

# BACnet Service Tool

## User's Guide



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Tour Andover Controls, Inc.  
One High Street  
North Andover, MA 01845  
(978) 470-0555  
Fax: (978) 975-9782  
<http://www.tac.com>

# ***BACnet Service Tool User's Guide***

30-3001-910  
Revision A

**December, 2005**



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# *Regulatory Notices*

## **Federal Communications Commission**

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**Caution:** the user that changes or makes modifications not expressly approved by Tour Andover Controls, Inc. for compliance could void the user's authority to operate the equipment.

FCC ID: DVE - ROAMIO2

## **Industry Canada Radio Equipment**

This digital apparatus does not exceed the wireless requirements for Industry Canada IC RSS-210 and is listed on the Industry Canada Radio Equipment List.

IC: 1026A - ROA

## **C-Tick - Australian Communications Authority (ACA)**



**N1831**

This equipment carries the C-Tick label and complies with EMC and radio communications regulations of the Australian Communications Authority (ACA), governing the Australian and New Zealand communities.

## **CE - Compliance to European Union (EU)**



This equipment complies with the rules of the Official Journal of the European Communities specified in the EMC directive 89/336/EEC governing the Self Declaration of the CE Marking for the European Union..

## **WEEE - Directive of the European Union (EU)**



This equipment and its packaging carry the waste electrical and electronic equipment (WEEE) label, in compliance with European Union (EU) Directive 2002/96/EC, governing the disposal and recycling of electrical and electronic equipment in the European community.

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## Table of Contents

# Chapter 1

## The BACnet Service Tool

This chapter contains the following topics:

- Introducing the BACnet Service Tool
- What Can You Do With This Tool?
- What You Cannot Do With This Tool
- Before You Get Started
- Connectors and Indicators
- Batteries and Power
- Compatible Controllers
- Hardware & Software Requirements
- The RoamIO<sub>2</sub> Hardware Adapter
- What to do Next

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**Note:** This manual describes the installation and use of the BACnet Service Tool for BACnet controllers. If your network has Andover Continuum Infinet controllers, you should refer to the *RoamIO User's Guide, Revision A*, TAC part number: 30-3001-891.

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## Introducing the BACnet Service Tool

The BACnet Service Tool is a software application, with a hardware adapter, that allows you to perform basic administrative functions to maintain a network of Andover Continuum and third-party BACnet controllers while being mobile, using a laptop or Pocket PC. The software can also be used from an ordinary desktop.

**Connections** If you are connecting your PC (desktop, laptop, or Pocket PC) to the service port of a controller, you will need the RoamIO<sub>2</sub> hardware adapter to make the physical connection (serial cable or Bluetooth wireless) between the MS/TP bus and your PC.

Other connections, such as Ethernet, will not require the RoamIO<sub>2</sub> hardware adapter, but will require a valid license from TAC to enable the connection.

## What Can You Do With This Tool?

Using the BACnet Service Tool, an administrator can plug into a Continuum controller on any BACnet subnetwork and perform basic administrative functions to any Continuum or third-party controller across the BACnet Internetwork.

Administrators can “view” an entire network of devices, and then select a specific subnetwork or device. The objects and classes defined within a device can be viewed or changed.

For example, some of the functions you can perform include:

- Adjusting a temperature setpoint
- Backing up and restoring a device
- Setting the date and time of a device
- Setting the MAC IDs for Continuum controllers during startup and commissioning
- Initiate the automatic “learning” function of Continuum controllers
- Upgrading an Andover Continuum device Operating System (OS)
- Renaming objects

- Viewing and editing object properties
- Viewing the controller's trend data log
- Viewing a controller's schedule of events
- Starting and Stopping a program

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**Note:** You can connect the BACnet Service Tool to Ethernet to view the Andover Continuum proprietary classes and properties of any device running controller firmware version 4.4, or later. For MS/TP connections, you can view the proprietary classes and properties of all connected devices, as long as at least one controller on the MS/TP network is running firmware version 4.4, or later.

## ***What You Cannot Do With This Tool***

The BACnet Service Tool does not allow you to perform all administrative and maintenance tasks available on Continuum CyberStation.

