Blackout Avoidance and Energy Saving Services with Alert Aggregation

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ABSTRACT
Peak electricity demands from huge number of households in a mega-city would cause contention, leading to potential blackout. This paper proposes bi-directional collaboration via a Smart Energy Monitor System (SEMS) between consumers and energy suppliers, exchanging real-time energy usage data with smart meters over the Internet and mobile devices for well-informed decisions and even predictions. The authors further propose the use of an Alert Management System (AMS) to monitor and aggregate critical energy consumption events for this purpose.

Keywords: Alert Management System (AMS), Customer Collaboration, Energy Monitoring, Event-Condition-Action (ECA) rules, Smart Energy Monitor System (SEMS)

1. INTRODUCTION
World population is forecasted to reach 9 billion by 2040, and it is also projected over 70% of the world population will live in cities by 2050 (Heilig, 2012). It has been a central issue for businesses, governments, and individuals to meet the energy demands of our growing population, while it is equally important for them to address carbon dioxide reduction. Modernization and rural-city migration continuously ask for the delivery of energy supplies. Energy efficiency and new energy technologies could certainly play a pivotal role. However, sustainability cannot

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be achieved without a change of behavior on the consumers’ side, for them to become more socially and environmentally responsible. This requires an understanding supported by data evidence, followed by adjustments or even a compromise of needs and wants and the willingness to subject to reasonable control.

China and India top the list of largest population in the world and both together account for about 37% of the world’s population (Rodriguez et al., 2008). China and India have become more developed and modernized and the buying power of their people has been increasing, there is a propensity for these countries to own many mega-cities. Given the current economic figures, the number of households in these mega cities that can afford electrical appliances will increase drastically.

The huge number of households in a megacity demanding energy at the same time would cause contention, leading to potential power outages (e.g., blackouts). Blackouts can paralyze economies and societies and seriously affect the knowledge-based society (Mega, 2005). It is probably the best time to look into realizing the call for a Smart Energy Monitor System (SEMS) integrated with household appliance control to save energy cost and reduce carbon footprints.

Every stakeholder of a city can contribute to the solution. We can start from energy consumption of a household, aggregating thousands and millions of households in a city multiply the effect, the results could be very positive, with winners from every side. Saving household energy cost is one benefit, decision optimization (on the various energy sources) enjoyed by the consumer is another; nonetheless, a more imperative mandate is to use intelligence to match capacity with demand to achieve efficiency, reduce unscheduled downtime, prevent power outages, and lower the negative impact to the environment.

To achieve these benefits both the consumers and the energy companies need data for well-informed decisions and predictions in the SEMS. The energy suppliers must be more agile to respond rapidly to the market and to adapt quickly and efficiently (Sharon & Etzion, 2008). An example is the ability to quickly shift power to where it is needed most to lessen contention to prevent a potential outage. The event-driven architecture is a sound and cost-effective way to support such a business environment, while the Alert Management System (AMS) would be effective in issuing notifications and early warnings in a proactive manner.

Our proposed solution requires bi-directional collaboration between consumers and the energy company exchanging real time energy usage data for well-informed decisions and even predictions. The communication infrastructure will basically include smart meters and the Internet; as well as mobile devices in the case of notification and early warning for the energy company to ensure the alert message gets received. Power line communications (PLC) technologies such as Power line Digital Subscriber Line (PDSL) and Broadband over Power Lines (BPL) now emerges to support an easy implementation of such an infrastructure (Carcelle, 2009).

The rest of our paper is organized as follows. We proceed to present some background and related work. Next, we highlight the major stakeholders’ requirements and introduce our approach. Then we present some details of our system architecture, supporting infrastructure, and our alert mechanism. Finally, we discuss our approach before concluding our paper with our future work directions.

2. BACKGROUND AND RELATED WORK

2.1. Energy Conservation and Renewable Energy Sources

Energy conservation is always a hot topic because the traditional fossil fuels, still the backbone of the energy systems, are scarce and limited. Technology and innovation towards efficient energy systems, gradually integrat-
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