Poster: R4Platform: A Reliable Data Platform for Continuous Performance Auditing in Buildings

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Abstract

This poster presents the *R4Platform* which provides an integrated set of tools and services that can be used as an enabler for continuous performance auditing in the built environment. The objective is to provide a modular set of components that when composed can provide an end-to-end auditing system for building managers, ESCOs and energy providers. The poster will present the platform architecture and its application in a real world environment, this will include a visual demonstration of the platform.

1 Motivation

The delivery of energy efficiency projects through energy performance contracts (EPCs) and Energy Service Companies (ESCOs) is widely seen as a way of addressing suboptimal post installation performance of energy efficiency technologies, where energy service providers take a financial stake in actual energy performance. This model is very attractive from many perspectives and is identified as a central route to delivery of energy efficiency gains in the Energy Efficiency Directive, methods and models for the accurate measurement and verification of energy savings are essential to the growth of the ESCO market.

2 R4Platform Architecture

Buildings with Building Management Systems (BMS) can typically collect large amounts of data, however most of the data is archived but insufficiently analysed. The R4Platform provides a flexible communication and middleware infrastructure that can connect to existing systems and provides secured web-based interfaces for open access and the creation of new energy management services. An essential element is to enable easily deployable data connectors which can integrate heterogeneous building systems across existing and new building blocks. This must be complemented by a secure communications infrastructure backbone that scales from building to multiple buildings. The platform architecture (Fig 1.) is analogous to the three tiered reference architecture specified by the Industrial Internet Consortium (IIC)[1], the following section presents a high level overview of the platform across the three tiered architecture as shown in Fig 1.

2.1 Edge Tier

There are a large number of protocols, systems (HVAC, lighting, shading, Security) that reside within buildings, often provided by different vendors with their own proprietary technologies. In result, the monitoring and control quality lacks the ability for coordination across these systems. The R4Platform aims to provide an easy integration and communication solution to improve interoperability and cooperation between technologies and stakeholders. A number of software based building system connectors are provided that can act as a gateway to underlying hardware, an example of such is an interface to a vendor specific BMS via an OPC. In addition, for the auditing process a building may not always contain all the sensors required to allow the auditor fully capture how the building is performing. The use of wireless sensor networks offer a flexible and low cost solution supporting short to medium term installations too allow the energy manager establish an accurate baseline or to support the creation of energy models. The R4Platform not only integrates a set of wireless sensors (Zigbee, EnOcean) as hardware components, but also provides planning tools to support the deployment and life cycle management of these networks (Site Manager). These tools allow users who have minimal experience deploying wireless networks to deploy a reliable monitoring infrastructure.

2.2 Platform Tier

The platform tier is composed of a number of components, including those for site, device and data management. Buildings can contain a significant number of devices and as such a large number of data streams. The R4Platform provides various management functionality, this includes a model store that incorporates device configurations (settings, sample rates, etc) and profiles (identity, location). This configuration data can be propagated to the end devices (via edge connector) to support reconfiguration post deployment. The platform tier also provides mechanisms to retrieve live data feeds and store them in a scalable timeseries database (Big Data Storage). To ensure consistent and high quality

