WHAT CONSTITUTES AN OPEN BUILDING AUTOMATION SYSTEM?

Much has been written and said about **"Open Building Automation Systems"** without really clarifying for those in the industry - manufacturers, vendors, engineers and owners what constitutes an "open system" and more importantly how to identify and require those features within a specification. The purpose of this document is to look at the different components of a BAS and to identify the features and functions of each that would provide a desirable degree of openness.

Defining an "Open System"

An BAS open system can be defined as: A hardware and software offering that provides for the level of access to product, programming tools, training and support that is in conformance with industry standards and that is acceptable to the owner and installing and service contractors.

Admittedly a somewhat vague definition, but one that is adaptable and definable by the rapidly changing industry and the demands of the customers. The key to the definition of "Open" is what is acceptable to the owner and contractor based upon their expectations that has been tailored by industry standards. Such an example would be Microsoft Windows based products. Certainly a proprietary design and ownership that dominates the market but acceptable to most customers as an open system due to availability of compatible products, development tools, sources of supply, support and its conformance to industry acceptable standards (although admittedly much of their own making). As such most customers are content with this form of open system. So, ultimately it is not the manufacturer or industry associations that define what is an acceptable open system but the owner and installing contractor.

> Why also the contractor? Because they are key to a successful installation and ongoing maintenance. If the contractor is limited in access to product, tools, training then they are limited in what can be installed and who can support and expand the system.

To understanding what could be considered an Open System for Building Automation, we need define the different parts and functions of the BAS and examine the attributes of each as they pertain to an Open System. The idea here is not to promote one methodology over another but to help the owner and the contractor in deciding what features that offer openness are important to them, versus the trade-off of accepting a proprietary solution. The different components of a BAS

that we will examine here are:

- FIELD LEVEL CONTROLLER
- GLOBAL ACTIVITIES
- NETWORK TOOLS
- NETWORK DEVICES
- GRAPHICAL USER INTERFACES
- SYSTEM INTEGRATOR
- MANUFACTURER
- SUPPORTING ORGANIZATION

1.1 - Field Level Controllers

AHU, VAV, FCU, RTU, central plant controllers. This category would include both configurable and custom programmable controllers. Within the field level controllers the key components that pertain to an Open System are:

1.1A - Controller Communications

A common language exists within all controllers and between controllers that communicates the information contained within the controllers. Regardless of the carrier medium - copper wire, PLC, Ethernet, etc, the language is the same with the exception of a gateway or protocol converter. Key properties to consider here:

- A communication language that is particular to only one manufacturer or that is not an industry standard will significantly limit the ability to mix controllers and the data (interoperate) from different manufacturers on the same network without the use of gateways. This could limit the use of "best of breed" technology in the design and options for future replacements and expansions.

- Do not confuse statements that the protocol is "published" or "available from the manufacturer" as an industry standard. Having access to the code for the protocol does not result in easy interoperability.

- Network communication standards such as Acrnet, Ethernet and TCP/IP are carrier methodologies and do not constitute a control language.

1.1B - Controller Programming

The methodology for developing the sequence of operation within the controller. Key properties to consider:

- How will the programming tools be provided? What are the available methods of access of these tools by the owner and contractor? Are the tools available only from one source and licensed to the installing contractor or owner with an associated fee or are they made available free from the manufacturer in the form of plug-ins, wizards or freeware?
- Consider the differences and needs between configurable and programmable controllers' programming tools. (See Programming Tools page #3) In general these field level controls programming tools will be required to be used with a network management tool from the manufacturer of the field level controller or in conjunction with an industry standard network management tool. In the case of industry standard network management tools, some controller manufacturers can provide their controller programming tools as a plug-in or wizard.

> Plug-in or Wizard as it applies to BAS, is an application designed for the programming of field level controllers and network devices that can be opened and used from any industry standard network management tool. They are generally used for configurable controllers but can also be found for custom programming. A properly designed plug-in or wizard will provide for complete access to all of the programming and configuration parameters of the controller

1.1C - Exposure of Controller Data

Information that is contained within a controller and made available for "read write" control. Key properties to consider:

- Is the data contained within a controller made available for read write use by tools other that the manufacturers'?
- Evaluate what information is important for exchange and viewing by other systems and non-manufacturer tools including network management, programming, and GUI

1.1D - Controller Hardware Inputs and Outputs

The physical connections to the controllers. Key properties to consider:

- Do the inputs and outputs conform to industry standards? Note that the primary areas of non-conformance to industry standards are in the sensor inputs.