For example, you cannot use the BACnet Service Tool to:

- Add or delete devices
- Create or delete objects
- View or modify a file within a device, such as a Plain English (PE) program

## ***Before You Get Started***

Before you get started, be sure you have all of the following items:

- RoamIO<sub>2</sub> hardware adapter and interface cables
- Desktop PC or Laptop PC
- Pocket PC with optional serial cable and docking cradle
- BACnet Service Tool software application

---

## **Compatible Controllers**

You can use the BACnet Service Tool by connecting to the following controllers:

- Andover Continuum bCX 40x0
- Andover Continuum b4920
- Andover Continuum b3xxx
- All third-party BACnet devices

# Hardware & Software Requirements

Before installing the BACnet Service Tool application, be sure that your Pocket PC, desktop or laptop PC meet the following requirements:

## Hardware & Software Requirements<sup>1</sup>

Desktop or Laptop PC Hardware Requirements	
Minimum	Recommended
Any Hardware that is compatible with ActiveSync 3.8 or 4.0	
CD ROM Drive or access to installation over a network	
Available 9-pin or 25-pin communications port, USB port or BlueTooth wireless <b>Note:</b> RS-232 cable with appropriate connectors is not supplied by TAC for PC connection	
5 MB available hard drive space space	
Desktop or Laptop PC Software Requirements	
Minimum	Recommended
ActiveSync 3.8 or 4.0	
Microsoft Windows XP, Windows 2000	
5 MB available hard drive space space	
Pocket PC Requirements	
Minimum	Recommended
Pocket PC2002 Operating System	Windows Mobile 2003 or 5.0 for the Pocket PC
32 MB RAM	64 MB RAM
9-pin RS 232 serial cable to comm port on Pocket PC or BlueTooth wireless	
5 MB available hard drive space space	

1. You must be able to download from PC to Pocket PC.



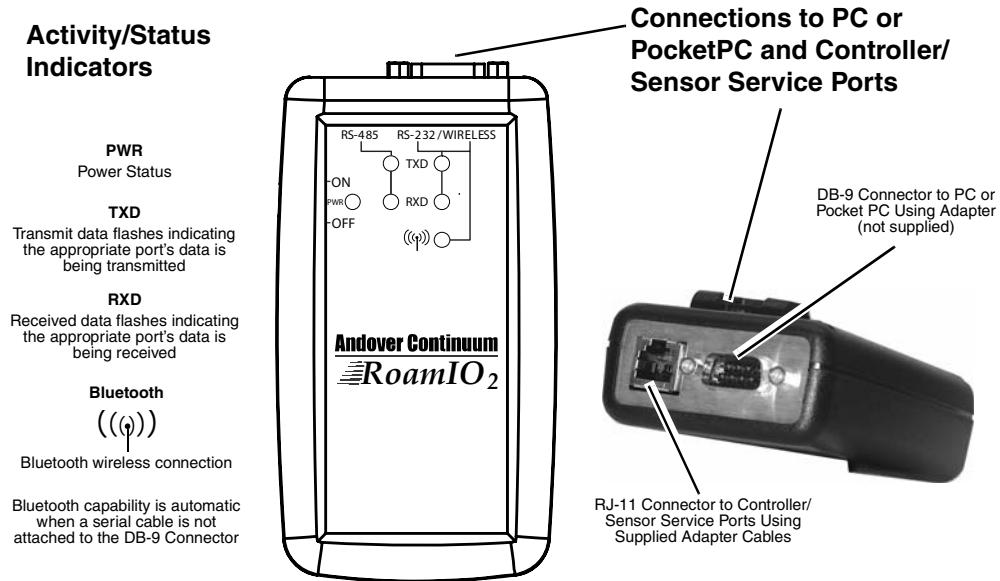
**Note:** The ActiveSync software is included as part of your Pocket PC package and is part of the installation and configuration of the Pocket PC itself. The ActiveSync software can also be downloaded from the Microsoft website. Refer to the documentation supplied with your Pocket PC for requirements, installation and operation of the ActiveSync program.

