

BACnet Manager™ Overview for Network Administrators

This document gives a brief overview of Baseline's BACnet Manager server. While the document is not intended to be a comprehensive description, it should help network administrators and other IT professionals understand the operation of BACnet Manager and address their own internal security concerns related to accessing the cloud-based BaseManager server or hosting an instance of the BaseManager server.

BACnet Manager Overview

Baseline's BACnet Manager™ for BaseManager™ integrates your irrigation system with a Building Management System. With BACnet Manager, any BACnet compatible Building Management System can display important information like water-use data and system alerts from BaseStation 1000 and BaseStation 3200 irrigation controllers.

BACnet integration requires both BaseManager and BACnet Manager. BACnet Manager must be installed on the local BMS network; however, BaseManager can be a cloud service or self-hosted. All communication to and from the Building Management system is routed through BaseManager to the irrigation controller.

BACnet Manager interfaces with the BaseManager server by connecting to the BaseManager server as a special client. BACnet Manager uses the proprietary BaseManager protocols to present real-time information via the BACnet/IP standard. BaseStation irrigation controllers are presented as BACnet Devices. These Devices publish binary, analog, and multi-state Objects. BACnet Manager also displays real-time controller status, Device status, moisture sensor measurement, flow meter water being used, flow meter total water used, and much more.

For more information about how Baseline's BACnet Manager complies with the BACnet protocol, refer to the BACnet Manager for BaseManager PICS Document:

http://www.baselinesystems.com/mediafiles/pdf/BL-BM2-BACNET_PICS.pdf

BACnet Manager Components

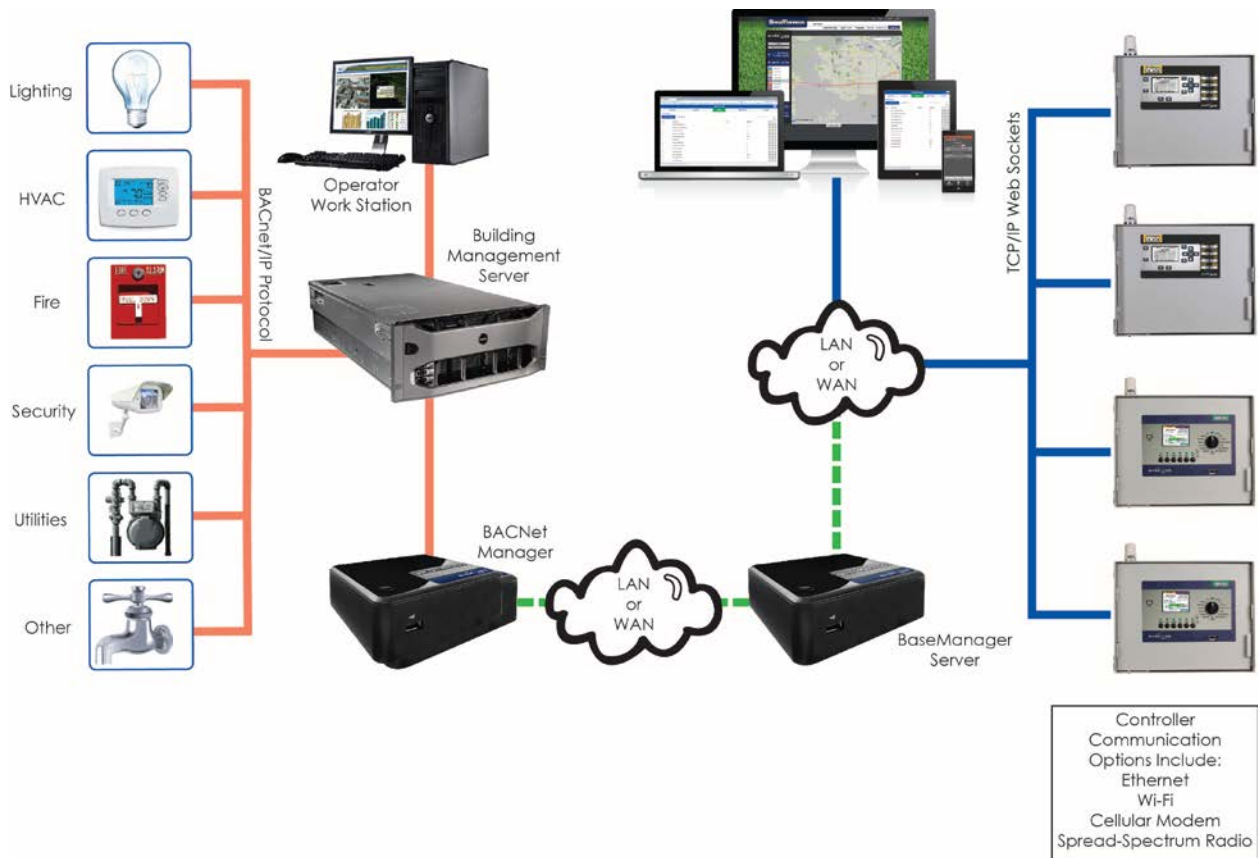
BACnet Manager has the following major components, which must be configured correctly within the network to provide the full benefit. IT professionals and building management professionals must work together during configuration to ensure smooth integration with the IT network and the building management system.

