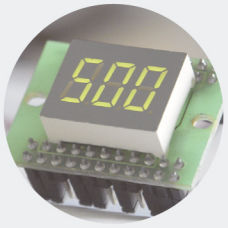
INSTITUTO SUPERIOR DE ENGENHARIA DO PORTO

MESTRADO EM ENGENHARIA ELECTROTÉCNICA - SISTEMAS ELÉCTRICOS DE ENERGIA






VERACITY IN POWER CONSUMPTION OF SMART HOME

ARAVINTH MANOHARAN

novembro de 2017

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Outubro de 2017

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Report elaborated for partial fulfillment of the requirements of the DSEE curricular unit – Dissertation for the Master degree in Electrical Engineering – Electrical Systems of Energy

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Mestrado em Engenharia Eletrotécnica – Sistemas Elétricos de Energia

2017

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Acknowledgements

At the end, the last stage of many successive stages over the course of my academic career comes to an end and its pride and pleasure that I completed it. During the development of this thesis work, the support and encouragement of several peoples were fundamental. So, I would like to thank all those who have left their footprints in my way.

This journey would not have been possible without the support of my professors, supervisors and mentors, family and friends. To my family thank you for encouraging me in all my pursuits and inspiring me to follow my dreams. I am especially grateful to my family and friends who supported me emotionally and financially. I always knew that you believed in me and wanted the best for me. Thank you for teaching me that my job in life was to learn, to be happy, and understand myself; only then could I know and understand others.

I would like to express my sincere gratitude to the School of Engineering, Polytechnic of Porto and Cside, Intelligence Solutions for the continuous support and encouragement. I express my sincere and special thanks to Prof. Teresa Alexandra Nogueira, Course Director and Miguel Braga da Costa and Thesis Supervisor, Cside S.A. for giving me an opportunity to use the facilities in College and Company premises to complete the Master's Thesis respectively.

I also extend my gratitude to Prof.: Sergio Filipe Carvalho Ramos Thesis Supervisor in ISEP and Lab Coordinator of Machines Lab for their guidance and sincere co-operation. With magnificent pleasure my profound sense of gratitude to Cside Empresas Porto, Other department Engineers, and Co-workers of central casa / Cside for their valuable support and encouragement to do this Master's Thesis. Thank you very much to everyone!

Abstract

This project is intended to develop for EDP Portugal from Cside for the newly launched smart home platform called EDP re:dy (Remote Energy Dynamics) Home Automation devices with digital controlling platform from anywhere with optimum power consumption pattern in order to make energy efficient home.During the realization of this project,the veracity of re:dy smart meter has been analyzed with different load factors (capacitive, inductive) in order to observe the harmonics distortion pattern with various home appliances and traditional energy meters.Gathering all collected data in SDP (Service Delivery Platform) online platform to analyze the sequence of energy values and according to that edp box will give effective power consumption pattern to the client's minimum tariff and energy saving pattern via reducing the power dissipation.As a final conclusion of the project, based on obtained results an effective method for smart home automation with edp re:dy box associated with MAC address of equipment added and controlled via online carrier/subscriber portal.

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Keywords

Z-wave, Smart Meter, Harmonics Evaluation, Service Delivery platform, GPRS (General Packet Radio Service), Power Factor, Data Fetching, carrier portal, subscriber portal.

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Context

List of Figures

List of Table

Acronyms

AMM	- Automatic Meter Management
API	- Application Programming Interface
Ajax	- Asynchronous JavaScript & XML
CP	- Carrier Portal
DNS	- Domain Name System
GW	- Gateway
GPRS	- General Packet Radio Service
HTTP	- Hyper Text Transfer Protocol
IR	- Infra red
OData	- Open Data Protocol
POP	- Post Office Protocol
PKID	- Primary Key Identification
Re:dy	- Remote Dynamic Energy
SDP	- Service Delivery Platform
TFS	- Team Foundation Server
TLS/SSL	- Transport Layer Security / Secure Socket Layer
URI	- Uniform Resource Identifier
VPN	- Virtual Power Network

XML	-	Extensible Markup Language

Chapter 1

1 . Introduction

To develope an energy efficient home automation module along with the digital platform for user to be analysed and give effective consumption and power loss chatrs for economic power consumption aim this project has been developed.

1.1 Contextualization

Nowadays the need for people to have the power to control everything is increasing. Since the utilization of more electronic devices harmonics dissipation increased along with power loss to reduce that a new design has been delivered and distribute many services inside and outside the house via networked devices in which all the different applications & the intelligence behind them are integrated and interconnected. These smart devices have the potential to share information with each other given the permanent availability to access the broadband internet connection. Hence, Smart Home Technology has become part of IoT (Internet of Things).

The main goal of this internship is to develop a smart meter with edp re:dy protocols in-order to measure the individual and total consumption of household (2 phase, 3 Phase) equipment with developed re:dy smart meter also to check with the re:dy online digital platform where one can store the all the customers consumption database.

Also, to analyze the existing similar power monitoring technologies and evaluation of Portuguese electricity market in order to create perfect energy consumption data for the smart meters in future. Although this new system is not intended to be a substitute, it is important to become familiar with the existing hardware and the protocols used by the company.

1.2 Objectives

The objectives of this project are to analyze and find an efficient energy power utilization in homes consider as smart homes. Here I use a specified energy meter from edp enterprise from Janz Electronic manufactures. It has been then connecting with power source combined with inverter and phase controller to create artificial harmonics to sort out the power variation in the equipment during utilization.

A capacitive and Inductive Load equipment have been used to monitor power factor variations and the third harmonics dissipation level is compared with traditional energy meters and clamp meters.

In addition, a Qubino based smart has also been used to monitor the same power level simultaneously during the operations then the values are collected for future rectification of power consumption level during peak/off-peak time to the clients who have been using EDP re:dy platform.

1.3 Motivations

To achieve zero pollution via green energy and to use energy efficiently for consumption ,the project has been proposed with my thesis supervisor .Also,it is a continuation of my bachelors project which is Hybrid Electric Vehicle Systems.

The developed will be used by consumers and the energy loss during consumption mainly via Home appliances can be reduced.The efficiently smart meter with accurate energy readings will be obtained by this for evaluation of induvidual and entity consumptions.

Chapter 2

2. Cside Intelligence Solutions, SA

CSide has it's headquartered in Portugal, with offices in Lisbon and Oporto. Ever since it's founding the international team of CSide has become widely recognized for its creative work, high-quality content and fast development of new products.CSide is a global technology solutions provider, developing pioneering technology in a variety of fields, enabling the company to provide to customers several innovative cloud-based services, namely advanced energy services, remote automation, professional video surveillance and security solutions. CSide offers innovative products, customized solutions, and services, acting in four major markets, through independent divisions: Energy, Home Automation, Investigation & Research, and Project. Powerful service delivery platform uses SDP Manager integrates new services more rapidly, including leading-edge components such as IP video, mobility, and cloud-based services.

Fig 2.1 Cside Company Logo [1]

It supports end-to-end device management, delivering a unified customer experience. Advanced software tools offer statistics of service usage, SMS/MMS management per subscriber and provide real-time support. SDP Manager includes advanced subscriber

management tools enabling the deployment and management of value-added services rollouts to thousands of subscribers.

SDP Manager enables additionally the definition of pricing strategies, including pre-paid and post-paid billing schemes, with standard and open interfaces to existing billing platforms.

InovGrid is an innovative project that aims to equip the electricity grid with information and devices to automate grid management, improve service quality, reduce operating costs, promote energy efficiency and environmental sustainability, and increase the penetration of renewable energies and electric vehicles.One of a complete smart city projects in Europe, the InovCity project, from the Portuguese utility EDP, includes the installation of 31.000 smart meters until June 2011, enabling real-time communication and advanced energy services edp customers.

CSide SA provided EDP with its smart energy and automation solutions enabling homeowners to visualize in real time, monitor and interact with their energy consumption while controlling multiple appliances in their homes.The cside sustainable home solution was delivered via its unique web and Android-based managed service platform which already provides utilities, telco's and service providers with a range of added value services.

For consumers, it enables control over total consumption of electricity and per each appliance at home every day, week, month or year. Consumers know the time period during the day of increased consumption and they know when they can use electricity at a more favorable price, being able to use their appliances to operate during these periods.

2.1 Entities Relationship

Typically, a subscriber represents an account, to where the services are subscribed and the devices associated.The Subscriber not only holds the billing information about the user, but it also embodies certain characteristics about the account, such as the language localization)

and time zone.Each subscriber can have one or more Users associated. A User represents an entity that can login to the platform.A Subscription represents basically the association between subscribers (accounts) and the services. A subscriber can have several subscriptions (services subscribed) even for the same service.A subscription can also contain the specific object. For example, a Home Automation Subscription can store the rooms or profiles of a user; a Remote Surveillance subscription can store videos and images from the cameras.

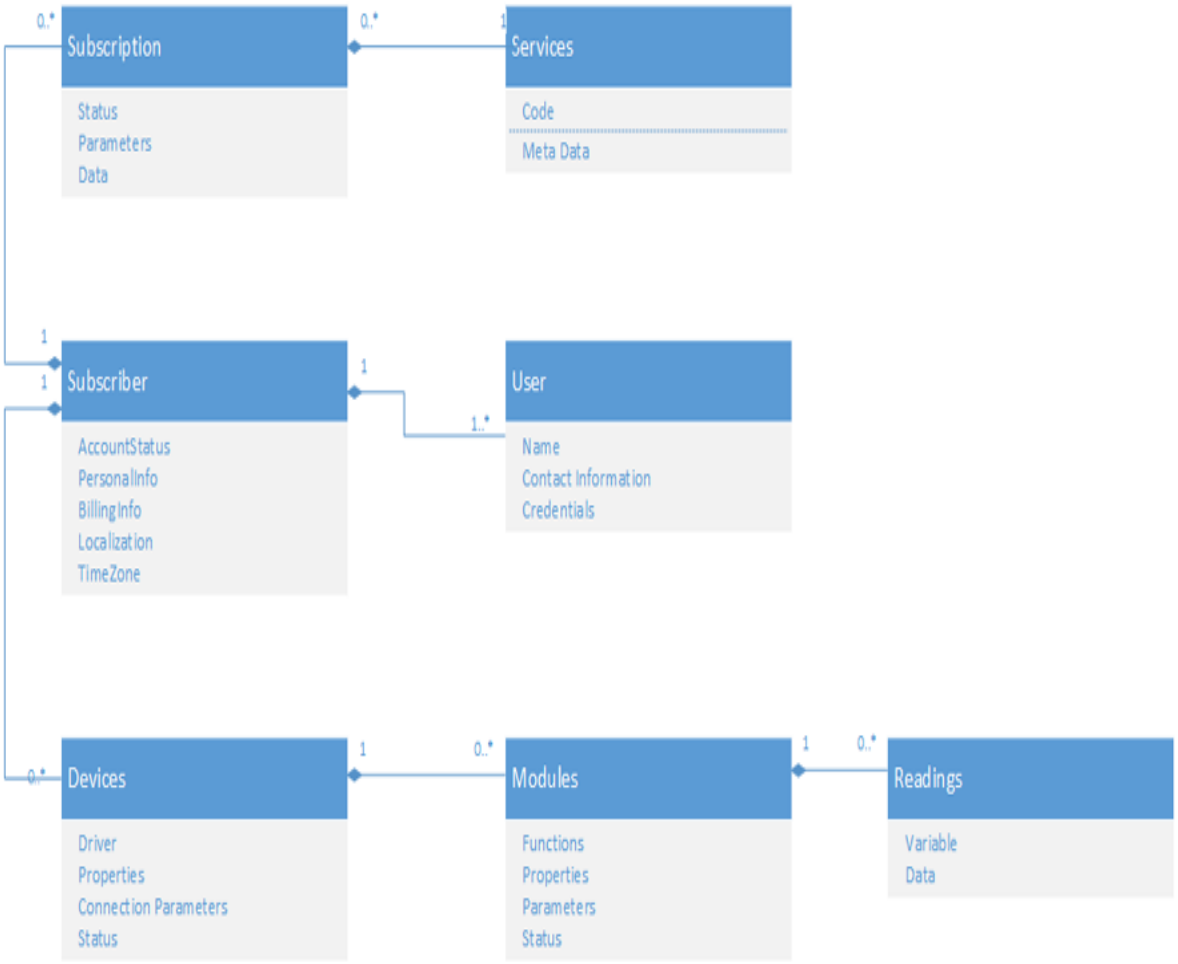

Fig 2.2 Working Protocol

The Devices characterize an IP equipment that communicates directly with the SDP Platform, like for example, a gateway or IP Camera.A device can have one or multiple modules connected to it. A module is characterized by having functions, i.e. certain capabilities (a plug can have the Switch and Power Meter functions), parameters (for example, the name for the plug or its mac-address) and status (for example if the plug is switched ON or how much power is consuming).Please note that, for example, an IP

Camera is also composed of a device - which holds the driver, connection parameters (IP, port, etc.) and status (online, offline); and a module, which indicates the functions (e.g. Pan and tilt support) and status (e.g. is recording), parameters (e.g. name).

2.2 EDP re:dy

EDP re:dy is a system that allows you to connect and control your home in a single application, wherever and whenever you want. It is developed by EDP Portugal. To Have all the energy connected and integrated into one platform. Find out that your home can do things you never imagined. Consumption, Production, Equipment Automation, Energy efficiency. Simple, easy to use and attractive.

Fig 2.3 Remote Energy Dynamics [4]

This is how edp re:dy application worked. It has also access via edp re: my platform on any computer.

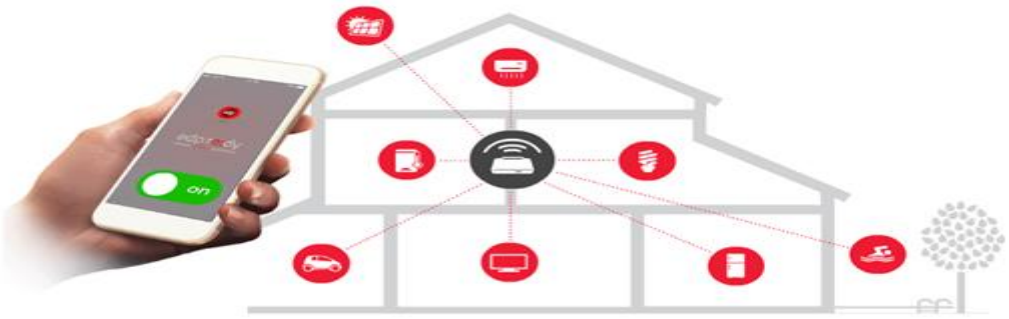

Fig 2.4 Home Utilization re:dy

Also, the similar methodology for smart metering and home function application cloggy a Guimaraes, Portugal based system is on for comparison for this thesis proposal.

Fig 2.5 Modules used in Smart re:dy

Below fig 2.5 describes the function of edp box with connecting with edp re:dy (Remote Energy Dynamics) modules.

Fig 2.6 re:dy Functions

EDP re:dy has won many awards and recognized as an international smart home equipment. The awards are mentioned below,

Energy Retail Award-EDP re:dy, in conjunction with the EDP Smart House solution, was the winner of the Energy Retail Award, under the European Utility Industry Awards 2016 (EUIA). The award was announced during the European Utility Week, which took place this year in Barcelona, and aims to reward innovation within the energy retail market, both for direct solutions to the customer relationship and for new energy retail models.

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World Summit Award 2016-The edp re: dy app was one of the winners of the World Summit Award, a UN award, worldwide in the category of "Environment & Green Energy". The World Summit Award was launched under the Information Society by the United Nations and is a unique global competition to recognize the best in interactive content and creative applications.

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CHAPTER 3

3 STATE OF ART

By using a Z-wave/ZigBee technology the smart meters record consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing Smart meters enable two-way communication between the meter and the central system. Unlike home energy monitors, smart meters can gather data for remote reporting. Such an advanced metering infrastructure (AMI) differs from traditional automatic meter reading (AMR) in that it enables two-way communications with the meter. Communications from the meter to the network can be done via fixed wired connections (such as power line communications) or via wireless. In using wireless, one can opt for cellular communications (which can be expensive), Wi-Fi (readily available), wireless ad hoc networks over Wi-FI, wireless mesh networks, low power long range wireless, ZigBee (low power low data rate wireless), Wi-SUN (Smart Utility Networks)

By connecting this with a re:dy server EDP PROD / BETA production and testing servers errors have been detected using bug finding and submit the results in TFS database for quality analysis the equipment is gathered via a home gateway with MAC 001D94:03FF68 and IP 192.168.2.179, EDP BETA is the PRE-PROD environment and I use CP beta.cside.pt/CarrierPortal and SP is beta.cside.pt.

EDP TEST is re:dy-test.cside.pt/CarrierPortal for Carrier Portal and re:dy test.cside.pt for Subscriber Portal.Below fig 3.1 represents the overview of the develped project with connecting states.

