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An information model for building automation systems

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Abstract

An information model of a building automation system (BAS) was created. It encapsulates several views of the system: the device list, network topology, points list, and sequences of operation. The model allows a single persistent representation of a BAS to be maintained from system specification through design to operation and maintenance. It will also allow other applications such as energy simulations, maintenance management systems, and building commissioning applications to extract information about the BAS. The model is not intended to represent control application programs; however, it would be possible to develop a software tool to parse the information model, then create the required configuration database and control application programs as output. The model was tested by creating an experimental implementation based on a BAS installed in a medium-sized office building.
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Keywords: Building automation; Direct digital control; Energy management system; Information model

1. Introduction

The process of specifying, designing, and installing building automation systems (BAS) typically begins with the plans and specifications produced by the mechanical, electrical, and plumbing (MEP) design engineer. The MEP plans and specifications include equipment and process schematics that specify the location of sensors and control elements for the mechanical system. Also included is a narrative "Sequence of Operations" which describes how the mechanical system is to be controlled. Despite its name, the "Sequence of Operations" does not describe a sequential process; it is an overall specification of the control strategy for the heating, ventilation, and air conditioning (HVAC) system. This information is provided to the control system integrator, who then creates a configuration database for the control system, which establishes communication, network, and device parameters as well as input/output (I/O) configuration parameters. The control system integrator also develops control application programs for the controlled equipment based on the narrative "Sequence of Operations." There is a great deal of variability in the level of detail provided in the "Sequence of Operations." The system integrator must determine how much detail is provided, then apply judgment in determining precisely how the mechanical equipment will be controlled. Ultimately, the building owner will receive the control schematic drawings and "Sequence of Operations" from the MEP design engineer in addition to as-built control system drawings and a user manual from the control system integrator.

The building owner needs to extract information about the architecture and operation of the BAS for various participants: the building engineer, maintenance contractor, commissioning agent, and energy consultant have diverse information needs related to the network topology, I/O configuration, hardware part/inventory data, software version numbers, as well as the control strategies and sequencing. Very little of this information can be extracted directly from the documents delivered to the building owner; it must be read, interpreted, and manually re-entered into a spreadsheet, database, maintenance management system, commissioning tool, or energy simulation program.

A far more effective solution to the problem of passing information about the BAS to each of the parties would be a single, persistent, computer processible representation of the BAS from specification through design to operation and maintenance. An open, standard exchange format would allow a number of software tools to be developed which

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could enable the MEP engineer to communicate the necessary BAS specification to the control system integrator at a consistent level of detail; allow the system integrator to automatically extract the BAS specification information, "fill in the blanks," and create the configuration database and control application programs; and allow the building engineer, maintenance contractor, commissioning agent, and energy consultant to automatically extract the information they need and enter it into their software applications. Development of the exchange format is the necessary first step, but to make this vision a reality, software tools must be developed which use the format to exchange information. For example, one software application might allow an MEP engineer to identify the components of the HVAC system and how they are to be controlled. The results would be saved in a file based on the exchange format, which could be opened by the system integrator using a different software application which allows him to view the information created by the MEP engineer, make additions or changes as necessary, create a system of control hardware and software for the system, and save in a file using the same exchange format. The system integrator's software might also automatically generate the configuration database and/or control application programs. Software applications already used by the building engineer, maintenance contractor, commissioning agent, and energy consultant might be modified to be able to read the files created by the MEP engineer or system integrator and extract the information needed for their specific applications, for example, a maintenance management system might look for the model numbers of the control hardware, while an energy simulation program might look for whether the air-side economizer is temperature or enthalpy based.

