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List of Abbreviations

API	Application Programming Interface
ATC	Athens Technology Center SA
BCU	Birmingham City University
CIBG	Centre d'Informatique pour la Région Bruxelloise
CSR	Customer Service Representative
DEL	Deloitte Consulting CVBA
EH	Energy Hive
EPIC	EU Platform for Intelligent Cities
HIL	Hildebrand Technology Limited
HVGA	Half-size Video Graphics Array
IBBT	Interdisciplinary Institute For Broadband Technology
IBM	IBM Deutschland GMBH
IMMO	Immoweb
JSP	JavaServer Pages
MCC	Manchester City Council
MVC	Model-Viewer-Controller
NAV	Navidis
POI	Point Of Interest
SME	Small and Medium Enterprise
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
WPF	WebSphere Portlet Factory

1. Executive Summary

This document presents the realized prototypes of the three Pilot Applications for the EPIC project. It is the result of several previous deliverables among which *D2.2 Stakeholder (User) Workshops' Results* and *D2.3 Online Service Delivery Baseline and Technical Requirements Report* and *D.5.1 Specification of Scenarios of Use & Ecosystems* particularly underpin the overall user, technical and scenario requirements that benefit the various stakeholders involved. This deliverable is crucial to ensure the timely and elaborate execution of the pilot and Living Lab phase which will be outlined in *WP7 Pilot Deployment* and *WP8 Results Validation*.

This Prototype Deliverable contains for each Pilot Application, respectively, Relocation Service Application, Urban Planning Service and Smart Environment Service, a summary of the structure and functionality of the initial prototype version, including a URL from which the Pilot Applications can be currently reviewed and/or downloaded. These are:

(1) Relocation Service

* Web Application (p. 19):
https://vhost1825.site2.compute.ihost.com/wps/portal (login: guest; password: guest)

* Mobile Application (p. 20):
https://testflightapp.com/join/e84eb49002e1619bfb470747c3289911-NTAzOTM/ (user needs to register!)

(2) Urban Planning Service

* http://www.georeporting.net/epic/app/framework_Data/Index.html (p. 33)

(3) Smart Environment Service

* Web Application (p. 35)
http://www.energyhive.com/

* City Portal View (p. 53)
http://www.energyhive.co.uk/manchester

2. Introduction

This deliverable reports on the delivery of the initial prototypes of the three EPIC Smart City Services:

1) Relocation Service Application,
2) Urban Planning Service and
3) Smart Environment Service.

Living Labs have used the EPIC platform to jump start the rapid prototyping and testing of these innovative new user-designed services. In addition Living Labs will assist in the testing of the services over the next 12 months through pilot deployments and, as a result, are likely to extend the current version of the Prototypes presented here.

The final delivery of the integrated platform complete with the service catalogue and appropriate testing reports will be presented in D4.1. This deliverable will signal the readiness of the technical solution for the pilot phase of the project.

The remainder of this document presents the delivery of:

• **Relocation Service Application** – this application helps users to find a place to live in Brussels by enabling them to perform queries to find certain locations in the city according to specific constraints. Query results are visualized on a map and in an augmented reality environment. Users are also able to visualize the results of their queries by 'walking' through their chosen neighbourhoods.

• **Urban Planning Service** – this application creates a virtual space for consultation and participation where interested stakeholders can exchange information on urban development projects, understand proposed visions for the city and experience potential developments first-hand. The application combines simplified view, 3D modelling, rich media and symbolic information to enable users to experience planned developments for themselves.

• **Smart Environment Service** – this application helps households to view their energy usage and then change behaviour to reduce their carbon consumption. In-home hardware measures instantaneous electricity consumption and transmits this data to a data repository for storage and aggregation. Information is presented online via an attractive dashboard that enables users to compare the performance of their home against a community average.

3. Overview of the Pilot Applications

This chapter provides an overview of the pilot applications in terms of objectives, prototype and technical descriptions, and a summary of preliminary testing to ensure functional prototypes.

3.1 Functional Prototype for Relocation Service Application

3.1.2 Objective

The aim of the Relocation Service Application is to assist individuals and families in their relocation to a new city (see D5.1). In its currently envisioned form, the application focuses on helping its users to:

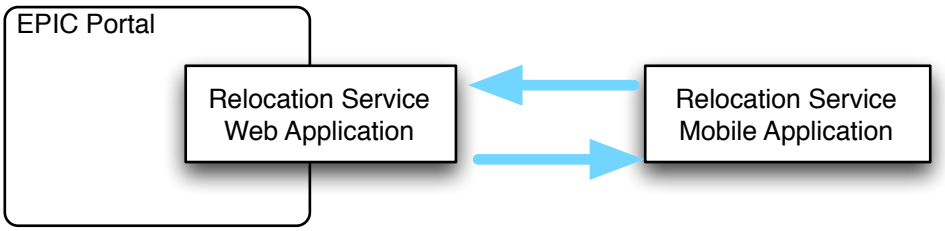
- Get to know the different areas of the city and help to decide which areas are preferable to live in.
- Find available housing, for sale or for rent within these preferred areas.
- Evaluate individual properties, for sale or for rent, based on a multimedia description of the property itself and of the neighbourhood it is in.
- Discover points of interest (e.g. Educational or Recreational facilities) around these properties.
- Discover and engage with institutions, organisations and facilities targeted at the integration and support of incoming and existing citizens of the smart city. This includes making sure the user knows what administrative tasks need to be fulfilled to move to the city, where family members can be enrolled in education and more.

3.1.3 Prototype Description

The Relocation Service Application meets these objectives by providing both a web-based component as well as a mobile application. The web application provides a feature-rich interface that can be used by incoming citizens when preparing their move to the smart city, during their first visits to the city and after their move.

The web application's functionalities are extended by an Internet enabled mobile application that supports incoming citizens when actually 'on the ground' in the smart city. Preferences and searches made in the web-based component are reflected in the mobile application as it guides its users to preferred properties and the points of interest around them.

The application also allows its users to add feedback to the properties and places visited during their visit. This information is stored online, so it can be used in both, in the web as well as in the mobile components.



In that sense there is a feedback loop between both components as the user switches between moments that he or she is seated behind an internet enabled computer, regardless of location and moments that he or she is 'on the ground' in the smart city, discovering the best place to live.

The information on properties available in the smart city comes from multiple data sources made available through the Internet. Instead of interacting with these data sources directly and individually, all of the information needed is brought together and made accessible to the web and mobile components to one single, custom-built set of web services, hosted on the EPIC platform.

3.1.3.1 Web Application

Although the mobile application can be used by itself, the web application is envisioned as the primary interface to initiate one's search for the best place to live in the smart city. Less restricted by the screen-size limits imposed by mobile devices, regular web applications can provide more feature rich interfaces and functionalities.

The application consists of 3 major parts, which we will describe below: 'Find a Place', 'My Favorites' and 'Living in Brussels'.

Find a Place

The main functionality of the Relocation Service application revolves around finding potential places to live in the smart city and being able to do a preliminary evaluation of these properties, be they for sale or for rent. This is done by (1) doing a search of properties, based on a given set of search criteria and (2) browsing through the search results, looking at individual properties in detail.

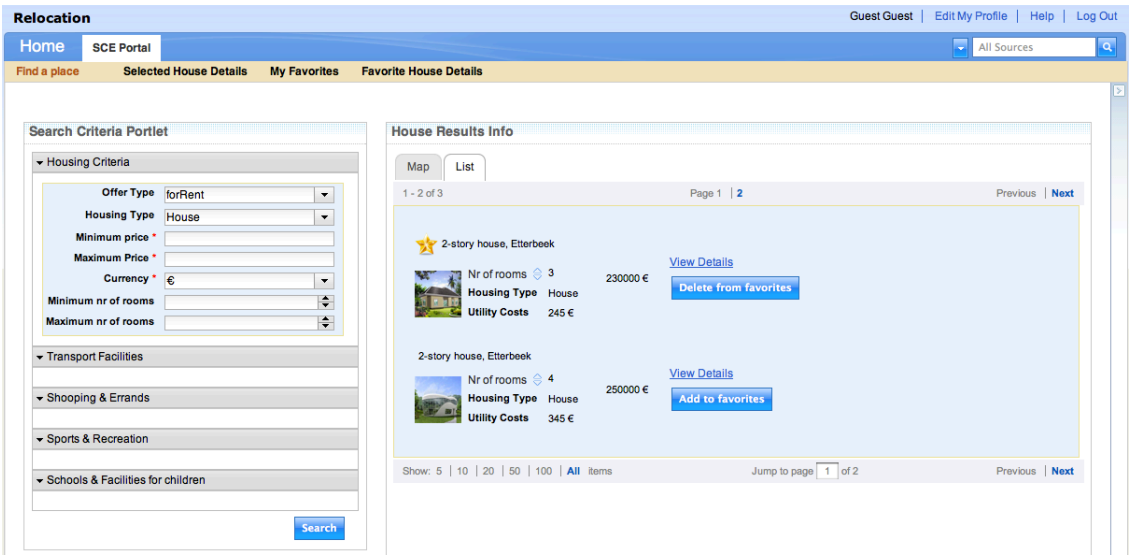


Figure 1 - Searching for a place to live in the smart city

Searching for available properties is done by entering a limited set of search criteria. Initial reviews by potential users of paper 'mockups' for this search functionality have shown that limiting and simplifying the amount of possible search criteria is desirable, so this is reflected in the current interface of the search window in Figure 1.

Search results are shown in a list, which shows only the most important information available on the properties that match the search criteria. Alternatively these search results can be viewed on a map, as shown in Figure 2.

Clicking on individual properties leads to a more detailed view of the selected property for further evaluation.

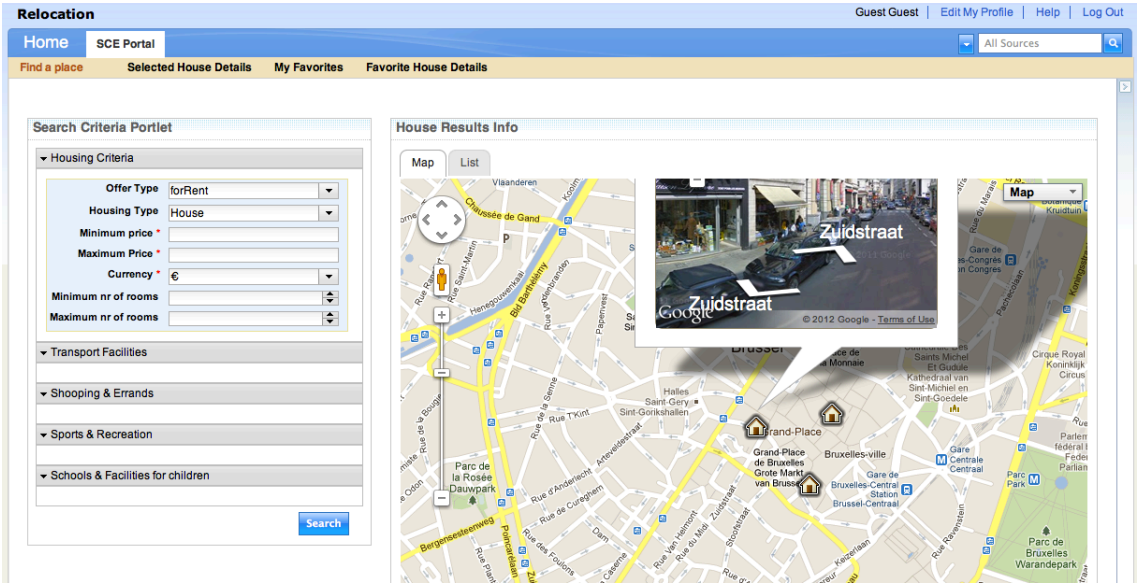


Figure 2 - Search results displayed on a map

In a detailed view of a property (Figure 3, below), the application shows more than just the information available on the property itself. Apart from this general description, the detailed view is supplemented with information about the area the property is in. This includes an overview of points of interest of different categories in the neighbourhood. In a later phase, this will be extended by more general indicators and information on the area itself.

By displaying the points of interest in the area around the property on a map, the user is assisted in further evaluating the property. Is a school nearby for his/her kids? Where is the nearest metro station? Is there a park in the neighbourhood? Different points of interest can be shown or hidden again, depending on the personal interests of the user.

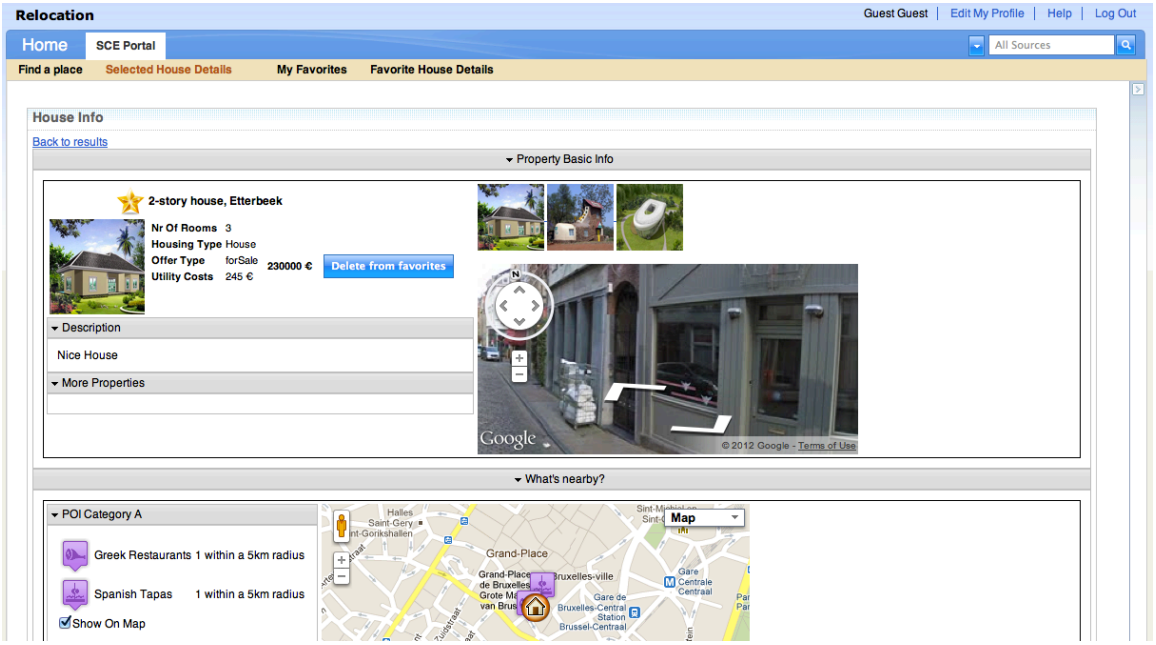


Figure 1 - Detailed view of a property

When a property is of interest, the user can add it to his/her favourites for later review or to easily retrieve the property when using the mobile application. The same can be done for the points of interest. Knowing that a school is nearby is one thing, but actually visiting it when 'on the ground' in the smart city makes all the difference on deciding whether it is the right school for one's kids or not. In this form, the application goes beyond traditional property-finding websites.

My Favorites

The "My Favorites" window provides the user with a one-stop overview of both properties as well as points of interest that were marked as a favorite. This allows the user to quickly retrieve these as well as remove them from the list in case they are of no further interest anymore.

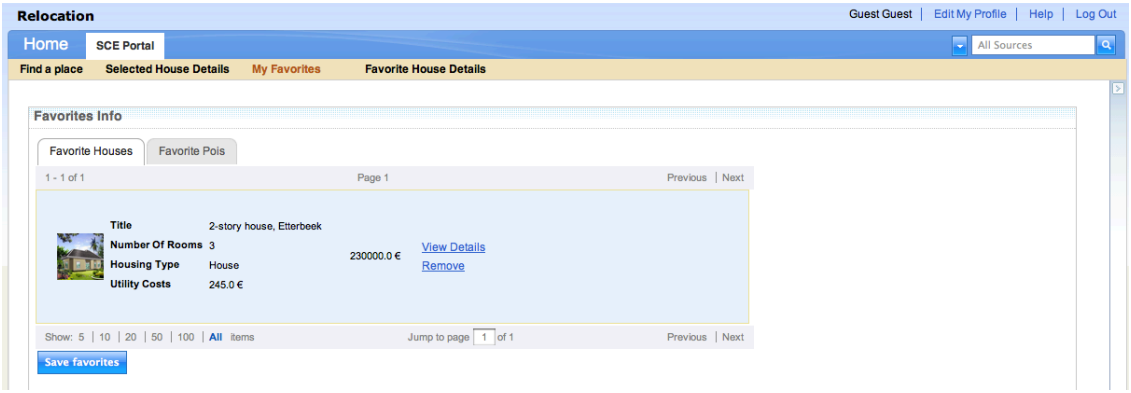


Figure 2 - Favorite properties and points of interest

Living in Brussels

Moving to a new city is more than just finding proper housing. It is also about connecting with the property institutions and facilities to take care of legal and other administrative matters that must be taken care of when moving to a new city underpinning the smart city vision (see e.g. D5.1). For anyone new to a city, and especially those from abroad, knowing where to go is not always clear from the beginning.

