21st Century Property Management and the Intelligent Building

White Paper

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Intelligent Buildings provide granular control and monitoring of energy use in an open environment — with a fluid exchange of information between a rapidly evolving Smart Grid and the commercial systems owned by stakeholders. As the Smart Grid and commercial systems continue to progress, an Intelligent building needs to be able to adapt to these changes. Open systems that can integrate with multiple systems through standard protocols and interfaces are a must.

Introduction

Electricity is getting expensive very quickly. Prices in the US commercial market have risen 25% over the past 5 years, and are projected to rise another 50% over the next 5 years. Real-time pricing is being introduced that rewards those who closely monitor their energy use and punishes those who can't. Property owners and managers need to be able to make tenants accountable for their energy use through cost allocation — while giving them the tools to reduce consumption and costs. Tenants are becoming aware of the impending impact of rising energy costs and are flocking to properties that help them manage its use.

Intelligent Buildings integrate Building Automation Systems (BAS) with IT systems and metering platforms to provide a detailed picture of a building's state. This unified system tracks, informs, and controls resource use while integrating with business systems — allowing property stakeholders (building owners and others) to closely monitor and manage their energy consumption and participate in energy and Green House Gas (GHG) markets.

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What Makes a Building intelligent?

A multi-tenant building (commercial or residential) is a complex entity that obscures energy consumption accountability through the sheer number of stakeholders and their complex relationship to each other. Electricity distributors, property owners, property managers, and tenants each have their own perspectives and needs.

Satisfying these diverse requirements is a communications and information technology challenge.

An Intelligent Building incorporates sensors, controls, communications and information technology in an architecture that promotes integration between multi-vendor and multi-owner systems — allowing information transparency between all constituent systems and, ultimately, to the stakeholders themselves. Building automation systems built before 2006 did not contemplate information transparency. In fact, they were designed to be closed for security sake — and static for management sake. The center of the BAS was local to the building it was in, and information was not expected to be shared beyond that footprint, and even beyond the facilities management group. The new design criteria for building automation is openness, communications and information availability.

The fundamental component of the Smart Grid is the smart-meter — with a traditional demarcation at the electrical service point of entry to a building. The fundamental component of the Intelligent Building is also the smart-meter, but in this case it is a smart sub-meter with sensor (current transformer) granularity that can be used to monitor loads in real time, correlate building operations and consumption, monitor tenant operations and consumption, and communicate this information to systems that enable action to be taken.

This action takes one of two forms — control or financial decisions. Action can be manual, but will ultimately become automated. Systems designed today must accommodate this evolution smoothly and in a future proof manner.

Four Layered Model

An Intelligent Building's system architecture is best represented as a layered model (figure 1). The foundation layer is the metering fabric that monitors the consumption of resources (water, gas, heat, electricity). The more granular the metering fabric, the better it is for cost allocation, fault detection, and building benchmarking.

The building automation layer is made up of control systems and sensors that allow programable command of a building's infrastructure — heating, air conditioning, and lighting for example. The metering fabric is differentiated from the control sensor network because it has higher accuracy, built-in storage, and the ability to communicate with other systems in parallel with the building automation system. This simultaneous communication is important because building automation systems often have

restricted access — to protect important facility equipment. Meter information is important to the building automation system, but it is also important to other stakeholders (tenants, building owners, managers, service providers) and therefore needs to be more widely available.

The Energy and Resource Management layer of the Intelligent Building consists of processes and systems that serve as a mediator between building automation and the metering fabric. These systems and processes analyze the use of resources within the building and pass information to the IT Systems & Business Applications layer.

The IT Systems & Business Applications layer is the new frontier in building management — where traditional building information connects the Intelligent Building with the Smart Grid and the financial markets that will dictate how a building can be managed profitably.

A Staged Approach to Creating an Intelligent Building

An Intelligent Building can be developed in stages — which is especially advantageous for existing infrastructures. Older buildings often have a simple automation system (perhaps with static set points) with no granular metering fabric. Building Automation systems are relatively expensive. Conversely, metering fabrics (especially electricity metering) are usually very inexpensive per meter point and therefore a great place to start to evolve a building into an intelligent one.

By combining a metering fabric with an energy management platform, resource consumption visibility is rapidly achieved. Visibility means that changes can be made in resource usage patterns by manually adjusting settings or building automation set points. Costs can be allocated at this point as well. Research shows that when building occupants are accountable for their own electricity, overall consumption can drop from 15 to 25 percent. By creating a metering fabric, those directly responsible for energy consumption can be made aware of the implications of their actions. In addition, degrading equipment and inappropriate ratcheting of building system settings can be easily identified and appropriate actions taken.

