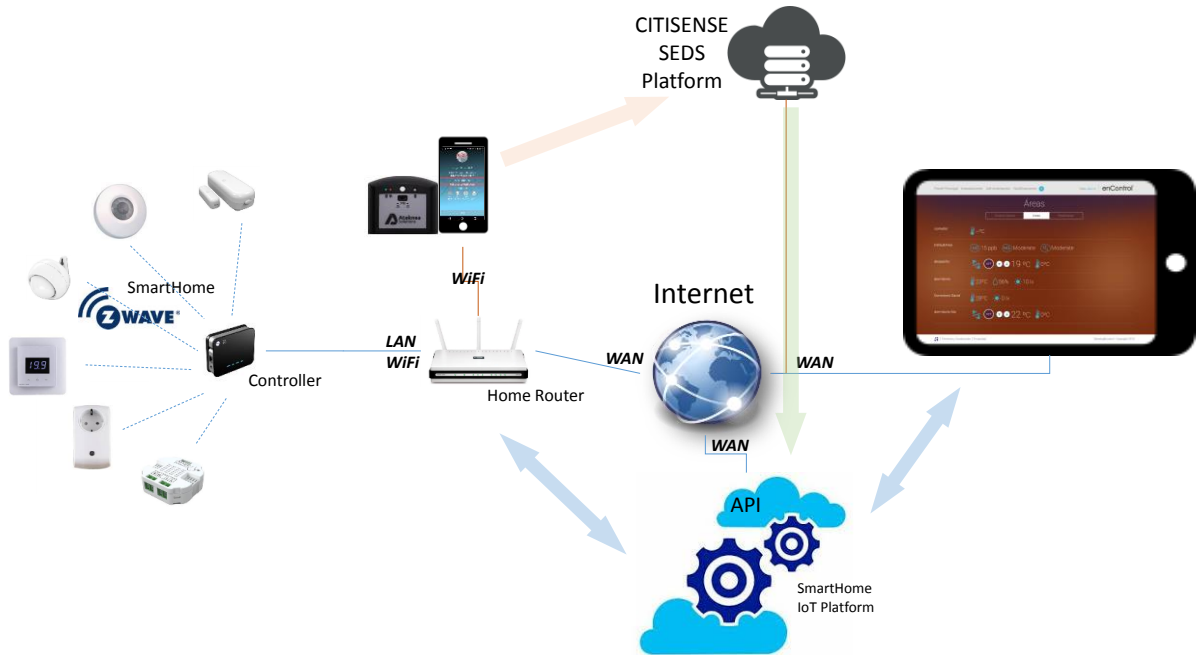


Figure 3 Data Flow Architecture for the LEO device, SEDS and enControl™

When available, AQI is preferred information to be shown to smart home user instead of ppb (part per billion) values, as provide more “clean” information to them. AQI is available for NO₂ and O₃, but not for NO. This is shown in **Figure 4**, a screenshot of enControl™ web client.

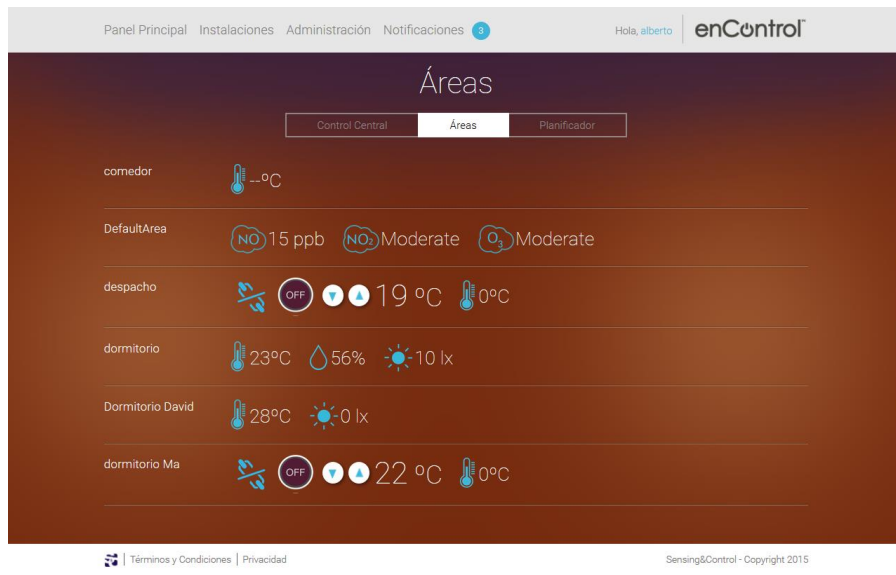


Figure 4 enControl™ user interface with LEO device measurement in area called “DefaultArea”.

Figure 4 shows last raw data (NO) or AQI/Health relation (NO₂ and O₃). Then user can then click on each of the values, is redirected to plot view of today’s values. The values are aggregated by 30 minutes (avg), then user can:

- 1) Zoom in/out current plot values
- 2) Plot historical values by selecting initial day and final day

Following screenshots gives a flavour of the information being available to end user through enControl™ client.



Figure 5: Nitrogen Oxide (NO) raw data aggregated (avg) on 5 minute interval

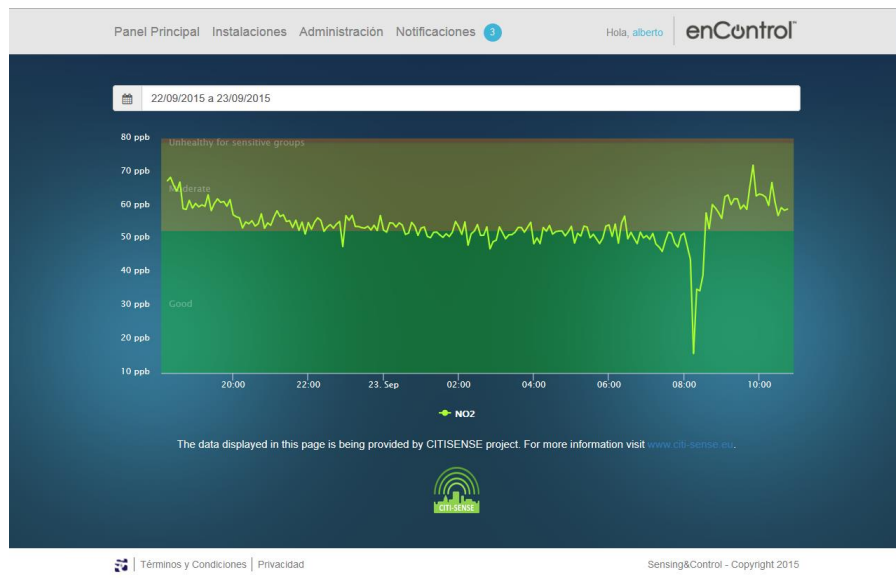


Figure 6: Nitrogen Dioxide (NO2) raw data aggregated (avg) on 5 minute interval with AQI on background.



Figure 7: Ozone (O3) raw data aggregated (avg) on 5 minute interval with AQI on background.



Figure 8: Ozone (O3) raw data aggregated (avg) on 30 minute interval with AQI on background.