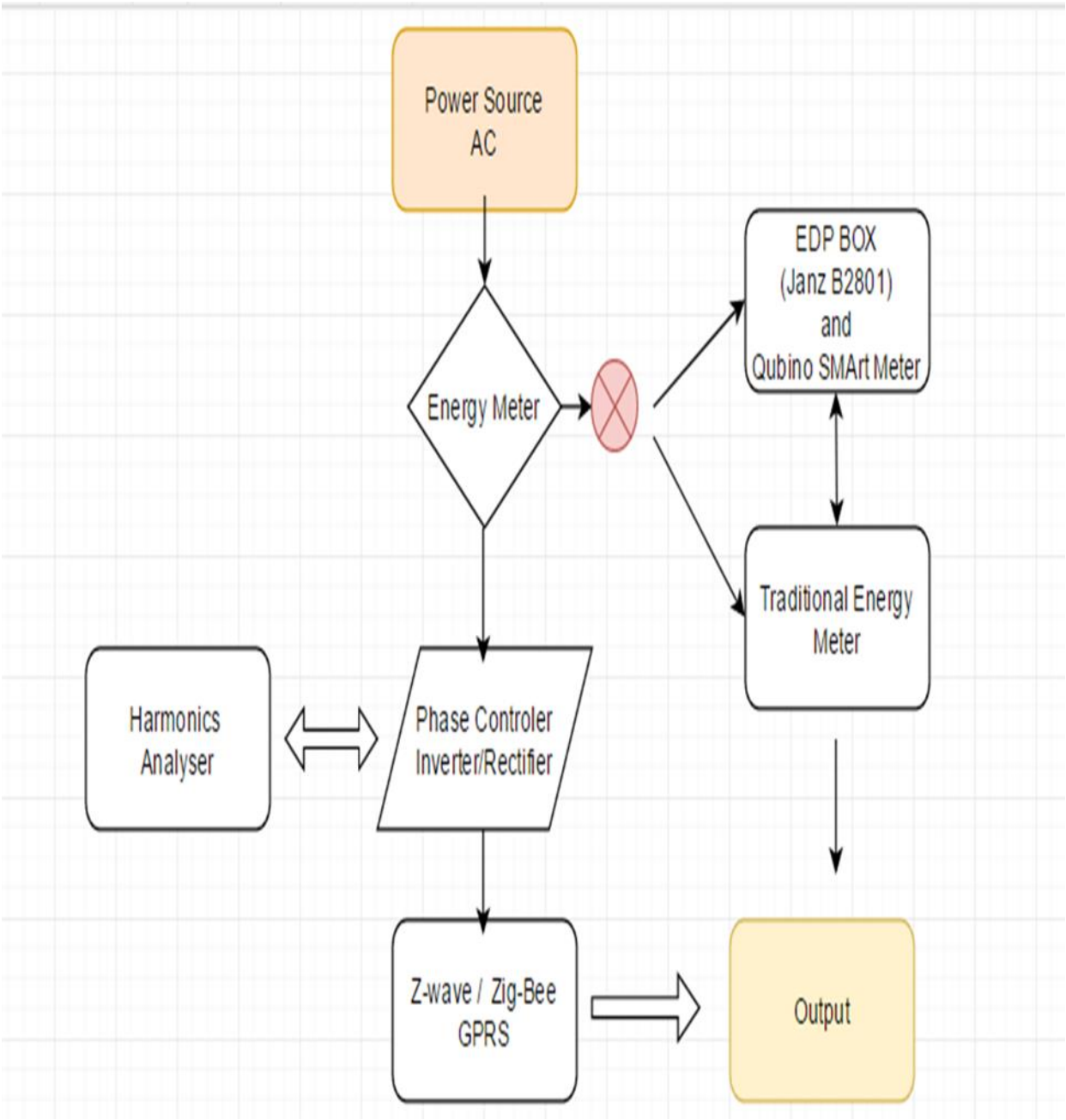

Fig 3.1 Flow Chart

3.1 Z-Wave

Z-Wave is the leading wireless home control technology in the market today, with over 2100 certified interoperable products worldwide. Represented by the Z-Wave Alliance, and supported by more than 600 companies around the world, the standard is a key enabler of smart living solutions for home safety and security, energy, hospitality, office and light commercial applications.Fig 3.2 explains the virtual functionalities of Z-Wave.

Fig 3.2 Z-Wave

3.2 ZigBee

ZigBee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless M2M networks. The ZigBee standard operates on the IEEE 802.15.4 physical radio specification and operates in unlicensed bands including 2.4 GHz, 900 MHz, and 868 MHz

Fig 3.3 ZigBee

3.3 Energy Production.

From 1973 to 2014,

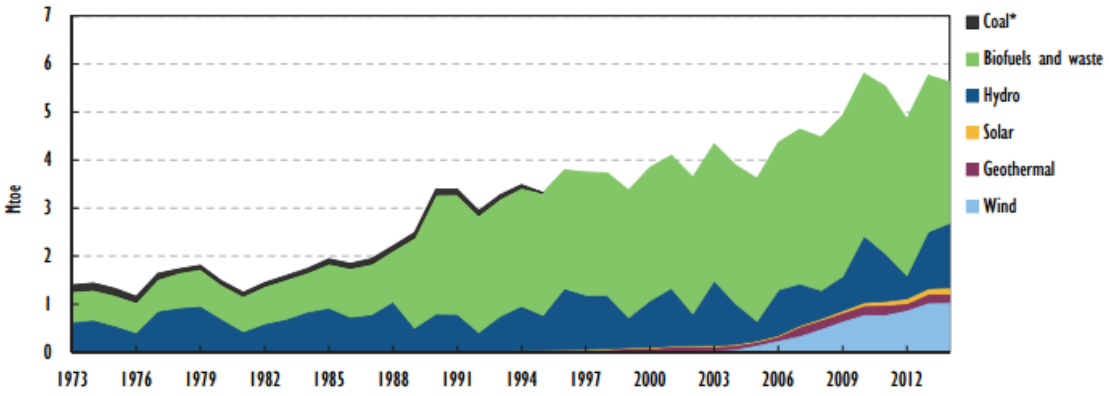

Fig 3.4 Fuel for Energy Production

3.3.1 Key Recommendations

1. Continue to implement measures to ensure that there is sufficient flexibility in energy policy to deal with uncertainty in demand growth and wider policy development at the EU level. This policy process should accommodate regular independent reviews and the development of a monitoring tool to examine the implementation of energy policy and ensures that it continues to remain relevant and cost-effective.

2. Ensure implementation of all measures to reduce the tariff deficit and continue its efforts to identify further potential cost-saving measures in the energy sector. In this regard, careful consideration needs to be given to the decision to extend regulated tariffs to 2017.

3. Alongside its regional partner Spain and the European Commission, pursue the development of key transmission infrastructure, including interconnections with neighboring countries, notably France, in order to foster market integration, facilitate renewable energy integration and enhance the security of supply (electricity and natural gas).

3.4 Cloggy Technologies

Fig 3.5 Cloggy Logo

It uses zig-bee home automation software along with Transmitter, Hub, Clamp, Plug to collect energy data values along with client's consumption rate. It is in Guimaraes based area for the client support in smart home automation with equipment for energy consumption with power source monitoring.Fig 4.4 Represents the Energy monitoring combinations.

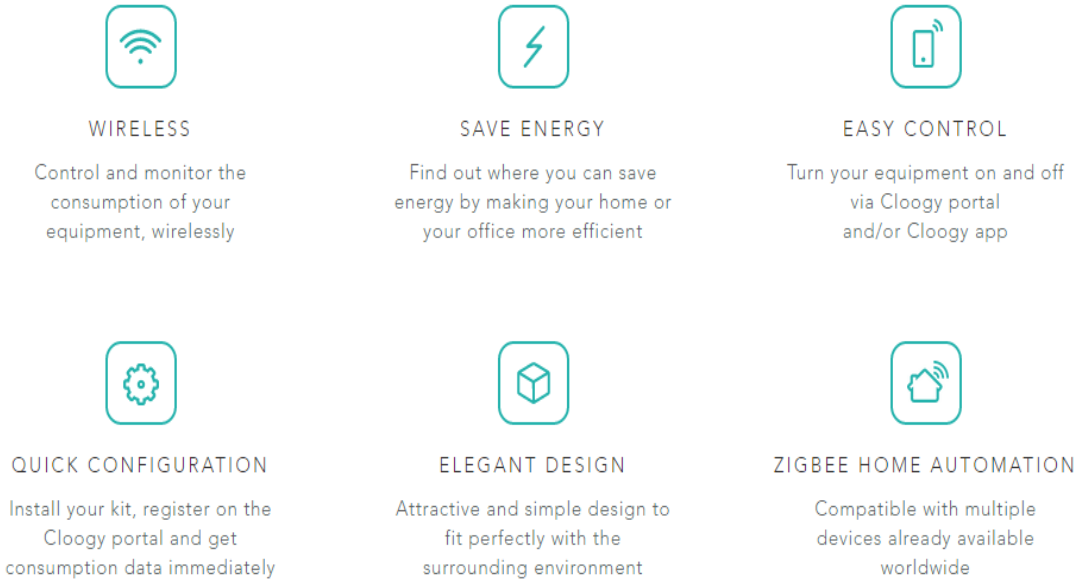

Fig 3.6 Cloggy Functionalities

3.4.1 Genesis Technologies

Leading supplier of premium home technology throughout Europe and the UK. Our dedicated Design & Experience Centers, expert integration consultants, and partners, all at your service, allow us to assist professionals in the design and creation of the finest technology solutions for homes & yachts. Visit or contact us to experience exceptional home technology. Serving professionals in search of excellence are what drives us. We are a service company with a solution offering where performance, design, and execution are all equally important to each other. We work hand in hand with our partners every step of the way to ensure even the most demanding projects turn into perfect references for the future.

Fig 3.7 Genesis Technologies

3.4.2 D-Link Smart Home Technologies

- ✓ D-Link was the first networking company on the Taiwan Stock Exchange
- ✓ D-Link was among the first to release IEEE 802.11a 5GHz Wireless LAN products.

- ✓ D-Link was the first company in the networking industry to introduce Green Ethernet technology in its Gigabit switches

It is with my Digital Link (d-link) Home app that you control everything in your automated home. Set power usage thresholds (yes, you can be notified when your son has used a month's worth of PlayStation 'power' in four days!), schedule light timers, establish thermal overload thresholds for high-current appliances... the list is almost endless.

3.5 Evolution of Energy Market

Despite the difficult economic climate, Portugal has continued to develop and reform its energy policy with undoubted benefits over the period since the previous in-depth review in 2008. These benefits include greater economic activity in the energy sector, rapid increases in renewable energy deployment, further market liberalization in the electricity and natural gas sectors, and greater emphasis on energy efficiency in policymaking. Significant changes in the Portuguese and European macroeconomic environment, such as declining energy consumption and funding, constraints resulted in a proposal to integrate the National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP). The outcome of this process was a new energy strategy, based on Cabinet Resolution 20/2013, on 10 April. This strategy allowed a concerted action for the accomplishment of national and European energy objectives, lower investment costs and greater national competitiveness. The new strategy also included proposals to reinforce interconnections between the European electricity and natural gas networks and measures to promote economic and environmental sustainability.

The new NEEAP raised energy efficiency as a policy priority while ensuring continuity of the majority of measures contained in the 2008 Action Plan. The revised plan established new energy savings targets of a 25% reduction of primary energy consumption nationally and a 30% reduction of energy consumption in the state-owned sector to be reached by 2020. The renewable energy sources (RES) target remained 31% of RES in total gross final energy

consumption. This will come from a 59.6% contribution of renewables to electricity demand, a 35.9% contribution to heating and cooling and an 11.3% contribution from the transport sector. Over the period since the previous in-depth review, Portugal has continued to experience growth in the RES sector and its contribution to total gross final energy consumption in 2013 was 25.7%. In the electricity sector, RES accounted for 63% of installed generating capacity in 2014, providing a 61.3% contribution to final electricity supply. The increase in renewable energy penetration has produced multiple benefits such as less dependence on imported fossil fuels and declining carbon dioxide emissions in the electricity sector. Renewable electricity generation with priority despatch has reduced wholesale electricity market prices by displacing the most expensive fossil fuel-fired generation.

A progressive arrangement for renewable electricity micro- and mini-generation has been introduced with simplified online licensing arrangements. Conversely, the costs of supporting RES have been costly and made a significant contribution to the tariff deficit. In recent years, rising subsidies to renewable energy have contributed to higher electricity costs and, as a result, growth in the tariff debt. Negotiated reforms of the electricity feed-in tariff regime to address these high costs included reduced feed-in tariff rates and an extension of the period over which renewable generators receive a subsidy. Portugal should be commended for its achievements and its ambitions in the large-scale deployment of renewable energy. Nonetheless, its focus on growth in renewable electricity brings with it some risks. While negotiated reform of the feed-in tariff arrangements and the introduction of competitive tendering to support future renewable electricity generation have reduced the risk of further increases in the electricity tariff deficit, Portugal remains exposed to a further reduction in electricity demand. Any reduction could both depress market prices, thus increasing the incremental cost of feed-in-tariffs and reduce the electricity supply volume on which the deficit must be levied leading to significant upward pressure on electricity prices.

The future additional contribution of renewable energy to the tariff deficit may be most effectively controlled by the careful management of the schedule for smallscale hydropower

and wind power capacity additions and, if necessary, rescheduling project execution. Portugal has also shown significant commitment to addressing the challenge of climate change and has adopted an ambitious 20% greenhouse gas (GHG) reduction target compared to a 1% increase permitted under the EU-Effort Sharing Decision. The National Low Carbon Roadmap (RNBC) includes a set of roadmaps for achieving long-term cost-effective GHG emissions reductions. The Green Growth Commitment and the Strategic Framework for Climate Policy (including a new National Climate Change programme and a new National Climate Change Adaptation Strategy) provide a solid basis to build on previous efforts. Portugal has also introduced a carbon tax in the non-traded sector in the context of a broader-scope green fiscal reform in place from 2015.

A general carbon tax is an effective measure that provides incentives to find the least-cost ways to reduce emissions among sectors. The country, which is projected to experience temperature increases and less precipitation, is vulnerable to climate change impacts. In response, it has adopted a National Climate Change Adaptation Strategy (ENIAC) which aims to improve the level of awareness and knowledge on climate change, supports the implementation of adaptation measures and promotes the mainstreaming of climate adaptation in sector-specific policies. It is important that major vulnerabilities in the energy system to climate change be identified and that studies to evaluate the possible expansion of the system in terms of its resilience be conducted and acted upon.

Country	Total Number of meters Deployed (in millions)	Number of Smart Energy Meters (in millions)	Smart Meters Share
USA	150	46	30.7%
Europe	281	61.2	22%
Canada	15	7.3	49%
India	200	-	<1%

Table 1 Smart Meter Production

Fig 3.8 Portugal Overview

3.5.1 Natural and Gas Electricity Market

In many aspects, the natural gas market in Portugal has made good progress since the publication of the previous in-depth review in 2009. The network operator, REN Gasodutos, has been fully unbundled, privatized and certified as transmission system operator (TSO) by ERSE, the energy regulator. Competition has started to emerge in the retail sector and

there have been many infrastructural improvements, which have strengthened the network and delivered greater security of supply.

Transmission infrastructure has undergone a number of significant investments since 2008: storage capacity at the Sines liquefied natural gas (LNG) terminal has increased with the addition of a third tank; three new underground storage facilities entered in operation and the project for the third interconnection between Portugal and Spain was identified as a project of common interest (PCI) by the European Commission and was recently awarded funds from the European Commission's Connecting Europe Facility (CEF) to support technical and environmental studies. Further infrastructure additions are planned including a new compressor station and new pipelines for the national network. While there is merit in expanding export capacity to Spain, the opportunity to take commercial advantage of the interconnection will be limited until such time as further connections are built to link the Iberian Peninsula with the European market as well as the creation of an Iberian natural gas market. Accordingly, additions to the transmission network, including storage facilities, should not proceed unless they are necessary to safeguard the security of natural gas supply.

The successful implementation of the Iberian Electricity Market (MIBEL) and its success indicates the need for an Iberian Natural Gas Market (MIBGAS). Despite this, progress on its development has been very slow since 2008. A regional natural gas market will offer greater energy security, a more liquid wholesale market and allow market participants access to a greater number of supply options. The Portuguese government and the sector regulator, ERSE, alongside their counterparts in Madrid must build on the consultation process that started in 2014 and develops a credible timetable for implementation of the new gas market. In the electricity sector, the market operator (the Iberian Energy Derivatives Exchange or OMIP) now offers a mature range of services including forward prices up to three years ahead and financial transmission rights for cross-border power flows. Spain and Portugal have been making good progress towards the 2020 target of 3.0 gigawatts (GW) of interconnection capacity with a price convergence 85% of the time. In 2014, progress was made on the provision of balancing services with France. This is an encouraging move towards a wider European approach to the provision of market services. The TSO has successfully undertaken an extensive investment programme to support the growth in renewables; at the same time as it improved its service quality. This has been mirrored at the

distribution level. Portugal has strengthened many of the building blocks which have allowed it to undertake the impressive increase in renewable electricity generation. Market liberalization has continued since the last review.

To date, competition for customers has seen large numbers of them move onto commercial offerings and a range of players now offer competitive services. Transitional end-user tariffs set by the regulator for both electricity and gas were scheduled to end on 31 December 2015 but this date has been postponed to 31 December 2017. The proposed expansion of vulnerable customers receiving a 34% discount to 20% of the household market needs to © OECD/IEA, 2016 1. Executive summary and key recommendations 10 are carefully considered. It is not clear that there are stringent criteria to target assistance to those in genuine need. The socialization of this cost onto energy companies (and eventually onto customers) is inefficient. The government should fund such assistance directly so as to ensure that support is effectively targeted

Below fig 3.5 represents the connection state of developed models.

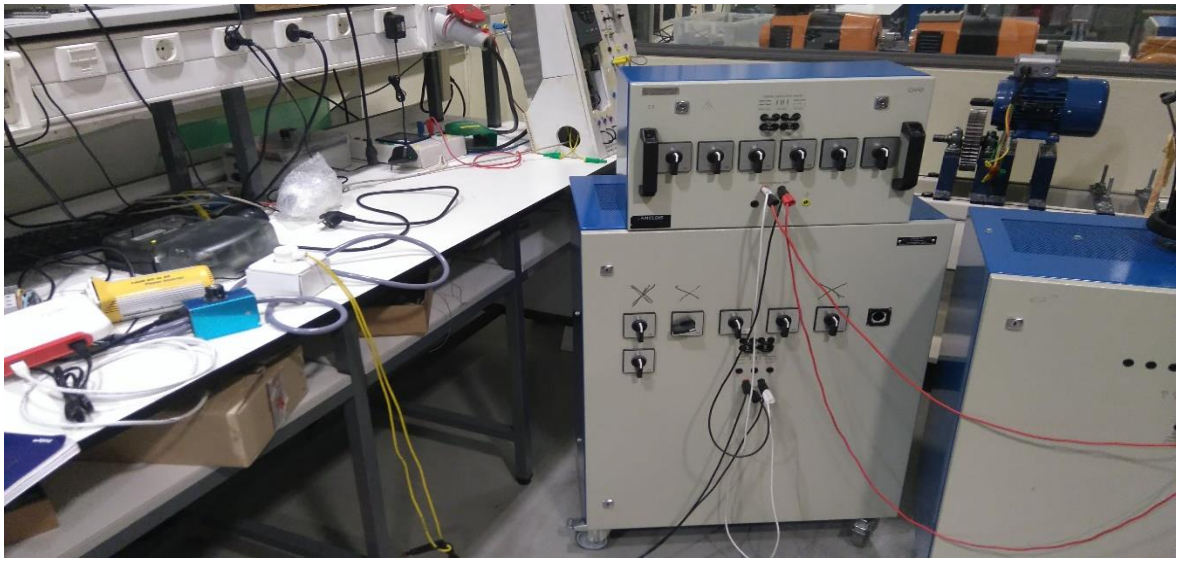

Fig 3.9 Developed Model

3.7 Capacitive Load

Reactive/Capacitive Load – A capacitive load charges and releases energy. Capacitive reactance resists the change to voltage, causing the circuit current to lead voltage. A capacitive load bank is like an inductive load bank in rating and purpose.