## The RoamIO<sub>2</sub> Hardware Adapter

The RoamIO<sub>2</sub> hardware adapter (RoamIO<sub>2</sub>) is a device that serves as an interface between the MSTP bus and a PC (desktop, laptop or Pocket PC). The RoamIO<sub>2</sub> is connected to the service port of the controller and then, using a serial cable or the Bluetooth wireless protocol, to the PC.

### Connectors and Indicators

The following illustration shows the connector and indicator areas of the interface unit.

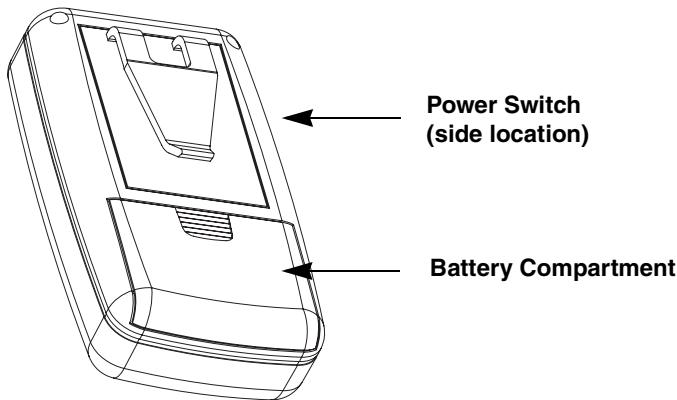


Dimensions = 2.748" wide x 4.937" long

## Batteries and Power

When the RoamIO<sub>2</sub> is connected to an Andover Continuum controller, it will draw power from the controller instead of the batteries, to prolong battery life.

Power is supplied by two AA batteries (included). Recommended batteries are Eveready type X91 1.5V AA alkaline or equivalent. The battery compartment is located on the back of the unit.



**Note:** A new set of alkaline batteries provides up to 30 hours of continuous use depending on the battery manufacturer.



### CAUTION

#### Damage to the unit

To avoid damaging the unit, slide the power switch to the OFF position before installing or removing batteries. During installation, be sure to observe correct polarity when inserting batteries. Align the + and - symbols printed on the batteries with the symbols indicated inside the battery compartment.

**Failure to observe this precaution can result in equipment damage.**

To turn on the unit, slide the power switch to the ON position. The Power indicator LED will illuminate if the batteries are fully operational.

## What to do Next

From this point in the manual you have two options:

- You can proceed to Appendix A, What Is BACnet?, for an overview of BACnet terminology and the relationship of BACnet to Andover Continuum products.

or

- You can go to Chapter 2, Getting Started, to:
  - Begin the process of installing the BACnet Service Tool software on your PC (desktop, laptop, or Pocket PC).
  - Configure the Service Tool software.
  - Make the physical connections between your PC and a controller.
  - Start the application and connect to the BACnet Internetwork.

# Chapter 2

## Getting Started

This chapter contains the following topics:

- Installing the BACnet Service Tool
- Upgrading the RoamIO<sub>2</sub> Firmware
- Getting Started with the Service Tool Software
- Creating Users and User Levels
- What to do Next

## Installing the BACnet Service Tool

The BACnet Service Tool comes with a RoamIO<sub>2</sub> hardware adapter, cables, and a CD that should be installed on a laptop or desktop PC, and may also be installed on a Pocket PC that is synchronized with the laptop or desktop.

The CD contains the following software:

Program	Description
SetupPC.exe	Installation executable for BACnet Service Tool software for the PC
SetupPPC.exe	Installation executable for BACnet Service Tool software for the Pocket PC
InfinetSetupPC.exe	Installation executable for Infonet Service Tool software
InfinetSetupPPC.exe	Installation executable for Infonet Service Tool software for the Pocket PC
RoamIO2Uprev.exe	Executable for upgrading RoamIO <sub>2</sub> firmware

The complete installation process involves the following steps:

- Step 1:** If you are going to be connecting your PC (desktop, laptop, or Pocket) to the RoamIO<sub>2</sub> hardware adapter, install and configure your Bluetooth wireless communication software.
- Step 2:** Install the BACnet Service Tool application on to your PC (desktop, laptop, or Pocket)
- Step 3:** Start the application and log on using the factory supplied username and password (*acc, acc*).
- Step 4:** Create usernames and passwords for your site
- Step 5:** Make the physical PC to RoamIO<sub>2</sub> connection, using a serial cable or the Bluetooth wireless protocol, and then RoamIO to controller.
- Step 6:** Set the communication options for the MS/TP or Ethernet network you are connecting to, and then make the connection

using the BACnet Service Tool to maintain and configure your BACnet Internetwork of controllers.

