2009 BFRL Project Description

Project Title: Integrating Building Automation Systems with a Smart Utility Grid

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Co-Investigator(s):

BFRL Program: Cybernetic Building Systems

Objective: To develop a technical basis for industry standards that will enable interconnection of building automation and control systems with a future "smart" utility grid and support industry efforts to develop the needed standards.

Problem:

What is the problem? The response to increased electrical energy demand cannot be met by the traditional build-out of central generation plants and new transmission lines due to national concerns over cost and environmental impact. Thus a new paradigm has emerged that focuses on demand reduction and distributed generation using alternative energy sources. Buildings consume 72 % of all electrical energy[1]. With modern automation and control systems, buildings have the potential to reduce peak loads in response to pricing and demand reduction signals. Increasingly buildings also have on-site generation capability from renewable or standby generation sources. Effective management and use of these capabilities in cooperation with utility providers is hampered by a lack of standards for building – utility communication. The Energy Independence and Security Act of 2007 (EISA) calls for the Nation to modernize the electricity transmission and distribution system, creating a "smart grid." The legislation specifically calls for Federal agencies to investigate ways to achieve demand response and distributed generation. It also calls for the development of an interoperability framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems.

Why is it hard to solve? Protocol development for pricing, distributed generation, and demand reduction requires analyzing the communication interaction and data exchange needs for a wide range of devices and market entities connected to the smart grid. Interactions between building loads and a smart grid are complicated because of the sheer number of building loads that must be managed and the requirement for maintaining stability in the grid. Success also requires understanding the needs and constraints of a diverse set of stakeholders across the electrical utility and building industries.

[1] *DOE Buildings Energy Data Book http://buildingsdatabook.eren.doe.gov/*

How is it solved today, and by whom? The measurement science needed to solve the problem is not currently available. There are no standards for signaling a need for peak demand reduction, exchanging information about on-site distributed generation capabilities or real-time pricing signals. There have been a number of efforts by independent utilities to test various technologies and proprietary communication approaches to implement demand response and real-time pricing. These efforts and their success vary widely but they offer an experience and knowledge base that can aid in the development of a robust national system.

Why NIST? EISA assigns NIST primary responsibility to "coordinate the development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems." BFRL has extensive ties to the building control industry and an established record of leadership in developing the BACnet communication protocol standards for building automation system now in worldwide use. BFRL already leads the Utility Integration Working Group (UIWG) of the BACnet committee which has developed BACnet extensions that enable building response to demand reduction signals. The work is aligned with the BFRL strategic priority of Measurement Science for Net Zero Energy High-Performance Buildings, and consistent with the BFRL core competencies of measurement science for building energy technologies as well as in the area of information, communication and automation technologies for intelligent integration of building design, construction and operation.

Approach:

What is the new technical idea? The new technical idea is to integrate buildings into the next generation "smart grid" by developing the technical basis for standards governing real-time pricing (RTP), demand reduction, and distributed generation (DG). This project will address data representation and application protocols for RTP and DG, working with industry stakeholders to analyze use cases and develop approaches that can be adopted through consensus standards. In addition, this project will look more broadly at potential interactions between buildings and the electrical grid by supporting an industry road mapping exercise called for in the EISA legislation to identify other needs and to identify gaps in standards and technology that must be addressed.

Why can we succeed now? The building industry has caught the vision for building energy use reduction and is beginning to recognize that intelligent buildings need to interact with an intelligent grid. EISA calls for a strong, coordinated Federal participation in developing a new smart electrical grid. A number of efforts to address this need have already begun that involve both the building industry (ASHRAE) and the utility industry (EPRI, Utility AMI, and Gridwise). These various groups are interacting and appear to be approaching a critical mass that will lead to a successful outcome.

What is the research plan? The focus will be on the research and standards development needed to enable demand reduction and real-time pricing that is widely recognized as important by the industry. The first step will be to assess and document the requirements for real-time pricing demand reduction based on analysis of industry RTP experience to date and the potential of new building automation and control systems to respond to RTP signals. The use cases identified in this process will be used to drive the development of recommended RTP data content and format, and test implementations. The testing will be carried out with industry

partners in California as part of an Open Automated Demand Response project using BACnet web services as the communication platform. The results of these tests will feed into the established standards development work of the BACnet UIWG.

BFRL will lead a coalition of industry stakeholders to identify additional technology and standards that will be needed to achieve the vision of buildings integrated with smart utility grid. This will result in a roadmap that will guide the work of future years.

Building on the success of the work in demand response and RTP, focus will shift to addressing the communication needs to enable effective management of distributed generation technologies. The approach will be similar, beginning with a collaborative assessment of the requirements followed by tests of possible solutions and then incorporation into industry standards. Further work will be guided by the outcome of the industry road mapping activities.

Recent Results:

New project

Standards and Codes:

The project results will become the basis for revisions to ASHRAE Standards 135 and 135.1, and their ISO equivents EN ISO 16484-6 and EN ISO 16484-6.