Inductive Load

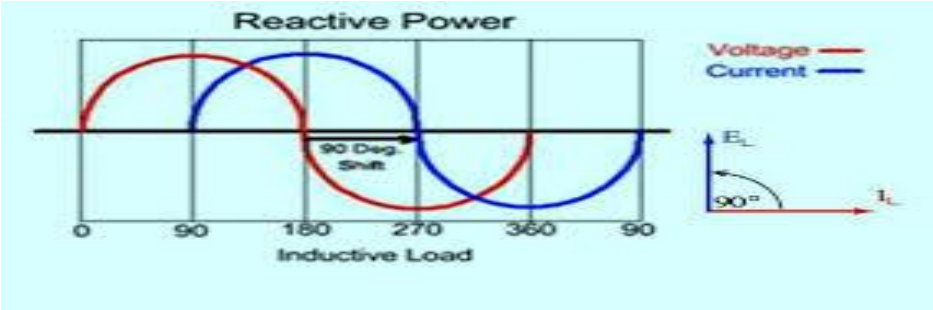

Fig 3.10 Inductive Characteristics

Resist changes in current and as such, when you measure the current, it lags (is behind) the voltage. Electromagnetic fields are the key to inductive loads, and as such all motors (fans, pumps, etc.), solenoids, and relays are inductive in nature. Inductance is measured in Henrys.

Name	Description
Itron	It is the largest manufacturers of smart meters in the world, with a huge market share in its home American market. Itron(NSDQ: ITRI) is one of the biggest independent smart grid companies in the world with 8000 utility customers.It has used its expertise in making meters for gas and water to win large contracts in the electric smart metering market as well. It has won

	contracts from SCE, DTE Energy, Center Point Energy amongst others. The company sells end-to-end smart grid and smart distribution solutions to electric, gas and water utilities around the globe. Itron is the world's leading provider of smart metering, data collection and utility software systems.
Elster Group	Elster is a leading manufacturer of Advanced Metering Infrastructure (AMI) and integrated metering and utilization solutions to the gas, electricity and water industries. Elster is a US-based private company that has a 170-year-old history, where a number of times its ownership changed hands. Elster electricity meters are used for residential, commercial and industrial, and interchange metering applications. They support both Automated Meter Reading (AMR) and AMI systems.
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General Electric	GE, as it is popularly known, is one of the biggest players in the Green Industry globally. General Electric like other industrial conglomerates eg. Siemens, Areva, and others are in fact low risk plays in the Green Investing sector. GE is strong across most of the Green Sectors today particularly in the area of Smart Grid and Energy Efficiency. GE is not that big in the Smart Meter market, but with its overarching scale, it has quickly won a number of contracts like the one with FPL.

Landis+Gyr	This Swiss-based PE-backed private company has a leading position in the European markets and has started winning contracts in the USA as well. With an installed base of over 300 million electricity meters, Landis+Gyr is amongst the top 5 smart meter manufacturers. Based in Zug, Switzerland, it introduced electronic meters in 1981. Through the late 90's the company saw a series of different investors and owners, including Elektrowatt, KKR, and Siemens. In 2004 Bayard Capital of Australia purchased the company with a vision of building the premier energy management company in the world that would combine positive environmental outcomes with the company's culture.
Schneider Electric	One of the biggest electrical and energy equipment suppliers in the world, Schneider has been one of the most aggressive in M&A. The company provides energy efficiency solutions to residential market, buildings, Industry & Infrastructure, and data centers. The company's range of services and products is quite awesome and provides a holistic solution to its customers. Though not a major player in the smart meter market yet, the company cannot be underestimated in the future.

Table 2 Smart Meter Analysis

(Source: http://www.greenworldinvestor.com/2011/05/10/smart-metering-list-of-top-smart-energy-meter-manufacturers-growing-smaller-as-consolidation-gains-pace)

3.6 Software Application Developed

Software interface known as API (Application Programming Interface) has been used to connect the hardware modules used and energy meter data appliances. Before start showing you how to use the SDP Platform UI API, it is necessary to first understand how the platform, and consequentially the API, is structured.

Applications - This is standalone applications, with their own logic, interfaces, and APIs, that provide the main features to the end-users.

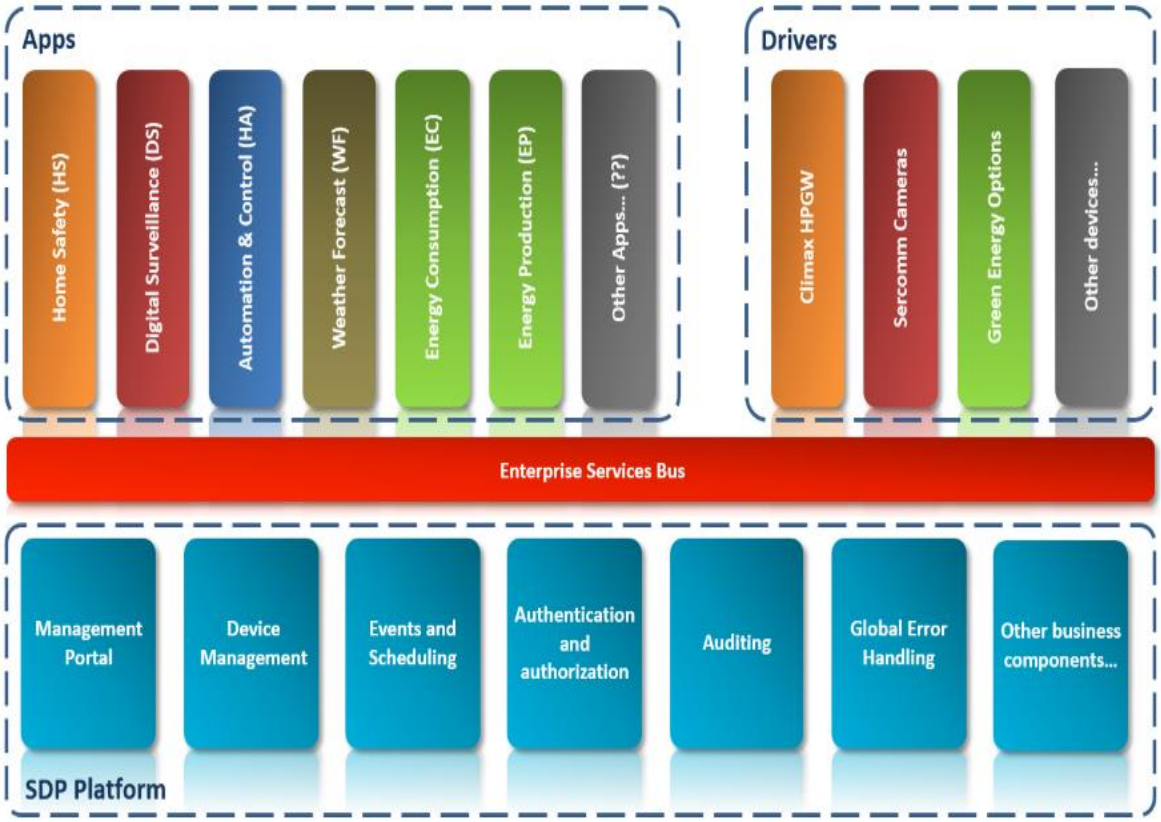

Fig 3.11 Software Layout

Platform Services - This is the services and functionalities that support all the platform: they enable billing, authentication, and authorization, error handling, network integration, etc. Enterprise Service Bus - To enable exchanging messages and consuming the different services in a very scalable and redundant way, is the responsibility of the ESB. This component provides different message exchange paradigms (request-reply, pub-sub, message queuing, etc.).In order to comply with such architecture and enable future evolutions, either by enabling new services or support new devices, the API is also separated the same way,

Base API - This handles all the authentication, authorization, user management, devices and module management, logs, etc.

App API - Each Application has its own API with their specific resources and functions. For example, Home Safety API or Remote Surveillance API.

3.6.1 STEP PROCEDURES

Step 1: First you need to authenticate using your API Code and Users credentials (more details on the next section).

Step 2: Afterwards, you need to get the list of Subscriptions that the user can access and, within those, find the subscription associated with the security service (using the mega-service field)

Step 3: You need then to get a valid session (Do Service Session) to the right subscription.

Step 4: Using the Subscription Session, you can then call any resource on the HS API. In this case, you request the Security Status.

Step 5: You can then provide the UI for the user to change the security status, e.g. to arm or disarm the system.

Drivers - This represents the pieces of software that handle all the communication with the underlying devices. They enable us to abstract the platform from the different devices messages and communication protocols. Since some devices have their very specificities, some operations are handled by the specific driver's API.

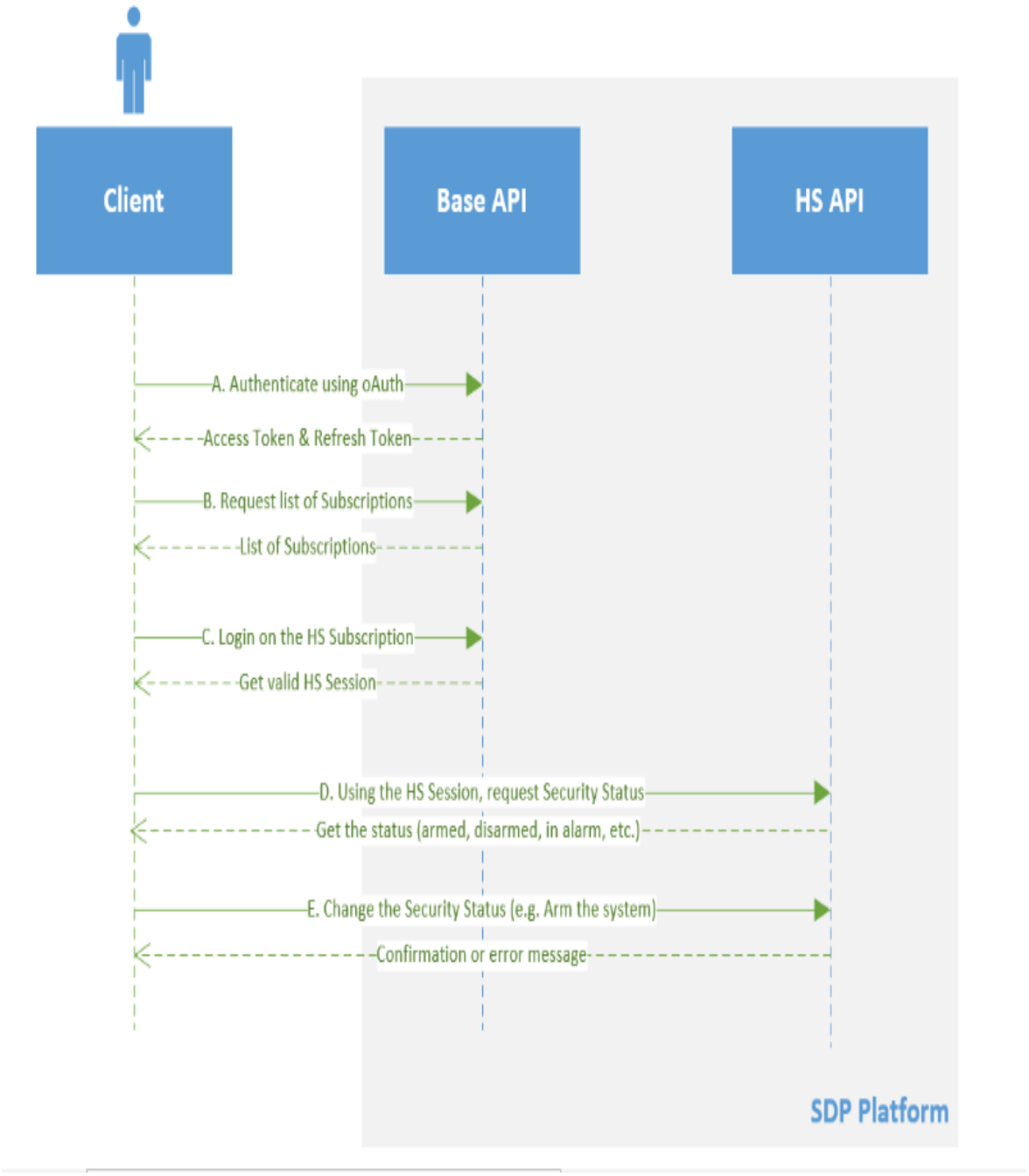

Fig 3.12 API Data

3.7 Visual Studio

It has been used to update an error occurred during the production and consumption operations in the house of clients later this can be monitored by re:dy support unit and bug's will be removed.

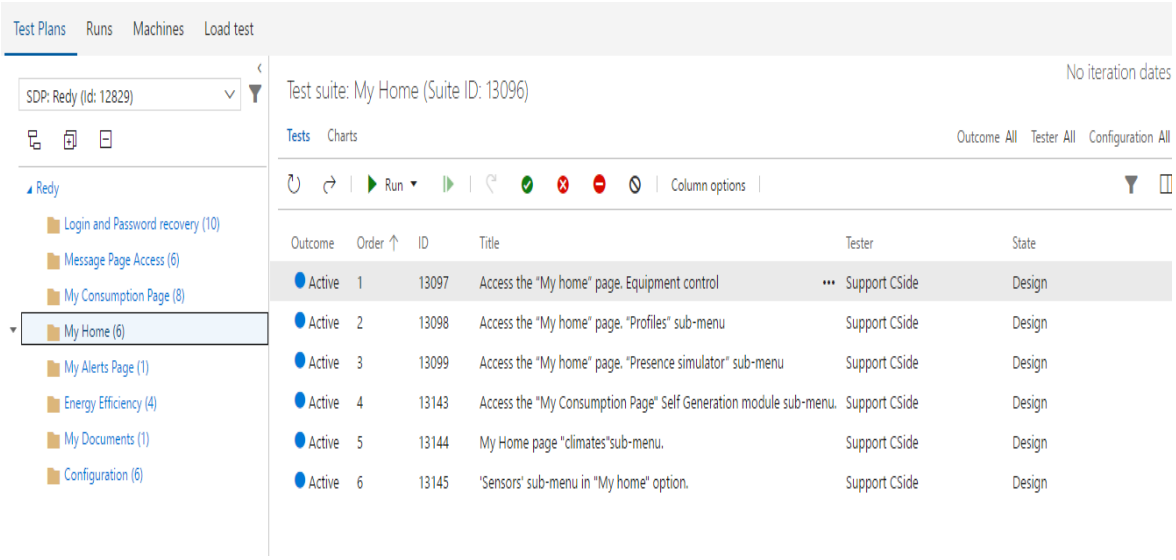

Fig 3.13 Test Report

Below figure represent the Team Foundation Server (TFS) functionalities for the bug uploading and for the future conclusion of results.

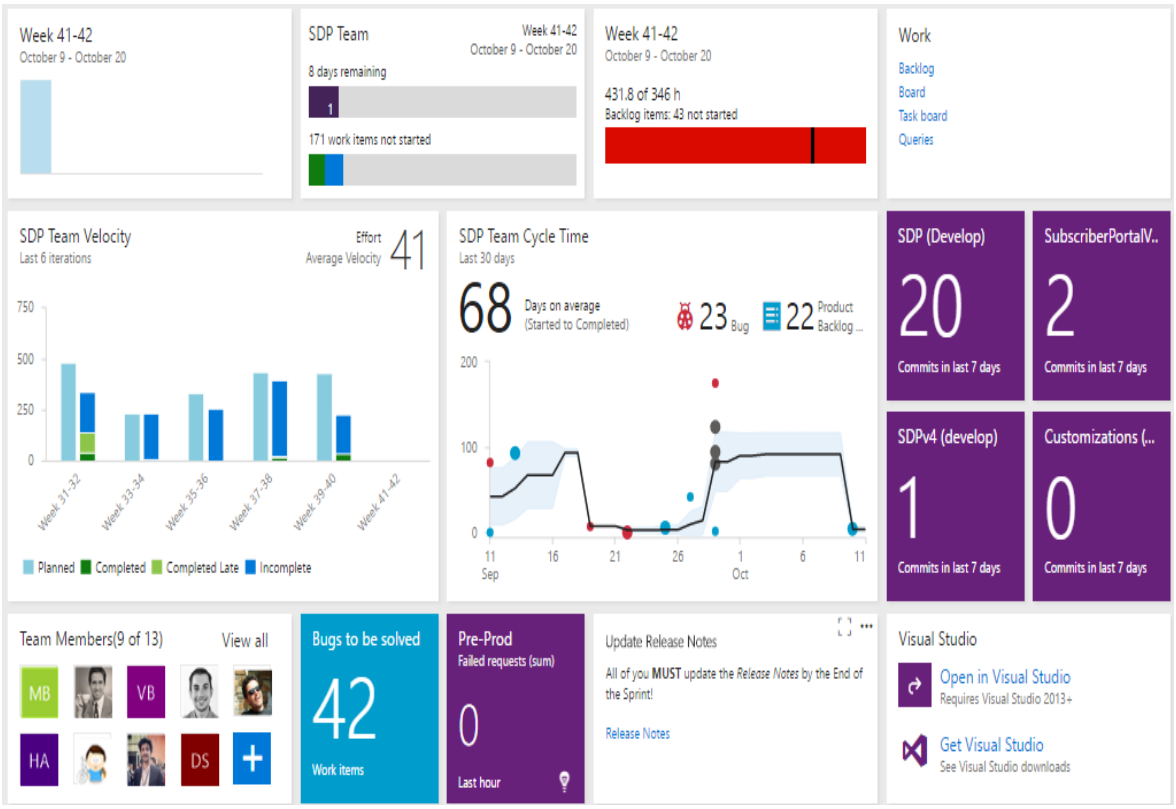

Fig 3.14 TFS OverView

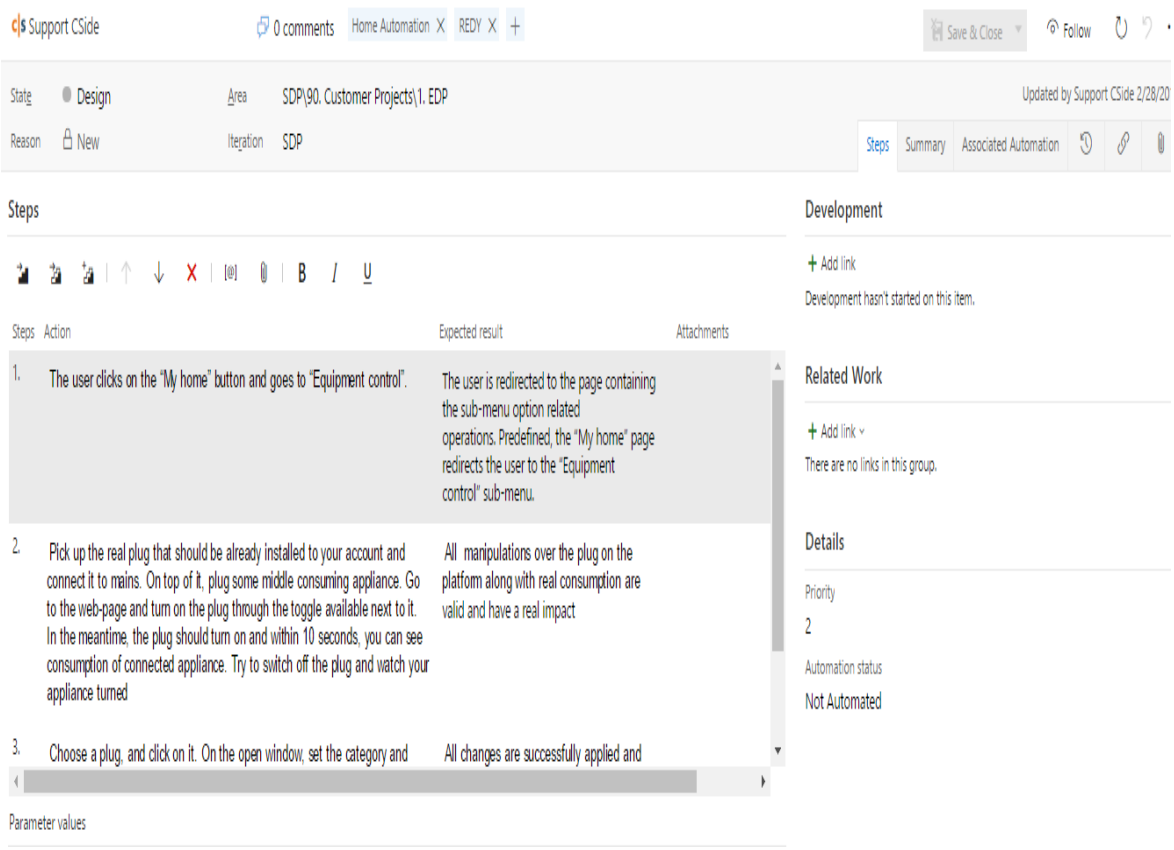

Fig 3.15 Inside Document

TFS can integrate with an existing SharePoint farm. SQL Server Reporting Services are supported for more advanced reporting against the data warehouse or the Analysis Services data cube. These installations can be on the same system or on different systems. Build servers, lab management servers, release management servers and proxy servers (to reduce some of the load on the application tier), test machines and load test machines can also be added to the infrastructure. To support teams requiring enterprise project scheduling, TFS also integrates with Microsoft Project Server, which allows enterprise-level portfolio management, resource management, and project tracking.