- The **BaseManager Client for BACnet Manager** logs into the BaseManager server which the irrigation controllers are connected to. The BaseManager Client gathers data, and configurations, and also

monitors status. The information is stored in an intermediate file (one file per controller or BACnet Device) on the BACnet Manager server.

- The **BACnet Interface for BACnet Manager** reads the intermediate files and publishes the BACnet Device and all of its Objects using BACnet IP protocol.

Network Topology Example for BACnet Manager



Configuration

BaseManager Client for BACnet Manager

The BaseManager Client for BACnet Manager (BC) logs into the BaseManager server with a web socket connection. Over this connection, the BC asks the BaseManager server for status and configuration updates for the controllers that the BC has access to. This information and the updates are stored in a text file. Every time a new status or configuration is received from the BaseManager server, the BC writes out a new file with the updated information.

To make this all happen, the BC must have HTTPS access to the BaseManager server that the irrigation controllers are connected to. If you have a self-hosted BaseManager server, it is generally best to place

the BaseManager server and the BACnet Manager server on the same subnet. If the BC is connecting to the cloud-based BaseManager server, it is necessary to allow HTTPS access through the network's firewall.

The BC logs into the BaseManager server as a "virtual user" with a username and password that is set up during the configuration process. These credentials should only be used by the BC.

All data for a BaseManager account falls under the company record. Baseline has assigned a default company name as a temporary placeholder. When you log into the BaseManager Company Admin interface, you can update this default name to your actual company name, and then create sites, and add irrigation controllers to those sites. The company admin must also create the BACnet "virtual user" that enables the BC to create the intermediate file for the associated controllers.

Client for BACnet Configuration

- Filename: basemanager_connector_config.ini
- File contents:
{"configData":["BACnet_Input/","BACnet_Output/","true","p1.basemanager.net/","bndemo1",
"bndemo1","440000","5"]}

Configuration Values (based on order) Note: All must be present	Default Value and Range
Input Directory	BACnet_Input/ Not Used
Output Directory Note: Directory where output of the bmw2BACnet controller files are stored.	BACnet_Output/ Note: Slash is needed. Can be a directory relative to /opt/baseline
BACnet Connector Enabled	Not Used
BaseManager Server to Log into	p1.basemanager.net/ Note: Slash is needed. Value is the URL after "https://"
BaseManager Login Username	bndemo1 Note: Any valid BaseManager login. Login must be created and have controllers assigned for any controllers to be seen.
BaseManager Login Password	bndemo1 Note: Must match exactly. Case sensitive.