Programming Tools

There are several different areas of programming and software based development that can be found in the creation of a control system. These development tools can be delivered in comprehensive all-in-one tool sets or as separate tools from one or more manufacturer. In general most programmers desire to have the programming tools for the field level controllers, network devices, and graphics in one tool-set as it will improve work efficiency. Programming tools are almost always proprietary to a particular manufacturer who has designed them to be used specifically to program their devices. The degree to which they are considered to be open depends on how available they are to purchase and how compatible they are with other industry standard tools that may be used in the programming process. The different types of programming tools are:

Field level controller programming – There are two levels of programming

- Configurable for high volume applications such as VAV, FCU, HPU and RTU. Configurable programming provides a series of menus for the selection of the I/O and for defining the operating perimeters. These tools will provide for most sequences of operation and reporting functions such as alarm threshold levels. Within this tool set you may have subsets of the tool to provide for test and balance and commissioning functions.
- Custom Programming – designed for programming of special sequences of operation, large AHU, and central plants. Programming can be accomplished in an object oriented or graphical programming language or in a text code or a combination.

Network programming tools – can perform multiple functions

- Programming of network level devices or master controllers.
- Network development – the assigning of location of the devices on the network, providing logical names of devices, database management
- Information sharing – defining what information is shared between devices and what is allowed to be transmitted over the network to user interfaces.
- Global activities – depending on the architecture of the system, alarm, trending and scheduling can be developed with these tools in a device on the network
- Management of field level controller and network level device programming tools – depending on the protocol and control standards selected the network programming tools can also manage the use of plug-ins or wizards used in the programming of field level controllers and network level devices from multiple manufacturers.

User Interface programming tools – tools used to provide a user friendly method of viewing the information provided from the controllers and network devices

- Creation of graphical or text based interfaces that allow for the access to data from the field and network level devices. These can be one comprehensive tool or multiple separate tools. These tools will provide for graphical object generation, graphical assembly and linking of data and functions to the controllers and for displaying the finished end user display.
- Tools that provide for transfer of data to third party applications such as maintenance management programs, accounting applications, and SCADA systems.

2.1 - Network Devices

A hardware device that resides between the field level controllers and a high-speed network. It can be as simple as a carrier converter such as LonTalk or BacNet protocol to TCP/IP via Ethernet or a more complex device such as a "PC in a Box" acting as a carrier converter and performing control logic, global functions, web page server and more. The selection of the network device is critical in maintaining an open system. The decision made here will dictate what choices the owner will have for selection of multiple suppliers for future expansion. This is due to the lack of compatibility of network devices from different manufacturers and the global functions contained within these devices.

> Example: Even though Manufacturer "A"s network device can accept the same protocol as Manufacturer "B"'s network device, they will perform all of their internal tasks and global activities in a proprietary manner. They may be able to provide information out over the network in a standard protocol but that protocol may not have standards for the global activities. The end result would be that when you access these network devices from a GUI or browser, you would be treating each network device as a separate system with separate methods of managing data-bases and global activities such as alarm, trends and schedules.

Yes, there are work-arounds such as gateways or PC-based protocol converters but it can prove to be difficult, costly, and not always functionally practical. So when you select the network device, realize that you are going to be buying a proprietary device, which can be considered acceptable as long as you keep in mind the Microsoft example. Key properties to consider

- Are network devices available for multiple sources?
- Do they meet IT standards?
- Does the network device provide access to all information contained within the field level controller?
- Can the network device data be viewed and controlled by a browser or by multiple manufacturers GUIs that conform to the broadcast protocol of the network device?
- Does the network device allow for use of the programming tools for the field level controllers over the network?
- Can web pages be served from the network device? If so, is there a limitation in the number of users accessing the network at one time through a browser?
- Can it send and receive information from third party applications through industry standards communication methodologies such as XML and SOAP

2.2 - Network Tools

Software tools used for the development of the BAS network. Typically, this tool will program or configure the network device, establish the field controllers on the network, arrange for the sharing of data between controllers and network devices and for the distribution of information outside of the network (alarms, trends, historical archives). Depending on the type of network tool selected it can also provide the ability to manage wizards or plug-ins for the programming of multiple manufacturers' controllers and network devices. Key properties to consider:

- Will the tool manage any device of the protocol specified? This is especially important if a decision has been made to use an industry standard protocol.
- Does the tool provide the ability to implement and manage data sharing between field level controllers and network devices?
- Can the tool manage controller programming wizards or plug-ins of the protocol specified?
- Can the tool manage databases from different manufacturers of the protocol specified?

