BACnet/IP Annex J with Quantum®

The Lutron® Quantum® lighting control system is capable of interfacing to Building Management Systems using the BACnet protocol. Each Quantum® system contains one or more Quantum® processors which serves as the integration point(s) for BACnet. The Quantum® processor is BTL listed with "native" BACnet communications exposing most of its points via BACnet Virtual Devices. The Quantum® processor contains an embedded BACnet stack and is classified as a BACnet Application Specific Controller (B-ASC). The Quantum® processor communicates using BACnet/IP and follows Annex J of the ASHRAE SSPC135 BACnet standard.

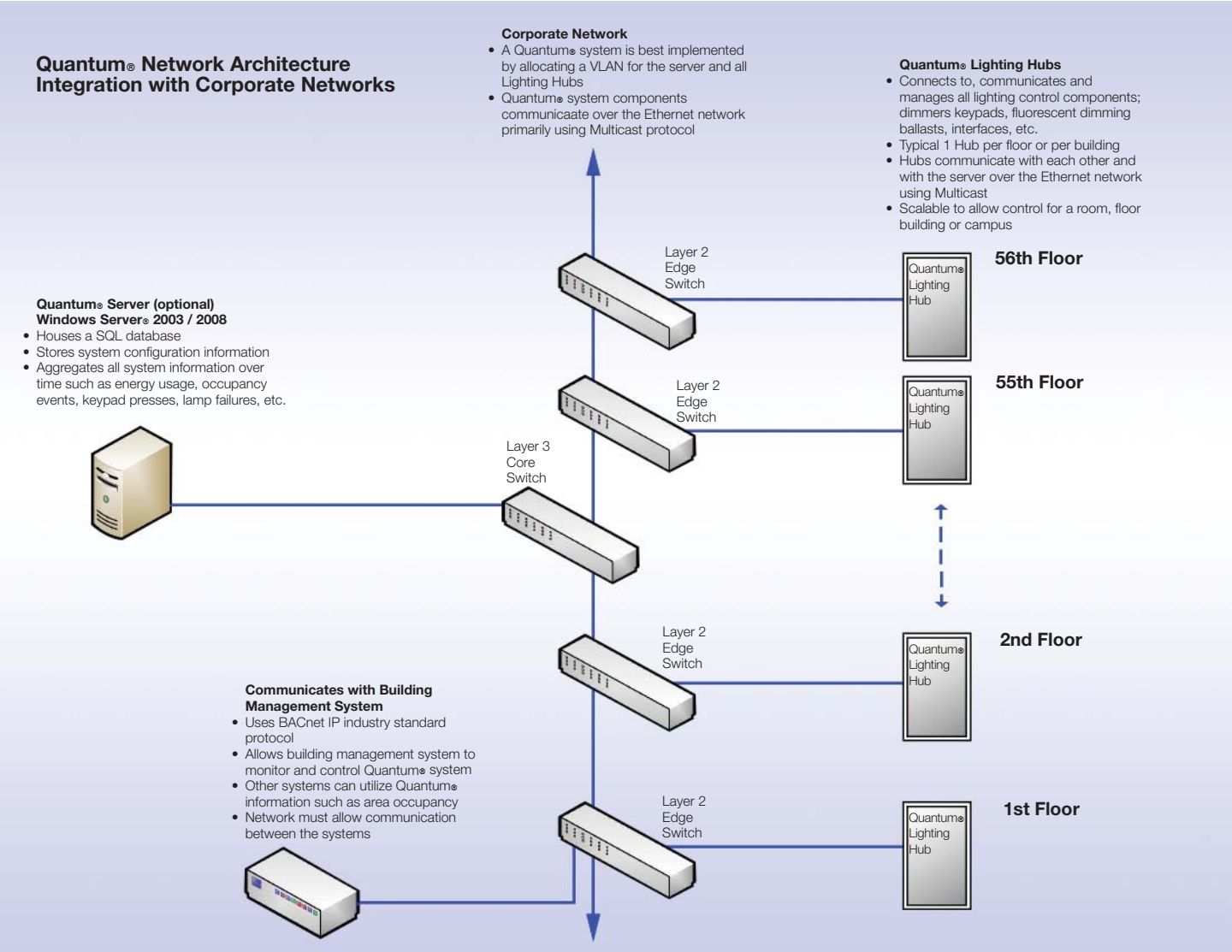
BACnet Testing Laboratories Listing

BACnet Testing Laboratories (BTL) of BACnet International is the only approved third-party certification for interoperability and compliance to the BACnet standard. Without third-party testing and approval, the BACnet standard is merely a 1000 page set of instructions that can be read and interpreted differently. The Quantum® processor passed all testing and is listed by (BTL) as a B-ASC.