BACnet Starting Point Number	444000 Note: Baseline is assigned 444000 and product ships with this point number. It is configurable. There can be no duplicates on the network. BACnet Manager needs to determine the correct starting point number.
Minutes between Updates from Database Note: bmw2bacnet will ask the BaseManager server to get a complete status from the database on this interval. In between this interval, partial updates via web socket are used to keep the status current.	30 Note: The default interval is 30 minutes. If your BACnet Manager connects to the cloud-based BaseManager server, do not configure a shorter interval. Self-hosted servers can get status more often.

BACnet Interface for BACnet Manager

The BACnet Interface for BACnet Manager (BI) pulls in the intermediate files created by the BaseManager Client for BACnet Manager (BC) to prepare for publishing BACnet Devices and Objects. The BI goes through the intermediate controller files one by one and parses them to create a BACnet Device, and then adds BACnet Objects for each program, zone, or alert stored in the Device. As the Device is being created, it has to have a unique port to bind to. The BI uses the ports that are specified in the BI configuration file (a starting port and ending port are specified).

Broadcasts of the BACnet "I am" message for each controller (or BACnet Device) are sent from the bond port to controller (default 40000 to 41000) to a broadcast port (default 47808). Building management clients (such as Tridium or Johnson Controls) listen for BACnet Devices on the broadcast port and ask for BACnet Device properties on the bond port. All of these ports (47808 and the range 40000 to 41000) are open on one IP address. BACnet Manager uses this configuration to support multiple BACnet Devices on one IP address.

BACnet Interface Configuration

- Filename: bacnet_interface_config.ini
- File contents:
{"configData":["BACnet_Input/", "BACnet_Output/", "443999", "444", "444", "47808", "false", "192.168.0.0", "47808", "", "false", "false", "40000", "41000"]}

Configuration Values (based on order) Note: All must be present	Default Value and Range
Input Directory Note: Directory where input to the BACnet protocol is logged	BACnet_Input/ Note: Slash is needed. Can be an directory relative to /opt/baseline

Note: Logging parameter must be true for files to be created	
Output Directory Note: Directory where output of the bmw2BACnet controller files are stored	BACnet_Output/ Note: Slash is needed. Can be an directory relative to /opt/baseline
Device ID	Not used
BACnet Physical Network Number	Not used
BACnet Virtual Network Number Note: This is allocated to Baseline and is always 444.	444 Note: The product is always shipped with this value.
BACnet Broadcast Port Note: All Devices broadcast "I am" messages here.	47808 Note: This hardcoded value is not used in the software. Will be used in the future.
BACnet Broadcast Enabled	Not Used
BACnet Broadcast IP	Not Used
BACnet Registration Key	Not Used
Debug Logging Enabled	False
Start Interface Program on Run	Not used
Start UDP Port Range Note: Starting with this port, an accept is added to iptables for two-way communication. Can be set up between BACnet manger Devices and BACnet console.	40000 Note: Can be any port number. To be good, network members choose unused ports. The 40000 range is used on BACnet networks for Devices.
End UDP Port Range Note: When no more ports are available no more Devices are added.	41000

Non-Supported Configurations

Does not allow one BACnet Device per IP address: BACnet Manager publishes one BACnet Device per port on a single IP address. The server is not designed to publish one BACnet Device per IP Address.

Does not register foreign Devices: BACnet Manager is not a BACnet gateway. The system does not allow other Devices to register as foreign Devices.

WebSocket Protocol

Communication from BACnet Manager to BaseManager based on the secure WebSocket Protocol. This approach allows for instantaneous, full-duplex communication.

Note: For more information on WebSocket Protocol, refer to the following URL:

<http://en.wikipedia.org/wiki/Websockets>

Running this communication protocol on the network means that traffic packets are not always in the format of a traditional HTTPS exchange (headers, body, etc.). Using this format and ensuring SSL-only traffic has proved to ease routing woes. We have found no difficulties yet in passing this traffic, even with sophisticated routers, packet-shapers (like F5), or web filters.

BACnet Server Components

BACnet Manager servers are built on the CentOS 6.5 distribution unless otherwise specified.