To facilitate this process, the "Living in Brussels" section gives the user a clear overview of these institutions and facilities, their purpose and contact details. For ease of browsing this section is grouped in different categories.

Information to be included in the "Living in Brussels" functionality is currently being gathered and authored and the functionality itself has not been added to the platform yet. Figure 5 below shows a mock-up of what its intended form.

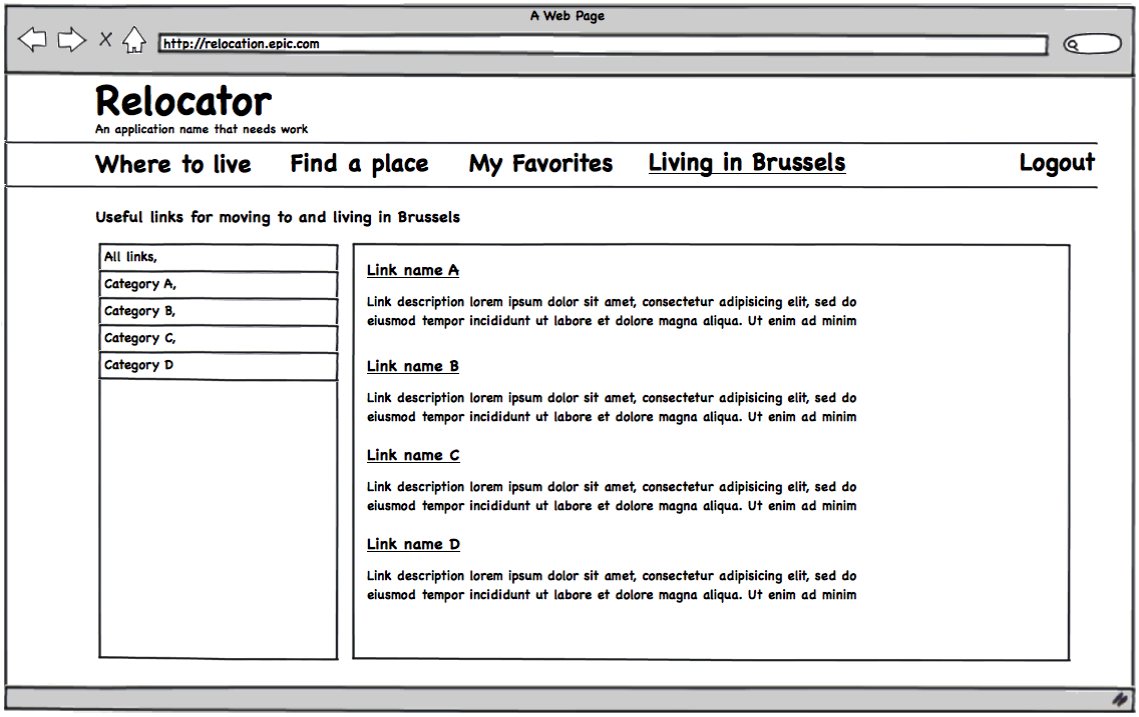


Figure 3 - Living in Brussels links and resources

3.1.3.2 Mobile Application

The mobile application can be used as an extension of the web version, moving things from the browser window to the streets of the smart city, or as a standalone application to assist its user to find properties in the smart city when actually walking around in it. Just like the web application, the mobile application relies on the web services provided on the EPIC platform for user authentication and information retrieval. This means that the application requires an active internet connection.

Due to a more limited screen size and due to the limited Internet connection speed most smartphone users will experience when walking around the city, the functionalities of this application are not as extensive as the browser version. Yet at its core the application does not differ much from the web application. The application allows users to (1) search for properties, (2) browse properties and view them in detail, (3) browser points of interest, (4) browse favourite properties and points of interest.

The user experience of this application is however streamlined towards supporting users when actually on the move in the smart city, allowing easy filtering of properties and points of interest near to the user's location as registered by the smartphone's GPS capabilities.

User Authentication

In its current form, the application is available only to users who have already registered themselves on the EPIC platform (see D4.1). When starting up the application the user is greeted by a login screen (Figure 6).

For security purposes, the application presents this login screen on every start-up of the application, as opposed to some mobile applications, which remain linked to a specific user until

the user chooses to remove his or her credentials from the application. The application does however store the username of the user who last used the application. This way, returning users need only to fill in their password again.

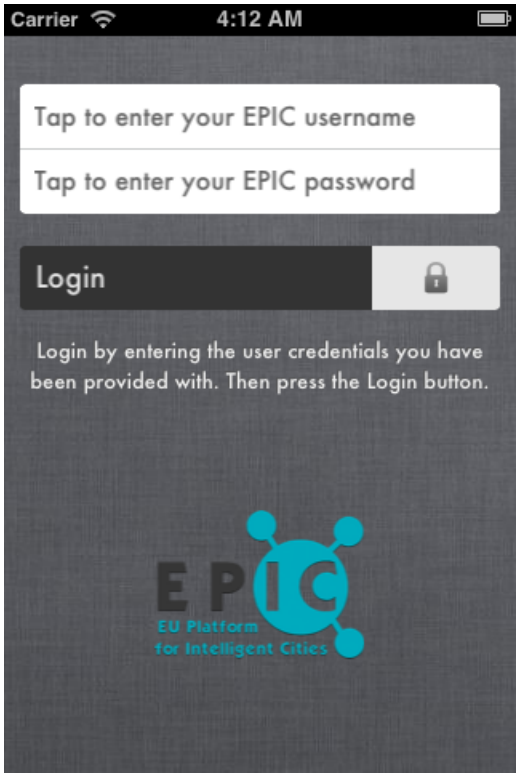


Figure 4 - Mobile application login screen

After successfully logging in, all functionality in the application is called from the main menu, shown in Figure 7.

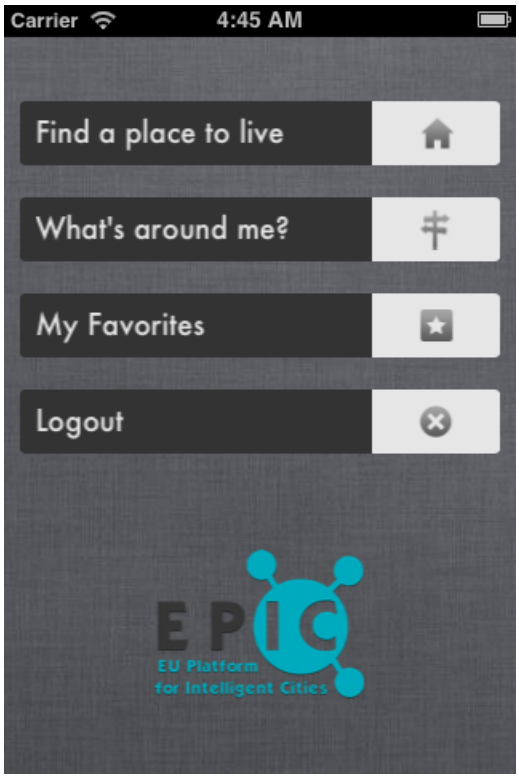


Figure 5 - Mobile application main menu

Searching properties

Clicking on the 'Find a place to live' button leads the user to a search form that allows the user to enter a number of search criteria, which shows a results screen with matching properties, as shown in Figure 8.



Figure 6 - Mobile application search results in Dutch (sample data)

Viewing property details

Clicking on a property shows the property's details for further reviewing, as shown in Figure 9. From the same screen the property can be shown on a map, relative to the user's current location and a list of nearby points of interest can be shown.

Via a button at the top-right of the screen, the user can add or remove the property from his or her list of favourites.



Figure 7 - Mobile application property details (sample data)

Browsing nearby points of interest

Clicking on the 'What's around me' button leads the user to a screen with an overview of points of interest nearby the user's current location (Figure 10), sorted on those points of interest that are nearest to the user. A filtering function allows the user to only show those points of interest from a specific category (e.g. schools).

Tapping a point of interest from the list leads to a more detailed view of the point of interest (Figure 11), together with a map of its location relative to the user.

Similar to a property, a point of interest can be added or removed as a favourite by a simple tap of a button.

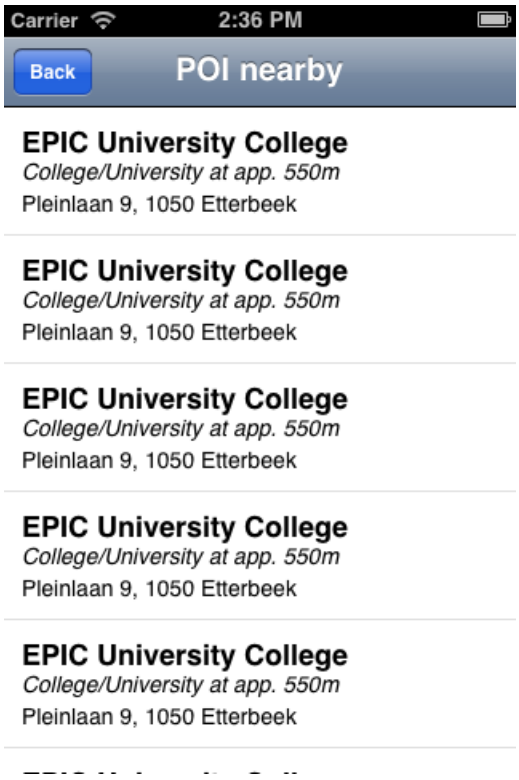


Figure 8 – What is nearby? (sample data)



Figure 9 - Point of interest details

Browsing favourite properties and points of interest

Tapping the 'My favourites' button on the homepage allows the user to quickly retrieve favourite properties or points of interest from a list.

Properties added or removed from favourites are automatically synchronized with the EPIC platform, so these changes are immediately reflected in the web application as well.

3.1.4 Technical Description

3.1.4.1 Web Application

The web application is comprised of a series of portlets communicating with each other and with web services in order to implement the functionality described above. These portlets are deployed in the EPIC Portal Platform and are accessed from the platform's users after they log in, according to their access rights, by using any known web browser.

Supported platforms

The web application is currently installed in the EPIC Portal Platform. It can be access from the Internet through all wide spread browsers. The overall supported platforms of the web application

are mainly limited by the supported platforms of the portal itself. Portal's supported platforms are referred in WebSphere Portal[1]. (login: guest; password: guest).

Indicatively the web application can be accessed through:

- Internet Explorer 6 SP2 +, 9 (Compatibility View)
- Mozilla Firefox 3.5+
- Google Chrome 8+
- Opera 10+
- Apple Safari 4.0+

The web application also supports the following databases

- MySQL Community Server 5.5
- PostgreSQL 9

Development tools

The application is built using the IBM's WebSphere Portlet Factory 7.0 (WPF) tool, which is based on the Eclipse platform. The advantages of using this tool are the rapid development of portlets and easy integration with the EPIC Portal.

Java, JSP and JavaScript are the main technologies the tool supports for the development of portlets. WebSphere Portlet Factory was created to apply concepts of software automation to help address the ongoing problem of software development complexity.

The main concepts of the portlet factory in terms of development are the "Builders" and the "Models". Builders are the basis of any WPF application and they are essentially wizard-based interfaces that automate common development tasks. Models act as builder call assemblers and list what builders WPF should use to generate the application and to store the specific values used for each builder input.

Instead of directly manipulating elements such as JSP, Java, JavaScript, and XML files, the developer has the choice to use "builders" and they then generate all the necessary code artefacts in response to the developer's high-level instructions, reducing this way the development time.

Development approach

For the development of the web application the service oriented architecture (SOA) was adopted by the use of web services. The portlets consume web services in order to retrieve and store information relevant to the pilot, with the help of service "provider" and "consumer" models.

Model-Viewer-Controller (MVC) design approach was also used and the IBM's best practices for development with WPF were followed in order to separate the application's different layers and increase its performance and extensibility. The overall architecture of the application makes it easy to plug in or plug out functionality without causing a problem to the rest of the application.

[1] Direct URL: https://vhost1825.site2.compute.ihost.com/wps/portal (login: guest; password: guest)

3.1.4.2 Mobile Application

The mobile application is a 'native' mobile application, meaning that it is compiled specifically for the smartphone platforms mentioned below and that it runs as a separate application on the mobile device (as opposed to mobile web applications, which are viewed through a devices browser application).

Native applications enjoy better support from the smartphone's hardware features, such as the camera, which is needed for the application's planned augmented reality feature.

Supported platforms

The mobile application is currently available on Apple's iOS platform as well as Google's Android platform. To be more precise the application will run on

- iOS devices with iOS 4.0 and upwards
- Android devices with Android 2.3.0 and upwards

As the app is still being tested it is not available in the Apple App Store. As a result, one can only access it by signing up as a beta tester, using iOS (iPhone) via the following link: http://bit.ly/zWrzCw[2]. Upon registration one will get authenticated by our developers and get access to the app.

Due to the large variety of screen sizes among the smartphones that support this mobile OS, only the most common screen sizes (HVGA) are currently fully supported. Other screen sizes will be able to run the application, but the user interface is currently not optimized to support these, possibly resulting in a less user friendly layout.

Development tools

The application is built using Appcelerator Titanium[3], one of many so-called cross-platform mobile development software development kits. The advantage of this framework, is that the same codebase can be used to compile the application into an iOS or an Android application, with only little adjustments.

Development approach

For the development of the mobile application, we started off from the MVC-design philosophy. MVC is a way of structuring code that cleanly separated user-interface related code from the actual business logics of the application, ensuring scalability and flexibility towards adding other screen-sizes, devices or even operating systems.

3.1.5 Evaluation

Evaluation of both the web as well as the mobile application prototypes took place in the weeks of January 30 and February 6.

In this phase, 4 prototype evaluation sessions, each with two participants, were held at the IBBT offices in Brussels. 7 of 8 participants had in recent years moved to Brussels, Belgium from

[2] Direct URL: https://testflightapp.com/join/e84eb49002e1619bfb470747c3289911-NTAzOTM/
[3] Appcelerator Titanium, http://www.appcelerator.com

another country. The other participant had expert knowledge on web and mobile application usability.

During these evaluation sessions, focus was put on evaluating:

- Whether all the currently implemented functions of both applications fit the needs of people moving to Brussels. This includes the question which functions should be added or removed.
- Whether the current form and usability of these functions answered to the expectations of the participants and how these could be improved.
- The relation between web and mobile application and their being complementary to each other. Can both be used interchangeably as well as individually?

Lessons learned from these sessions have been integrated into a list of change and feature requests that will be implemented in the development cycles to come. Both applications will keep on being evaluated based on feedback coming from the closed and open group user tests planned for the months ahead.

3.2 Functional Prototype for Urban Planning Service

3.2.2 Objective

Through a process combining innovation, design and editorial, this Urban Planning Service solution meet needs of various users (see D5.1) in terms of:

- Communication around the issues of the city to develop and promote projects and activities.
- Decision support as part of urban planning projects and implementation of decisions or local policies.
- Training: to accompany any political change.
- Information sharing: aggregation of heterogeneous data and multimedia, geolocalized information and services.



Figure 12 – Urban Planning Services

The aim of the Urban Planning Service is to allow citizen and visitors to discover the city through specific topics of interest like Culture, Sustainable Development, Urban Planning Projects, and the economical tissue with the enterprises of the city. This activity will be done through the simulation of a 3D model of the city for a better understanding of the area which will offer different services such as:

- Access to topics of interest (different layers will be offer)
- Access to points of interest (list of specific POI to discover)
- Access to symbolic information (tag information)
- Access to geolocalized information (stamp information)
- Access to geolocalized Media Center (detailed information)

3.2.3 Prototype Description

The Urban Planning Service solution offers a triple vision:

- A comprehensive local view using multiple levels of information.
- A thematic view, to better visualize the activities, projects, issues.
- A contextualized vision, offering a quality and a wealth of information.