Phase 2 in an Intelligent Building evolution involves the addition of automated work-flow (figure 2). This step requires a modern building automation system that reacts to external conditions

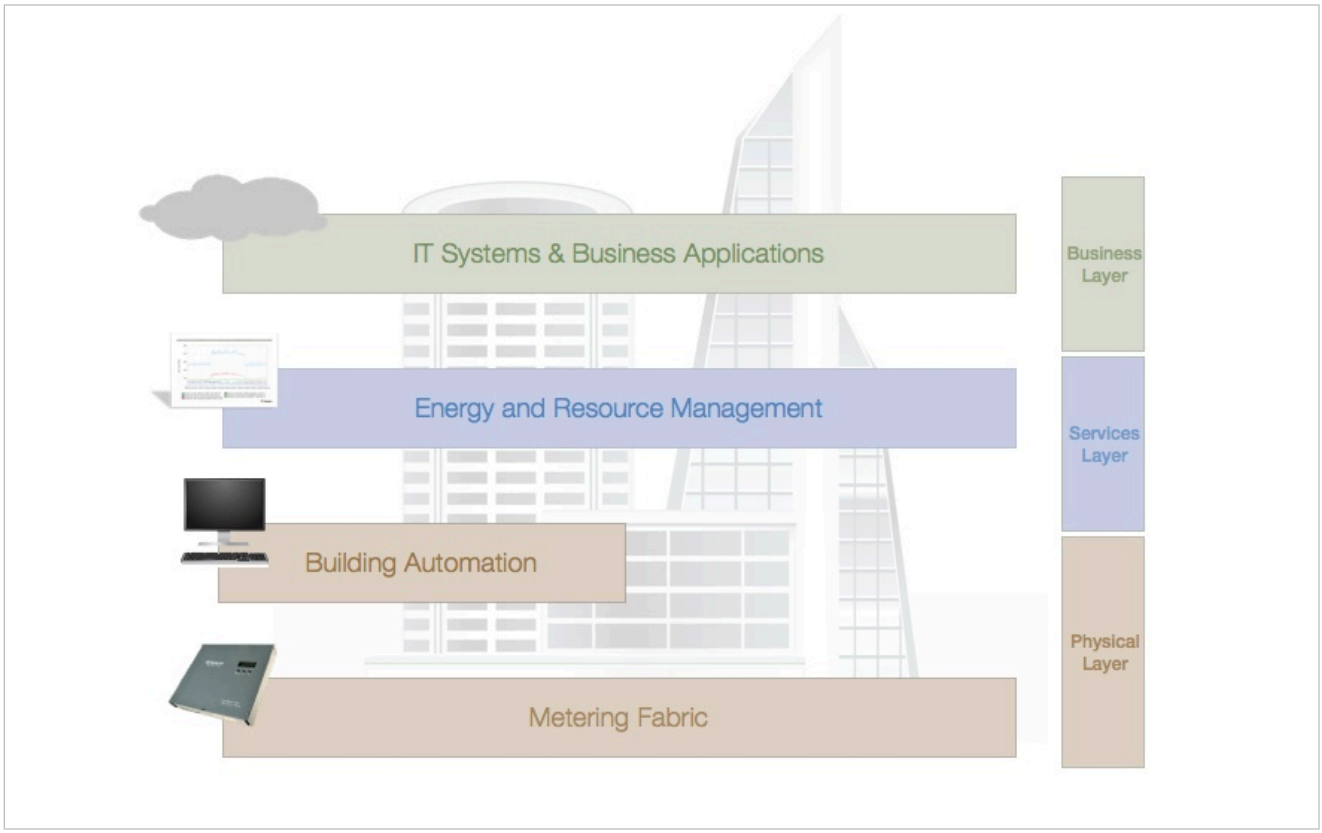

Figure 1: Intelligent Building Layer model

and events according to established rules. Communication and integration between the metering fabric, the resource management platform, and the business automation system is achieved via industry standard protocols and Application Programming Interfaces (APIs). There are many standards at play here — including BACnet, MODBUS, and higher-level middleware such as the Tridium Niagara AX framework and Cisco's EnergyWise. One of the most important selection criteria for any component of an Intelligent Building project is flexibility — with the ability to adapt and integrate with other parts of the system.

The final stage in the creation of the Intelligent Building is the integration of in-building components (building automation and metering fabric) with business systems such as energy and GHG market trading programs, demand response systems, and billing operations (see figure 3). Information needs to flow between all components of the solution, emphasizing the need for interface and protocol flexibility. System architectures must be flat, with all components reachable by each other. Built-in Internet Protocols (IP), therefore, becomes a critical selection criteria for any component in an Intelligent Building.