## ***Bluetooth Installation and Configuration***

If you are going to connect your PC to the RoamIO<sub>2</sub> hardware adapter using Bluetooth wireless communication, you will need specific Bluetooth security and service configuration settings.

If Bluetooth is already installed on your PC, make sure the following settings are configured:

- Security "Pairing" PIN # = *ACC*
- Serial Port Service is enabled

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**Note:** When configuring your Bluetooth hardware to work with the RoamIO<sub>2</sub> hardware, you should refer to the manual or the online help that came with your Bluetooth adapter.

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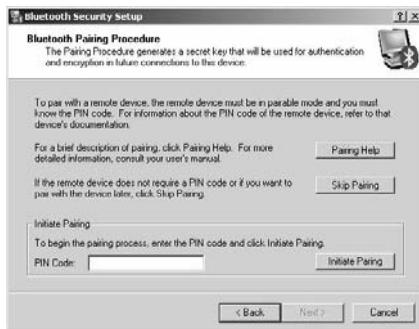
The steps listed below generically describe the configuration process. You will notice variations depending on whether you are configuring a laptop or a Pocket PC, the specific operating system and the driver that is installed.

**Step 1:** Turn on your RoamIO<sub>2</sub> device. (Make sure you have installed batteries or have the device connected to the service port of a powered Continuum controller.)

Use the Bluetooth management software on your laptop or Pocket PC to discover the RoamIO<sub>2</sub> device. The RoamIO<sub>2</sub> will be listed as "Serial Port Device: COM1". COM1 denotes the communication port on the RoamIO<sub>2</sub> and is not the communication port on the laptop or PocketPC. The discovery tool is often referred to as a "Bluetooth hardware configuration wizard"

**Step 2:** After selecting the RoamIO<sub>2</sub> device, most drivers will automatically ask you to assign a PIN code. This process is called "Pairing" your bluetooth adapter to the bluetooth device. If the driver does not automatically ask you to pair your

device, look for a button that allows you to initiate a device pairing. Enter the Pin Code of ACC.



**Step 3:** The driver will allow you to select a Bluetooth Service. This is sometimes displayed as a Service Selection window. Select the Bluetooth Serial Port service.



**Step 4:** Select the COM port number your PC will use for Bluetooth communications and record this number. Some drivers assign the COM port number for you and do not allow you to change it. It is common for a Pocket PC Bluetooth driver to have two COM port assignments; one for Incoming and one for Outgoing connections.

The RoamIO<sub>2</sub> will connect to the COM port labeled as "Outgoing" connections. This COM port will provide the connection to the RoamIO<sub>2</sub> hardware adapter.

**Step 5:** Complete the Bluetooth installation.

## ***BACnet Service Tool Laptop or Desktop Installations***

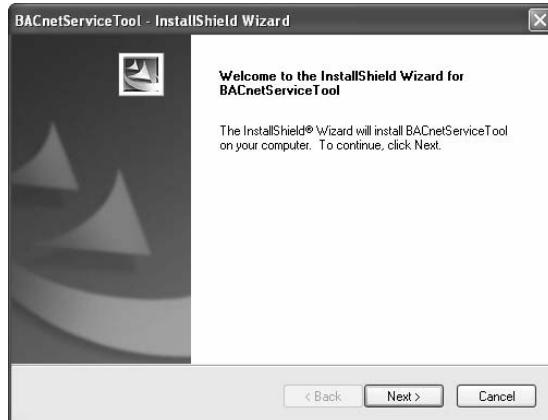
To install the BACnet Service Tool application onto your laptop or desktop PC, perform the following steps:

**Step 1:** Insert the BACnet Service Tool CD into the CD drive of your laptop or desktop PC.

**Step 2:** Double-click the **My Computer** icon on your desktop

**Step 3:** Double-click the **CD** drive icon

**Step 4:** Locate the **SetupPC.exe** file and double-click to activate the installation program.



**Step 5:** Follow the directions of the installation wizard to complete the installation of the program. At the end of the installation, you should see the following screen.