2. Methodology

There are two elements of the exchange format: a model of the information to be exchanged, and a method of encoding the model in an electronic format. The second part is provided by an international standard, International Organization for Standardization (ISO) 10303–21:2002 [1], which specifies the encoding of an information model written in the

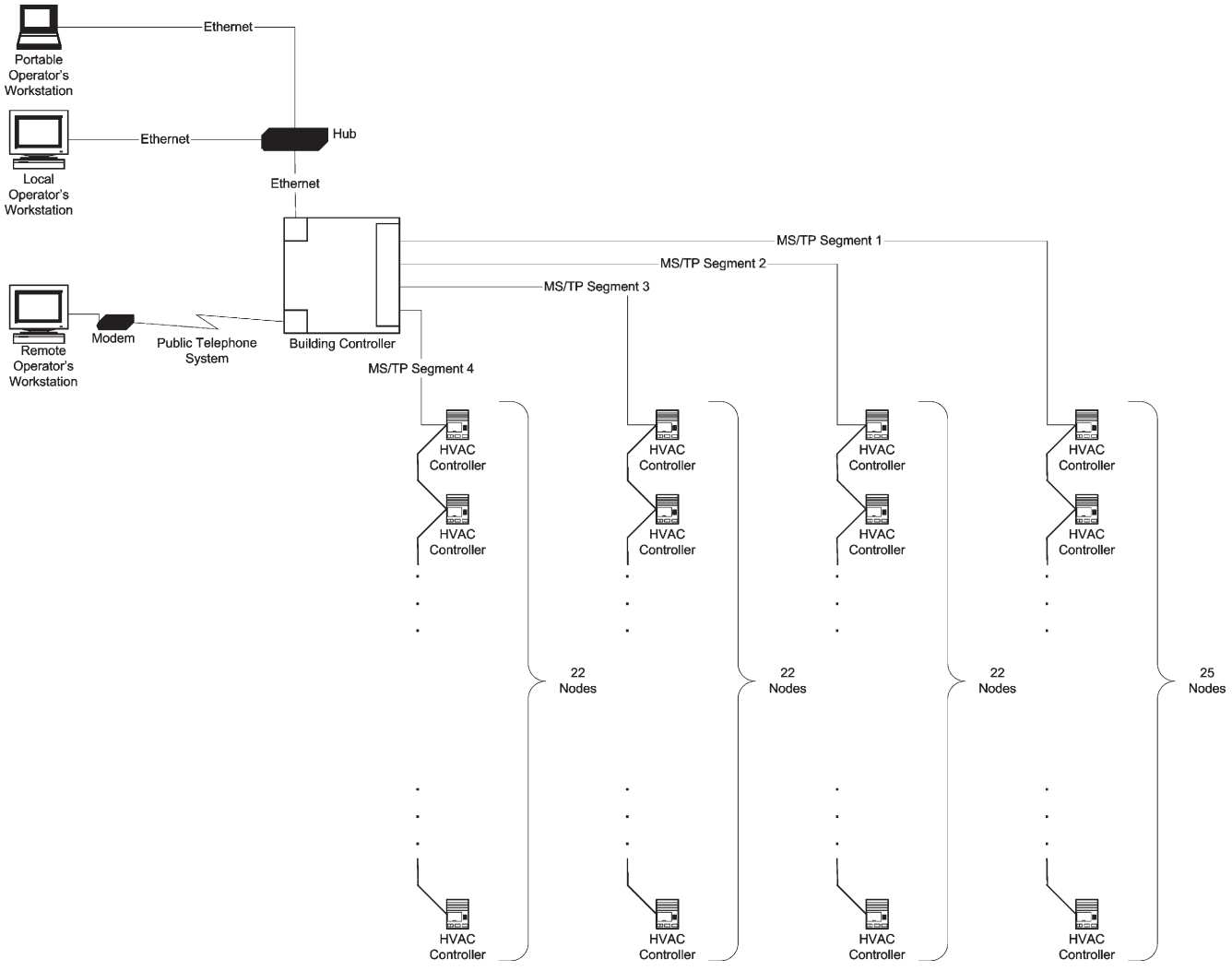

Fig. 1. Building automation system information model data point entity diagram.

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