> *"Experience has shown that BACnet products submitted for testing have errors that were unknown to the manufacturer. In fact, there has never been a case where a new product was found to be error-free the first time it was tested. In every case, changes needed to be made in order to qualify for the BTL mark. This alone is a testament to the high standards and quality of the testing process."*
>
> *Steven T. Bushby*
> *Leader, Mechanical Systems and Controls Group*
> *Building and Fire Research Laboratory*
> *National Institute of Standards and Technology*

Physical Architecture

Quantum® processors and the Quantum® server use a standard network architecture allowing the system to be on its own dedicated LAN/VLAN or within the institution's intranet. The physical connection uses the IEEE 802.3 Ethernet standard. This means a single connection point to any network switch within the Quantum® network will access all BACnet "points" for the entire system. Standard physical and data layer IT parameters apply.



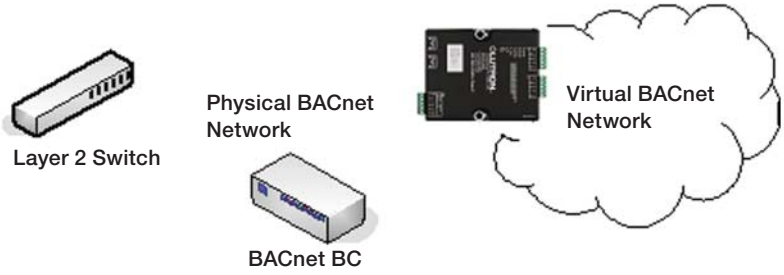
Note: The Quantum® server has no BACnet capabilities and thus has nothing to do with the BACnet connection. The BACnet stack exists in the embedded lighting control processors, and thus BACnet connectivity does not require a server running 24/7. Also, connecting to the server directly will NOT provide any BACnet information; the BMS connection must be made to the network on which the Quantum® lighting processors reside.

BACnet Broadcast Management Device (BBMD)

The Quantum® processor supports foreign device registration within our B-ASCs to a BACnet Broadcast Management Device (BBMD), as listed in BACnet standard Annex J.5.2 to route between network subnets. Once given the IP address of the BBMD within our subnet, Lutron® commissioning agents will configure the Quantum® processor for BBMD foreign device registration.

Virtual Devices and Point List

Virtual BACnet devices and objects have been a concept of the BACnet standard since it was first published. Quantum® has embraced that concept for its flexibility and enhancement of communications with BMS systems. Because of this, each Quantum® processor is also a BACnet virtual router, routing between the connected physical BACnet network and a virtual BACnet network.



The Quantum® processor is a physical BACnet device on the physical BACnet network. Through the virtual router, within the Quantum® processor, are virtual BACnet devices called AREAS. AREAS represent a logical geographical area of the building like a room or hallway. Within each AREA you will find an extensive list of virtual objects (Analog Values, Binary Values, and Multistate Values). They are not representative of physical devices but the function within an area. An example of this is OCCUPANCY STATUS which is not representative of each physical occupancy sensor but an aggregation of the information of all the occupancy sensors in that AREA. Virtual objects correspond to the database and thus an actual “points list” for any particular project can only be produced after the database for that project is generated. Database creation occurs before system startup, so the points list can be generated and shared with the integrator in advance of commissioning.

Because the Quantum® processor is a BACnet virtual router, like all routers, it is meant to relay communications between two different networks. In this case one is physical and one is virtual and they need different BACnet network numbers. In the Quantum® setup utility, the BACnet virtual network number needs to be set to a different BACnet network number than the one the processors are physically connecting to. The processors will automatically pick up the physical network number that they are connected to. Only the virtual network number is settable. This must be done per subsystem.

Device instances range, for all Quantum® BACnet devices (both real and virtual), from 1 - 4194302 and are set through database generation. These can be changed or modified to correspond to the project requirements. Each AREA can have the possibility of over 4000 virtual objects to monitor and/or control which are always available from the Lutron® system. Each area has a set of predefined objects that will always be present. These include objects representing the occupancy state, lighting state (on/off), power usage, loadshed level and various other objects (see PIC statements). Also, each area can have a number of objects that vary by quantity per AREA such as lighting zones and motorized shade zones. The quantity of objects provided gives great flexibility to the BMS integrator.