The Urban Planning Service consists of middleware that manages the 3D model, the movement within it, the display of specific geolocalized information (tag, stamp, symbol, media center) and the selection of specific functionalities. Specific web services will be made available for allowing applications to display additional information.

A back office tool will be deployed for the administration of data and features of the middleware. There will be several levels of administrative rights for managing it like: super user administrator (EPIC level for managing all data), city user administrator (for managing data of the city), and enterprise user administrator (for managing data of its own enterprise). These administrative rights cover five thematic layers:

- Discovery of the city
- Leisure and Culture
- Sustainable development
- Urban Planning
- Economical Development



Figure 13 – 3D Web-based application

This real-time web-based application is in 3D, developed and running under the 3D engine "Unity".

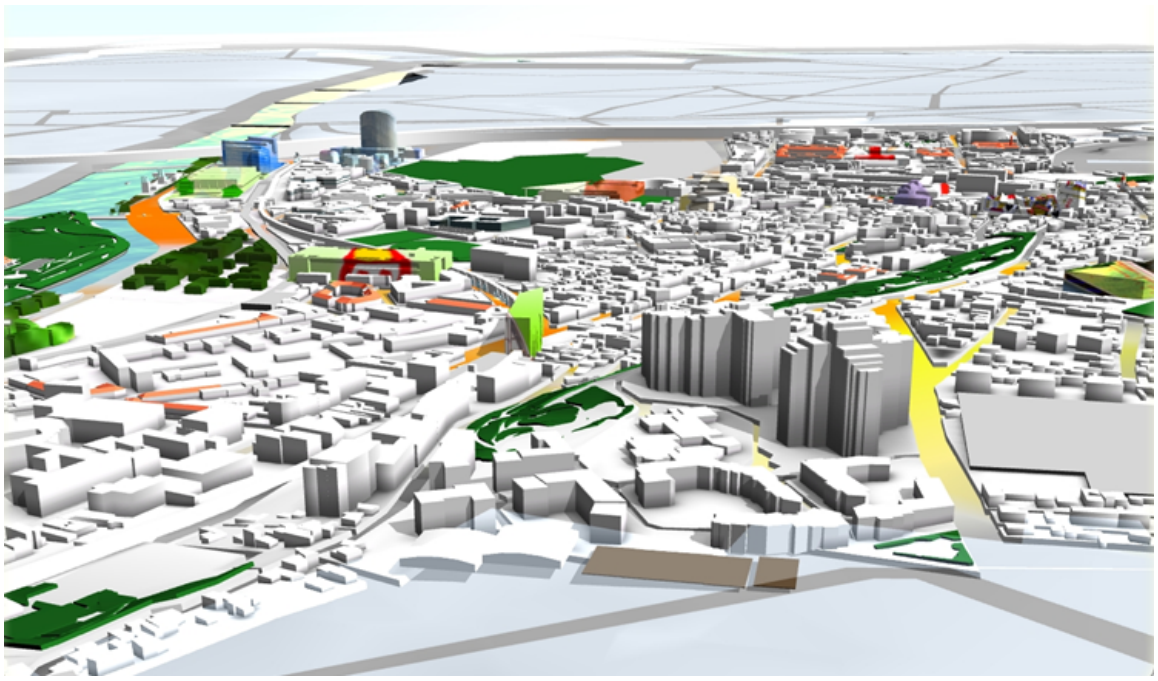


Figure 14 – 3D Web-based application

EPIC has identified the following areas of navigation and information where the interface design needs to be improved during feedback from the piloting phase:

1) The top of the screen:
   - Identification of the application and the City
   - User identification (input window to enter name and password)
   - Search (input window)
2) The central part:
   - 3D Model of the territory
   - Navigation within the territory
   - Identification of the premises by colours, tag, etc.
   - Access to information by roll over → Information into a bubble
   - Access to information by clicking → Information in opening a media center
3) The lower part:
   - Choice of themes
   - Choice of tools
   - Other contractual information



Figure 15 – Leisure and culture layer (example)

On the 3D model specific information is projected onto the selected layer. For example an overview of the traffic is displayed in orange.

On some buildings, POI, edited by the city, are highlighted by an image which becomes animated when a user rolls their cursor over it.

When the user clicks on a POI, the camera zones in on the specific area (characterized by a specific colour) and opens a menu giving access to list of information relevant to the POI including description text, photos, videos, 360° views, internet links, documents PDF, etc.

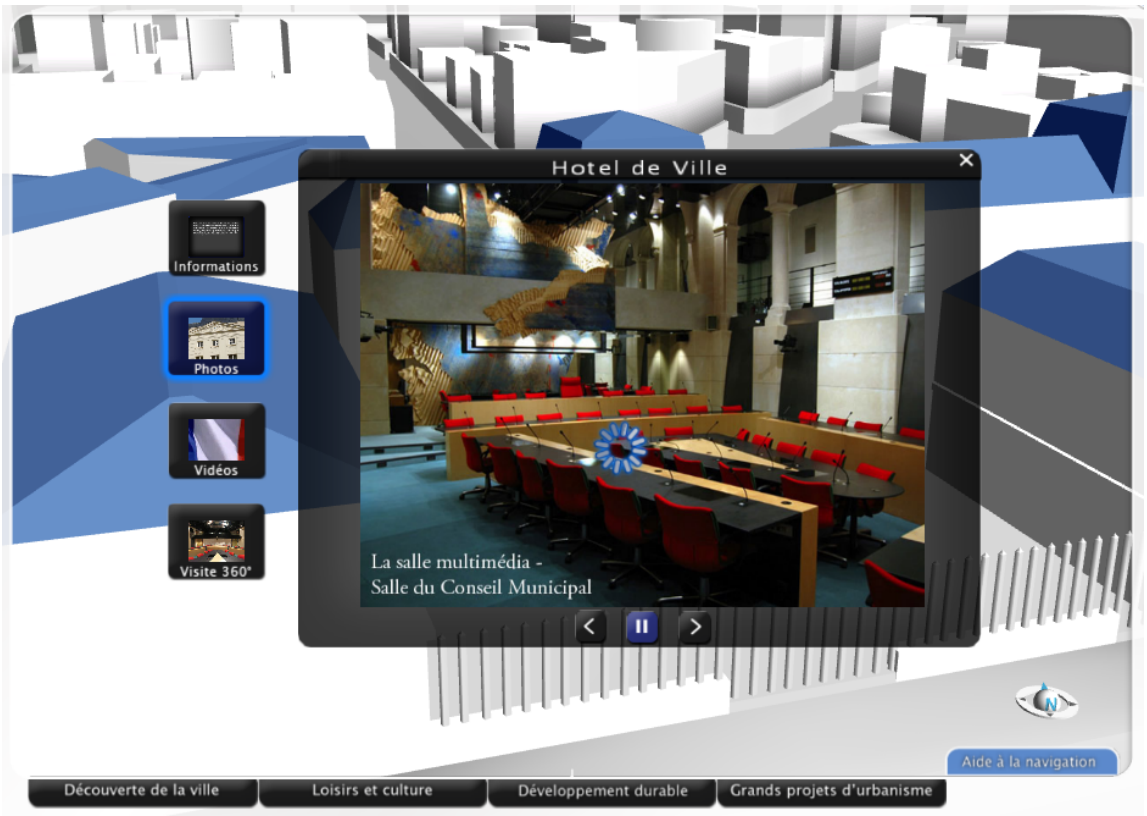


Figure 16 – Navigation



Figure 17 – Information display

3.2.4 Technical Description

Here is the global architecture of the Urban Planning Service Solution using NAVIDIS ICECUBE Solution (see D3.1 and D3.1B).

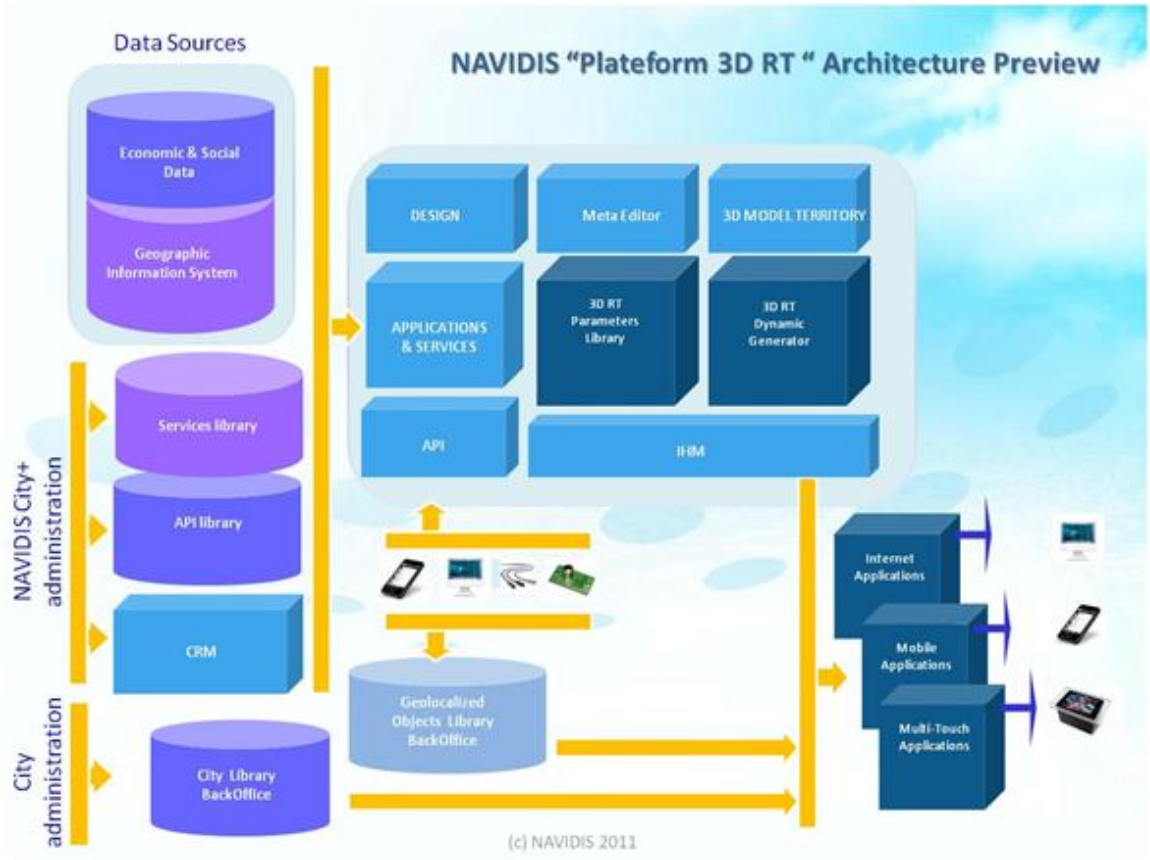


Figure 18 – Architecture preview

The process for making the user able to connect to the system is based on the right access level.

If the user does not have any login password they will have direct access to websphere with just the 3D portlet. Meaning you can just have access to information reserved to “Citizen”.

With the user login and password you will be identified through “Trivoli” to get access to the different features available for your group then the user is on the “websphere” portal.

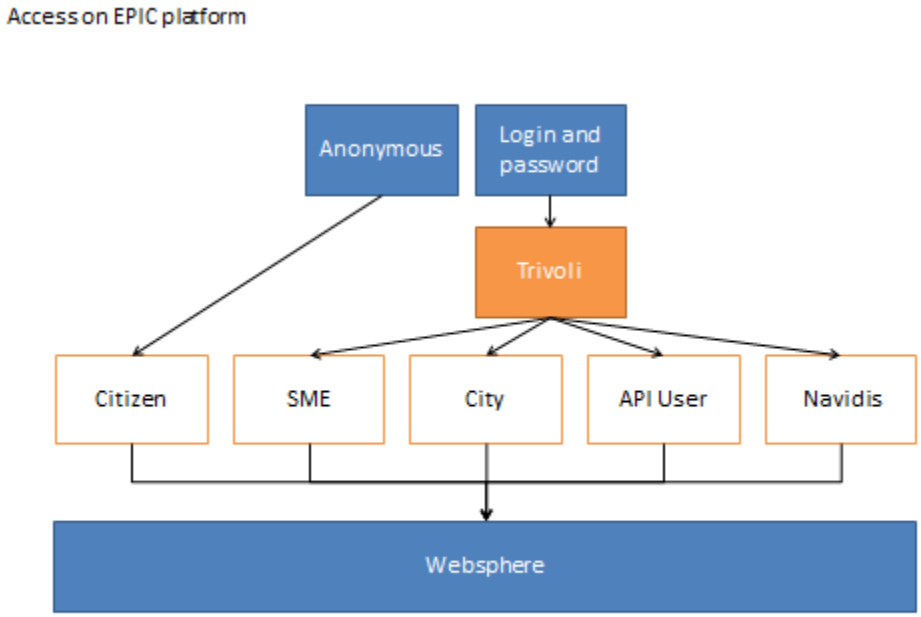
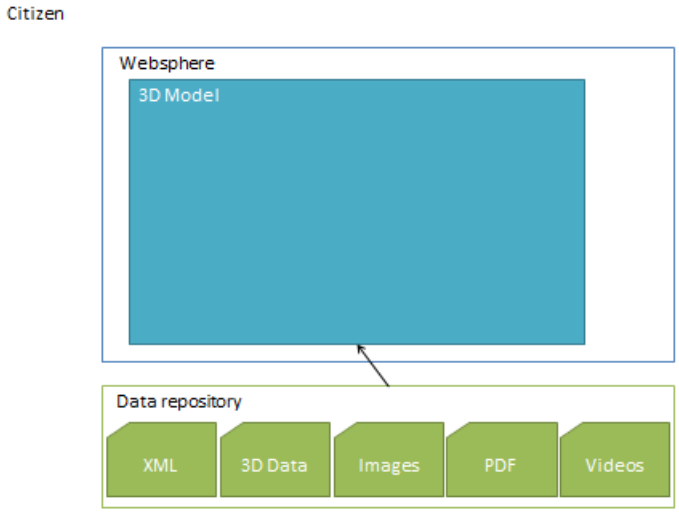


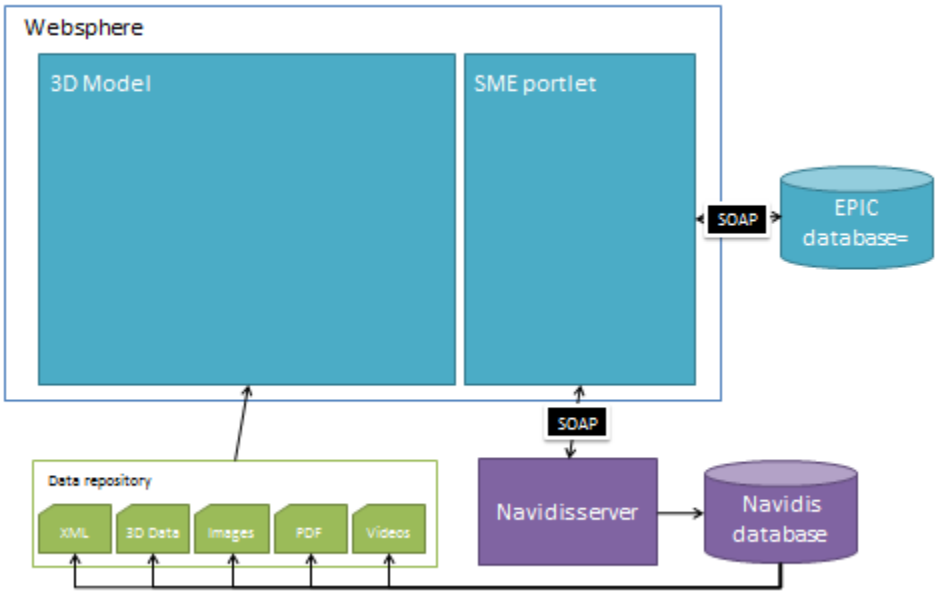
Figure 19 – Access

During the load of the 3D Model, the application calls java servlets to get data within the NAVIDIS Server in SOAP (wsdl): XML, 3D Data, Rich Medias and files to display.