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CHAPTER 4

4 Case Study

By comparing the similar products available in the energy market it's easy to understand the energy market strategy on basis of generation, distribution, utilization by clients, also by various smart home automation entities techniques.

4.1 Existed System

For this work, existing meter reading techniques in India are analyzed and conducted an extensive study on different energy measuring instruments available now. In the existing system, either an electronic energy meter or an electro-mechanical meter is fixed in the premise for measuring the usage. The meters currently in use are only capable of recording kWh units. The kWh units used then still must be recorded by meter readers monthly, on foot. The recorded data need to be processed by a meter reading company. For processing the meter reading, the company needs to first link each recorded power usage datum to an account holder and then determine the amount owed by means of the specific tariff in use. Wireless electric power management and control system for short distance is developed using ZigBee technique. For this IEEE 802.15.4 standard protocol is used as a ZigBee standard, the microcontroller is used to manage energy data and ZigBee to enable communication between the energy meter and data centers. The secure mobile agent concept was presented in, instead of one person for one meter according to geographical area energy meters can be organized. For one location energy meters, a security manager can do his

work. The local mobile agent can do his duty for a specific location to avoid the visit of the external mobile agent to energy meters directly. If there are any queries of security manager local mobile agent can solve at his level and visit energy meters. The embedded energy meter concept is based on the prepaid recharge concept of mobile recharge, where the maximum demand of energy of a consumer is indicated in the meter. After exceeding the maximum demand, the meter and hence the connection will automatically be disconnected by an embedded system inserted in the meter itself.

4.2 Proposed System

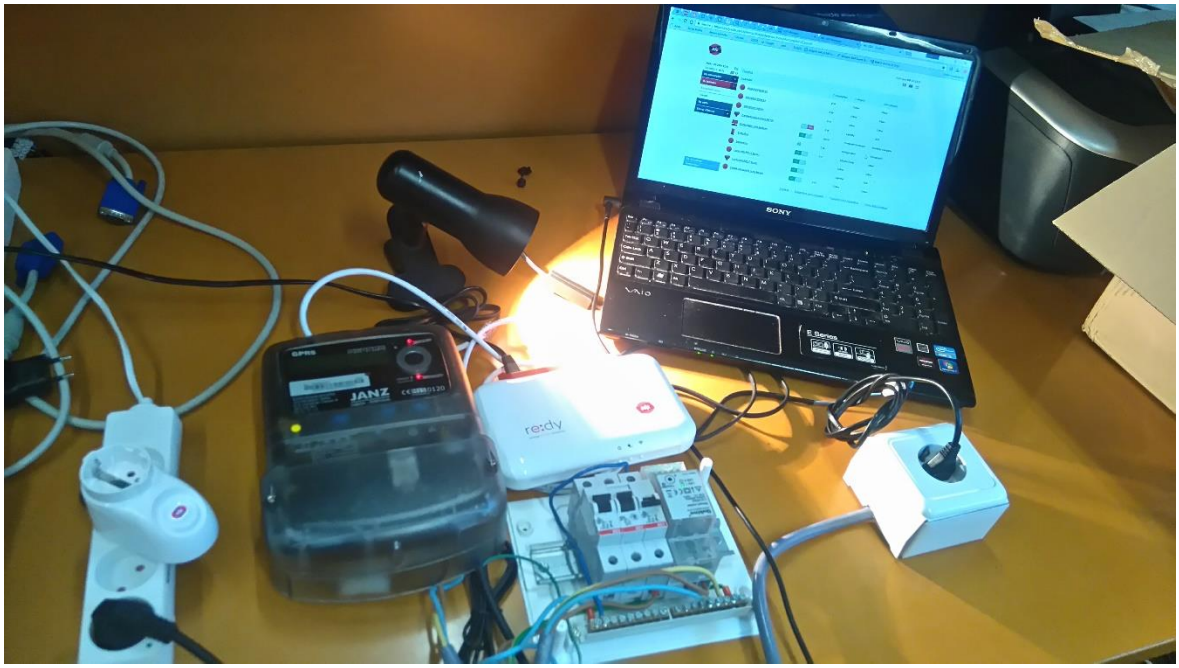

Fig 4.1 Final State

The current system of electricity billing is error level and also time-consuming. Errors introduced at every stage are due to electro-mechanical meters, human errors while noting down the meter reading, errors while processing the paid bills and the due bills. The smart energy meter is a technique which can reduce the problems associated with billing and reduces the deployment of manpower for taking meter readings. It has many advantages

from both suppliers as well as consumer's point. This paper is also intended to present an overview of prepaid energy meter, which can control the use of electricity on the consumer side to avoid wastage of power and is a concept to minimize the electricity theft. As the billing process is done automatically in the proposed system it mainly reduces the manpower, fig 4.1 represents how the power factor variation works and the proved values will be calculated for equipment consumptions.

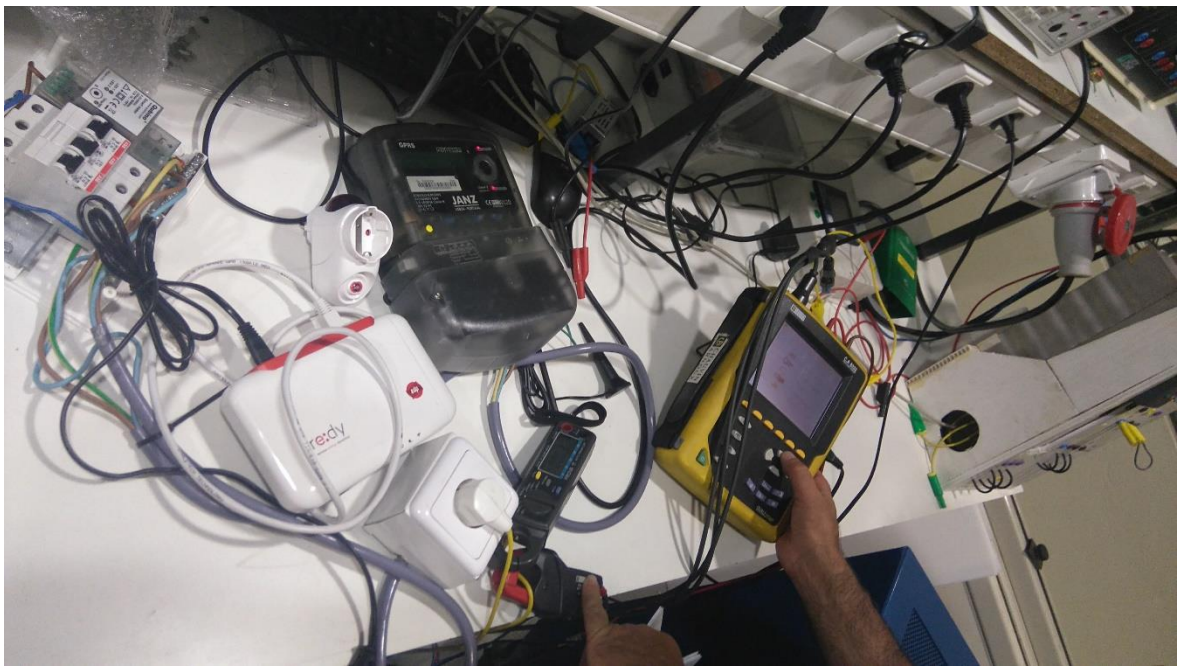

Fig 4.2 Quality Analyzer Testing

Energy Meter Images			
Model	TED 5000	E--Gauge	Power Save Envy
Manufacturer or Distributor	Energy, Inc.	gauge Systems, LLC	Power Save, Inc.
Channels Main: 240 V (2-pole) Aux: 120 V (1-pole)	4 Main	1 Main, 10 Aux (12 total)	10 Main Wireless transmitter & CT's required. for each channel
Single Phase	Yes	Yes	Yes
Three Phase	No, Future Product	Yes	Yes - 208 V. 277 V. w/ Multiplier
Voltage Range	85-140 V. per Line	85-277 V. per Line 3 Channels	Pre-set, No Voltage Measurement
Current Range of CT's	0-400 Amps across 2 Panels (100 A /CT Max)	0-3,000 Amps Depends on Load	200 Amp CT's Standard
Accuracy	+/-2%	n/a	n/a

Resolution	1 Watt	0.10 Watt	n/a
Web Server Location	Local	Local w/Lifetime Free Access via egauge.net	Local w/3rd Party Software, Remote w/Web Bridge
Communication to Display	Power Line Transfer to Gateway, ZigBee to Display	No Display Available	Wireless. 433 Mhz SRD Band
Communication to Computer	Ethernet	Home Plug Ethernet Adapter	USB or Web Bridge
Analysis Software	TED Footprints See Dashboard	Built-in w/Free Lifetime Upgrades See Dashboard	Various 3rd Party Options
Data Logging Capacity	Up to 10 years + .csv downloads to MS Excel	1 yr. @ 1 Min Interval, 30 yrs. @ 30 Min Int.	Up to 7 Years w/ PC Link
Energy Cost Displayed	Yes	No	Yes
Power Source	Line Voltage to MTU & Gateway, 120 V Adapter to Display	Line Voltage	Display - AC/DC Adapter Transmitter - 2 D Batteries
Operating System Compatibility	PC, Mac, Linux	PC, Mac, Linux, iPhone, Android	PC, Mac, Mobile, Tablet

Alternative Energy Metering	Yes	Yes	Yes
Carbon Footprint Displayed	Yes	Yes	Yes
Size (HxWxD)	Display w/Base 4.25 x 4.0 x 2.75	6.9 x 3.2 x 1.9	Display w/Base 6.2x4.8x3.7 Transmitter 4.8x2.8x1.2
Weight	< 1 lb	8.8 oz	n/a
Documentation	Installation User Manual	Data Sheet Manual	Envy Brochure Installation Manual
Special Features	TED the Toolbar FREE Download Monitors TED data live on your Firefox Toolbar	3-phase Capability Can Serve Small Comm. & Ind. Markets	Up to 10 wireless x-matters of 1, 2 or 3 phases feed display.

Table 3 Traditional Energy Meter Comparison

4.3 Service Delivery Platform

The Service Delivery Platform (SDP) is a fully integrated system for the management, deployment, and execution of multiple high-value applications such as Home Safety,

Remote Surveillance, Home Automation, Energy Consumption, Energy Production and Multi-utility Metering, over narrowband and broadband.

SDP delivers to any service provider, namely telecommunication or utility companies, the ability to generate multiple high-value service revenue streams over a single low-cost platform and thus increasing revenues on their broadband infrastructure. SDP aims to enable the rapid deployment, by service providers, of personalized content-rich services to customers. Service providers can easily create, deliver and manage new and existing service offerings in the digital media, residential security and home automation sector.Service Delivery Platform provides an end-to-end technology solution that enables access and control of any enabled device or appliance locally or remotely over the Internet, using any web-enabled device, from PC, Laptops, Tablets, Mobile Phones, and TV Set-top boxes. Using our technology to connect from remote locations to a gateway in the home, Service Delivery Platform enables users to control, command and monitor devices from anywhere in the world using a standard web interface.

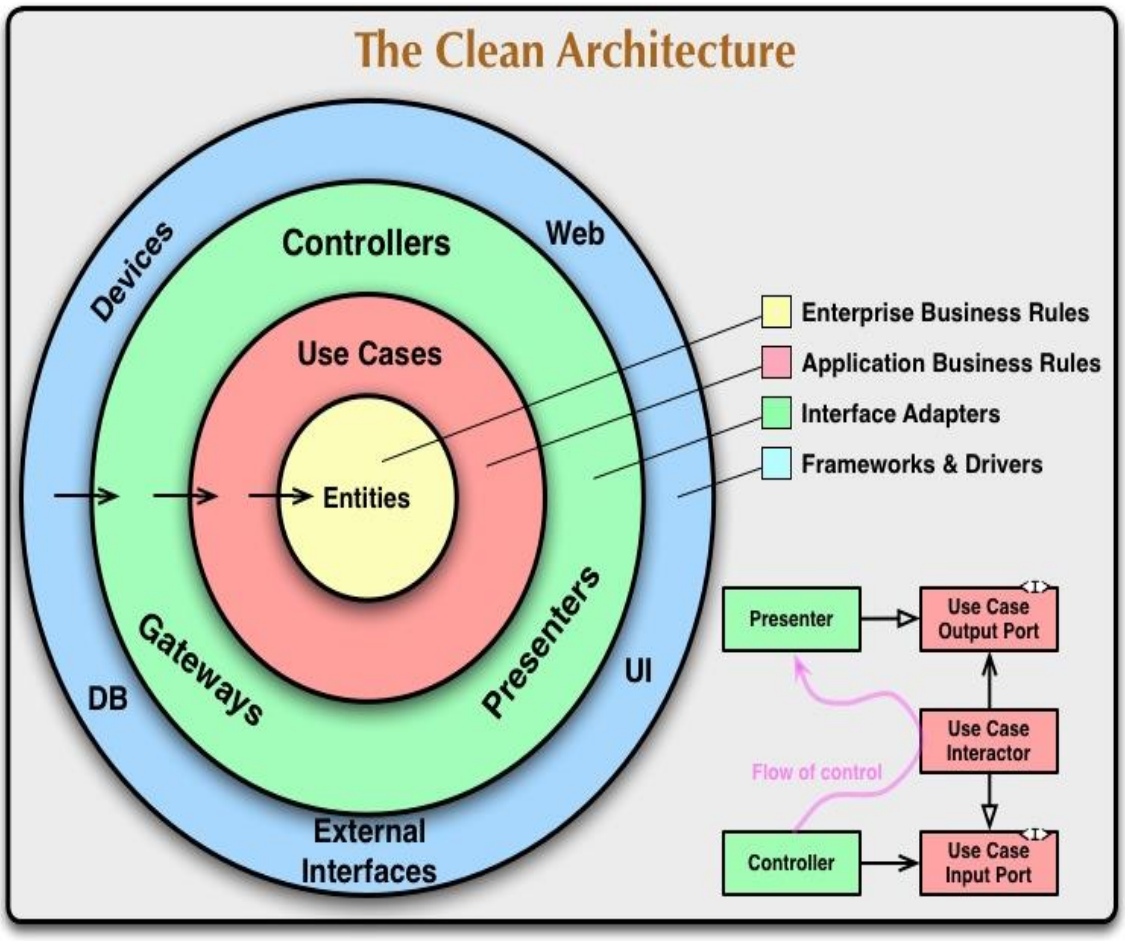

Fig 4.3 SDP Architecture [6]

This API enables any third-party developer to create an application, either a mobile-native application, Set-top box or even any web application that enables full interaction with the SDP Platform, its services, and devices.The SDP Platform and this API is developed and maintained by Cside.

4.4 Work Functionalities

The UI API is based on the REST protocol, with JSON formatting, and uses OAuth for authentication and authorization. The queries are based on the OData protocol.