**Step 6:** Select Finish to complete the installation on your desktop or laptop PC.

## **BACnet Service Tool Pocket PC Installations**

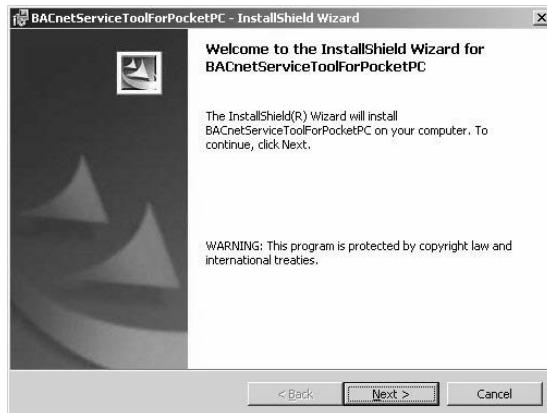
To install the BACnet Service Tool application onto your Pocket PC, perform the following steps:

- Step 1:** Place the Pocket PC in the docking cradle that is connected to your laptop or desktop PC. Refer to the documentation supplied with your Pocket PC for operation and detailed information.
- Step 2:** Once the laptop or desktop PC and the Pocket PC are properly synchronized, insert the BACnet Service Tool CD into the CD drive in your PC.
- Step 3:** Double-click the **My Computer** icon on your desktop
- Step 4:** Double-click the **CD** drive icon
- Step 5:** Locate the **SetupPPC.exe** file and double-click to activate the installation program.

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**Note:** The install process interacts with the Pocket PC using active sync to automatically transfer and install the application onto the Pocket PC.

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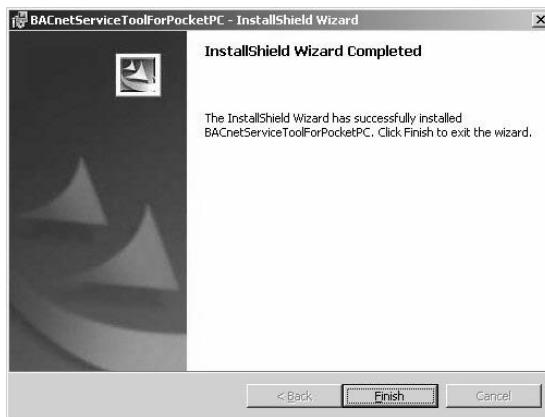


**Step 6:** Follow the directions of the installation wizard to complete the installation of the program. At the end of the installation, you should see the following screen

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**Note:** If you are running the Windows Mobile 5.0 operating system, the screen may prompt you to look at messages on your Pocket PC for final instructions.

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**Step 7:** Select Finish to complete the installation of your BACnet Service Tool for the Pocket PC. Synchronization with your desktop or laptop PC should be automatic.

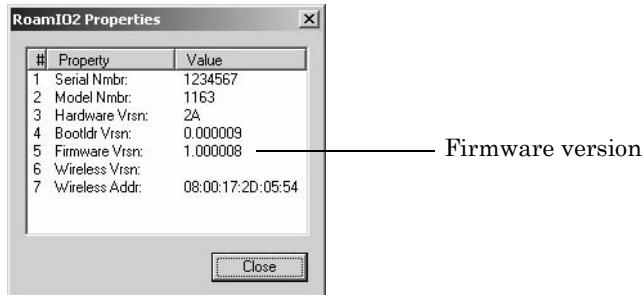
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**Note:** If for some reason your Pocket PC does not automatically synchronize with your PC, you will need to synchronize to complete the installation.