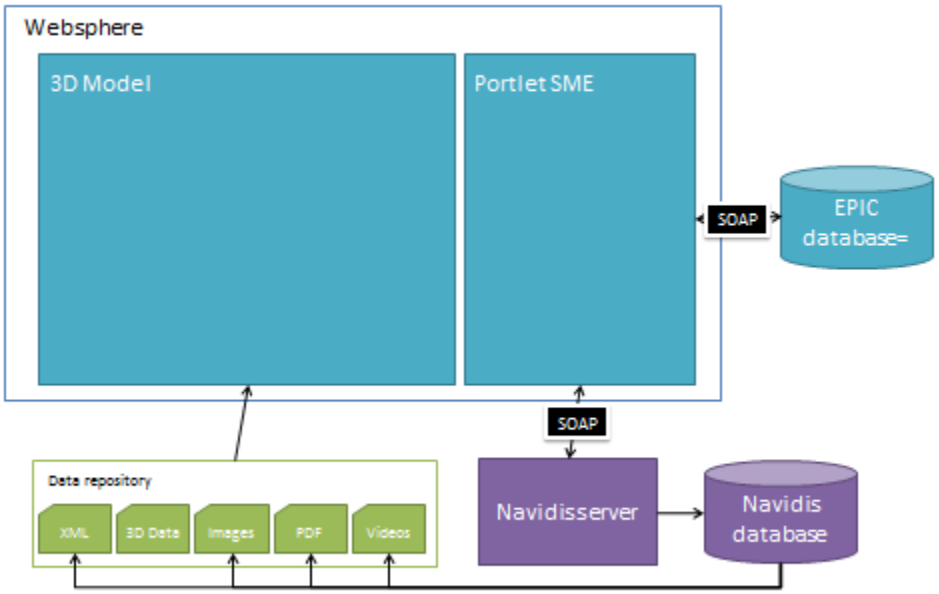


Regarding the level of administration the user has additional features making them able to administrate City data and SME Data.

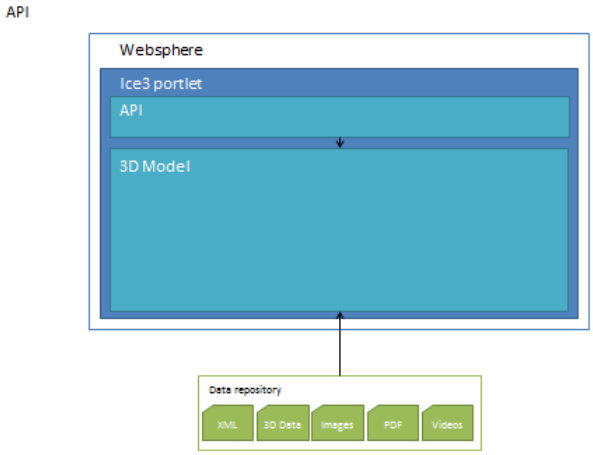
Cities


Websphere
3D Model
SME portlet
SOAP
EPIC database=
SOAP
Data repository
XML
3D Data
Images
PDF
Videos
Navidisserver
Navidis database

SME

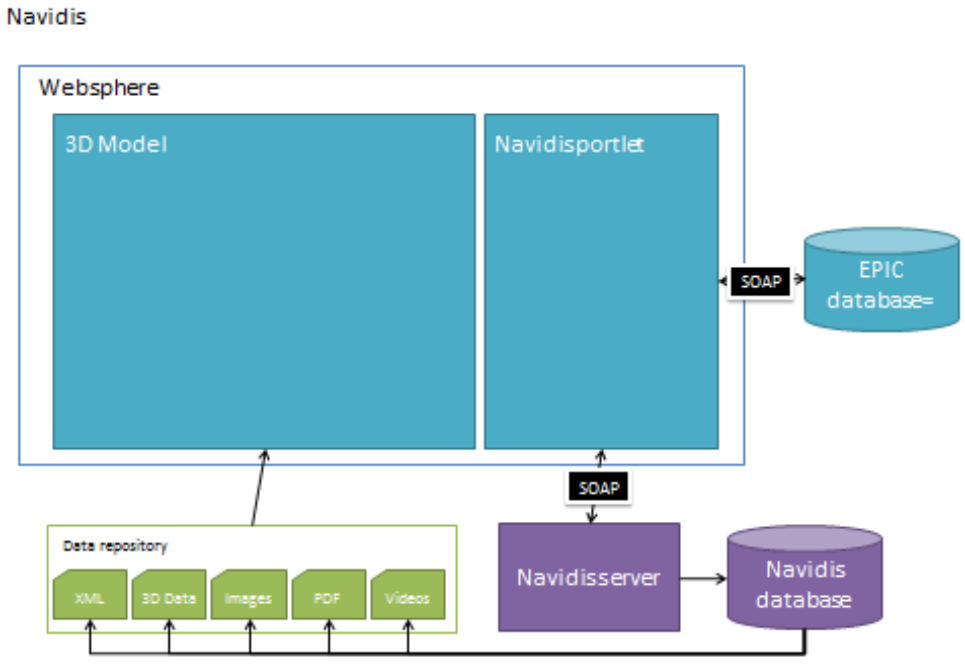

Websphere
3D Model
Portlet SME
SOAP
EPIC database=
SOAP
Data repository
XML
3D Data
Images
PDF
Videos
Navidisserver
Navidis database

Within the ICECUBE Portlet a set of APIs will be available for any partner software to administrate their own geolocalized data on a blank city model, for example their own layer.



NAVIDIS has its own environment for displaying and managing information following the same process. It's in there that NAVIDIS manages several layers and thematic for displaying the appropriate information in real time 3D.

It's through the NAVIDIS Portlet that SMEs and CITY will be able to update and increase the availability of data to display, the way it will be displayed and the design it will follow.



3.2.5 Evaluation

Evaluation of the web application prototype started on February 6.

Five attendees participated in the evaluation of NAVIDIS ICECUBE in Issy-les-Moulineaux focusing on manipulation of the 3D model and then on the available features for Citizen, City administration and Navidis administration.

During this evaluation session, focus was put on evaluating the architecture, the communication protocol and the software environment followed by the usability of the application:

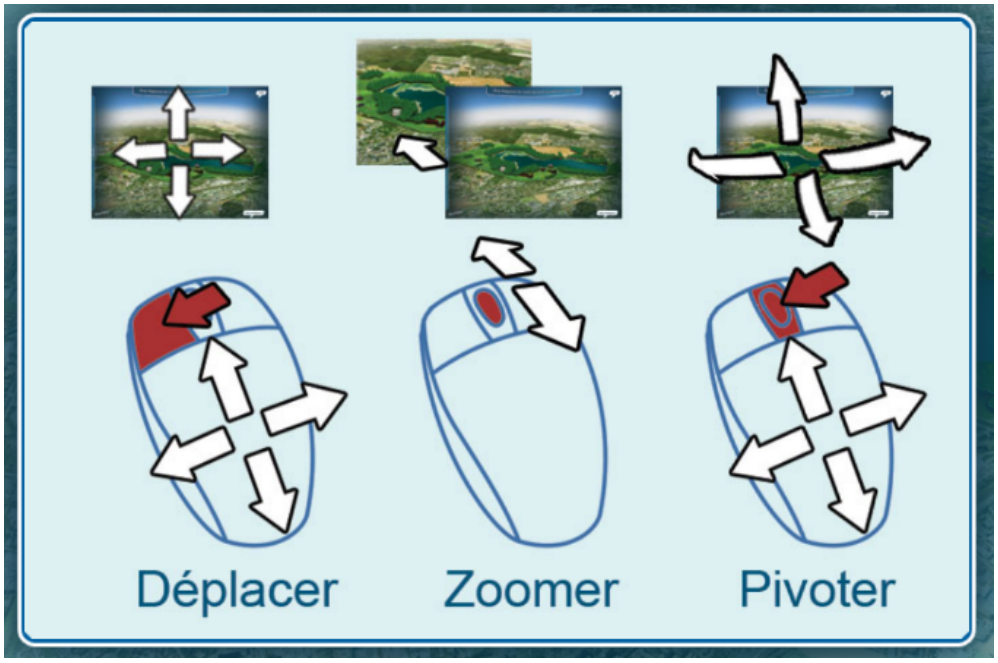
1) Access the prototype with the url below:

   http://www.georeporting.net/epic/app/framework_Data/Index.html

2) Focus of the evaluation on the following features:

   - Ensure that the Unity Web Player is correctly downloaded (automatic)
   - Ensure that the 3D model of the city is displayed in the center of the screen
   - Ensure that you can navigate within the 3D model
   - Ensure that you can select all layers you want
   - Ensure that you can access "point of interest"
   - Ensure that you can open "media center"

To navigate with the mouse, the navigation features is explained here after:



MOVE ZOOM ROTATE

On the top left of the 3D screen, there are five items which are the thematic layers:

- Discovery of the city

- Sustainable development
- Urban Planning
- Leisure and Culture
- Economic Development

These can get selected one by one or simultaneously; specific colours will then appear associated with the area/theme, and a label will be displayed 'on top of the building' when one rolls over an "official" POI.

If one clicks on the coloured building an automatic camera movement will operate to allow for zooming in on the POI and, thus, gets the label displayed. If one clicks on this label then the "Media Center" is displayed with enriched information such as:

- Short description (text)
- Diaporama (photos)

To leave the Media Center, click on the red cross at the top right of the mc window.

For each layer, the city administration and enterprises will provide POI addresses and all additional information they would like to display, as well as label names and Media Center contents using the backoffice administration tool.

What we have learned from initial usability testing so far is that several features are still missing for managing editorial content and also that the geolocalize chat for SME still does not work.

Starting in March/April 2012, a first test run will be conducted with closed "end users", people from:

- City administration: enable the contacts to enrich the application with POI through the Discovery, Sustainable development, Urban Planning and Leisure and Culture layers.
- Enterprises: enable the contact to enrich the application with information about the company
- Citizens: after the application is updated enriched, test the application.

A list of changes will be updated with feedback from the users based on their experience, required or expected improvement at different level will be notified: Platform access, Application access, Application download, Application features and usages, BackOffice administration tool for City & Enterprise admin, etc.

3.3 Functional Prototype for Smart Environment Service

3.3.2 Objective

The Customer Portal is one of the primary interactions with the household for the Smart Environment Service, allowing them to see energy usage and provide tools to help their understanding of their energy usage (see D5.1).

The Smart Environment service supports the city in its citizen engagement and their contribution to carbon reduction. Given that some householders will volunteer to have sensors in their homes, we will be able to use real-time data and history as an open data source for energy consumption. The application that will be deployed will have the following objectives:

- Show participants a view onto the real-time consumption of domestic properties in the city;
- Create opportunities for the city to interact with citizens around the low carbon agenda;
- Provide an evidence base for effectiveness of city efficiency interventions with citizens i.e. educational campaigns, building improvement schemes and volunteer programmes; and,
- Engage citizens with data that they can build effective neighbourhood efficiency plans at a grassroots level.

3.3.3 Prototype Description

The Smart Environment service will be delivered through the EPIC portal with support from the Energy Hive (www.energyhive.com) web application. The breakdown of functions is shown in the diagram below with the Energy Hive customer experience of a dashboard and management of the device provided by Energy Hive (EH) and the city view provided by EPIC.

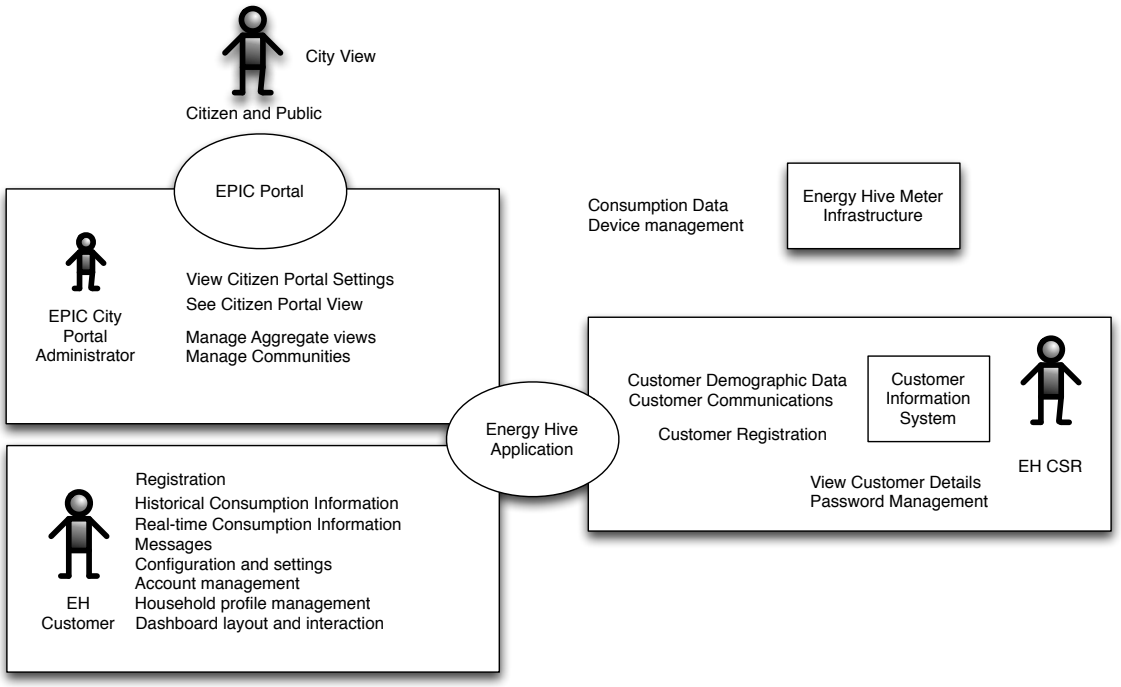


Figure 20 - Logical separation of functionality between Energy Hive and EPIC

3.3.3.1 Energy Hive Customer Service Representative (EH CSR)

The EH CSR has the responsibility to maintain the configuration and content of the Energy Hive Application for Energy Hive Customers as well as supporting the API for the EPIC Portal.

The following interactions have been identified related to CSR functions.

ID	Name	Description
SI-1	Customer Demographic Data	The CSR will configure the groups and dimensions that are available for analysis. These are generally on customer demographic attributes such as the number of occupants in the home, size of home, etc.
SI-2	Customer Communications	Administrative messages, such as the system maintenance, changes in terms and conditions and the like are supported by customer communications functionality.
SI-3	Customer Registration	Registration attributes and screens are configured by the CSR. If there are any issues during the installation, these are handled by the CSR as they will support registration of the Energy Hive customers.
SI-4	View Customer Details	The Customer details, including device configuration must be available to the CSR.
SI-5	Password Management	The administrator must be able to reset the password for the Customer and securely communicate the change.

3.3.3.2 Energy Hive Customer

The EH Customer is one that has installed the electricity sensor and gateway within their home. They are distinctly different from a general term "customer" or "user" as someone may use the EPIC portal without having Energy Hive services running in their home. To that end, someone who is an EH Customer, must have support functionality for their equipment and will have the standard EH functionality available for reporting.

The following interactions have been identified related to EH Customer functions.

ID	Name	Description
SI-6	Historical Consumption Information	Consumption over previous periods of time will be presented as graphs, charts and numeric results with some analysis on trends.
SI-7	Real-time Consumption Information	Meter readings can be requested for a granular update time of 6 seconds to 1 minute. Real time consumption information shows the kW consumed for the time period of the update.
SI-8	Messages	Messages can be targeted to individual customers and displayed on their home page. If messages are sent to a group or community, they will be individually delivered to an account.
SI-9	Configuration and settings	Each customer has a configuration and setting for the portal and widgets. This could be rates for energy cost, tariff data, etc.
SI-10	Account management	The ability to manage the account, including changes to passwords, acceptance of terms and conditions, house moves, real name and other account related information. Un-enrolling in the must also be supported.
SI-11	Household profile management	Each house has a set of profile information that will be collected buy the project for reporting and comparison purposes. The household profile is maintained by the end user and minimal information is required upon registration.
SI-12	Dashboard interaction and layout	The dashboard will target widgets to customers
SI-13	Registration	Each customer must go through the process of registration to join the Energy Hive Application. There is a validation process for email address plus usual descriptive registration information.

3.3.3.3 Energy Hive Meter Infrastructure

The meter infrastructure provides communications with the sensors at customer premises.

ID	Name	Description
SI-14	Consumption Data	Clamp meter readings of the power (kW) are sent as data points taken with a time stamp. The data will be delivered on an asynchronous basis to the Hive Analytic engine. The data will be delivered over SSL with a Household key/hash.
SI-15	Device Management	Data about the device [battery level, IP address, last reading] will be sent via the gateway.

3.3.3.4 EPIC City Portal Administrator

The city portal administrator will be able to provision widgets deployed into the EPIC portal platform. These widgets are consumed by the Citizen who may or may not be an Energy Hive customer.