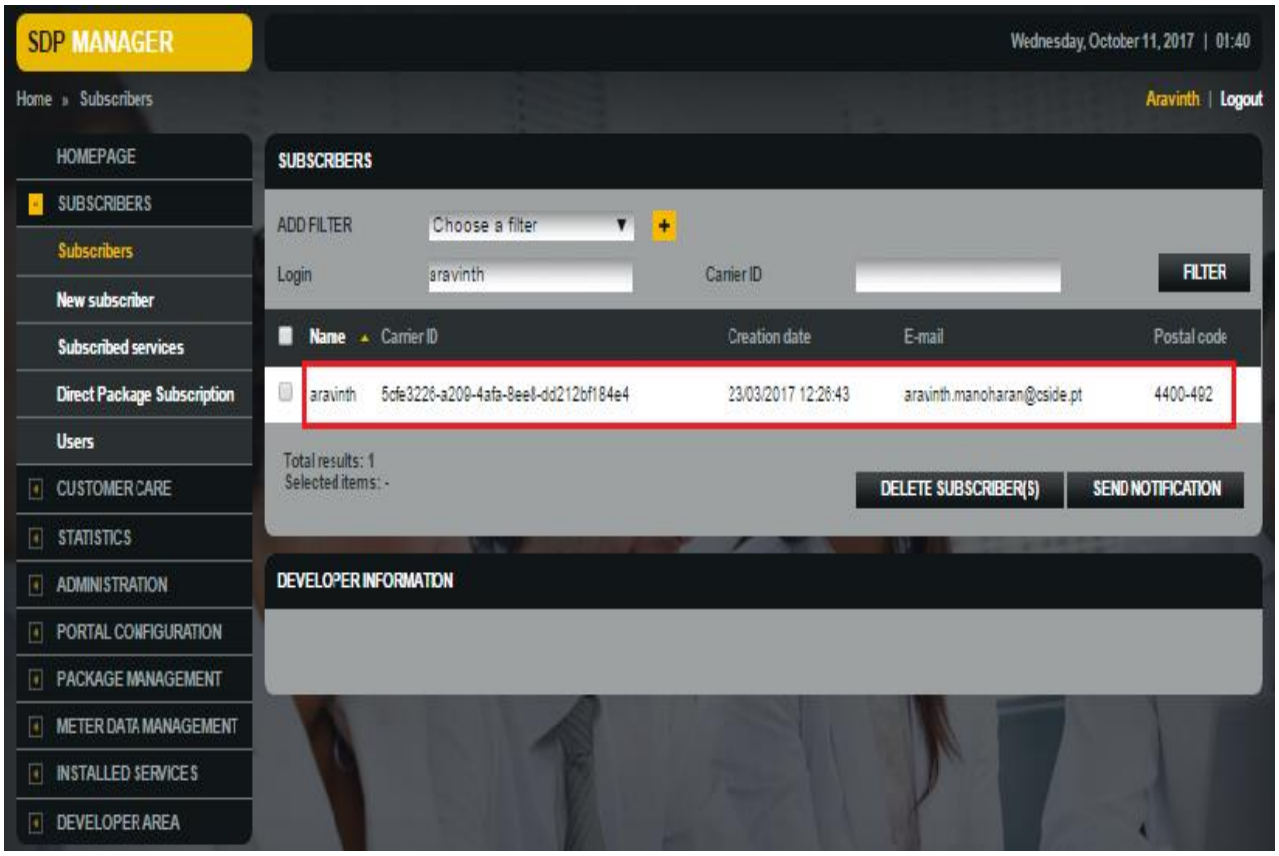

Fig 4.4 Customer Carrier Identification

Fig 4.4 represents the login user for the re:dy controlled equipment via Service Delivery Platform (SDP).

Service Delivery Platform provides an end-to-end technology solution that enables access and control of any enabled device or appliance locally or remotely over the Internet, using any web-enabled device, from PC, Laptops, Tablets, Mobile Phones, and TV Set-top boxes. Using our technology to connect from remote locations to a gateway in the home, Service Delivery

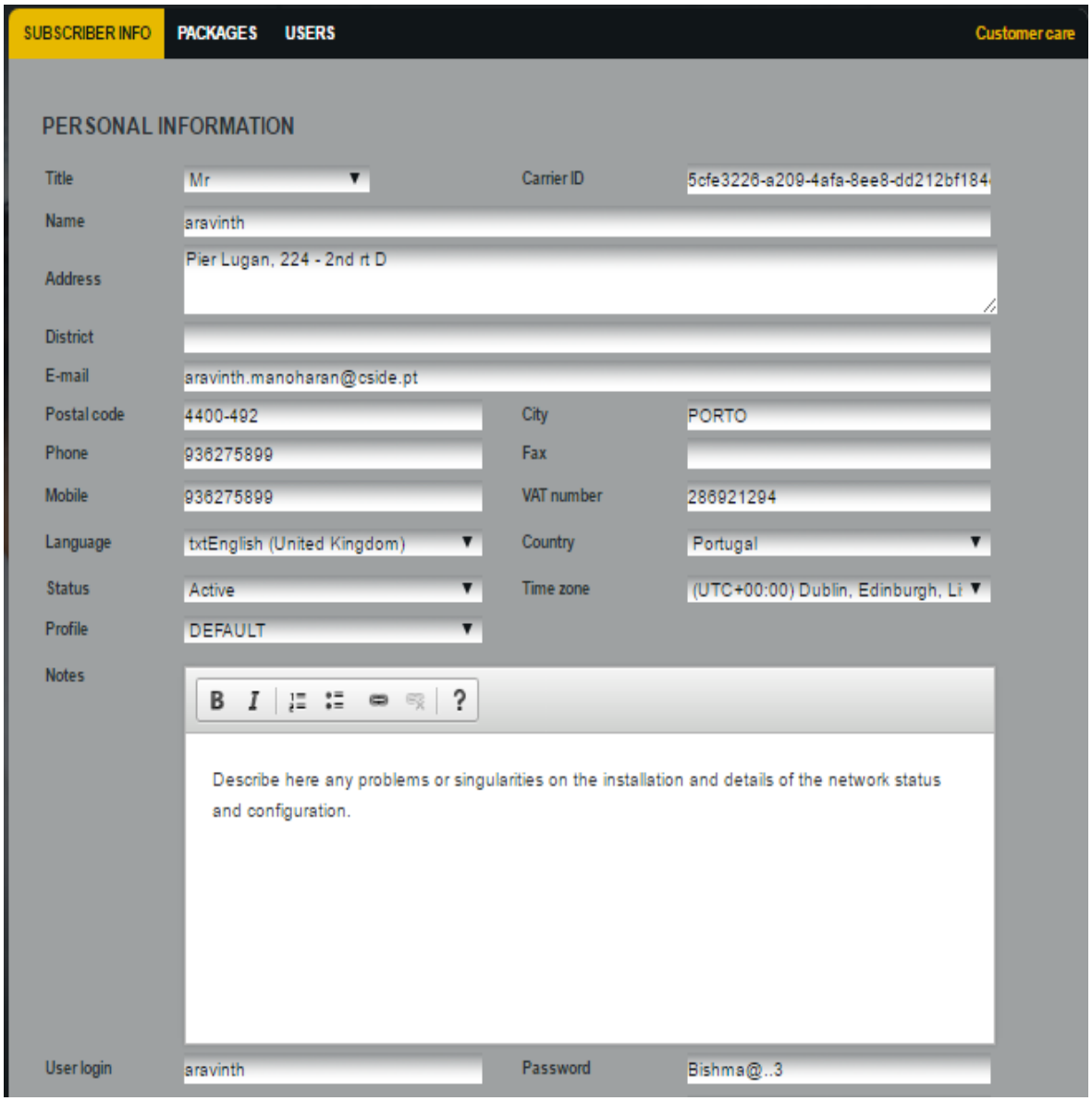

Fig 4.5 Subscriber Info

The platform enables users to control, command and monitor devices from anywhere in the world using a standard web interface.

Service Provider - The Service Provider represents the owner of the platform and the company and its employees who are providing the service to the end-users.

Operator - It represents an employee from the Service Provider with rights to access the SDP Management portal. The authorizations of an operator may vary depending on the access level assigned.Subscriber - A Subscriber is the customer of the Service Provider. It represents the billable user who is the owner of the services.User - A Subscriber can create

one or more Users. A User is someone with a login and password who can log in to the SDP platform and

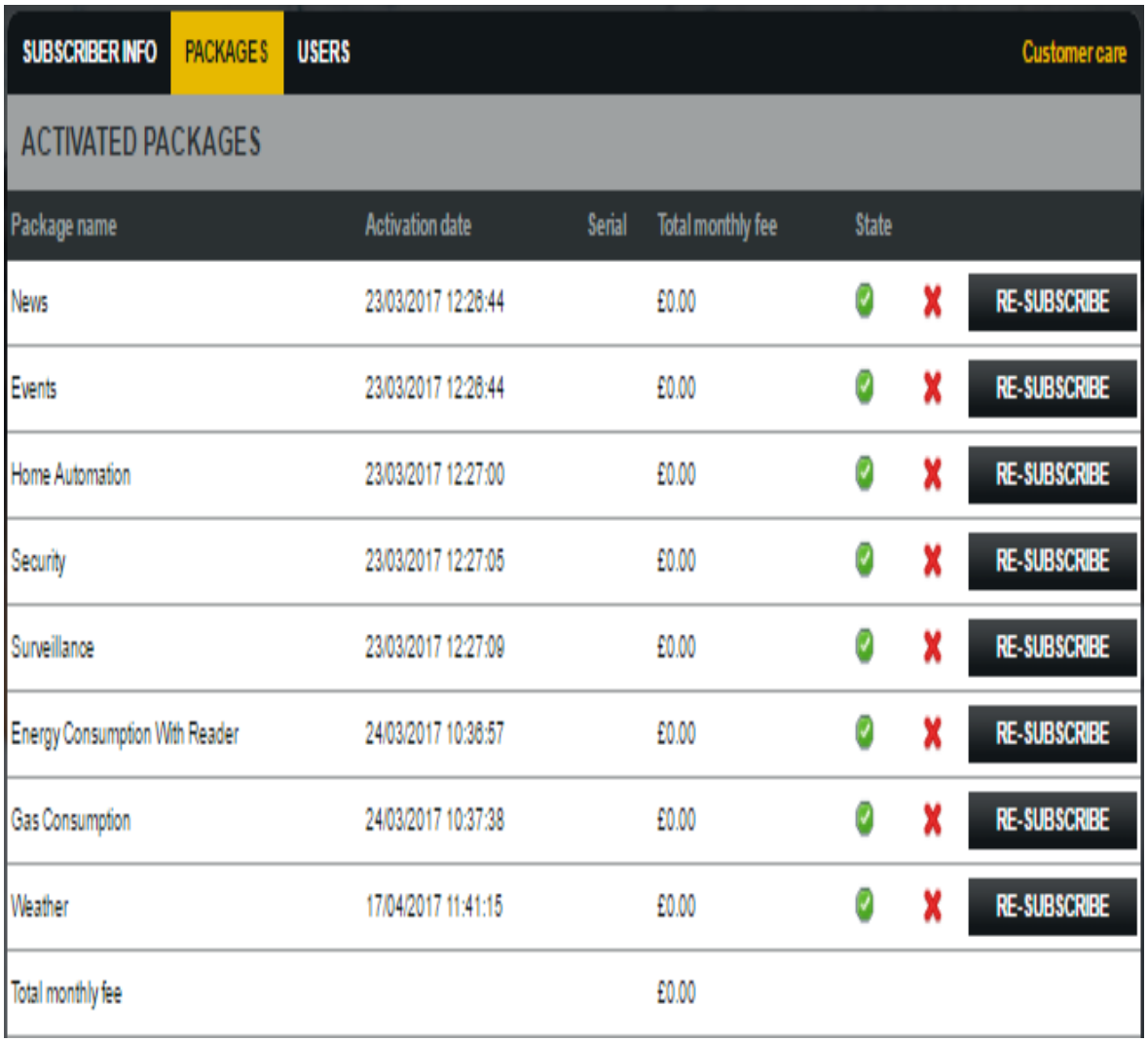

Fig 4.6 Package Information

use some or all applications. A user must be associated with a subscriber.Service - Remote surveillance, energy consumption, home safety, etc. are some example of applications available on the SDP Platform. The list of available applications depends on the applications installed for the specific instance of the SDP Platform.

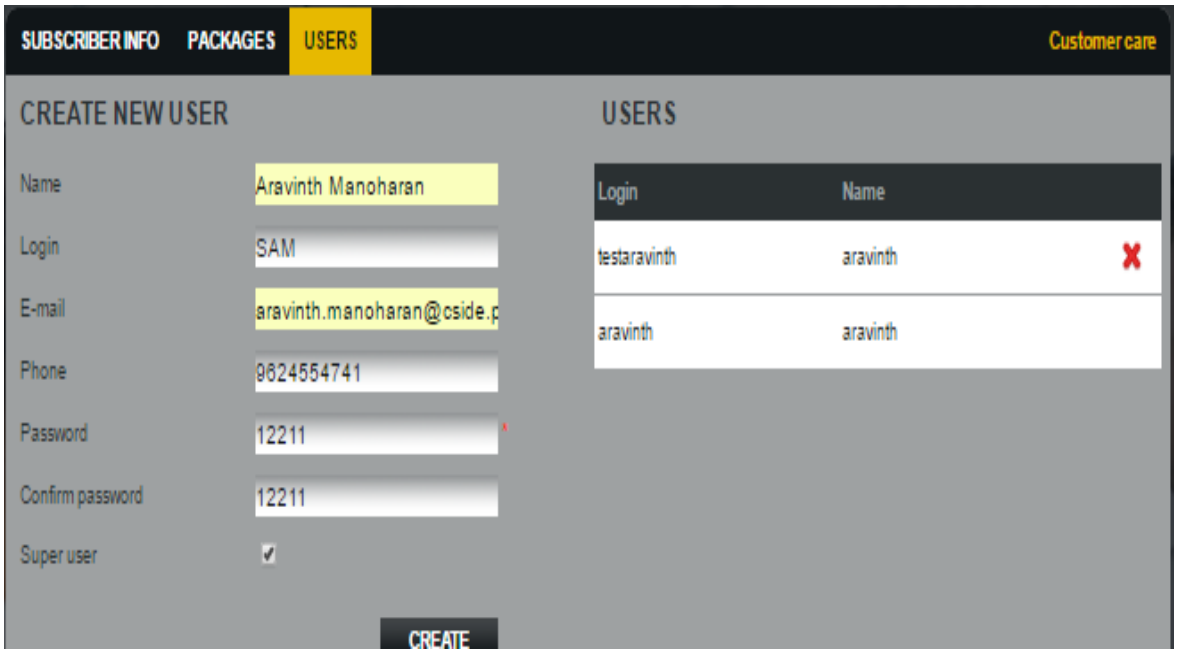

Fig 4.7 User Info

Package - A package represents a bundle of one or more service and, optionally, some devices. A package that includes devices is called boxed package, while a package that only includes applications (without any device) is called unboxes package.A package marked as platform package is automatically subscribed to any newly created subscriber

.

When defining the applications associated with a package it is possible to define the default subscription parameters. This enables, for example, to create a Surveillance pro package which includes the surveillance service with 10GB of remote storage and creates also a Standard Surveillance package which only provides 1GB of storage capacity.

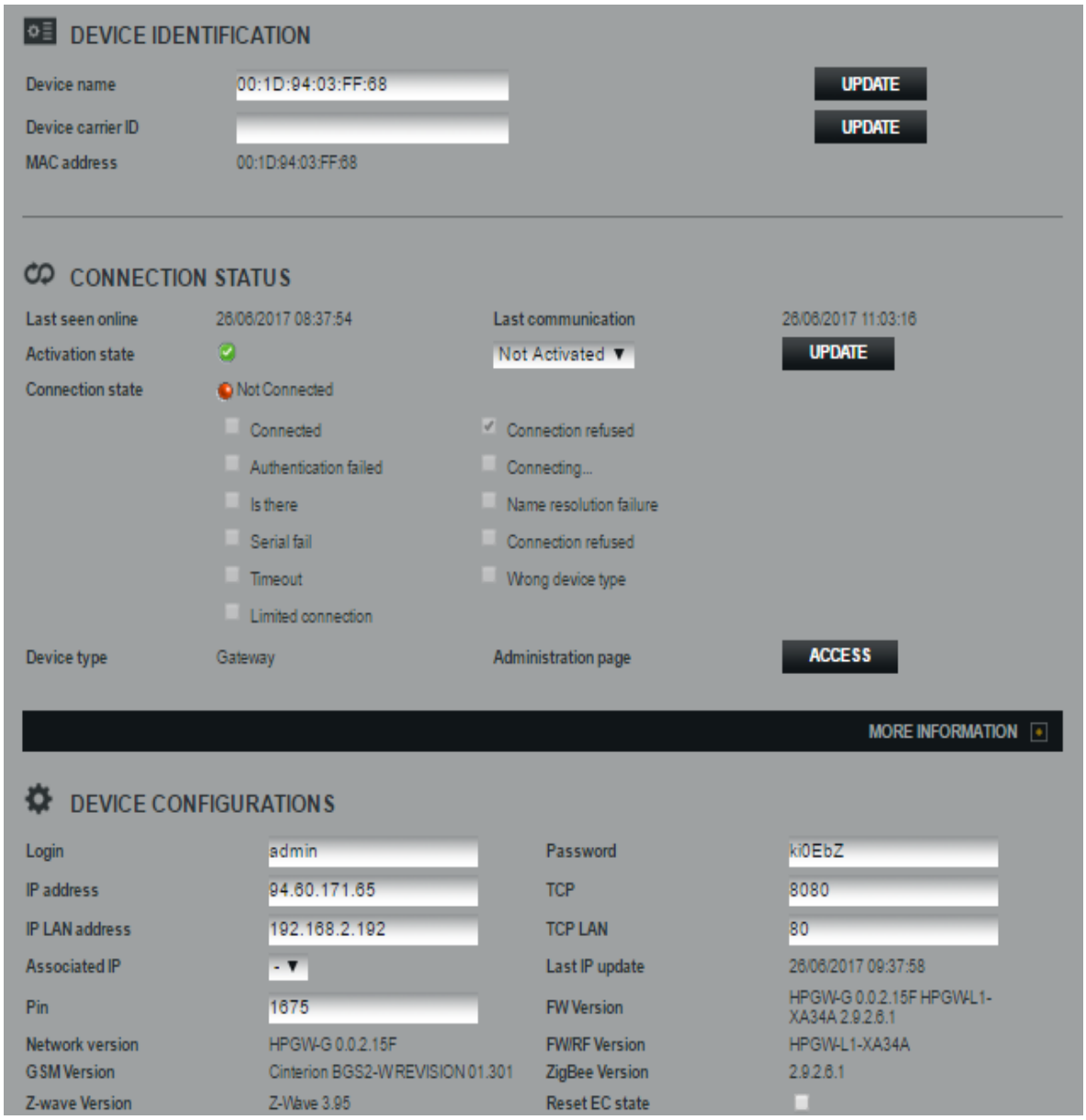

Fig 4.8 Device Info

Subscription - When a service is subscribed to a Subscriber, it is represented as a Subscription. Each subscription can include one or multiple subscription parameters that represent what features are available on the present subscription. For example, the total storage capacity of a Remote Surveillance subscription is defined as a Subscription Parameter. The cost plan associated with an Energy Consumption subscription is also stored as subscription parameters.