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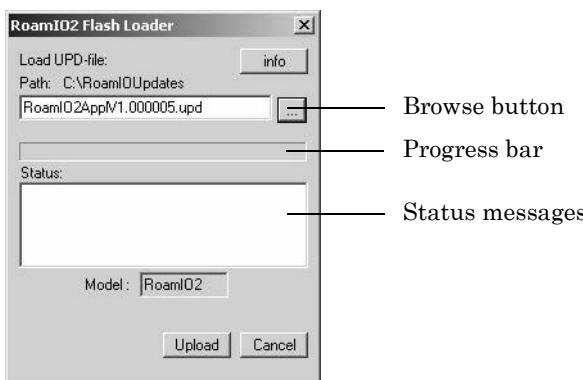
## Upgrading the RoamIO<sub>2</sub> Firmware

To see what version of firmware is running on your RoamIO<sub>2</sub> hardware adapter, go to the **View** menu and select **RoamIO Properties** to display the following window.



To upgrade the RoamIO<sub>2</sub> firmware, perform the following steps:

- Step 1:** If you are connected to the BACnet network, disconnect from the network (**File -> Disconnect**) before beginning the upgrade procedure.
- Step 2:** From the **Tools** menu, select **Update RoamIO** to display the following dialog.



- Step 3:** Use the **Browse** button to find the new UPD file you want to load into the RoamIO hardware adapter.

**Step 4:** Click on the **Upload** button to start the upgrade installation. When the progress bar is completely filled, the installation should be complete. Scroll down the Status area to confirm that the process was successful.



**Step 5:** Click **Cancel** to close this dialog.

## Getting Started with the Service Tool Software

Once the software is installed, you can start the application, configure users and set preferences before you begin to connect and work with controllers.

### ***Starting and Logging on to the Application***

To open and log on to the application, perform the following steps:

**Step 1:** Start the program from the BACnet Service Tool icon on your desktop, or from the Start menu item.



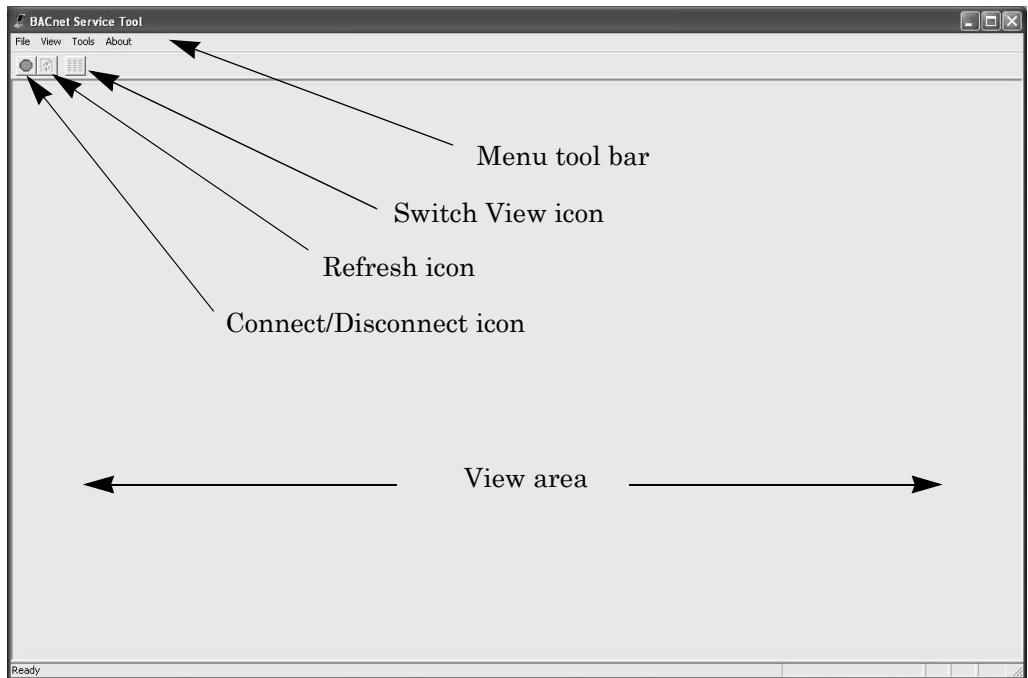
After the TAC splash screen displays for several seconds, the logon dialog displays.