ID	Name	Description
SI-16	View Citizen Portal Settings	Ability to view the portlets and templates that are configured for each Citizen
SI-17	See Citizen Portal View	Ability to bring up the same view as a Citizen
SI-18	Manage Aggregate Views	Ability to configure and manage the data source and views of the city
SI-19	Manage Communities	Ability to configure and manage the statistical characteristics of the community

3.3.3.5 Citizen and Public

The Citizen and public will be able to have an over view of the city wide view whether or not they are a direct participant within Energy Hive. The prerequisite is that they have an EPIC account to view the City energy portlets.

ID	Name	Description
SI-20	City View	Page containing the portlets that show the City view of energy consumption.

3.3.3.6 System Interactions and Prototype Screens

The system interactions (SI) described above will have detailed implementations that are captured in this section. This includes screen shots and data flows between the web services that are hosted by Energy Hive.

[SI-1] Customer Demographic Data

Demographic data is available from the administrative web interface. It is a fixed set of data that is optional at registration time. The email address (used as user ID as well) is the only mandatory item.

Demographic fields are available for the end user to edit and update from their account management. The inclusion of fields as mandatory can be done via the registration form template that is configured by the CSR.

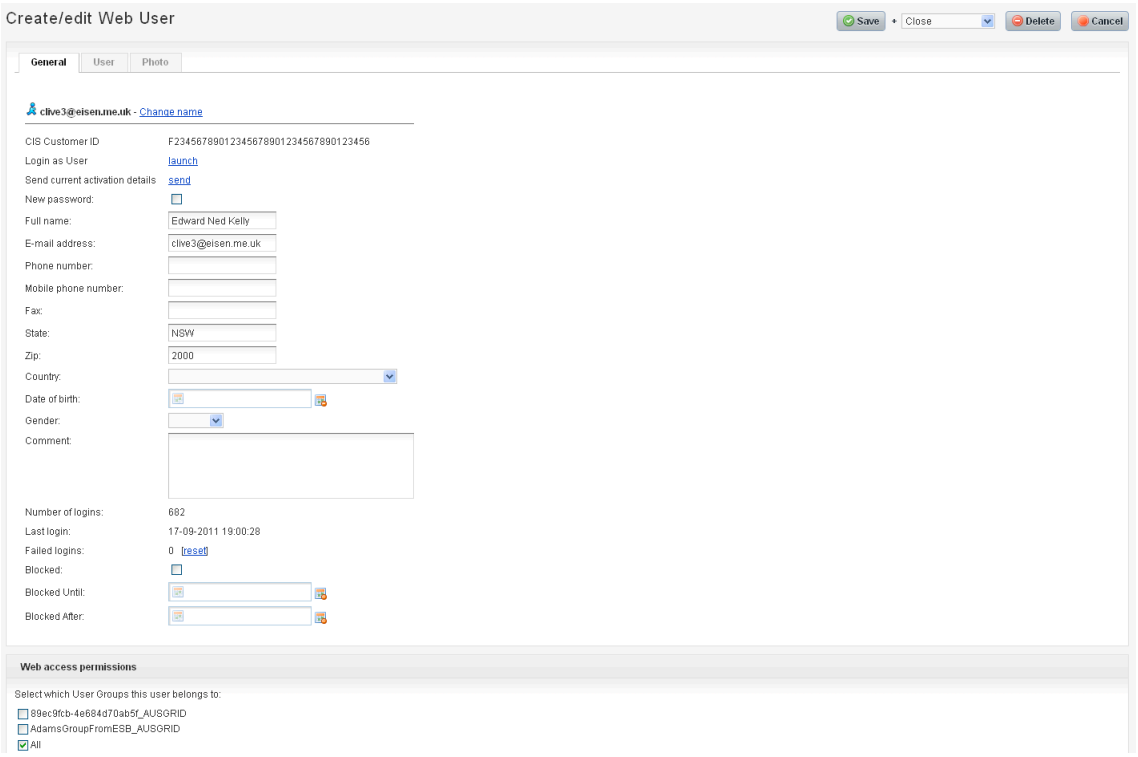


Figure 21 - Customer demographic fields. Additional fields are available, on the User tab, that set the aggregate dimensions that can be used for comparison

[SI-2] Customer Communications

Messages can be sent to end users through either email or as portal messages displayed within the message widget. This is available to the CSR for managing the messages to end users. A message state is kept for each user (read, unread). There is an opportunity to open this functionality as a web service at a later date. See API section for sendMessage().

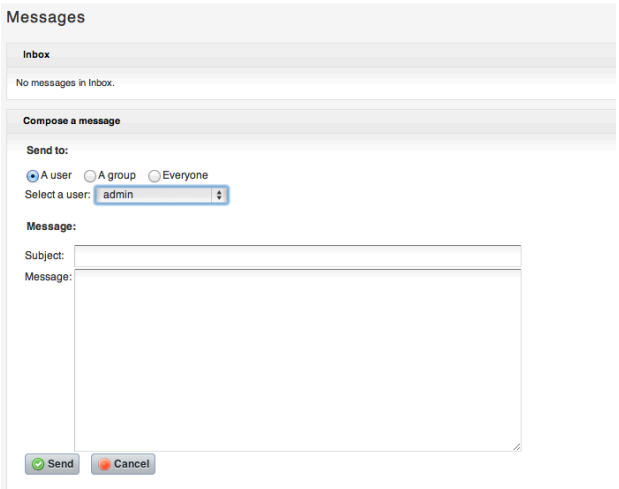


Figure 22 - Customer messages to display on the EH portal

[SI-3] Customer Registration

The Customer registration is controlled as a content management system template. It is the <form> section of the registration form with markup indicating which demographic elements to be captured. At the moment, it is proposed to initially capture just email address. There is an opportunity to open this functionality as a web service at a later date. See API section for registerEPIC().

[SI-4] View Customer Details

Within the Administrative portal of Energy Hive, customer details can be retrieved and edited. The Postcode (or Zip) field must contain a valid high level Manchester postcode in order to be available to the City filter for data contributing to the City aggregates.

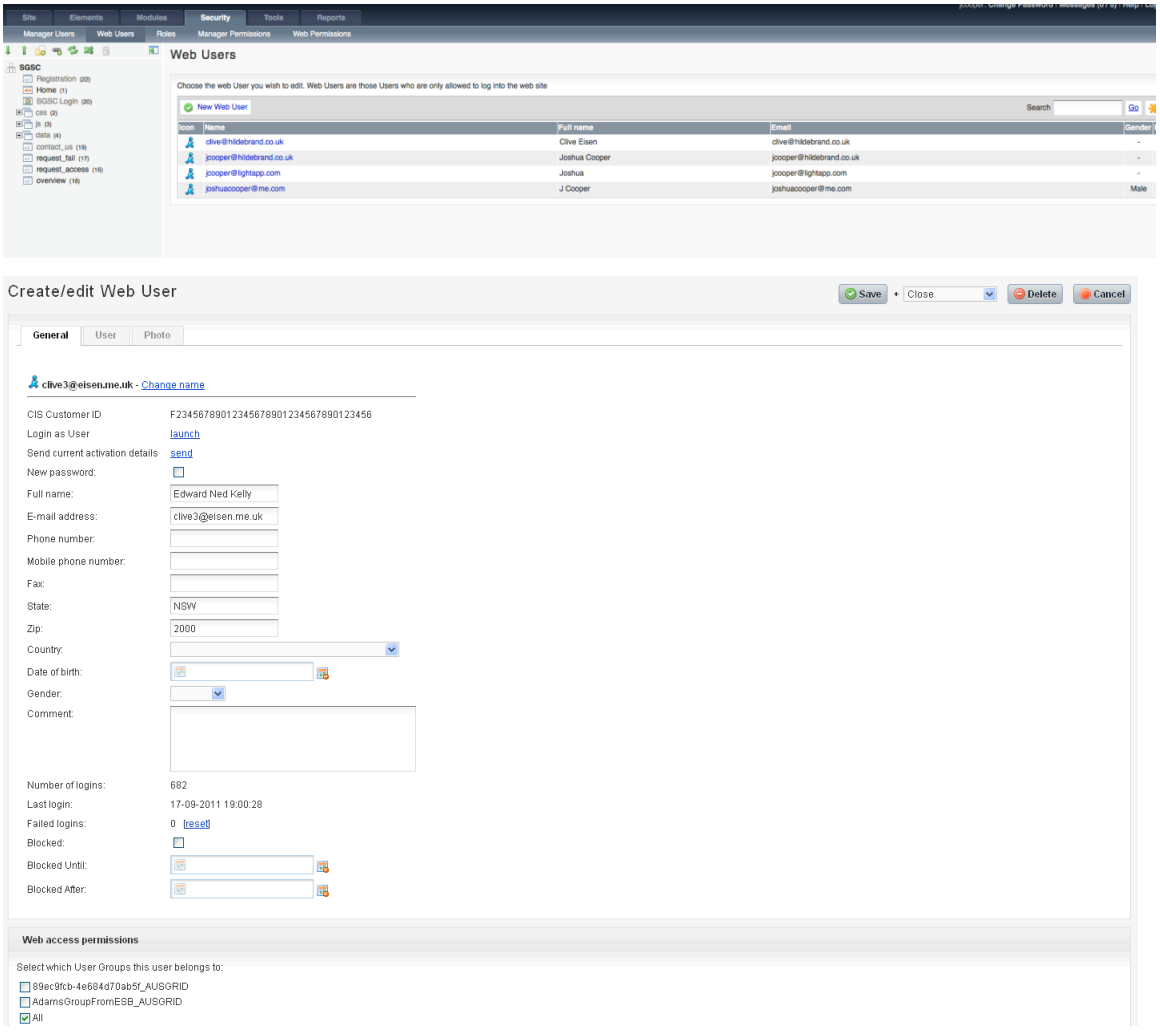


Figure 10 - Customer lookup and edit, administrative screens

[SI-5] Password Management

The CSR has the ability to send a password reset via email, such that the password is not known to the CSR. It is a system generated random string.



Figure 11 - Ability to set a new password that will be transmitted via email

[SI-6] Historical Consumption Information

Historical consumption information is available as a widget on the EH dashboard as well as from an API call by an external system (see API section). For individual historical consumption, the EH portal will be the user experience.

ID	Name	Description
CM-13	User Browser	
CM-10	Web server - Dashboard	User will be in a logged in
CM-10	Electricity History Widget	Naming is different from the display name which is “My Electricity Use”
CM-8	Timeseries DB	

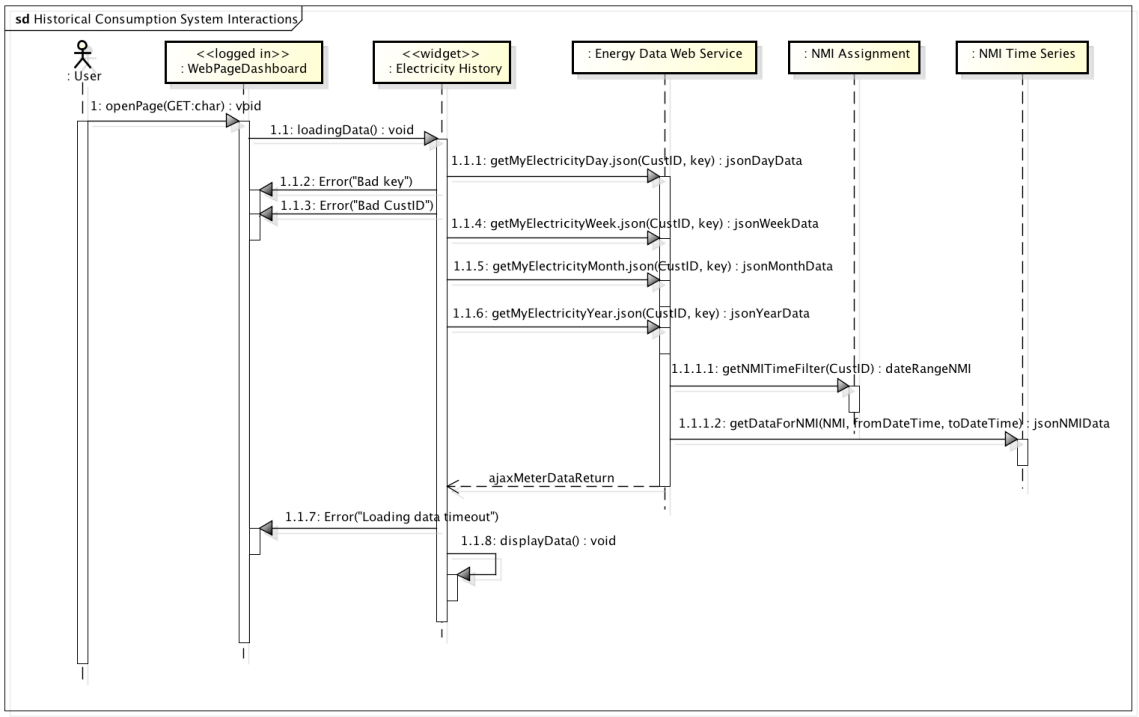


Figure 12 - Component interactions for the historical consumption

[SI-7] Real Time Consumption Information

Real time consumption is every 6 – 10 seconds. It is a "pull" rather than push based query and therefore must be polled by the display entity for updates to the widget. This is also available as an API call.

ID	Name	Description
CM-13	User Browser	
CM-10	Dashboard	User will be in a logged in
CM-10	In-memory DB	
CM-8	Real-time Consumption Widget	
CM-2	Meter Data Adaptor	Implements the request for meter data

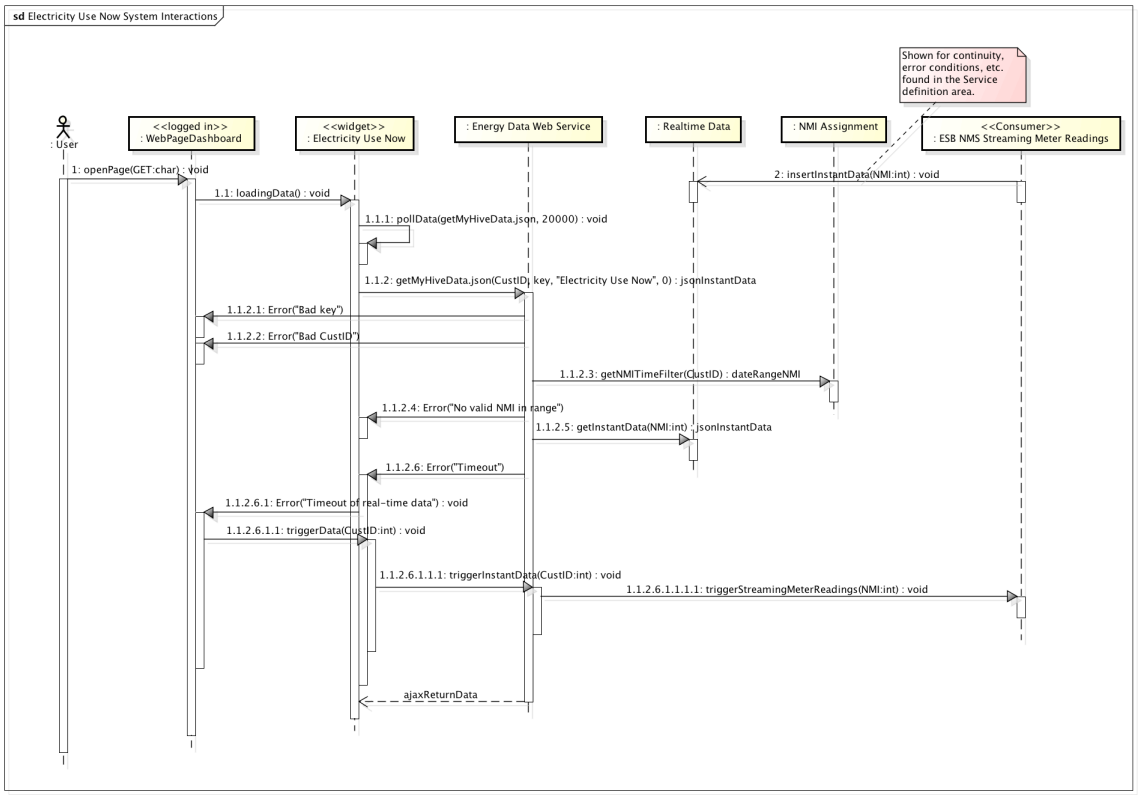


Figure 13 - Component interactions for the realtime consumption

[SI-8 through SI-12]

These are standard Energy Hive screens that are captured in the following screenshot.