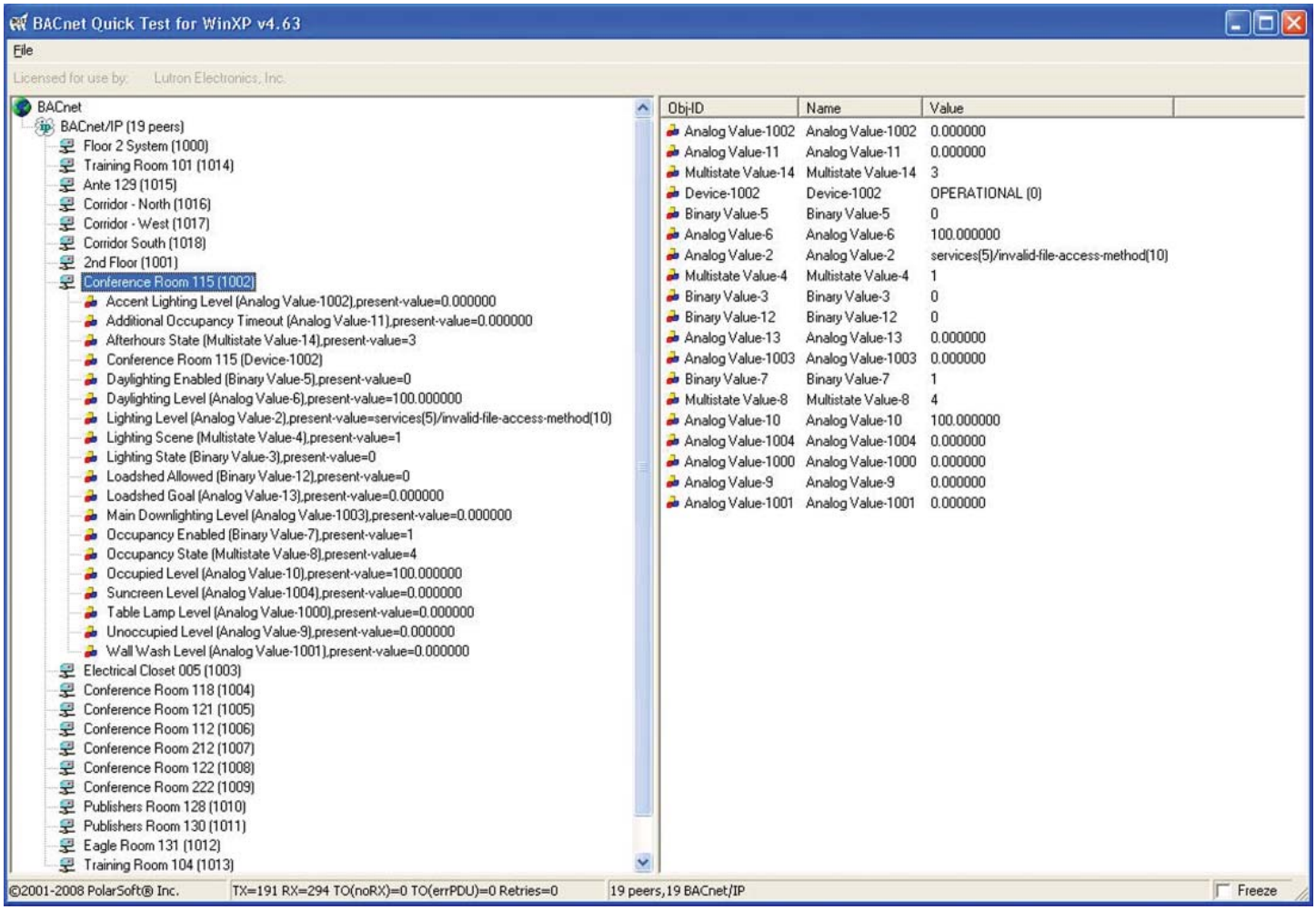
Subsystems

The maximum number of processors in a Quantum® system is 2048. However, for database transfer optimization the 2048 is divided into 128 subsystems with a maximum of 16 Quantum® processors per subsystem. Each subsystem within a Quantum® system looks like a separate lighting system within BACnet.

The rule-of-thumb for Quantum® database generation is to make each floor a subsystem, unless specifically requested. This will allow for upload and download of a single floor without any impact to the other floors. If this is followed when a “Who-Is” request is received the “I-Am” will look like a separate lighting system for each floor. This is also advisable for BACnet redundancy, as in this case of connectivity being lost to any processor, only that floor disappears off the BACnet system.

Dynamic Naming

The AREA concept, while new in BACnet devices, can be seen by many Graphical User Interfaces (GUIs) within BMS Workstations. AREAs within the Quantum® system can be setup to correspond with the AREAs within BMS software along with dynamic names. These are the names that will be returned from a “Who-Is” with an “I-Am”. The more descriptive the name in the Quantum® database, the more information will be provided for ease of programming. If the database has offices on the west corner of the 3rd floor but in the Quantum® database the offices are labeled office 1, office 2, and office 3 that is the only description that is returned after a “Who-Is”. However, if coordination with the BMS integrator occurs a possible naming could be more descriptive returning names like 3fl_W_Conference_Room_115 saving setup time for the BMS integrator. The example below shows BACnet Device ID 1002 is named “Conference Room 115”.