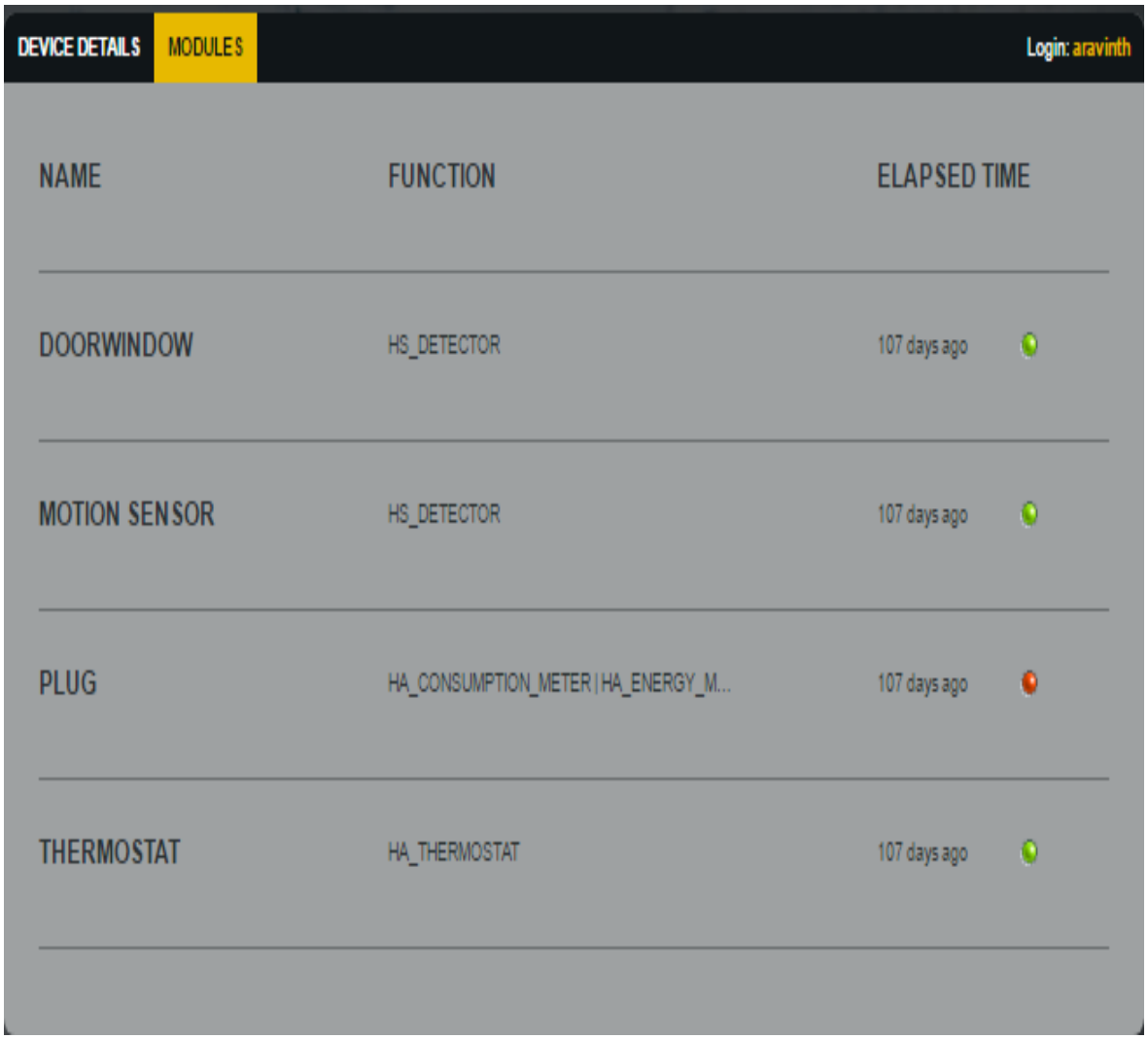

Fig 4.9 Modules Installed

Device - A device represents any IP connected device that communicates directly with the SDP Platform, independently of the protocol used. Example of devices are gateways, security consoles or IP cameras.

Modules - A module represents all equipment's that are connected to a device. For example, a sensor connected to a security console is named module. Other examples are plugs or temperature sensors connected to a gateway or analog cameras connected to a video server.

4.5 Authentication Procedures

To use any method of the API, it is necessary to first request a client ID and password. If you haven't yet been provided one, please to request one from CSide. With your application's credentials and the user's credentials you should be able to retrieve an access token directly through one request at https://[server_url]/UIAPI/token. When the client wants to send to the server authentication credentials, it is used (Basic Access Authentication) to pass the client identification and the client secret.

1. Client Identification and Client secret are combined into a string "clientId:clientSecret";
2. The resulting string is then encoded using the RFC2045-MIME variant of Base64, except not limited to 76 char.
3. The authorization method and space i.e. "Basic " is then put before the encoded string.

To release Gate way,the code used is,

<cmd a="doDebugCommand" id="12345678">

<httpd v="1"/>

</cmd>

Example Parameters,

```
Authorization: Basic
Y2xpZW50SWQxOjEzNjc4NjNELUQxRjctNDY5OS1COERDLTI3Qjk3RkE0N0U5RQ
==
```

It should also include the body with the following parameters string:

```
grant_type=password&username=test&password=testPwd
```

If the credentials are good, you should receive:

```
HTTP/1.1 200 OK
Content-Type: application/json;charset=UTF-8
Cache-Control: no-store
Pragma: no-cache

{
  "access_token":"2YotnFZFEjr1zCsicMWpAA",
  "expires_in":10800,
  "refresh_token":"tGzv3JOkF0XG5Qx2TlKWIA",
}
```

Note that access tokens expire. This means your application will not be able to use them after, in this example, 10800 seconds. To retrieve a new access token, please use the refresh token. Keep in mind your application shall not keep copies of the user's credentials (which may change) and should only remember tokens.

In case of an error (invalid credentials, missing args) you should receive an HTTP error like,

```
HTTP/1.1 400 Bad request
Content-Type: application/json;charset=UTF-8
Cache-Control: no-store
Pragma: no-cache

{
  "error":"invalid grant"
}
```

4.6 Refreshing an Access Token

Once an access token has been obtained, it can be used immediately to access the REST APIs. After a certain amount of time, the access token expires and the application needs to use the refresh token to renew the access token. Both the refresh token and the expiration time are obtained during the authentication phase.

To renew an access token with a refresh token, use a POST request to https://[server_url]/UIAPI/token.

```
POST /oauth2/token HTTP/1.1
Host: [server_url]
Content-Type: application/x-www-form-urlencoded;charset=UTF-8

grant_type=refresh_token
refresh_token=[YOUR_REFRESH_TOKEN]
client_id=[YOUR_APP_ID]
client_secret=[YOUR_CLIENT_SECRET]
```

A new access token should be present in the answer. Please note the refresh token and the associated expiration delay may change and their new values should be acquired:

```
HTTP/1.1 200 OK
Content-Type: application/json;charset=UTF-8
Cache-Control: no-store
Pragma: no-cache

{
  "access_token":"2YotnFZFEjr1zCsicMWpAA",
  "expires_in":10800,
  "refresh_token":"tGzv3JOkF0XG5Qx2TlKWIA",
}
```

4.7 Controlling Home Automation Modules

The SDP Platform supports multiple gateways and, each gateway can support multiple modules. To handle this extensive and dynamic list of different modules, I have created the concept of functions aka capabilities.

So, a module is characterized by having functions, i.e. certain capabilities (a plug can have the Switch and Power Meter functions; a thermostat can the THERMOSTAT and

TEMPERATURE functions; etc.), parameters (for example, the name for the plug or its mac-address) and status (for example if the plug is switched ON or how much power is consuming).

When creating a new UI for the SDP Platform, i strongly recommend that the UI for each module is dependent on the function of such module, always being careful that a module can accumulate functions. Although some modules have some fixed parameters (Id, Name, and Address) and a fixed status vats (Operational), the rest of the mandatory and optional parameters and status varies available depend on the module functions. Note: i consider a parameter as some static property assigned to a module, e.g. a name, and, a Status Var, something related to the status of the device.

Also, depending on the module functions, some actions may be available. Each action may require additional parameters, e.g. stamp action of a thermostat requires a pre-defined temperature. In order to keep track of all supported capabilities, its associates parameters, status varies and actions, i provide a separated document which identifies the most up-to-date list of supported module capabilities.

4.8 Visual Studio

It has been used to update an error occurred during the production and consumption operations in the house of clients later this can be monitored by re:dy support unit and bug's will be removed.

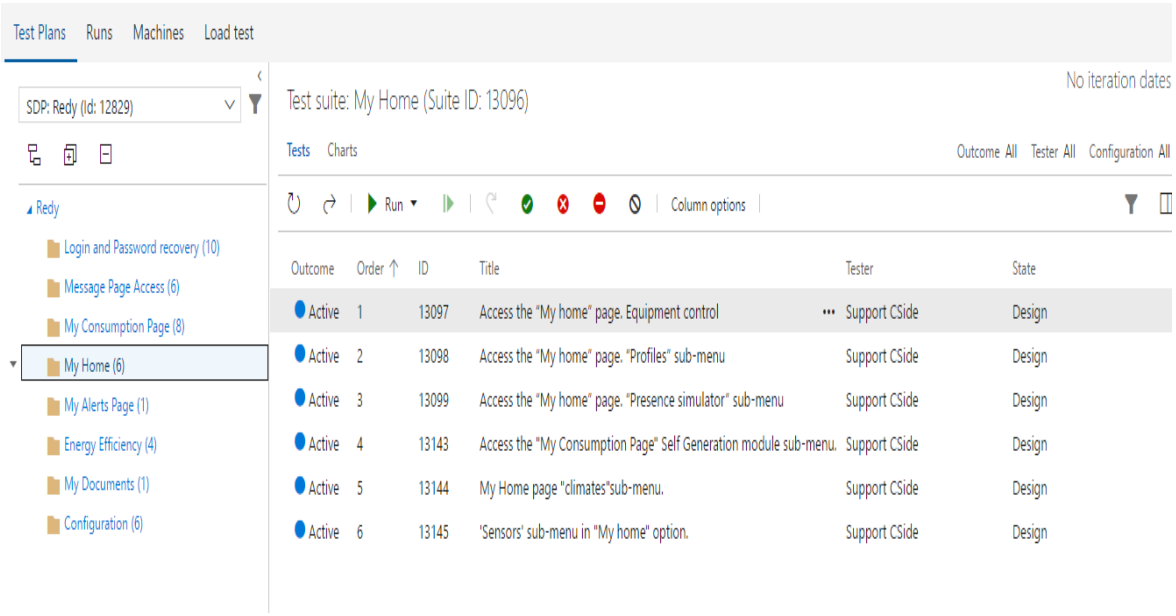

Fig 4.10 Test Report

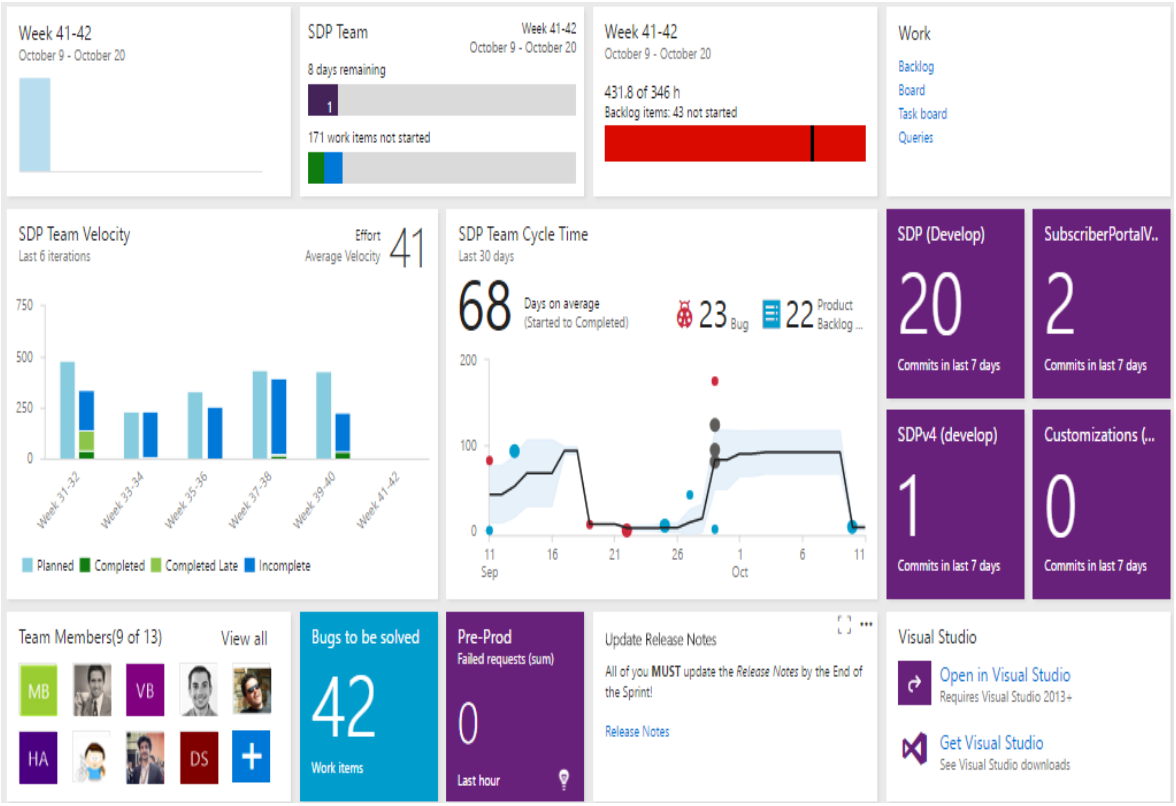

Fig 4.11 TFS OverView

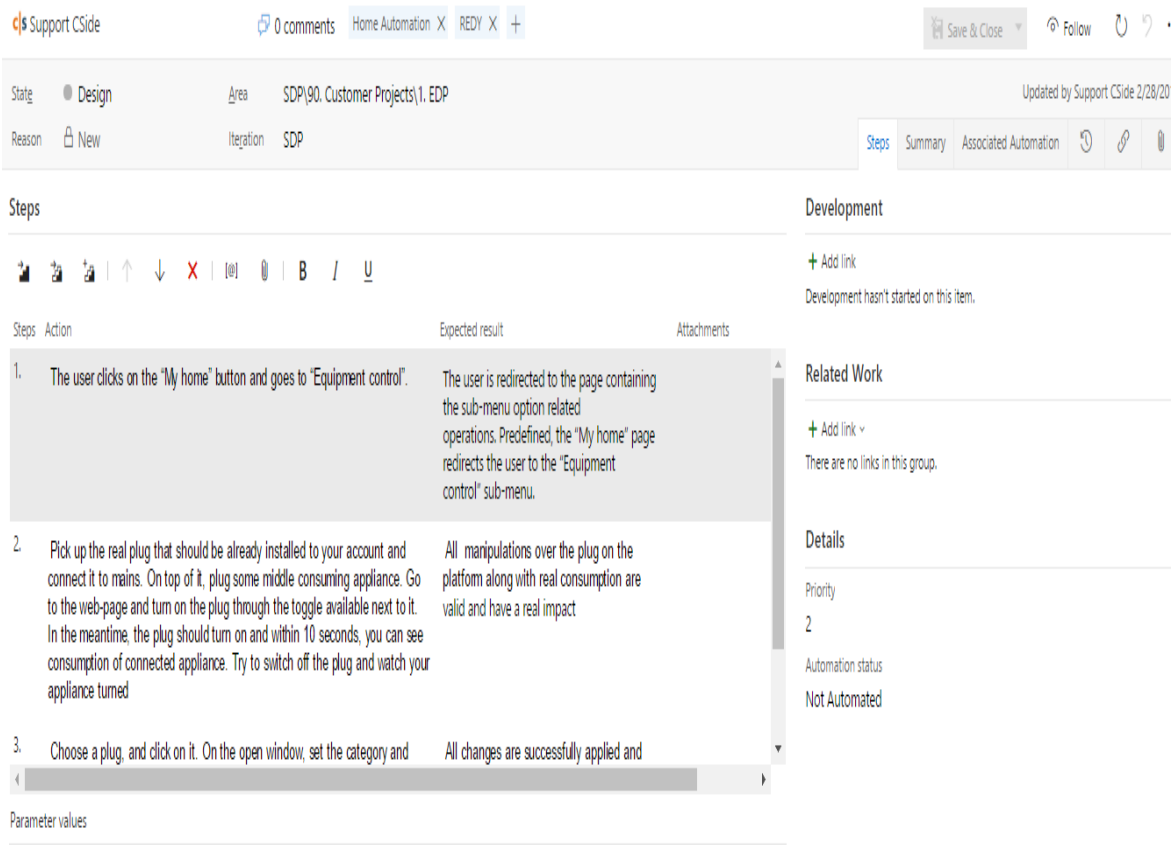

Fig 4.12 Inside Document

4.9 Manage platform events and scheduling

This application enables the customer to create actions and notifications based on multiples applications. For example, a customer can program his account to start recording a video from the Surveillance application, after the security console has detected an alarm and, at the end, send an e-mail to a list of users.

Details - This object holds the generic event properties, such as the name, description, start/end dates, last execution, etc.

Triggers - This array holds the list of triggers that will trigger the execution of the event.

Scheduling - These are the list of Date Triggers, a time pattern that will execute the event accordingly to an execution plan.

Actions - This array includes all the actions (e.g. switch on a light) that will be executed.

Notifications - This represents the list of users (it can be a user id or a direct email or mobile phone) that should be notified. The notification capabilities (SMS, Email, Voice Call or Push Notification depend on each platform deployment.

Energy Consumption HistoricVars

VarStat Names	Description
CurrentDay	Current Day consumption
CurrentMonth	Current Month consumption
Last24Hours	Consumption in the last 24 hours
Last48Hours	Consumption in the last 48 hours
Last30Days	Consumption in the last 30 days
Last60Days	Consumption in the last 60 days
Last12Months	Consumption in the last 12 Months
PreviousDay	Previous day consumption
PreviousDayStandby	Previous day standby consumption
PreviousMonth	Previous month consumption

Table 4 Energy Consume Varus

4.10 HARDWARE DEVELOPMENT

By connecting the edp box smart meter and qubino meter ,the analysis of demo equipments of home will be analysed and reported.

Integrates your home appliances, using communication protocols (ZigBee and PLC) and peripherals, and processes all the information re: dy box also has an intelligent meter that connects directly and provides information on the total consumption of your home. With the consumption, production and aggregate equipment, you can manage your house in a simple, integrated and intelligent way from the application

.It has the wifi enable remote energy dynamics to function capable of self-charging along with z-wave functionalities to connect the work modules in order to gather data and send feedback to the company as well as the client to eradicate the losses in power consumption pattern. With re: dy, you can control the consumption of electrical equipment using a portal on the Internet or by smartphones and tablets with the iOS and Android operating system.

The consumer analysis service, which allows EDP to know and record the total consumption of the household, is done by a connection to the customer's home via the broadband Internet. This communication will make it easier for the company to record consumption data using M2M (machine-to-machine) technologies.