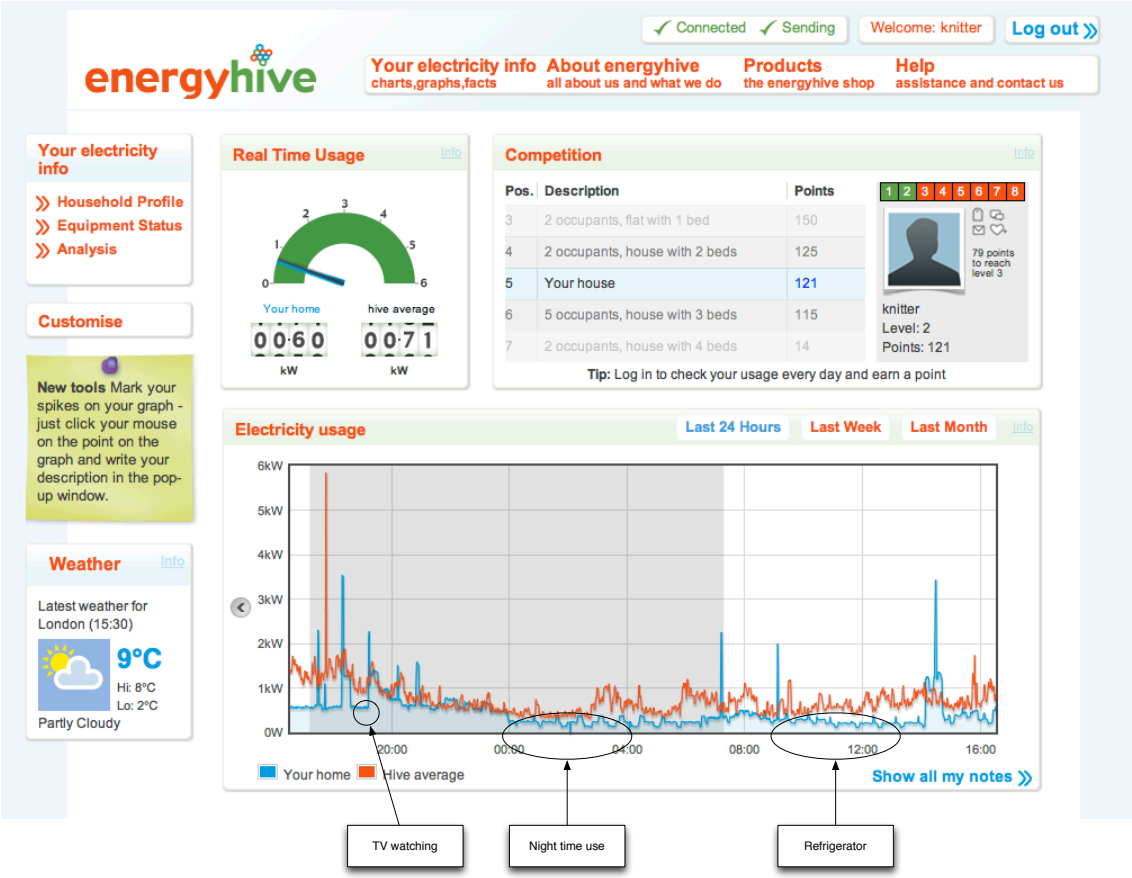


Figure 14 - Component layout, including the messages box (sticky note), with configuration settings available on the Customise button on the left menu.

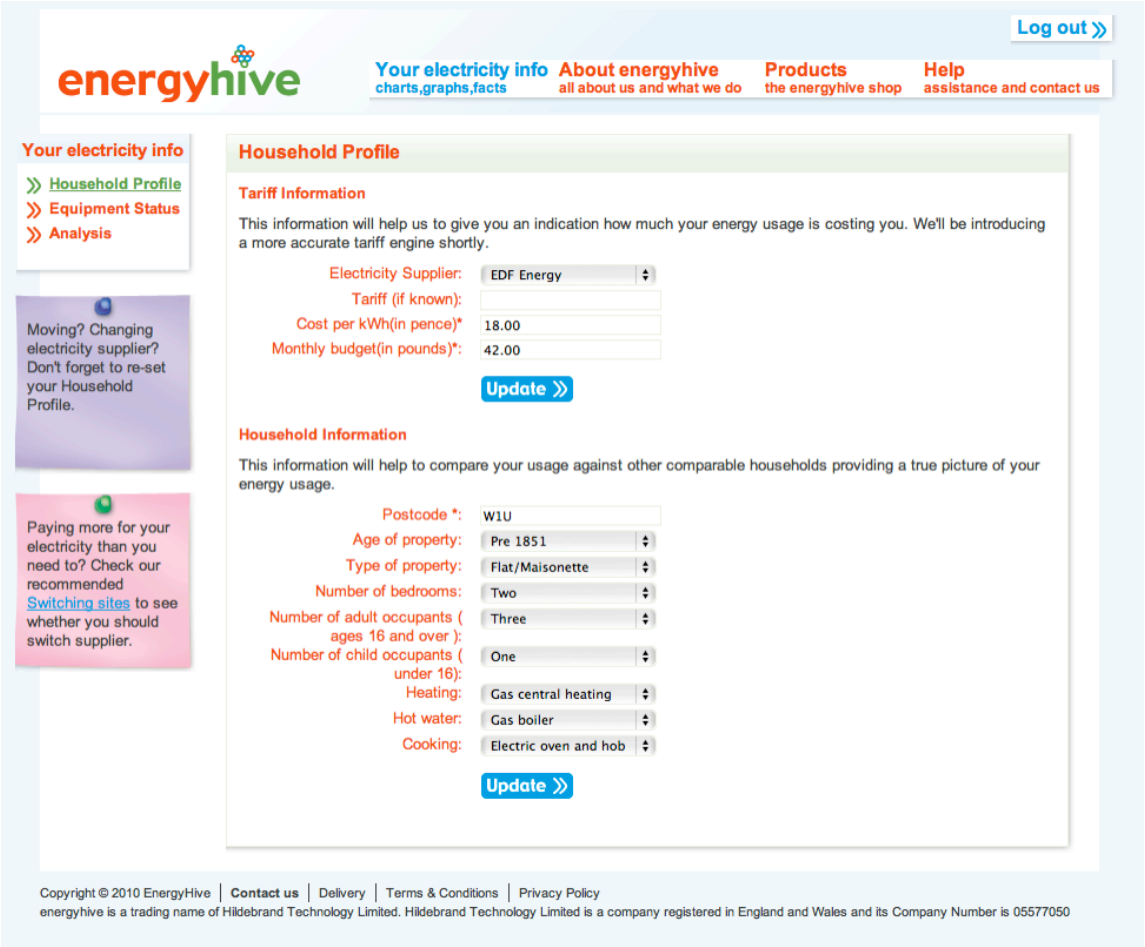


Figure 15 - Profile and attribute management screen

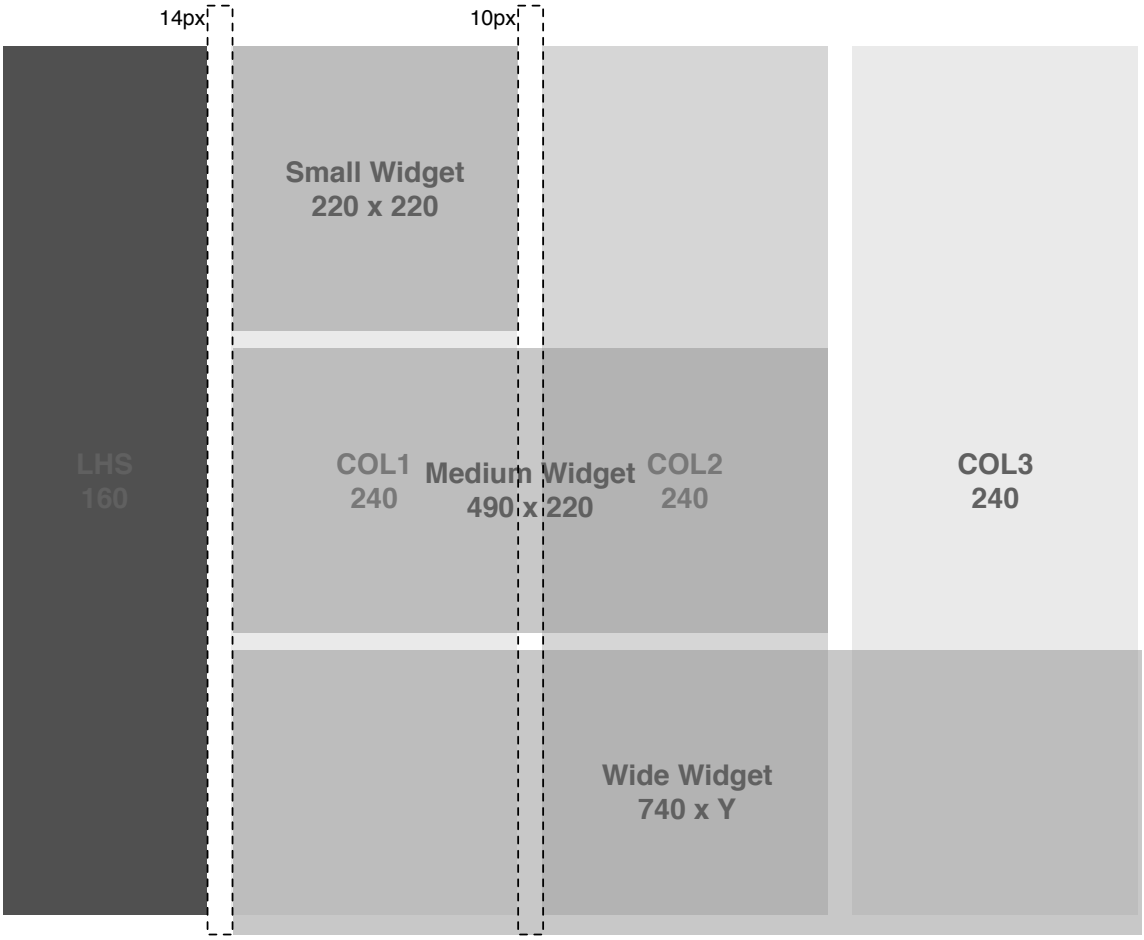


Figure 16 - Dashboard and grid layout

[SI-13] Registration

The following screens show the process for initial registration of the Energy Hive equipment. These are completed on the Energy Hive website for the open pilot. The precondition for this step is that the Energy Hive user has created an Energy Hive account to be able to come back and manage the device in the future.

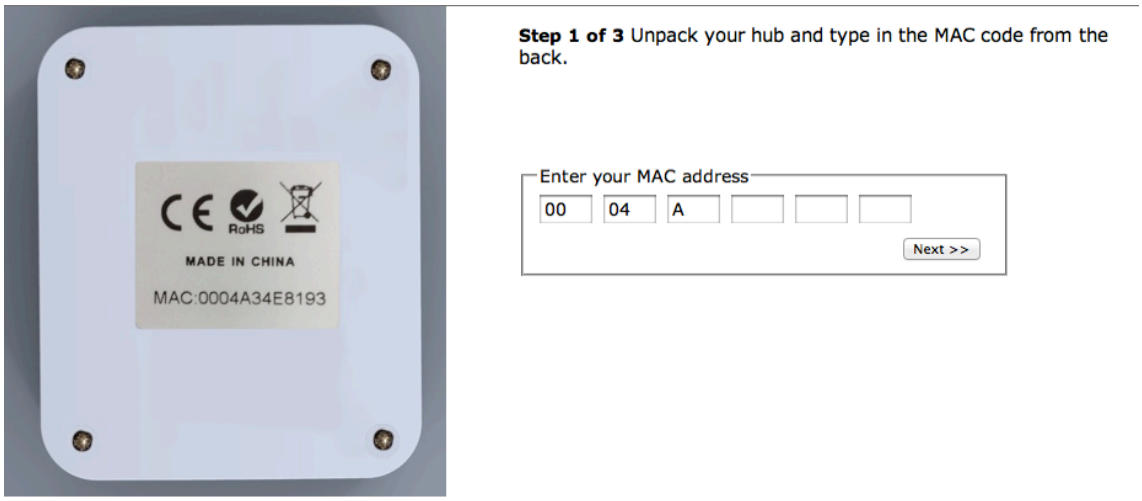


Figure 17 - Identification of the hub through MAC address

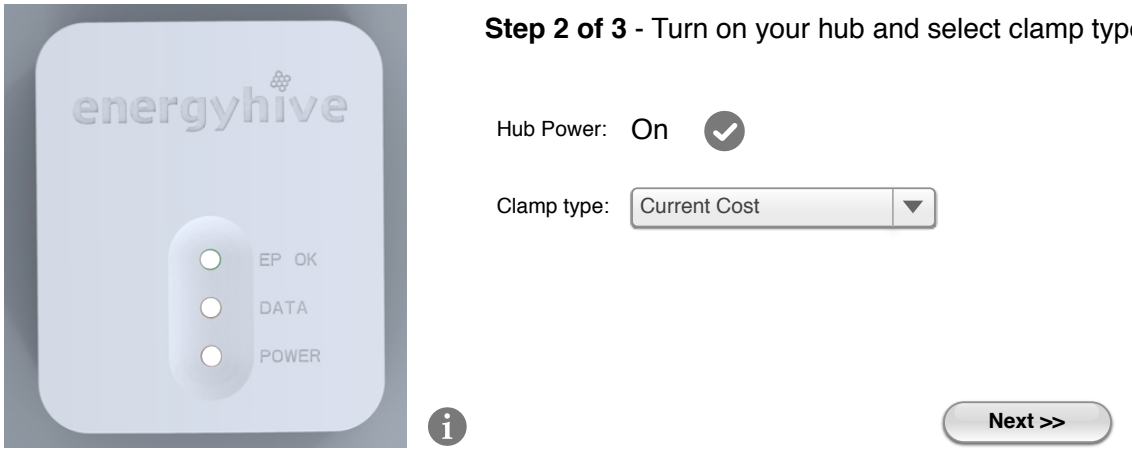


Figure 18 - Clamp type is able to be selected once the hub power is detected

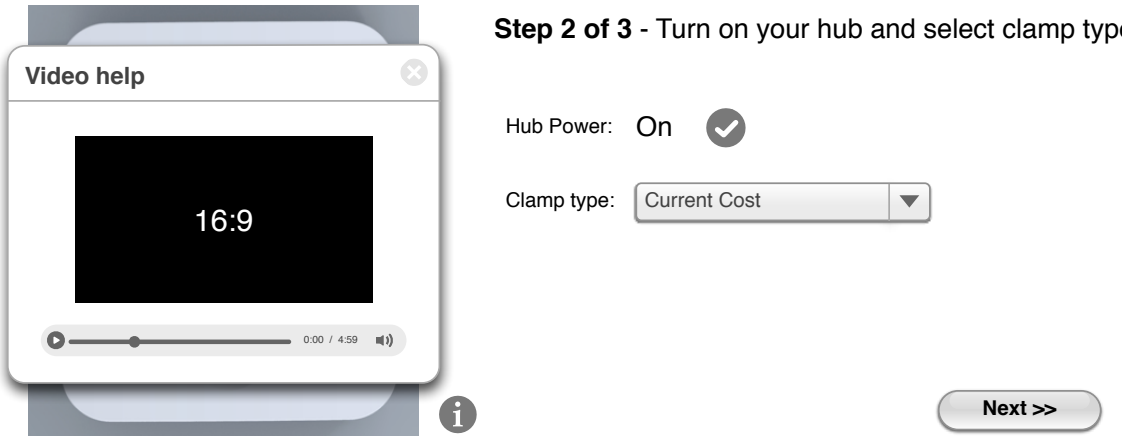


Figure 19 Video help is available by pressing the (I) button

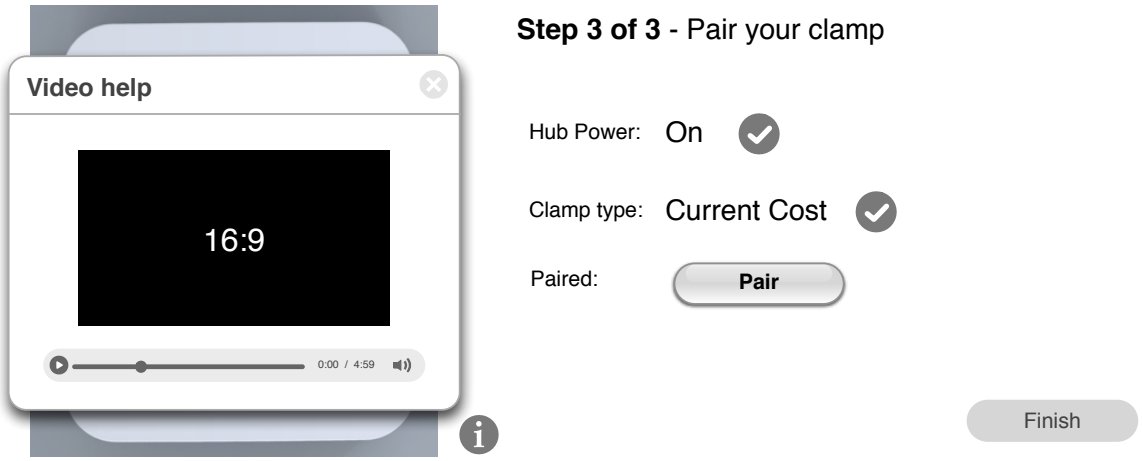


Figure 33 - Clamp pairing is initiated according to the instructions for the clamp type, the finish button is inactive until this is complete

