Resource Management as a Service

HP Labs Sustainable Ecosystems Research Group
Overview

HP Labs’ Resource Management as a Service (RMaaS) is a research project to create an integrated hardware, software, and services solution for the management of non-renewable utilities (energy, water, and waste) in multi-use campuses. Existing campuses were built largely before the advent and spread of information technology. Over the next decade, emerging markets are expected to need new physical infrastructure while mature markets are expected to upgrade their aging physical infrastructure. RMaaS will deliver an IT-based solution for managing the flow of supply-constrained (and expensive) critical resources. The team is building a platform wherein cyber-physical hardware infrastructure (of facility systems and IT devices) is coupled to a management software layer that serves as the ‘operating system’ (OS) for a campus. Specifically, we are exploring three areas of research: (1) templates for provisioning measurement and monitoring hardware (such as smart meters) as well as integrating the appropriate IT infrastructure and actuation means for different monitoring objectives; (2) a secure and configurable management software layer, that virtualizes the physical facilities to facilitate communications between authorized users and resource-consuming equipment on a campus; and (3) a series of software applications for assessment and benchmarking, demand response and management, and supply optimization. These “apps” for integrated supply-demand management of campuses will also ensure extensibility of the platform to support various HP and third-party apps.

RMaaS: towards City 2.0

RMaaS is research in support of our City 2.0 vision. It has been estimated that, in 2011, more than half the world’s population – roughly 3.6 billion people – lived in urban areas. The U.N. forecasts that this will increase to 6.3 billion people, or about 67% of the world’s total population (9.3 billion), by 2050. In 2011, there were 23 megacities of at least 10 million people worldwide and this number is projected to grow to 37 megacities by 2025. This population growth coupled with increased per capita consumption will require the creation of a new generation of cities – City 2.0 – in emerging economies and around the globe. The starkest difference between City 2.0 and previous generations of cities will be the pervasiveness of IT. The need for information and the ability to communicate this information have always been a mainstay of cities, but now we are at a position when information and communication technology can be embedded within everything. IT can be truly interwoven within the fabric of the physical infrastructure of the city. Figure 1 shows a conceptual sketch.
electricity and information) on demand, through an intelligent management system based on the gathering, aggregation and analysis of disparate data, communications and policy-based control. The supply and demand side management resulting from IT-based business models will drive societal and business activities while providing a net positive impact on the environment. In order to achieve the scale required to sustain City 2.0 services, the cost of IT services will be significantly reduced through life-cycle design with a cradle-to-cradle perspective (Figure 2). RMaaS instantiates this architecture.

RMaaS in action @ HP Labs

An RMaaS resource monitoring test bed, with Advanced Metering Infrastructure (AMI) and facilities data from the entire site, has been deployed at the HP Labs Palo Alto, CA campus (1501 Page Mill Road). With this test bed, various RMaaS solutions can be piloted and showcased for internal and external customers. Thousands of meters and hundreds of additional measurement systems track the resources being used in the test bed including electricity, gas, water and waste. The test bed feeds real-time information to researchers about when and where resources are consumed. The test bed is also linked to the Palo Alto site Net-Zero Energy data center prototype recently unveiled by HP Labs.

Researchers suspect they’ll find plenty of places where energy use is greater than the need, says Amip Shah, principal investigator for the RMaaS project. With the test bed in place, says Shah, “we can begin to ask, what are the dependent parameters that influence the consumption of resources in the building?” He adds, “And that’s a non-trivial problem, because we already have tens of thousands of parameters in our data system, sending information every few seconds. But with this holistic view, we’ll be able to fine tune the lighting, heating, and cooling of [a] building to much better match the actual use of the spaces as it varies through the day and year.” Part of the point of the RMaaS test bed is to establish exactly how smart a “smart metering infrastructure” needs to be before it can have a real impact.

Figure 2. Vision of the City 2.0 Architecture.

Figure 3: an example of how RMaaS solutions help demonstrate how and where resources - in this case energy - are being consumed on a campus.


In an initial study, RMaaS researchers explored what type of metering infrastructure may be required to derive optimal value from the application of smart meters in commercial and industrial sectors. Monitoring resource consumption of commercial and industrial buildings is becoming desirable, especially as resource prices increase and corporate sustainability reporting becomes more common. Most existing approaches to energy efficiency within commercial or industrial facilities mostly rely upon audits or spot metering; however, such approaches generally provide a snapshot of the facility at a particular point in time, with the result that departures from typical operating conditions – including changes in load conditions or degradation of physical equipment - often go undetected. Moreover, site-specific energy audits, while helpful at the level of a single building, do not typically scale very well for global enterprises with hundreds or thousands of facilities. For commercial sites with smart meters, existing techniques may prove insufficient to get to a level of detail where actionable information becomes available to the facility manager on a real-time basis. For more information regarding this study – including our methodology, results and conclusions – refer to our ESFuelCell 2012 paper (see Further reading).

RMaaS research is ongoing around adaptive lighting, building energy forecasting, AMI and building management systems (BMS) analytics and more. Beyond that, the team is creating a variety of sophisticated tools that can both model resource consumption and suggest corrective actions in real-time based on the information.

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Further reading:
• HP Labs Sustainability: http://www.hpl.hp.com/research/sustainability.html

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