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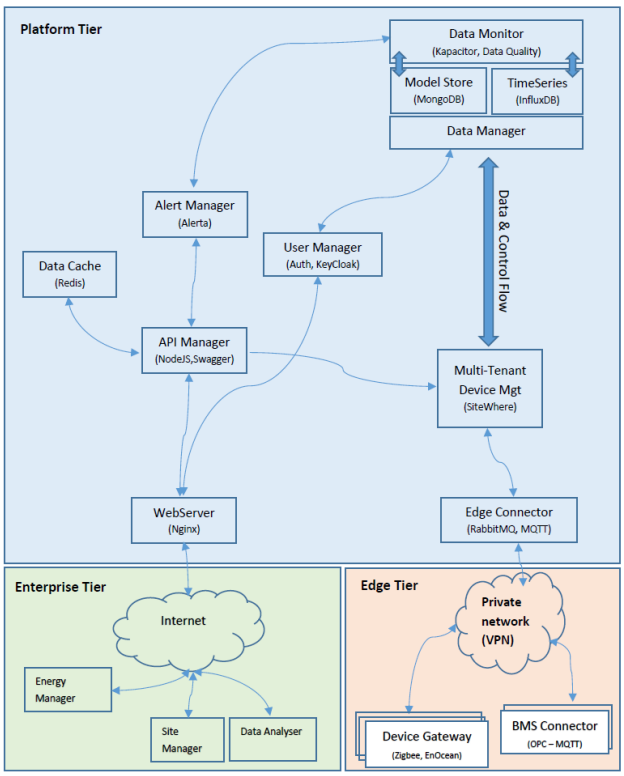

Figure 1. R4Platform three Tier Architecture

data, monitors can be setup to identify data losses, inaccuracies and provide context based alerts to site managers via the alert manager to ensure an intervention is put in place to minimise significant data loss. The alert manager is used to priorities and distribute actions that require attention to the various stakeholders via email, sms and management interfaces. The webserver, data cache and API manager provides a uniform interface over HTTP that combines the functionalities of the systems sub-components. It allows for the swapping out/upgrading of sub-components without affecting other parts of the system.

2.3 Enterprise Tier

The R4Platform provides a set of reusable HMI components that can be integrated into a web based user interface. This is achieved by identifying the most relevant information that allows the user get a better understanding of the current status across their site and provide insight to support their decision making process, for example detailed dashboard showing performance metrics of blocks of buildings, 3D visualisation of site with performance indicators and detailed view of building zones related to performance. The current UI provides a visual representation of the various system sub-components such as device management, alerts, data history as well as real-time data visualisation (dashboard).

3 Use Case: Heating Control using WSN

The R4Platform is being evaluated at the Cork Institute of Technology college campus. To demonstrate the complete workflow (data extraction, control action and visualisation),

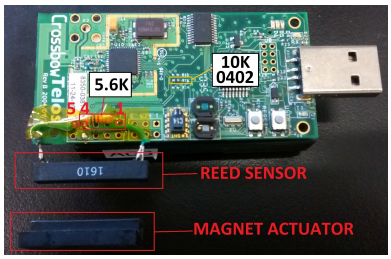

Figure 2. Wireless Sensor for Zone Monitoring

the R4Platform is used to extend an existing BMS and allow for more fine grained heating control across the building. The heating in the building involves an on/off schedule for the complete building. There is a number of radiator zones with control valves (RCV) (on/off) across the heating loop controlled based on a defined set point and occupancy detection in a specific zone. This provides an opportunity to split up the building into a number of virtual heating zones, however the standard configuration of a zone takes the average temperature in the complete zone and a common set point for each of the RCV valves. As a result it is not possible to control the zones based on local environmental conditions. The R4Platform was utilised to eliminate the need to replace devices, re-program the BMS and the addition of wired sensors. A set of wireless sensors (extended TelosB platform running ContikiOS shown in Fig 2.) were deployed to monitor the environment (temperature, humidity, light, 14 in total) and events (PiR, Open/Close Windows and Doors, 11 in total) in the individual zones, the data collected via the edge tier device gateway and propagated to the platform tier where it is stored and processed. The R4Platform then uses this data to update the BMS with the current temperature of the virtual heating zones, thus providing a virtual sensor in place of the physical device. Utilising this data the objective is to deploy a new control strategy via the R4Platform to independently control the temperature in each zone based on occupancy, air quality and user comfort. As the controller will have a better view of the specific zone it can dictate the valve status in each zone independently.

4 Conclusions

This abstract provides a high level overview of the R4Platform that is used to effectively and reliably manage performance related data extracted from the built environment. The platform is currently being used to collect and integrate data from multiple buildings at a college campus to provide a tool to support building performance management.

5 Acknowledgments

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6 References

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