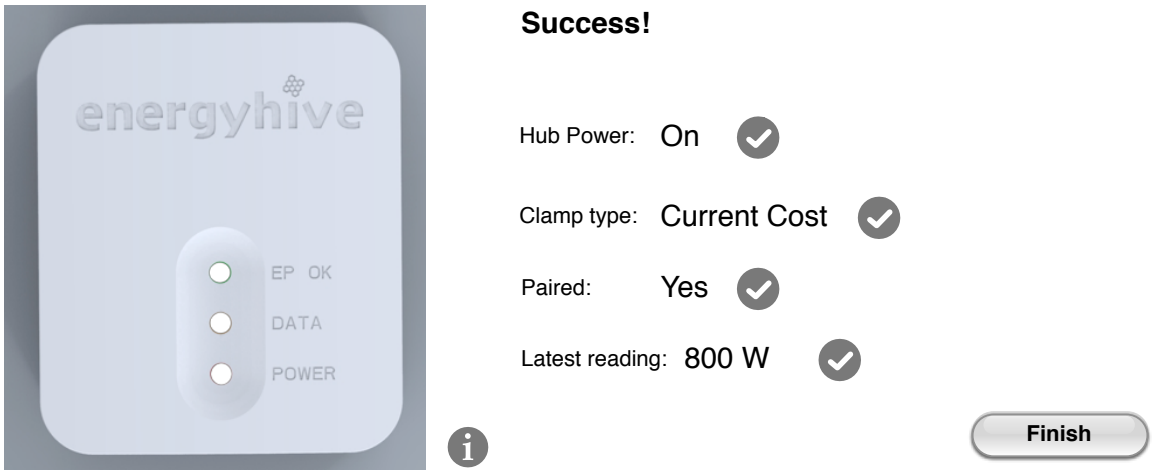


Figure 34 - Successful pairing shows data, the finish button which will launch into the Energy Hive dashboard

[SI-14 & 15] Meter Infrastructure

The sensor and metering infrastructure is handled as a system level set of APIs. They are described by the following activity diagrams.

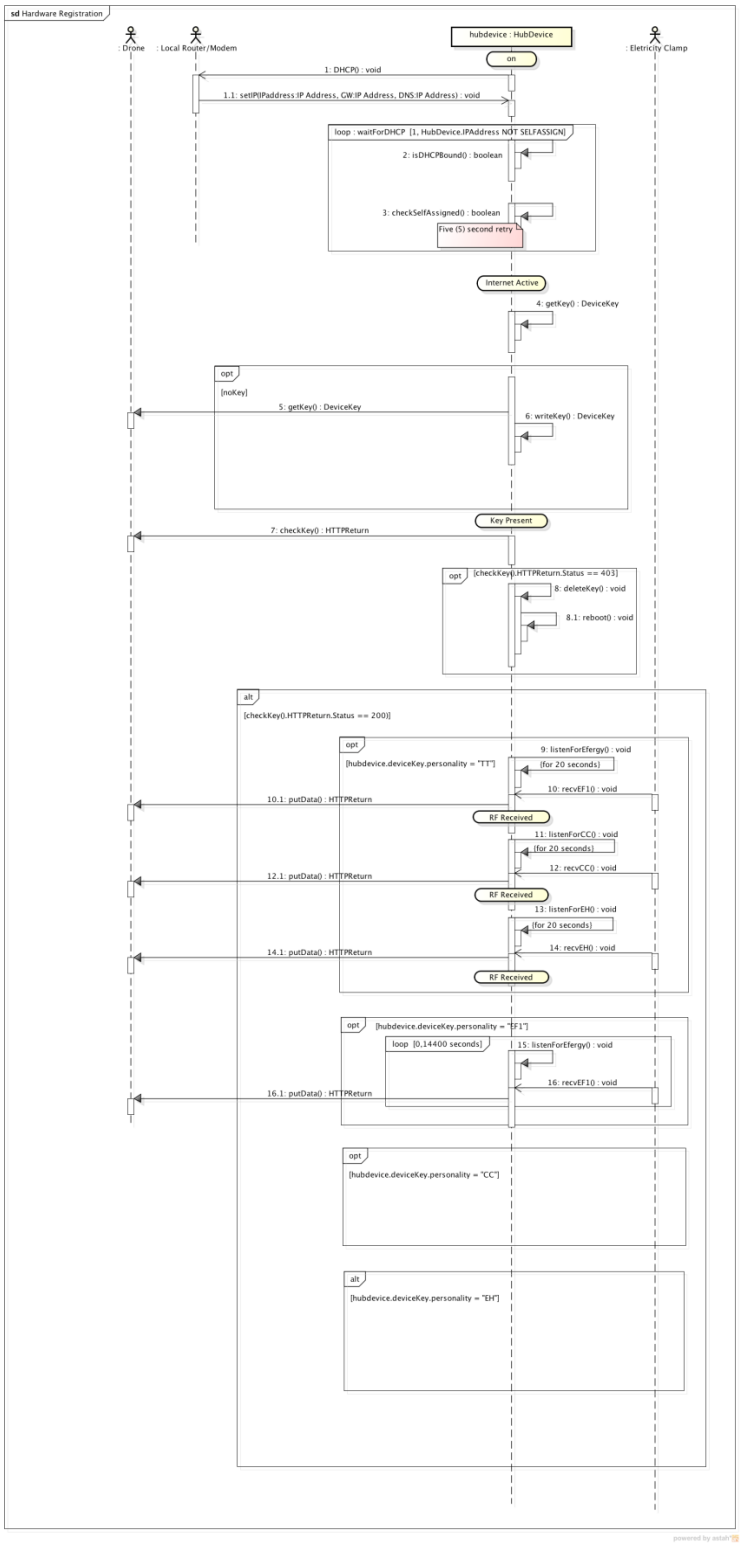


Figure 20 - Device management

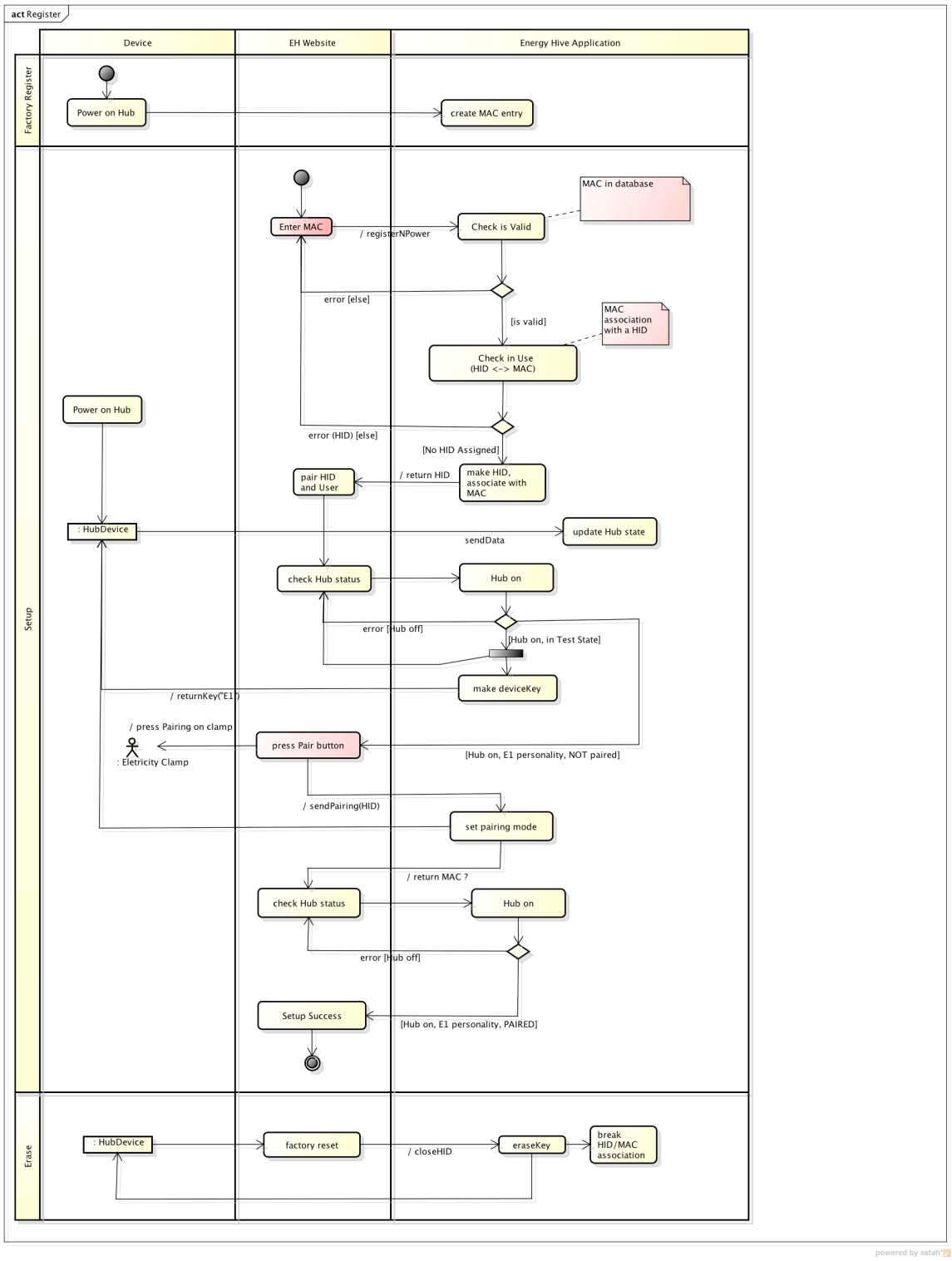


Figure 21 Device states mapped to registration sequence and API calls

[SI-16] View Citizen Portal Settings

The EPIC portal will house the Citizen and Public view with the City Administrator requiring access to the settings. If the City Administrator has EPIC administrative rights, then they will be able to navigate to the "Manage Pages" functionality and select the Energy Hive page. The Administrator can edit the page layout, theme type and properties for the page.

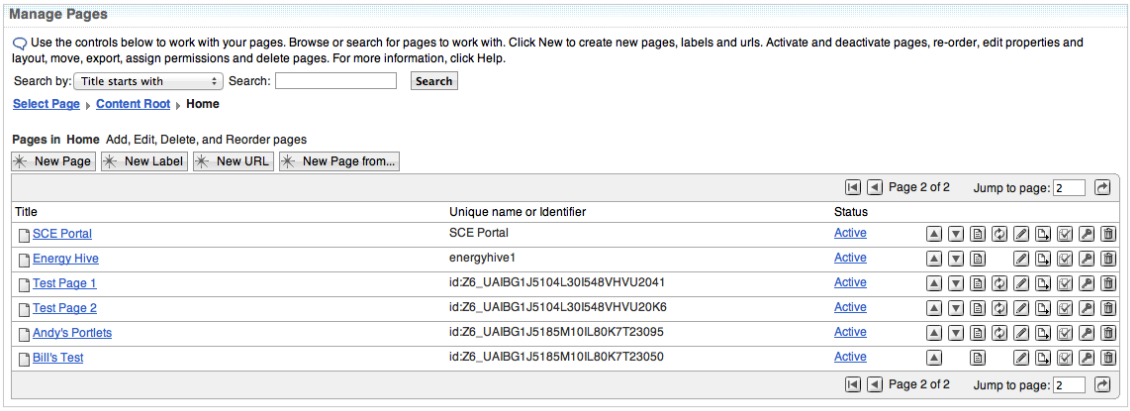


Figure 22 EPIC page management with the Energy Hive (Citizen View) page listed

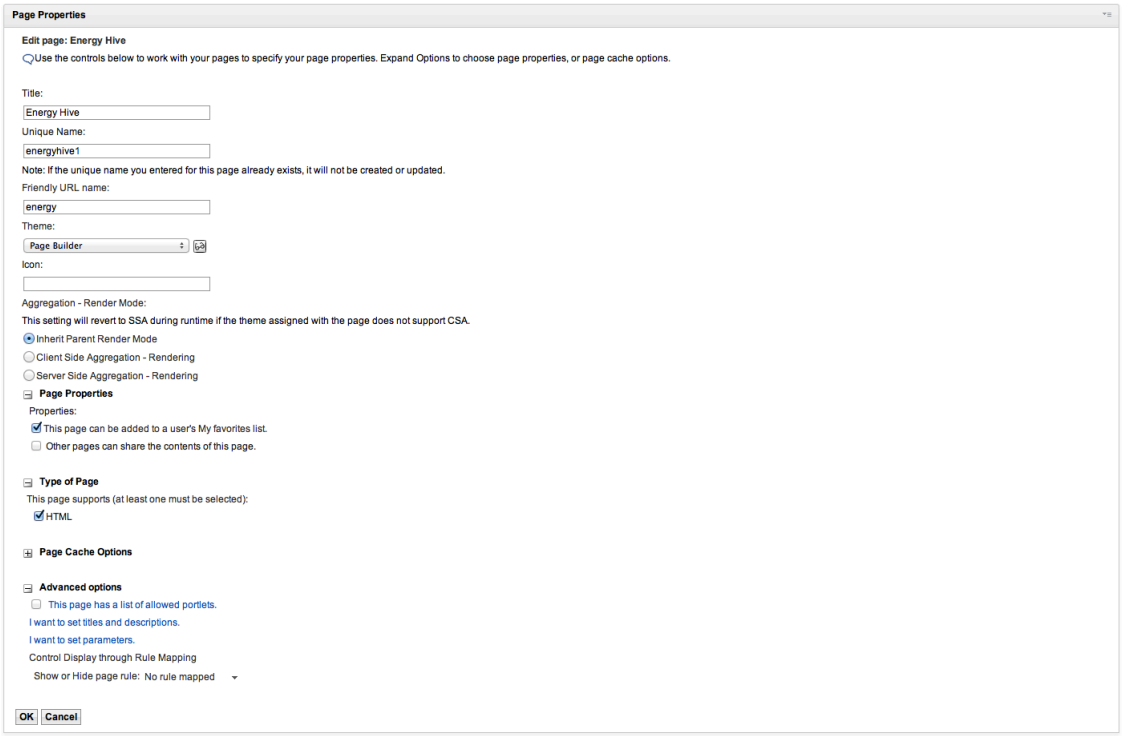


Figure 38 - EPIC page properties can be set by the City Administrator

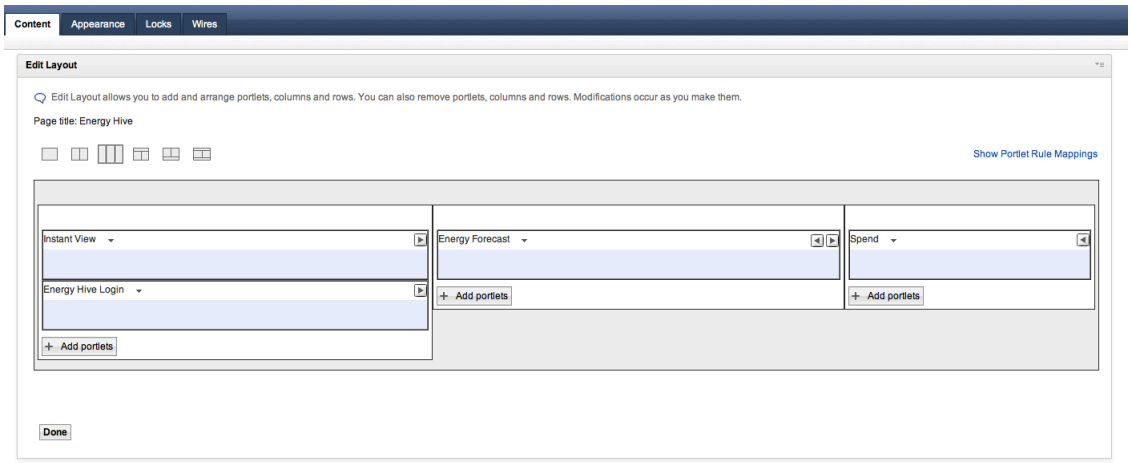


Figure 39 - Portlets can be selected from the catalogue and placed on the dashboard page