However, according to the company's announcement, the service will be paid (99 euros in membership, plus 5.99 euros monthly for a loyalty period of one year) and has "unique features that distinguish it from other energy management systems in the market ", such as:

- ✓ real-time information, available via the Web and smartphone;

- ✓ individual control of the equipment manually or automatically and scheduling of tasks;
- ✓ historical analysis of consumption and tools of budgetary control
- ✓ programming of operating profiles according to their needs, habits and periods of absence
- ✓ receiving alerts that help eliminate waste
- ✓ advice on the best tariff and contracted power
- ✓ reception of customized reports of consumption analysis.

Smart sockets that allow you to make any electrical equipment, which will plug into an outlet, part of your smart home.

Fig 4.13 Plug Top View

Television, lamps, consoles, washing machines, fridge, whatever. Simply connect the device to the EDP re: dy plug

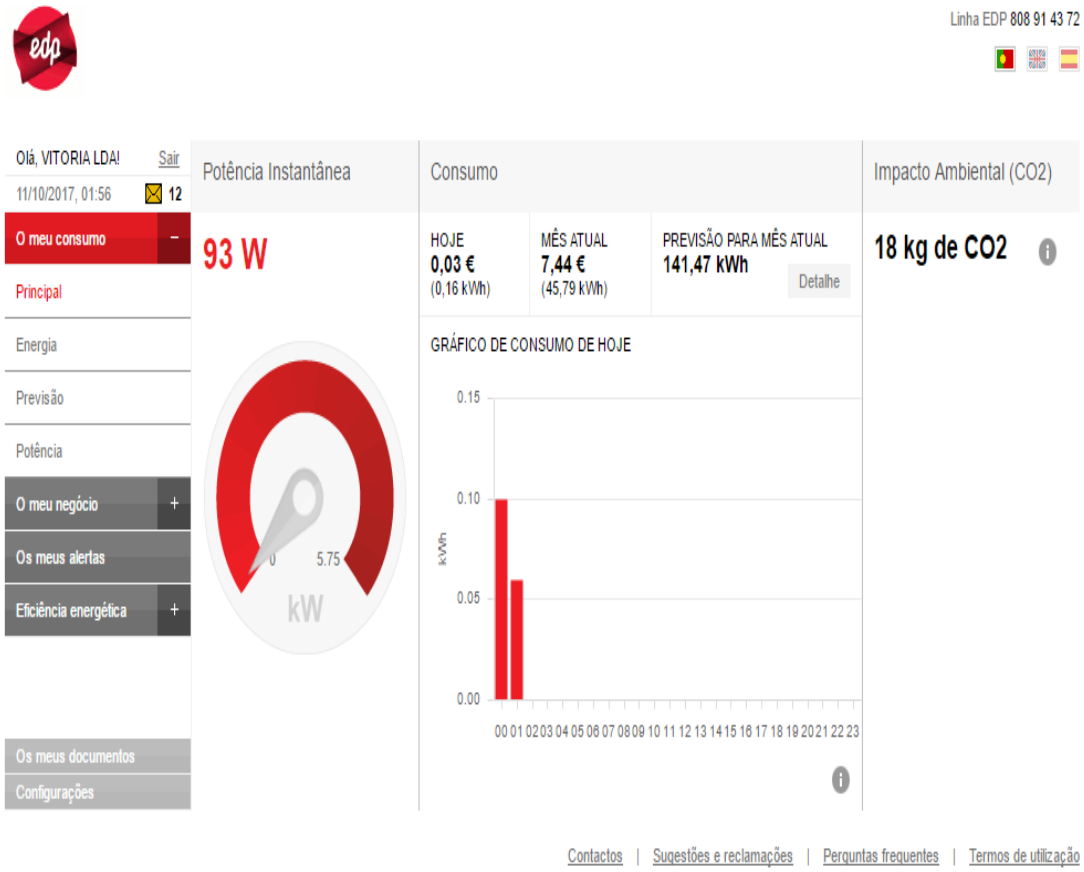

Fig 4.14 Source Page [2]

The above fig 4.12 represents the source power and client power consumption pattern web platform.

4.10.1 Hardware Functionalities

B280 PRIME is a new generation product, equipped with technology in the field of Energy Management, which contemplates the need for greater Energy Efficiency, of Greater Consumer Participation and Information and the new Micro Producers, which (wide range of new tariffs), transparency (real-time information), a reduction of fraud, with the possibility of cutting, resetting, and changing the remotely contracted power and optimization of the consumption. Intelligent Counter for active and reactive power consumed and produced in three-phase alternating current and direct connection in Low Voltage, in indoor use, to multidrive counts (up to 32 tariffs), capable of operating with 2 tariffs, with a built-in tariff clock, consumption profiles (6-month load diagram), tips with a broad communication capacity via GSM, GPRS, PSTN, Ethernet, PLC, among others (compatible with Multidrop solutions) and seamlessly integrated into a AMM solution).

4.15 JANZ KIT

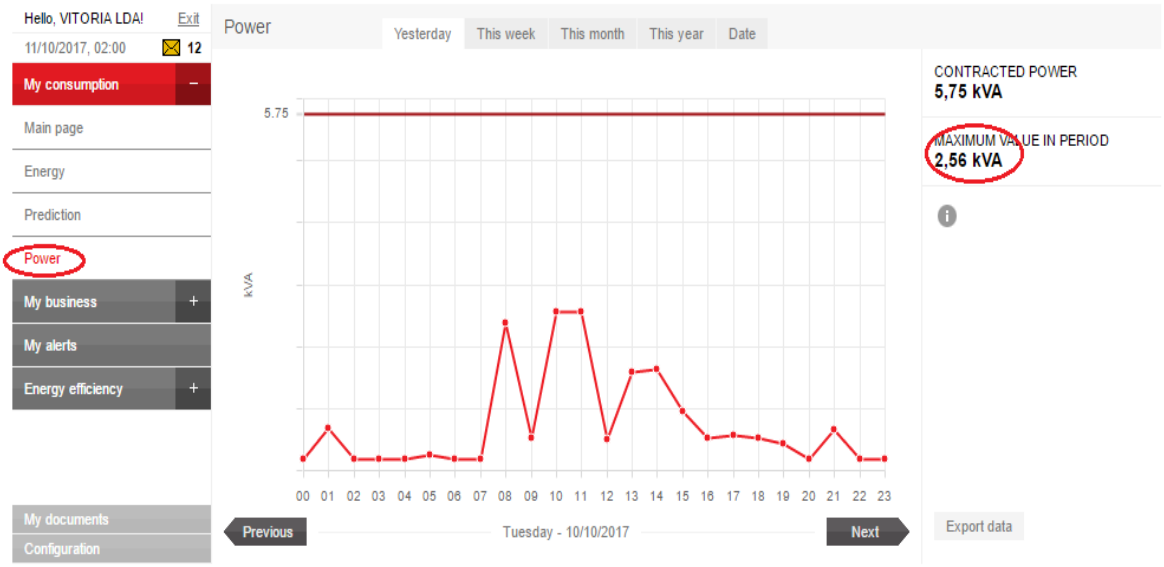

Fig 4.16 Power Consumption Pattern

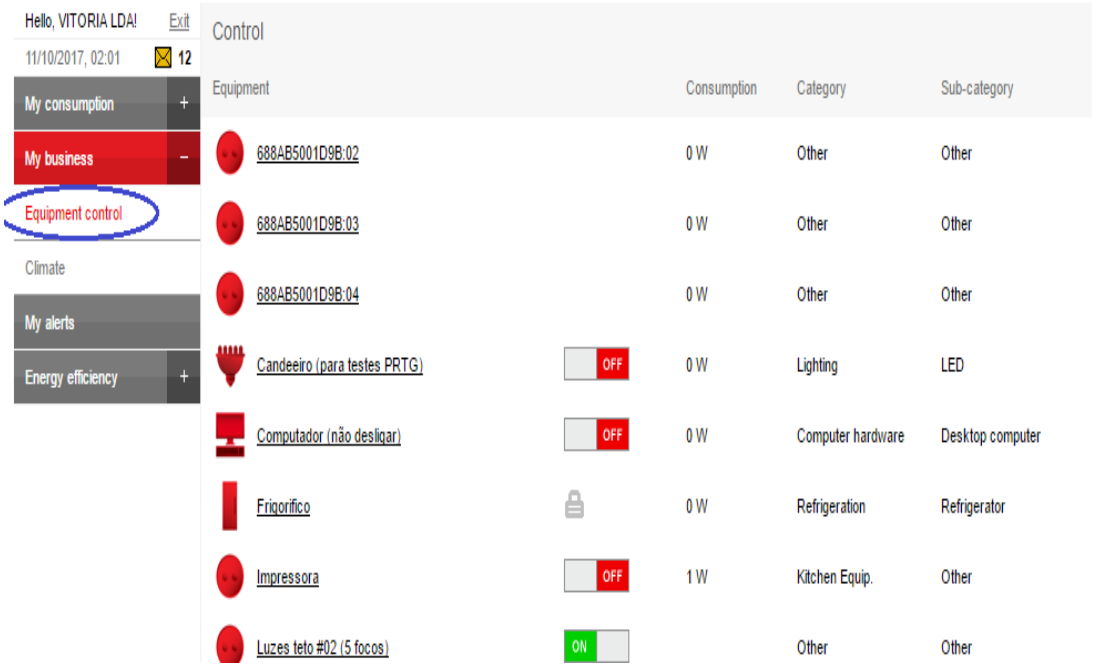

Fig 4.17 Equipment Operation

4.10.2 CHARACTERISTICS

1. Reference voltage: Un = 3x220 / 380V (-20% ... + 15% Un) and Un = 3x240 / 415V, (-20% ... + 15% A)
2. Operating limit voltage: 440V (for 24h)
3. Current range: Iref / Ib = 0.5 / 10A, Imax = 80A, Itr = 1A, Imin = 500mA, Ist = 40mA
4. Frequency range: 50Hz (5%)
5. Precision / Class B index for active energy (according to EN50470-3) and class 2 for reactive power (IEC 62052-11 and IEC 62053-23)
6. Constant: 3200 pulses per kWh and 3200 pulses per kvarh
7. Direct reading available on LCD, with registers up to 9 999 999 kWh / kvarh / kVAh
8. Maximum power and tips available on the LCD, with records up to 9 99,999kW / knar / kVA Voltage circuit load: less than 0.8W (active power) and 2VA (power apparent) at 230V, 50Hz
9. Current circuit load: 0.02VA at 10A, 50Hz, Terminals capable of receiving cables of sections from 6 up to 35mm2

10. Built-in clock / calendar, accurate better than 5ppm at stabilized temperature of 25 ° C, Operating temperature range: -25 ° C to + 60 ° C,Operating temperature range: -40 ° C to + 70 ° C, Storage temperature range: -40 ° C to + 80 ° C.

4.10.3 Description

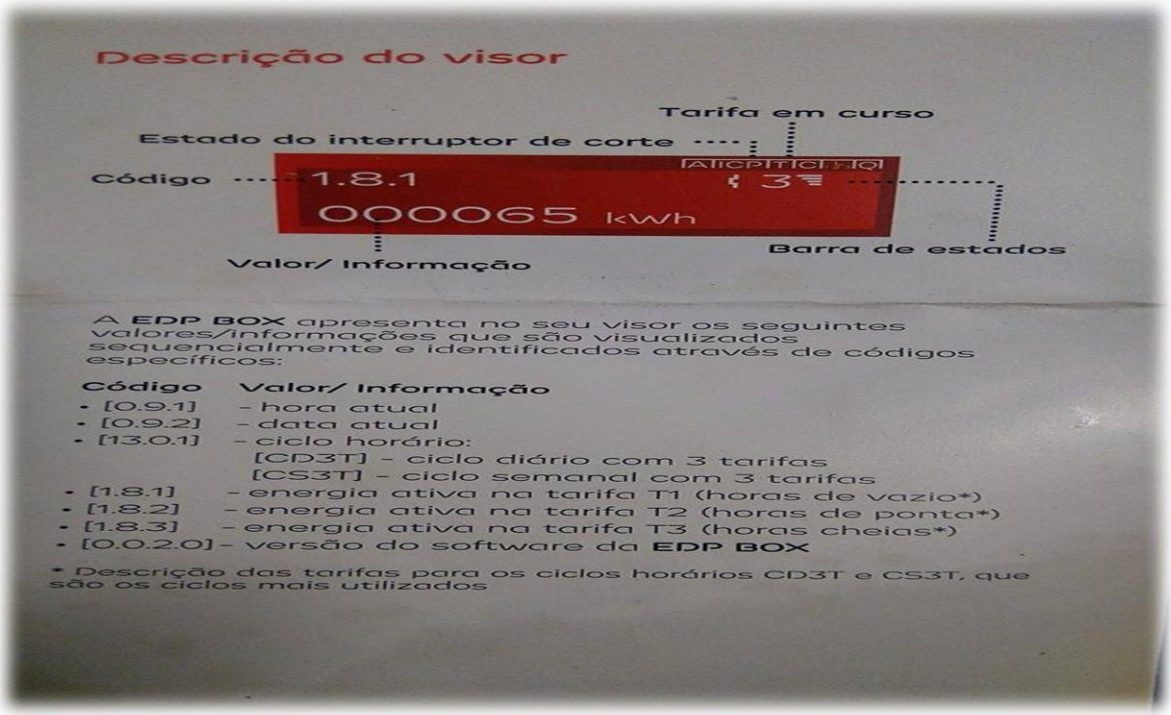

Fig 4.18 JANZ Description

1. 32 Independent registers, to combine measurements (active/reactive apparent energy or maximum points) with tariff registers (TOU)
2. 11 Power Totalizers
3. 10 total maximum points (regardless of tariff registration programmed)
4. 2 Daylight Saving Time (programmable) / 2 tariff stations (programmable)
5. 72 Possible tariff changes throughout the day
6. 15 Fixed holidays per year / 120 mobile holidays in total
7. 45 consecutive days of daily registrations

This meter was approved under the (MID), reference 2004/22 / EU, the technical references of which are EN50470-1 and EN50470-3 by the notified body SGSUK. By the same organism has been proved the conformity with the norms IEC62052-11 and IEC62053-23 in the field of reactive energy measurements.

Fig 4.19 PLC Formation [3]

Immunity to: electrostatic discharge; radiation fields electromagnetic; fast transients; induced disruptions by radio frequency fields; shock waves; cuts and shortfalls of tension; continuous electromagnetic fields; electromagnetic fields alternates; suppression of radio interference.

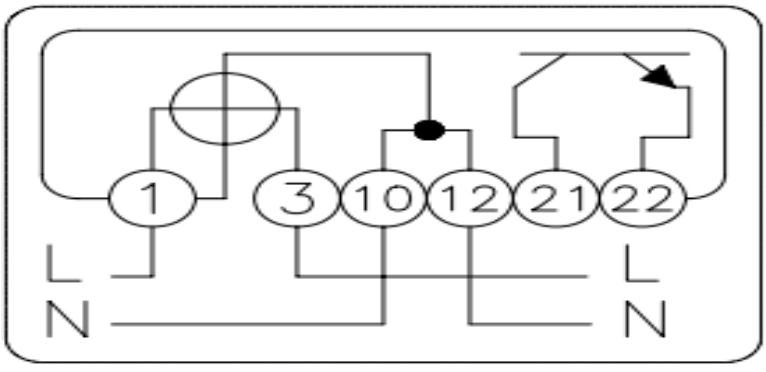

Fig 4.20 Wiring Diagram

Communication Modules such as Power Line Carrier (PLC) or GSM / GPRS, among other technologies, have been developed to application range of the B280 PRIME meter, namely its integration into an intelligent power management network (Automatic Meter Management / Smart Grids) Locally: Standard optical port according to IEC 62056-21, using FLAG - Mode E (communication protocol) Remotely: RS232 serial port multi-drop, HAN, Wi-Fi and ZigBee accessible by RJ12 outlet, running at 9600 baud, using the DLMS-COSEM communication protocol.

ICP: Power Control Switch

The B280 PRIME meter has a bi-stable relay, controlled by the microprocessor, and operations may occur in local mode (version standard), or in local mode and remote mode. ICP makes it possible locally or remotely, Cutting and resetting, Change of parameters such as: First contracted power (kVA), Overload tolerance of the first contracted power (in%); Monday contracted power (kVA); Second Power Overload Tolerance contractor (in%); Maximum permissible current (for safety of the installation); Permissible overload time (maximum 60s).

Fig 4.16 has re:dy meter with qubino smart meter measurements connection diagrams with the wiring diagrams.

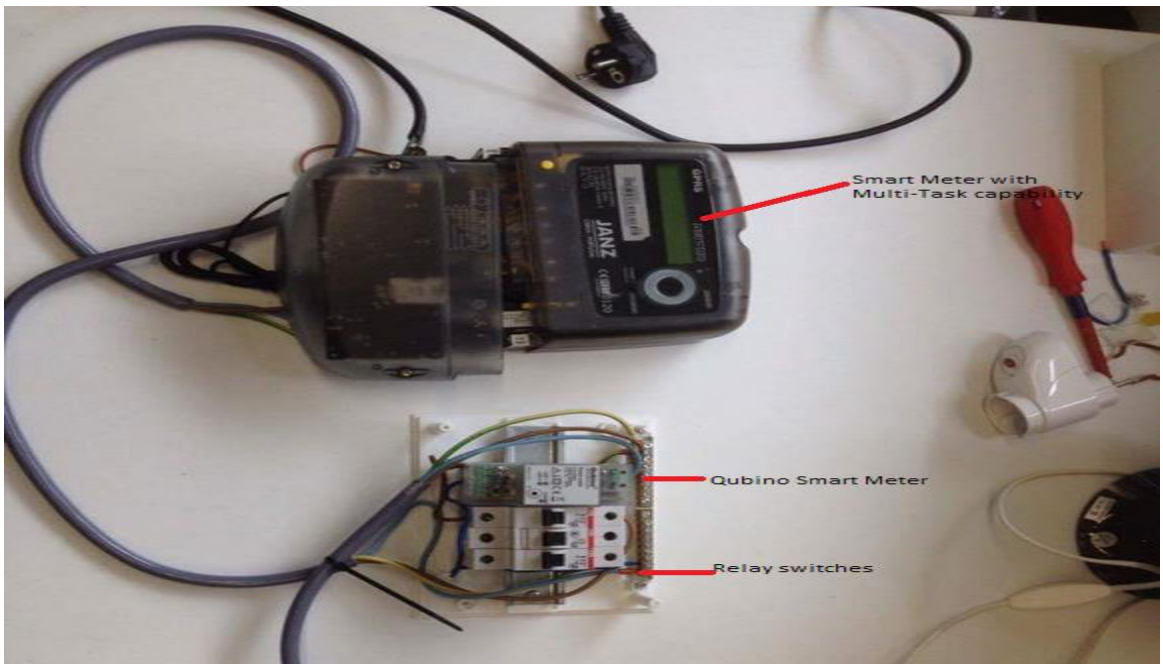

Fig 4.21 Hardware Overview

4.11 Qubino Smart Meter

Fig 4.22 Qubino Smart Meter

The Qubino Smart Meter can be used in residential, industrial and utility applications. It measures energy directly in 2-wire networks by means of fast sampling of voltage and current signals. It calculates energy, power and power factor from the measured signals. You can control the module through the Z-Wave network. It also acts as a repeater to improve the range and stability of the Z-Wave network. The Smart Meter is designed to be mounted on a DIN rail.