BACnet IP to MSTP or Ethernet Router

The Quantum® processor uses BACnet/IP Annex J but routing communications between BACnet/IP and BACnet/MSTP or BACnet/Ethernet across local area networks can be easily achieved through the use of a third-party BACnet/IP to MSTP or Ethernet router. This allows BACnet/IP devices to communicate with BACnet devices on a BACnet/MSTP or BACnet/Ethernet networks. BACnet routers are not gateways or translators between protocols but simply allow for the BACnet message to be transported over different physical mediums.BACnet routers can be found at the following companies;

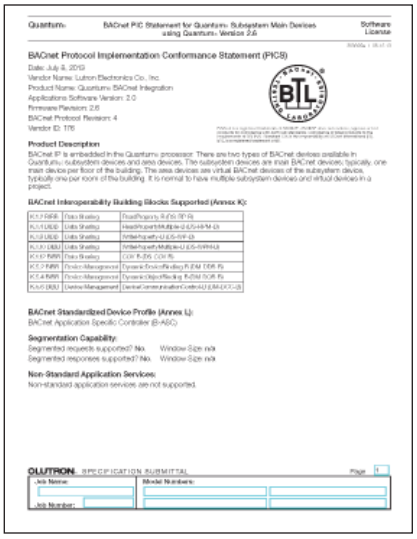
PolarSoft www.gopolar.com

Cimetrics www.cimetrics.com

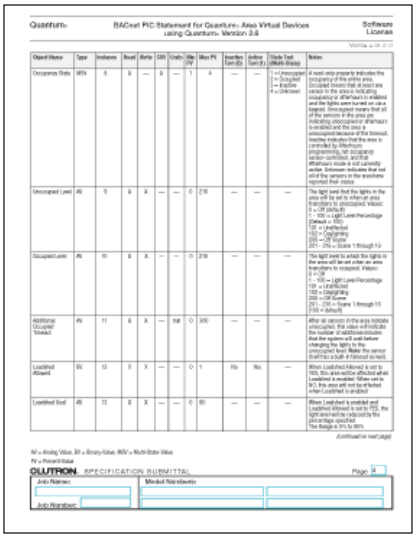
Contemporary Controls www.ccontrols.com

Protocol Implementation Conformance Statement (PICS) and Lutron® Object Tables

The Quantum® processor being a B-ASC and virtual router has two PICS associated. One is for the physical B-ASC (Main) and the other is for the virtual devices (Virtual). Both PICS can be found at www.lutron.com under SERVICE & SUPPORT > Product Specification Submittals > Quantum®

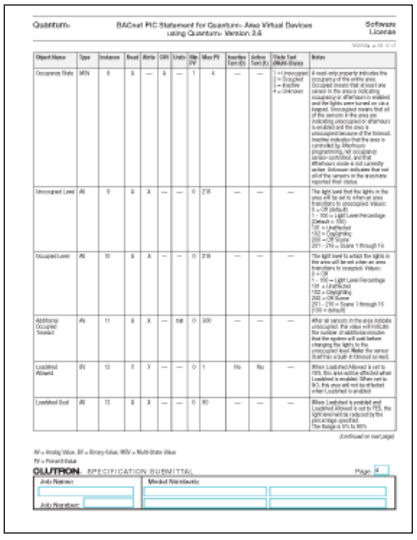


Main



Virtual

As stated most BACnet devices in the Quantum® system are AREAs representing a logical geographical area of the building like a room or space. Tables showing the available objects, object types, IDs, functionality and description are available for each AREA device as an attachment within the Quantum® PICS.



Object Name	Type	Instance	Read	Write	COV	Units	Min PV	Max PV	Inactive Text (0)	Active Text (1)	State Text (Multi-State)	Notes
Occupancy State	MSV	8	X	—	X	—	1	4	—	—	1 = Unoccupied 2 = Occupied 3 = Inactive 4 = Unknown	A read-only property indicates the occupancy of the entire area. Occupied means that at least one sensor in the area is indicating occupancy or afterhours is enabled and the lights were turned on via a keypad. Unoccupied means that all of the sensors in the area are indicating unoccupied or afterhours is enabled and the area is unoccupied because of the timeout. Inactive indicates that the area is controlled by Afterhours programming, not occupancy sensor-controlled, and that Afterhours mode is not currently active. Unknown indicates that not all of the sensors in the area have reported their status.

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