2.2A - Global Activities

These are tasks that affect more than one controller and are implemented using a Network Tool. These tasks can be as simple as the sharing of information between controllers or more complex activities such as alarm, trending and scheduling. These activities can be resident on a field level controller or on a network device including a PC. The trend in the industry is to have these higher-level activities on a dedicated network device. Key properties to consider:

- Where will global activities such as alarm, trends, and schedules be managed, at the field level or network level devices?
- Consider the availability of the device that the higher-level global activities reside on.
- Can it be obtained from multiple sources? Is it considered to be an industry standard?

Whatever device you select here will have to be used for all future expansions in order to maintain consistency in alarm, trending and scheduling. See additional details under Network Level devices.

3.1 - Graphical User Interface – Thick Client

A software application resident on a PC that provides for a graphical representation of the BAS, management of alarms, trends and schedules. Key properties to consider:

- Can it be acquired from multiple sources? This will be important if there is a need to have multiple points of access into the system under future expansions.
- Can it read and write to any manufacturer's device with the protocol specified?
- Can it accept database queries from third-party applications through industry standards communication methodologies such as SQL?

3.2 - Graphical User Interface – Web based

A software application that would reside on a network device or PC that would provide for graphical representation of the BAS through a browser. It may also be supplemented by a thick client application that could perform alarm management and network functions. Key properties to consider:

- Can the development tools and applications be acquired from multiple sources?
- Can the system support unlimited users at one time (bandwidth permitting) or is it restricted by a limited number of licensed users?

4.1 - System Integrator (SI)

A control contractor with experience in multiple protocols and manufacturers systems. A few key properties of the System Integrator to consider that will help insure the successful implementation of an open system are:

- Can the System Integrator source products of the protocol selected from multiple sources? This will insure that should one manufacturer not meet the needs of the SI or owner or if the source becomes unavailable, that the contractor can continue to have other sources of supply to meet the needs of the owner.
- Can the owner obtain the services of other installing and service contractors with in his geographical area that can access products of the manufacturer and protocol selected in order to maintain the system?
- Does the System Integrator have experience in installing multiple manufacturers' products of the protocol selected?
- Will the System Integrator implemented the programming in such a way that it exposes all required information?
- Will the System Integrator provided copies of the database and software tools and maintained updates throughout the service and warranty periods?

5.1 - Manufacturer

Most manufacturers promote some degree of an open system offering. Based upon the criteria laid out here some are significantly more open than others. Some of the key properties to consider are:

- Is the manufacturer providing field level controllers based upon an industry standard protocol or are they using a gateway or protocol converter?
- Are the network devices based upon an industry standard protocol?
- How do they provide for access to their programming tools – plug-ins, wizards, or freeware?
- Does their distribution structure allow their contractors to freely install their products without territory restrictions?
- Is their entire product available from multiple sources of supply without geographical limits, including sales to the owner?

6.1 - Supporting Organizations

For any standard for open protocols to be successful it should be developed and maintained by an entity that has a vested interest in its success. The predominate organizations within the North American BAS industry that promote an open protocol are: ASHRAE for BacNet, Echelon for LonTalk and Tridium for the Niagara Framework. The key properties to consider are:

- Is the protocol a published standard recognized by other certifying organizations in the industry?
- Is it equally available to all who wish to develop BAS solutions?
- Are there clearly established guidelines for the implementation of the protocol or published APIs for the extension of the tools?
- Do they provide a support structure for development of tools, integration issues, technical support, and market development?
- Is there a supporting organization for verification of conformance to the protocols and standards?

CONCLUSION

There are obviously many factors to consider in selecting a BAS that will meet the open system criteria that is right for your facility and business. It is not necessary to include all of the items mentioned above to receive a BAS that provides for the level of openness that you are comfortable with. The key to receiving an Open System that you are comfortable with now and into the future is to understand what your needs are, know what to ask for and to be able to evaluate that you have received what was required. Hopefully this document will serve as a guide in that process.

FOR ADDITIONAL INFORMATION AND ASSISTANCE IN DESIGNING AN IMPLEMENTING AN OPEN SYSTEM PLEASE DON'T HESITATE TO CONTACT US.