Qubino modules are "install-and-forget" products. Our products are made to last, so i only select and use top-quality electronic components. Our modules are also the most tested Z-Wave microcontrollers on the market. The Slovenian Institute of Quality and Metrology (SIQ), an independent testing body, tests safety parameters including temperature rise, construction, insulation resistance, power consumption and overload in accordance with the EN 60669-2-1 standard.

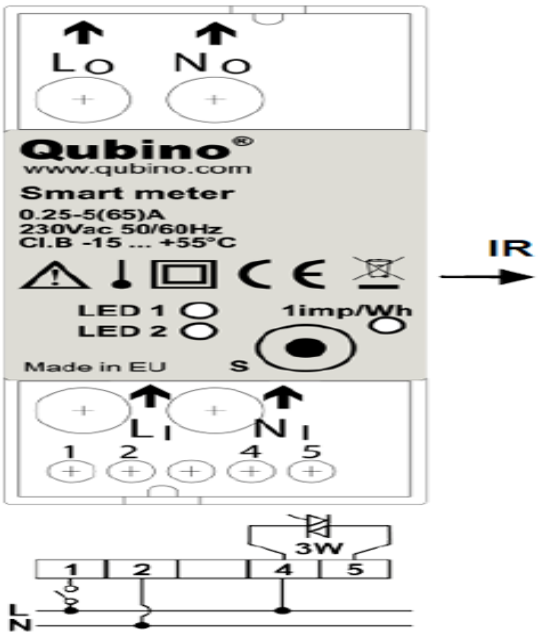

Fig 4.23 Technical Specification

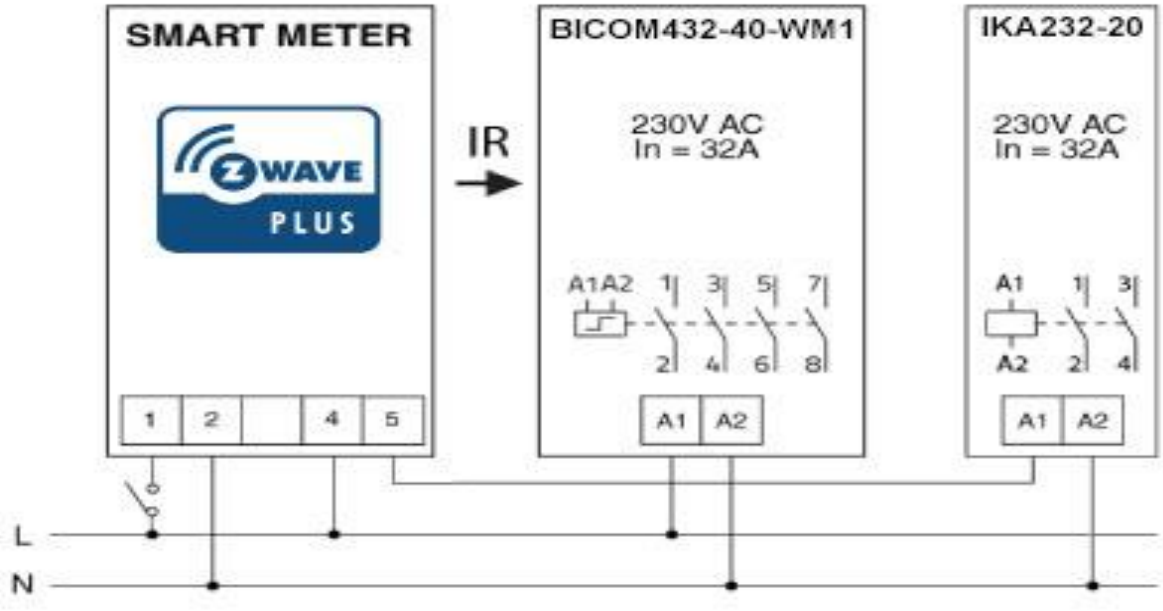

Fig 4.24 Relay Wiring Diagrams

4.12 Applications

Home Safety-The Home Safety Application is an easy-to-use software suite that facilitates the creation, maintenance, and management of an advanced electronic protected home. Following simple and intuitive wizards, the user is guided step by step through configuring his alarm being in control over his smartphone or web. With the Home Safety Application, the user can remotely arm, disarm or partially arm his security panel, check the full status of all installed sensors and check the latest logs from the gateway.

Digital Surveillance-The Digital Surveillance application provides all services related to accessing and recording of surveillance images and videos at home or SME. A complete

range of surveillance possibilities includes live-video streaming with audio, digital recording on the platform and remote control of the cameras. Digital surveillance application supports recording manually, scheduled, triggered by an event of videos and images. All images and videos can be recorded over the Digital Surveillance application and remotely accessed.

Home Automation-With the Home Automation Application, users can remotely control any kind of home appliance. Using different modules, the HA Application empowers the user to switch on or off devices, check the temperature and humidity, control thermostats, regulate the dimming of a light, among other possibilities. Using remotely controlled central thermostats, the system set the right temperature based on customers scheduled instructions and home profiles of usage. Using radiator thermostats per radiator, the platform adjusts the temperature by each room automatically, in the most efficient way. The application enables easy ways for automation by organizing devices/equipment into rooms, favorites or categories; all done by simply dragging and dropping devices/equipment in the interface. A scheduling calendar enables customers to easily drag & drop the weekly agenda of actions that must be performed. A profile status allows a simple definition of the aimed status of the home at any time: 'Away', 'At Home', 'At Work' or 'On Holidays' making homes more intelligent, quickly adapting itself to customers profiles of usage.

Energy Consumption-Energy management applications gather the data from homes and add intelligence to provide real insight to end users. Information about standby, comparison tools, tariff optimization engines, notifications, and reports enables to engage residential customers. Energy management application enables detailed graphs of historic energy consumption of all household or detailed view per device. Customer may check the history of energy consumption per day, week, month or year, together with indoor/outdoor temperature evolution and past weather information. A comparison of the levels of consumption in different periods is available, through illustrative graphs, images, and diagrams.

Events and Scheduling-The Event Manager enables you to create automation tasks as easily as using a windows calendar. The user simply chooses the date/time and/or event-based conditions, set his desired actions and the system is ready to go. The user can therefore easily program taking snapshots or starting video record when a door is open or, for example, daily

snapshots of the garden in the summer cottage that are sent to the user email or mobile handset.

Weather Forecast-The Weather Forecast Application gathers information of weather information and makes it available on appealing ways to users enabling them a better management of the smart home.

Energy Production-The application provides graphical diagrams of past energy generated by day, week, month and year. When passing the mouse over the diagram, detailed values become visible. All information visualized on the diagrams, including notes, can be exported in numerical format (.csv) and organized on chronological table format for easier reading. Customer may choose to watch the past evolution: of energy generated (per kWh or per production unit); of revenues (€) or check the impact of CO2 emissions.

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Chapter 5

5 Conclusion & Test Results

Current technological solutions for real-time energy feedback suffer from multiple issues, for example, unengaged users; failure to address users' personal motivations and needs to be embedded in daily routines and social practices; information comprehension issues caused by abstract numerical information in kWh or financial costs; and inattention to users' personal characteristics. It seems clear that users need something more to motivate and engage them than plain energy feedback in kWh or cost if we are to get energy reductions of 10% or more. Some research indicates that intelligent energy feedback that offers different feedback options might be effective.

By comparing the obtained results with Janz and Qubino also along with consumer database of re:dy equipment of two days ,the better solution with optimum energy reading value equipment is EDP re:dy smart meter.The

obtained readings from two days of re:dy equipment with compared values of Qubino module energy measurement from computer with different harmonics level pattern shows us,

Computer re:dy – 35 Watts(00.035 kW)

Qubino Value - 45 Watts

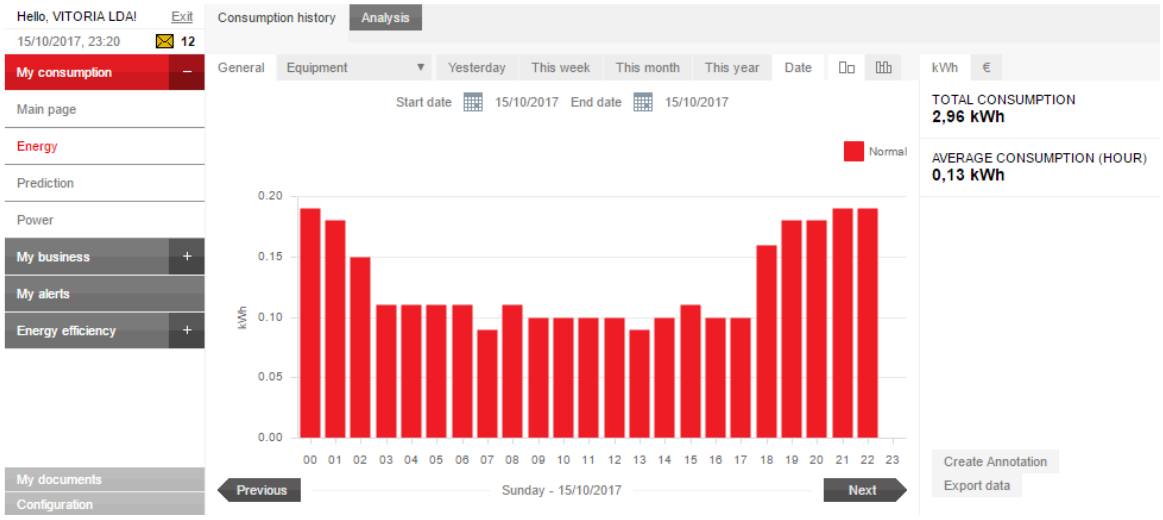

Fig 5.1 Energy Reading 15/oct/2017[2]

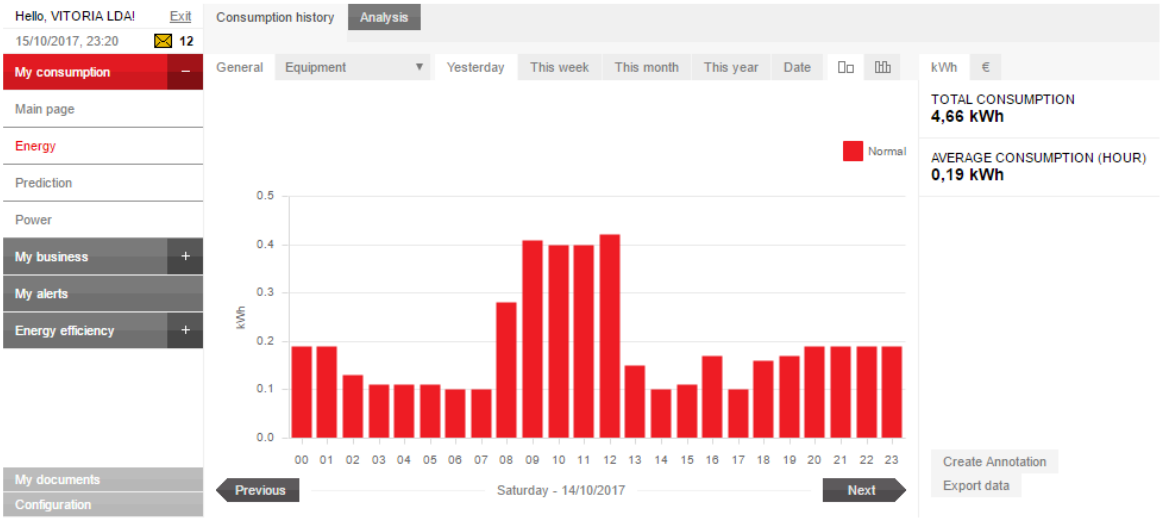

Fig 5.2 Energy Reading 14/oct/2017 [2]

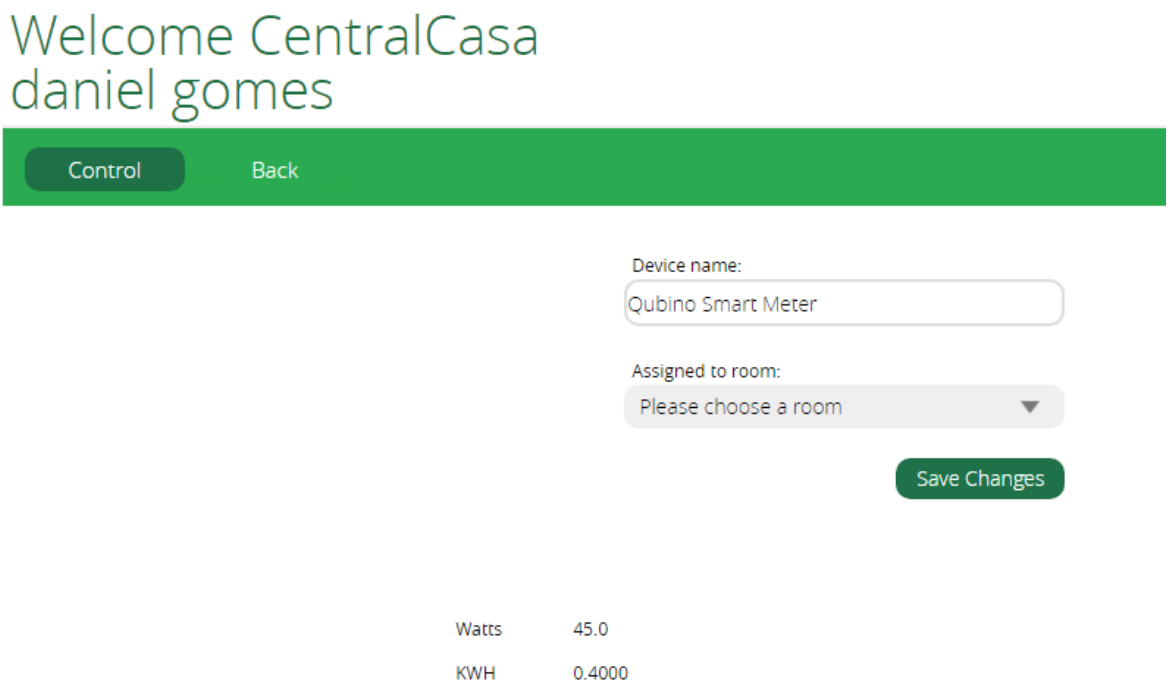

Fig 5.3 Qubino Readings -Computer

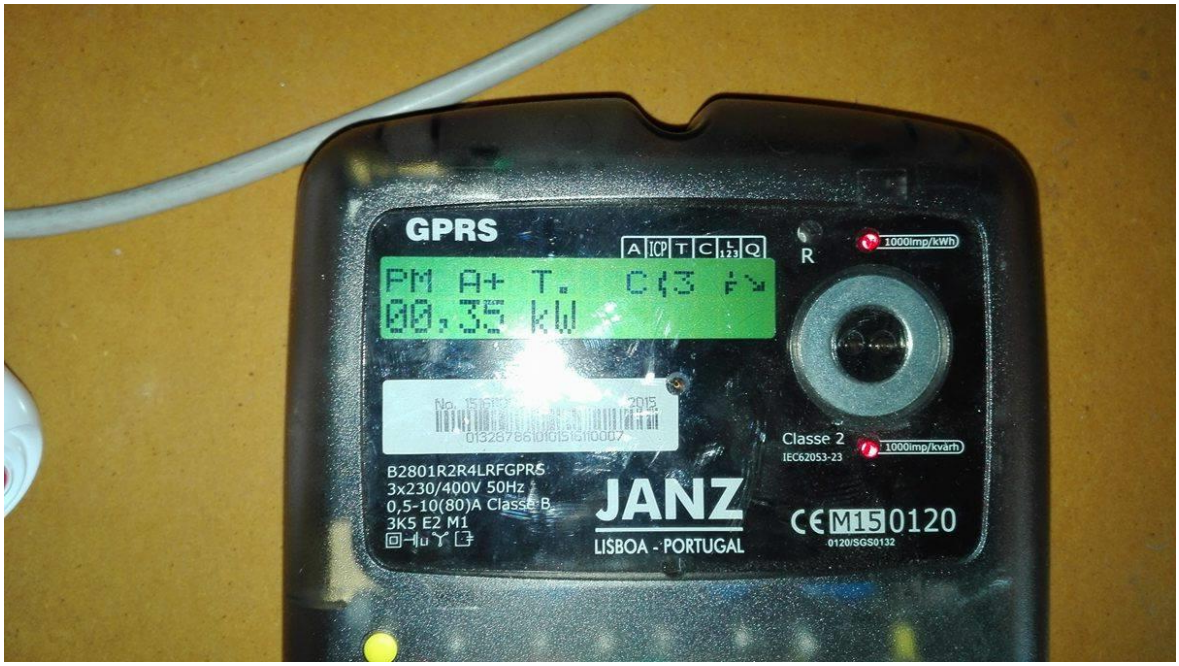

Fig 5.4 re:dy Readings

5.1 Advantages:

Tracking software provides a detailed accounting of whole house energy use by service entrance, appliance or circuit level. IP based systems provide energy data across home networks or to anywhere using smartphone apps. Data logging and level of detail provide the greatest potential for sustained energy savings.

5.2 Disadvantages

Prices escalate as the number of measurement points increase. Installation requires work to be done on the main circuit breaker panel. Hire a licensed electrician to do the work unless you are acutely familiar with residential wiring. Basic IP networking knowledge may be needed to troubleshoot communications.

- Qubino smart meters may temporarily lose smart functionality When switching suppliers, meters may have to turn to "dumb" mode until support for these older meters is implemented. First generation meters (SMETS1) are not compatible with all suppliers. In this case, I would have to revert to giving meter readings. This issue is set to be resolved by 2018.

- Qubino smart meters aren't currently compatible with solar or microgeneration we may find that the supplier cannot offer you smart meters just yet as they are not able to work with solar or microgeneration.

  The location of your meter could be inaccessible If your meter is located in a place where signal may be an issue (e.g. in the basement) your supplier's current generation of meter may be unable to achieve an appropriate signal to send information remotely to the supplier — in this case, you won't presently be offered one.

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