The lists below specify the required and optional packages that are included by default in the self-hosted BACnet Manager server and the virtual machine server image.

Required Packages (Included in BACnet Manager Distribution)

Note: The following list includes only the packages that may be required in addition to those that are included in a minimum CentOS distribution.

- httpd-server
- mysql-server
- MySQL-python
- python-devel
- flex
- libtool
- make
- rsync
- mod_ssl
- subversion (for checkout of mod_pywebsocket below)
- php
- php-mysql
- bind-utils (provides nslookup)
- gcc
- httpd-devel
- ntp
- ntpdate
- php-xml

- python package
- pytz – time utilities
- webmin
- mod_python
- mod_pywebsocket (required for websocket operations)
- php_ioncube_loader

Optional/Helpful Software (Included in BACnet Manager Distribution)

- mlocate – Locate and update database

Security Overview

Security Measures Common to Self-hosted BACnet Manager

- All IP traffic between the BACnet Manager and the BaseManager server is SSL-encrypted.
- Firewall is established by Linux kernel IPTABLES (statewise). The only ports essential to be opened are 443 and BACnet Device ports specified in the configuration. Although, if remote administration is desired, port 22 should be opened as well as https port 10001 for Webmin management tool.
- External access to the server is available using pre-shared keys by Baseline administrative employees only from known IP addresses.
- BaseManager Client for BACnet Manager is allowed to remain connected indefinitely to the BaseManager server. If logged off, BaseManager Client for BACnet Manager will attempt to log into BaseManager server again.
- All data is stored in a text file that can be accessed by ROOT.
- Connections to the server are on ports opened for each BACnet Device and administration ports. All other connections not accepted.
- Connection to BaseManager server is WebSocket Protocol (not HTTP), and only through encrypted traffic.
- The connection to BaseManager and the BACnet Devices use just one IP address and one Ethernet cable.
- Webmin (a web-based system configuration and management tool) is enabled by default on a specified SSL (https) port 10001. Webmin access can be disabled from external access (i.e., localhost only) or disabled entirely.

Hardware Options for the Self-hosted Server

The self-hosted BACnet Manager server is a full-function Linux based server. This server is available from Baseline pre-installed on a solid state server module based on the Intel™ Next Unit of Computing™ (NUC) hardware. The self-hosted BACnet Manager server is fully web manageable and does not require a monitor or keyboard (a keyboard, monitor, and mouse are available as an option.)



The system is designed to be a low power, high reliability server unit suitable for customers who do not have an existing rack-based virtual server environment, or for customers who do not wish to install BACnet Manager Server on a managed IT server.



For those who prefer to use existing managed servers, BACnet Manager server is also available as a virtual machine image suitable for installation in modern rack mount server environments. The BACnet Manager server virtual machine requires a minimum of 4GB of RAM, 120GB of disk space, and an Intel i3 class processor or equivalent.

The BACnet Manager self-hosted server or virtual machine server can be fully managed via the built-in secure web server.

Installation Support, Ongoing Support, and Updates

All BACnet Manager server purchases include 8 hours of remote training and configuration support and 6 months of free updates.

After the first 6 months, updates and technical support are available for a yearly fee of \$1000. This fee covers updates and remote technical support, as long as virtual private network (VPN) access or a similar remote access method that provides SSH/SCP access to the BACnet Manager server has been granted to Baseline Support.

Remote installation support for the BACnet Manager server is available for a fee of \$2000. Installation is limited to Baseline software only. Network configuration changes must be completed by site's network administrator.

On-site technical support is available for \$1000 per day plus travel expenses.

For complete details, refer to the following Terms, Licenses and Agreements on the Baseline web site:

- Support Services Agreement for BaseManager, Mobile Access Advanced, and BACnet Manager http://www.baselinesystems.com/support.php/bm2_ssa
- BaseManager & BACnet Manager Self-Hosted Software End User License Agreement http://www.baselinesystems.com/support.php/standalone_eula