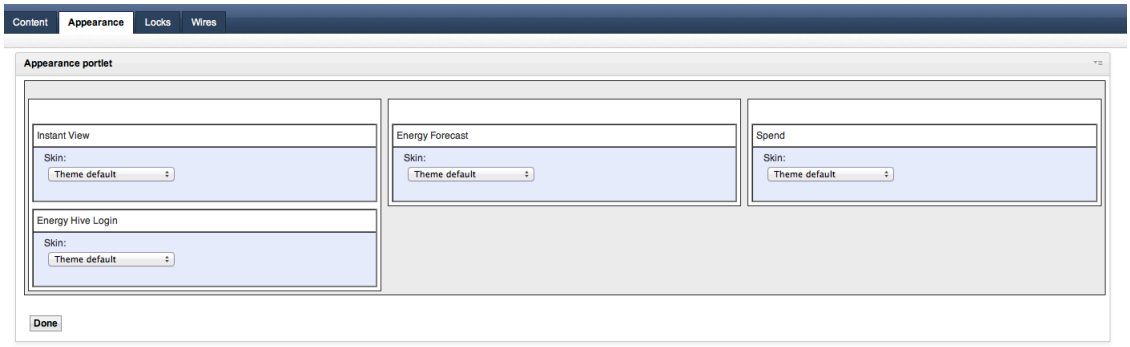


Figure 23 Portlets themes can be selected from the catalogue

[SI-17] See Citizen Portal View

The City portal page will be hosted at:

https://vhost1825.site2.compute.ihost.com/wps/myportal/Home/energy

A valid EPIC login will be required in order to view. It will have a lay out that will include an Instant View, a Forecast of power consumption over the next 3 days, a spend figure and history view to explore. The demo can now be viewed here: http://www.energyhive.co.uk/manchester

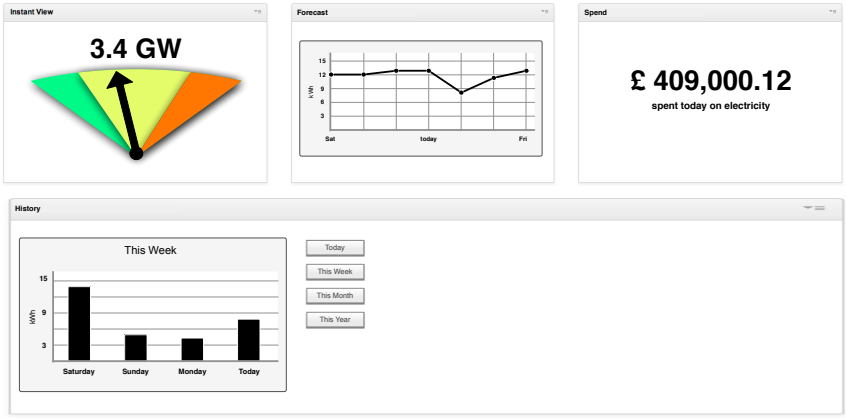


Figure 41 - Portlets rendered for the Citizen view

[SI-18] Manage Aggregate Views

Behind each of the portlets are shared settings that let the City select from different filters on the aggregate and configure specific portlet parameters.

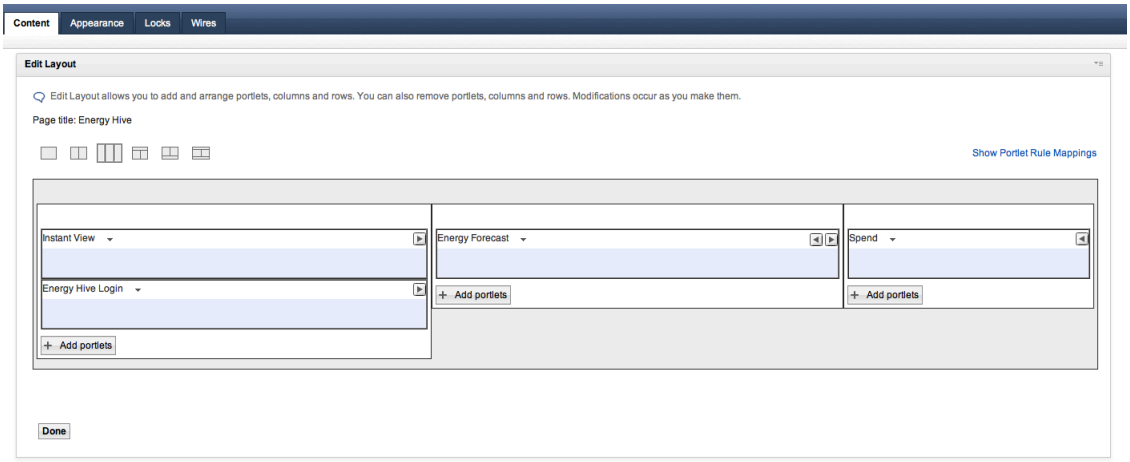


Figure 42 - Portlets have shared setting that can be edited in the page view

Instant view: Centre of postcode, radius

Forecast: Centre of postcode, radius, number of days

Spend: Centre of postcode, radius, number of days, average rate of electricity cost

History: Centre of postcode, radius

[SI-19] Manage Communities

Each City can have its own portal page with the ability to configure a postcode and radius to define a community.

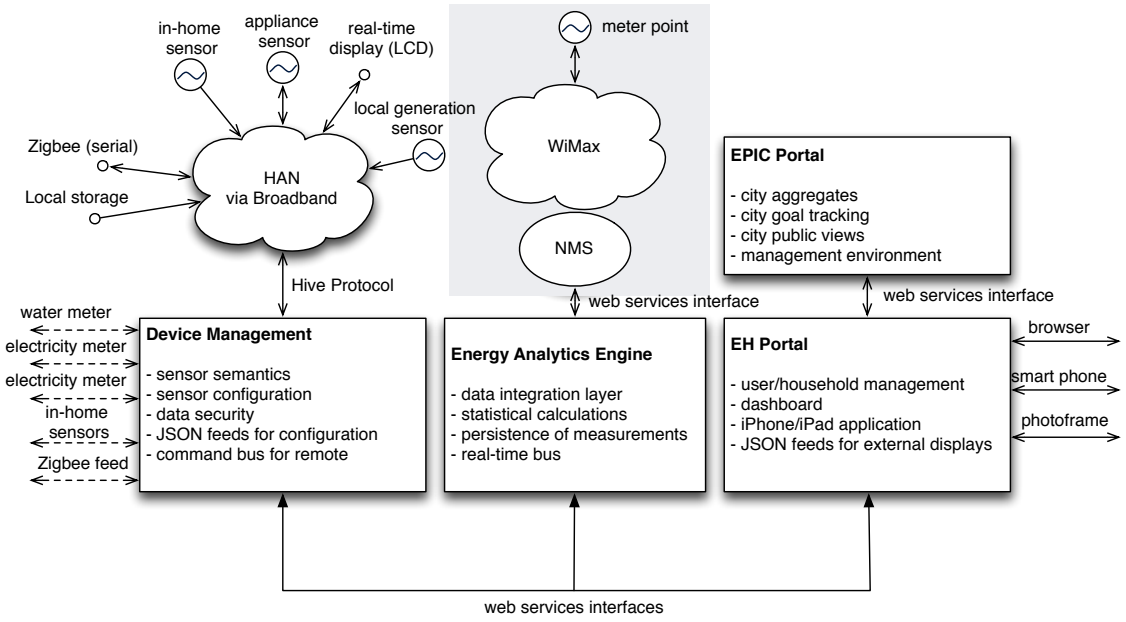
[SI-20] City View

As in SI-17 above.

3.3.4 Technical Description

The system that is being implemented is provided by Hildebrand Technology Limited in conjunction with Current Cost sensors and Energy Hive gateway hardware is also known by the product name "Energy Hive". Hildebrand is implementing Energy Hive as a backend database, analytics and device management service such that end user's will interact with the system through a combination of the EPIC portal and Energy Hive system.

The integration with EPIC will be done on a trusted basis such that Energy Hive will present data to the EPIC system for the group of users it creates and manages without end user authentication at the Energy Hive level.



City Portal [EPICPortal]

The City Portal is a web site that has a dashboard design using widgets to implement data views and interactivity. The Portal is modular in that new widgets can be developed and deployed through the framework and targeted at specific end users. The user experience is designed to be secure, easy to use and simple to understand data while presenting a level of detail. Hildebrand will be providing four city view widgets and sample jQuery components for EPIC to extend that are configured to work with the Energy Hive API.

API [Energy Hive]

The API will secure access to the other backend systems. This will be done on a trust basis between EPIC and Energy Hive.

Hive Analytics Engine

Data storage, analysis and retrieval of meter readings are critical functions of the web site and pose a challenge to traditional relational databases. The Hive Analytic Engine is a specialised time series database engine that enables efficient calculation, filtering and storage of time-based

readings. The Analytic Engine will be configured with the data streams and statistics that are required by the customer portal.

Device Management [Drone]

The Smart Environment service involves the deployment of Current Cost real time sensors and Energy Hive gateways to handle the collection of data and the in home presence with the customer. Device management is necessary to source data and cooperate with the other elements of the entire solution.

Monitoring and Management [Queen]

In order to maintain the health of the Portal system a monitoring and management environment will be deployed that communicates its knowledge to our operations team. This monitoring and management is a Nagios environment configured with the Portal service topology.

Client Applications

A browser is the preferred target client application. However the Portal solution can target presentation layers to smart phones, digital photo frames and machine interfaces.

3.3.4.1 System Logical Architecture

The EPIC portal will be given an application ID and shared secret to be able to make data calls to the EH API. The following logical diagram shows how those interfaces are exposed to the EPIC platform.

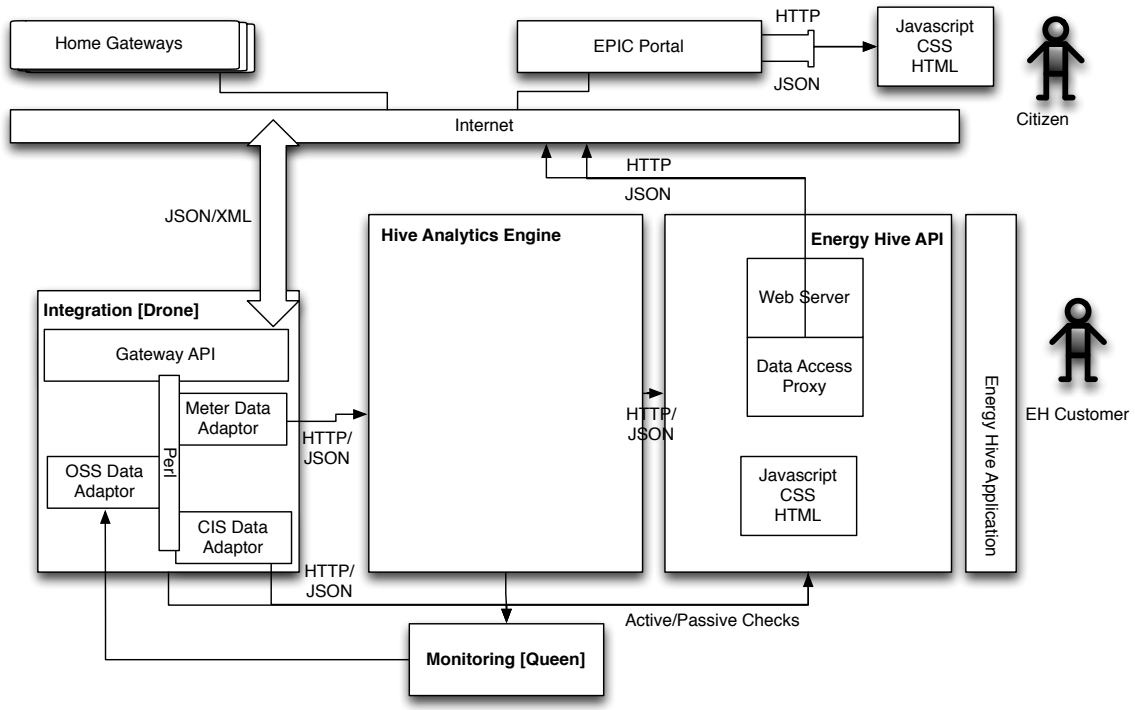


Figure 24 Logical system architecture

3.3.4.2 Energy Sensor Device

The Energy sensor device consists of two elements, the energy clamp (Current Cost) and the Energy Hive gateway device. The clamp is a current transformer that uses a Hall effect transducer to sense current flow and wirelessly transmits readings to the Energy Hive gateway via 433MHz radio.



Figure 44 - Physical hardware used for the system

The device is user self installed and works with a number of alternate clamp devices. The clamp device that will be used for the pilot will be Current Cost.

The Energy Hive gateway then plugs into mains power and the Internet via the home router Ethernet port. DHCP must be enabled on the router in order for the device to work.

3.3.4.1 Service APIs

The service APIs will be exposed via the integration. Online documentation will be published via http://epic.hbcontent.com

ID	Name	Description
API-1	registerEPIC	Starts the registration process for a
API-2	getDay	Gets the day individual and aggregate values of electricity consumption. The EPIC portal will scale up the sampled houses so that the entire population is represented statistically.

API-3	getWeek	Gets the week individual and aggregate values of electricity consumption. The EPIC portal will scale up the sampled houses so that the entire population is represented statistically.
API-4	getMonth	Gets the month individual and aggregate values of electricity consumption. The EPIC portal will scale up the sampled houses so that the entire population is represented statistically.
API-5	getYear	Gets the year individual and aggregate values of electricity consumption. The EPIC portal will scale up the sampled houses so that the entire population is represented statistically.
API-6	getDeviceStatus	Gets the device status for a householder ID (HID), this is helpful in aiding registration.
API-7	getHousehold	Get Household attributes for a given HID
API-8	setHousehold	Set Household attributes for a given HID
API-9	updateTariff	Updates a named tariff that can be applied to a consumption timeseries.
API-10	applyTariff	Associates a named tariff with a household (HID)
API-11	createTariff	Creates a named tariff that can be applied to a consumption timeseries.
API-12	sendPair	Sends a pairing request to the gateway device

3.3.5 Evaluation

The Energy Service prototype for the EPIC project has been evaluated through input from the DEHEMS (http://www.dehems.eu) project and the feedback from Energy Hive trials in a number of test homes.

Manchester City Council has tested and has given feedback on the support processes. These have been taken into consideration with the proposed design.

Further evaluation will be done in the closed and open user groups whereby takeup and frequency of use among others will be examined (see D4.1 and D7.1).

It is the intention to create an area for Citizens to create their own portlets that can be published by the City if they so choose. We will be evaluating the tool set that makes this producer role effective over the course of the open user group trials.

4. Conclusion

This document has outlined the initial delivery of the three Pilot Applications for the EPIC project. Each Section outlined its delivery in text, imagery, and a link to where the (working) applications can be reviewed and/or downloaded. For detailed information regarding the *integrated platform delivery with testing reports and service catalogue* we refer to the upcoming D4.1.

Furthermore, as this is an initial prototype, plans for further iterations – detailed in the *Pilot Operations Plan* (D7.1) – are scheduled over the coming months based on five testing cycles conducted in closed and open user groups, organized through Living Labs in Brussels, Issy-les-Moulineaux and Manchester. Each cycle consists of a testing and evaluation phase supporting an iterative process of improvement and further development such as in terms of usability, stability and performance. In some cases this may result in the extension of the set of functionalities and breadth of information offered through the applications on offer, and which will be reported accordingly in the designated deliverables.