Creating a Flexible Metering Fabric

PowerHawk® multi-circuit meters are designed with interface and protocol flexibility in mind. PowerHawk multi-circuit meters are revenue-grade meters that have been adopted by electrical utilities and world-class electrical panel manufacturers as standard equipment for their offerings. More importantly for the Intelligent Building, PowerHawk multi-circuit meters have advanced communications technology built-in — making them the ideal choice for any Intelligent Building deployment.

PowerHawks can have multiple network interfaces (Ethernet, V.90 Modem, Wifi, Cell, Modem, Zigbee, 6LoWPAN, serial bus and Power Line Carrier) and multi-protocol capability (MODBUS® TCP, BACNet® IP, HTTP, FTP, and EnergyWise®). Communications can occur using any protocol or interface simultaneously. PowerHawks can be deployed in a typical building automation master/slave configuration, or as stand-alone web-enabled clients that can push information directly through firewalls to SaaS or server-based systems to any business application or they can perform both roles in parallel. Triacta's PowerHawk meters are equipped with pulse inputs for collecting data from water and gas meters that, when combined with electricity, provide an accurate picture of a building's state.

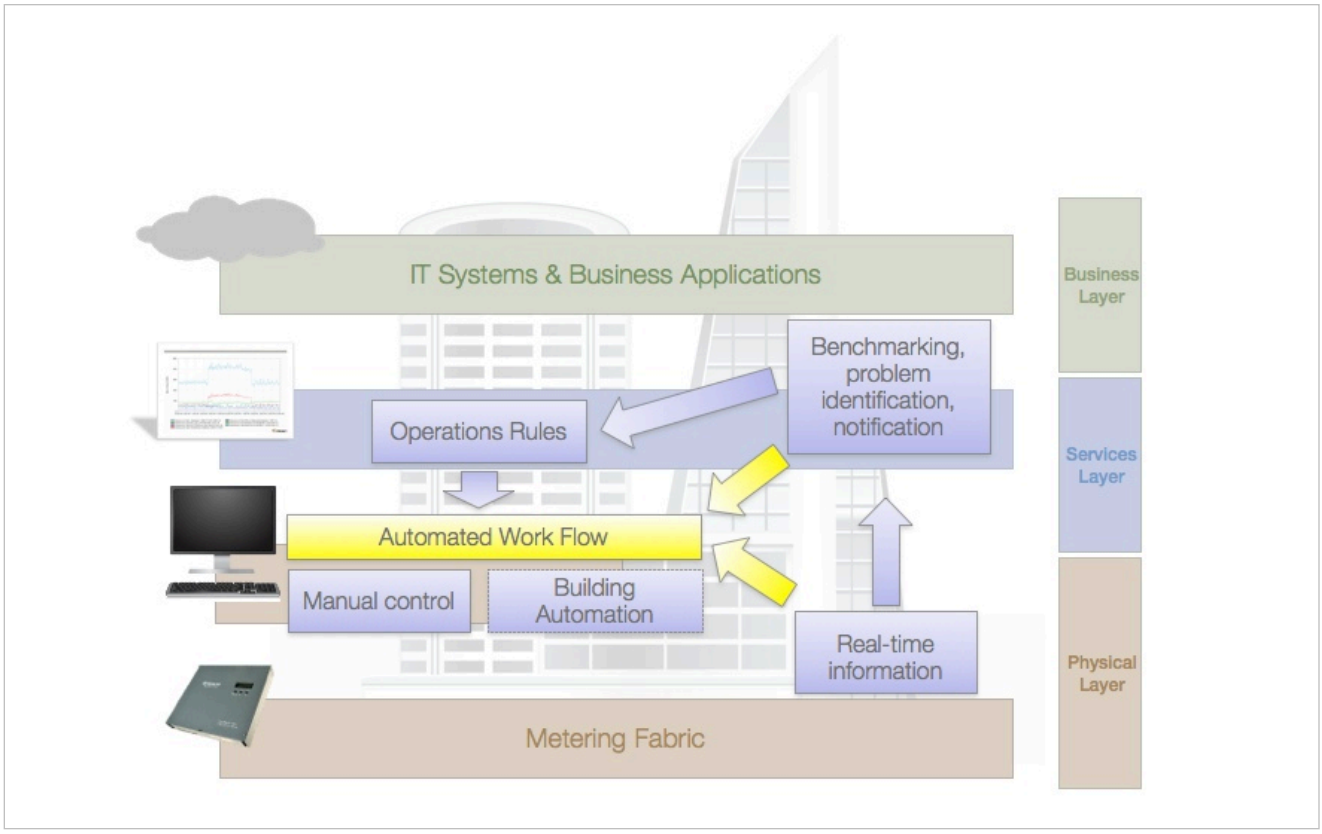

Figure 2: Automated Work-Flow

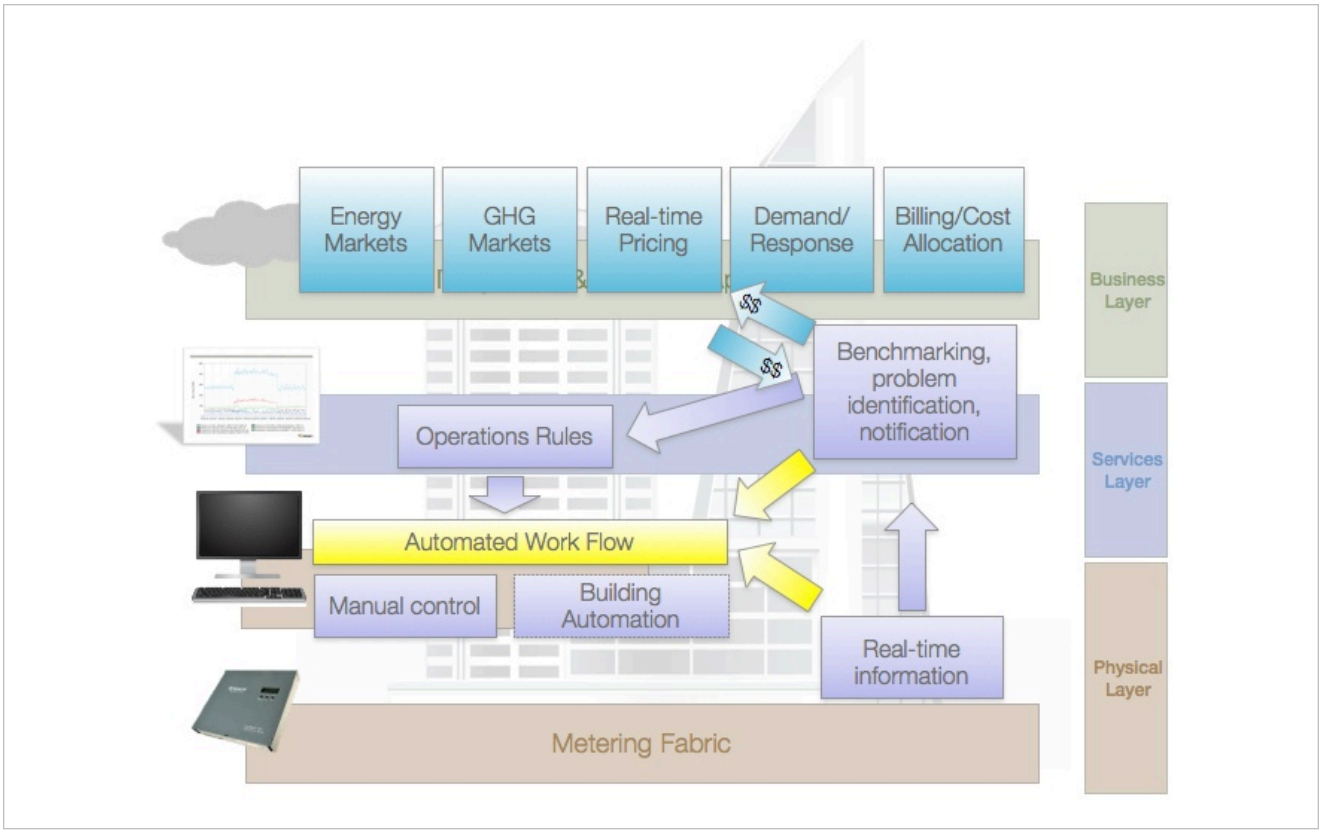

Figure 3: Integration of in-building components with Business Systems

A Future Proof Solution

When a new protocol or API is introduced into an Intelligent Building's system architecture, new firmware can be easily down-loaded from the Internet to the PowerHawk meter — quickly evolving it to the new requirement. This ensures that the foundational metering fabric is protected against future changes in business needs or communications standards.

The key to profitably managing multi-unit (commercial or residential) properties is to rapidly adapt to changing business and technological landscapes. The systems used in an Intelligent Building should be open and flexible, allow for staged and affordable evolution, and protect building owners and managers against ever evolving industry standards and business requirements.

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