

Future Potential for Building Management Systems Technology at Saudi Aramco

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ABSTRACT

An introduction to Building Management Systems (BMS) including some important definitions and background is presented. An overview on the development and future potential for BMS at Saudi Aramco is analyzed in detail. The influence of standard protocols is analyzed, and some of the most promising ones are described in detail.

INTRODUCTION

When minicomputers and mainframes were the only computers available, BMS only were used on larger office buildings and college campuses. With the shift to microprocessor-based controllers for Direct Digital control (DDC), the cost of integrating building management functions into the controller is so small that a BMS is a good investment for commercial buildings of all types and sizes. The objective of a BMS is to centralize and simplify the monitoring, operation, and management of a building or buildings. This is done to achieve more efficient building operation at reduced labor and energy costs and provide a safe and more comfortable working environment for building occupants. In the process of meeting these objectives, the BMS has evolved from simple supervisory control to totally integrated computerized control. Some of the advantages of a BMS are as follows:

- Simpler operation with routine and repetitive functions programmed for automatic operation.
- Reduced operator training time with on-screen instructions and supporting graphic displays.
- Faster and better responsiveness to occupant needs and trouble conditions.
- Reduced energy cost with centralized management of control and energy management programs.

- Better management of the facility using historical records, maintenance management programs, and automatic alarm reporting.
- Flexibility of programming for facility needs, size, organization, and expansion requirements.
- Improved operating-cost record keeping for allocation to cost centers and/or charging individual occupants.
- Improved operation using software and hardware integration of multiple subsystems such as DDC, fire alarm, security, access control, or lighting control.

BACKGROUND

The BMS concept was suggested in Saudi Aramco in the early 1980s and has since changed dramatically both in scope and system configuration. System communications evolved from hardwired (and home-run piping for pneumatic centralization) to multiplexed (shared wiring) to today's two-wire all digital system. The EMS and BMCS evolved from poll-response protocols with central control processors to peer-to-peer protocols with fully distributed control.

DEVELOPMENT AND FUTURE POTENTIAL FOR BMS AT SAUDI ARAMCO

Saudi Aramco facilities must meet business needs more and more closely and reduce operating and maintenance costs. Leaner budgets and environmental considerations demand advanced energy management. Growing expectations for comfort and service require advanced managerial instruments. Every project has a unique pattern of building management requirements.

Ability to choose the right solution to meet specific needs is crucial. It's time to change the way we look at facility and building management. Only a coherent automation and control framework, within which many different systems are to evolve, can remove the barriers to progress. A common interface, open, normative system standards, web technology and advanced integration are fundamentals for success.

Below is a list of actual customer requirements:

- Reduction of initial investments;
- Building Automation uses existing IT and CT infrastructure;
- A unique user interface for all building disciplines (HVAC, lighting, lifts, fire, access, intrusion, ...);
- Customers want higher supplier independence in case of later system enhancement;
- Reduction of operating, energy and maintenance costs;
- Mobile operators want to operate the building at any time, from everywhere, immediately;
- Less trained operator needs "obvious" operating;
- Technical competence centre serves many buildings in a defined geographical region;
- Growing expectations for comfort and service; and
- Reduced energy consumption.

EFFICIENCY MEANS PROFITABILITY

An integrated management system enables a building to be operated more easily and with greater efficiency, so helping to reduce operating costs and increase profitability. Instead of using a variety of dedicated devices for operation, the facility manager's team can perform all activities from operator stations with the same look and feel, keeping training and operating costs to a minimum and reducing the likelihood of incorrect operations. Dedicated security systems, of course, send their alarms to the security guards. However, if information of all systems in the building is brought together to one or many networked operator stations with unique human interface, faults and alarms can be identified and dealt with immediately, for the better protection of people and property.

WHAT HAS TO BE COVERED BY OPEN COMMUNICATION STANDARDS FOR BUILDING AUTOMATION AND CONTROL SYSTEMS?

I would like to highlight some concepts on which to focus our attention when deciding which protocol is the right solution for BMSs.

The involved parties should consider different topics when deciding which standard protocol fulfils the requirement. The following main issues have to be addressed:

➤ **DATA**

Provide all complex and simple data structures to accomplish daily functions like:

- Exchange data between devices;
- Monitor and operate inputs, outputs, set-points, alarms;
- Time Scheduling;
- Online Grouping / Regrouping
- Trend / History; and
- Backup / Restore.

➤ **Services**

Support services for system start-up, network management and back-up / restore.

➤ **Media**

Provide independent media access to support modern IT and CT networking standards and cabling systems.

➤ **Extension**

Allow extensions to provide the possibilities of future innovations.

BACnet VERSUS LONMARK

If we apply above criteria to BACnet and LonMark we get the following picture, (see **Table No. 1**), where we can see a clearer positioning where to use what.

<i>Functionality</i>	<i>BACnet</i>	<i>LonMark</i>
Exchange data between devices	✓	✓
Monitor and operate values, alarms	✓	✓
Time Scheduling	✓	✗
Online Grouping / Regrouping	✓	✗
Trend / History	✓	✗
Engineering	✗	✗
Backup / Restore	✓	✗
Remote management (autodial)	✓	✗
IT compliance (TCP/IP, Ethernet)	✓	✗
Very large number of suppliers)	✗	✓
Low implementation cost	✗	✓
Network management	✓	✗

Table No. 1

COMMUNICATION STANDARDS

Standardized communication protocols such as LONMARK, BACnet, etc. allow exchange of information between different manufactures devices, systems and programs in an agreed way. Communication standards are the prerequisite for cost efficient integration of various manufactures subsystems.

- **LonMark**

The LonTalk protocol is a proprietary product from Echelon Inc. The defined LonMark templates cover the functionality needed for the field level: Data exchange and interactions between devices on the same bus, monitoring of values such as temperatures, operating states and simple control functions e.g. lights on/off, etc. The field device functions are normally implemented in one single chip (the Neuron and the LonWorks transceivers support a range of transmission media, e.g. the inexpensive Cat. 4 cables. In addition there is a relatively large (>180) number of manufacturers available to choose devices for building applications from, but the product's ability for interoperation has to be checked by the system integrator.

All this may give the LonWorks-based products a future potential to network at the field level. But "normal" sensors and actuators cost less without taking the overall

system costs and the engineering into account.

- **BACnet**

In most other protocols there are some basic BACS functionalities missing for open interoperability. Services and functions which are needed for mature building management such as: Trend / history, time scheduling, back-up/ restore, remote management, alarm distribution, and many others.

BACnet covers all these requirements. In addition BACnet supports, in a flexible way, modern IT and networking technology such as Ethernet and Internet Protocol (IP) this is needed in today's modern IT environments.

BACnet is therefore the best choice for the upper system levels where a broader functionality and full IT compliance is needed.

BACnet, LONMARK, ETC. - WHERE TO USE WHAT?

On the floors, for room automation, where a large number of devices have to be linked together and to interact - LonMark for more complex engineered solutions offers good cost-effective products covering the functionality needed.

However, in plant rooms - more functionality is needed - this functionality is currently best

covered in a standard way by BACnet. For BACnet the most effective physical media has to be selected, e.g. the same as for the floors. For management applications we need in addition to BACnet's high functionality also its IT compliance, so here BACnet on Ethernet/IP will cover the requirements.

CONCLUSION

Upgrading and furnishing our facilities with the latest technology of building management systems through emerging standards is occurring at a phenomenal pace. The fact that today's BMS manufacturers are able to create products with a global reach increases the importance of having such system within an organization like Saudi Aramco. In addition, Saudi Aramco is committed to evolving today's network and investments to a next generation network that will deliver a wide variety of services while providing the lowest cost of operations.

IMPORTANT DEFINITIONS

Building Management System (BMS): A system which centralizes the monitoring, operations, and management of a building to achieve more efficient operations.

Building Control System (BCS): A system that controls the comfort and safety of a buildings assets and environment.

Building Management and Control System (BMCS): An integrated BMS and BCS.

Energy Management System (EMS): A system that optimizes the operation, temperatures, and processes of an HVAC system within a building. Except for some early versions, a BCS or BMCS includes all EMS functions.

Communications Protocol: A set of conventions used to govern the format and content of messages between processors.

Building Automation and Control Network (BACnet) Protocol: A BMCS communications protocol developed by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).

LonMark standard: A communications standard for control networks developed by the Echelon Corporation and the LonMarkT Interoperability Association.

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