**Step 2:** Enter a **username** and **password**.

The default username is **acc** (lower case) and the default password is also **acc** (lower case). You can create additional usernames and passwords when you configure the BACnet Service Tool.

**Step 3:** Select the **OK** button to complete the logon or **Cancel** to close the application.

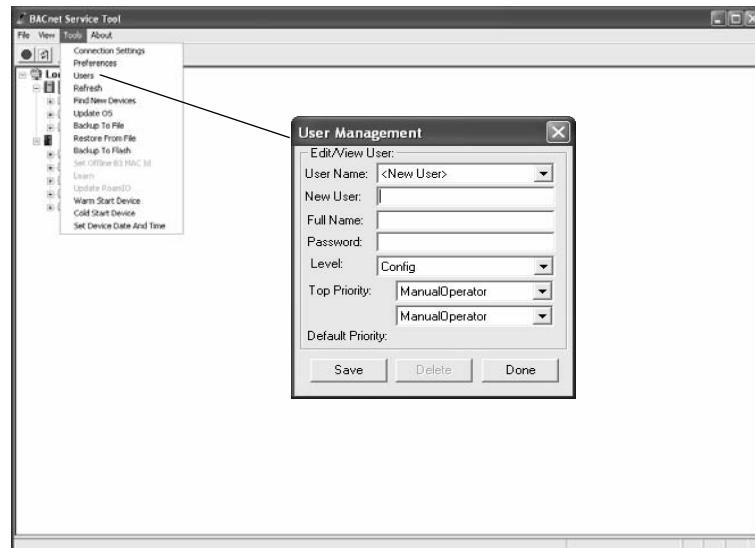


## Configuring the BACnet Service Tool

The BACnet Service Tool provides user management capabilities in the form of user and user levels in determining what operations a person can perform. User levels are already defined in the BACnet Service Tool for each available operation and their assignment to a user determines the permissions he/she has to perform for administrative and maintenance operations.

### ***Creating Users and User Levels***

Users are added to the Service Tool using the **User** option from the **Tools** dropdown menu.



In addition to **User Name**, the User Management dialog defines the following fields:

Field	Description
User Name	Allows you to bring up an existing name and user profile for editing
New User	Allows you to assign a new user name

Field	Description
Full Name	Allows you to record a user's real name
Password	Allows you to assign this user a security password
Level	<p>Allows you to assign a Continuum security level for this user that allows him/her to perform pre-defined operations on specific classes and objects.</p> <p>Security Levels (from high to low) include:</p> <ul style="list-style-type: none"> <li>• Admin - Unlimited access to all classes and objects</li> <li>• Program - Allows user to use objects in Plain English (PE) programs for altering controller actions</li> <li>• Config - Allows user to alter or set the values of pre-defined classes and objects</li> <li>• Ack Alarms - Allows user to acknowledge alarms based on some pre-defined specific object values or states</li> <li>• Enable/Disable - Allows user to enable or disable actions based on pre-defined object values</li> <li>• Change Values - Allows user to change the values on some pre-defined objects</li> </ul> <p>Security at one level, automatically includes the privileges granted at a lower level. For example, if a user's security level is set at <b>Config</b>, he/she automatically has the privileges assigned to <b>Ack Alarms</b>, <b>Enable/Disable</b>, and <b>Change Values</b>.</p>
Top Priority	Allows you to select one of the 16 BACnet command priority levels (Priority_Array) for this user to establish his/her ability to execute a commandable property when in conflict with other BACnet priorities
Default Priority	Sets the default BACnet priority level for this user. The current default value is 8 - Manual Operator

In addition to adding Users, you can also use this dialog to change user information or levels, and to remove users from the Tool.

---

**Note:** When a user logs on using the BACnet Service Tool, the user name and password are first checked against the security level tables in the Andover Continuum controller (for example, bCX). If the username and password is unknown to the controller, the security levels are determined by the Service Tool .

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## What to do Next

Now that you have been able to start the application, logon, create users and set any initial preferences for your site, you can complete the product installation by making sure your physical connections and communication settings are correct . Refer to Chapter 4, Connecting to a BACnet Controller.



# Chapter 3

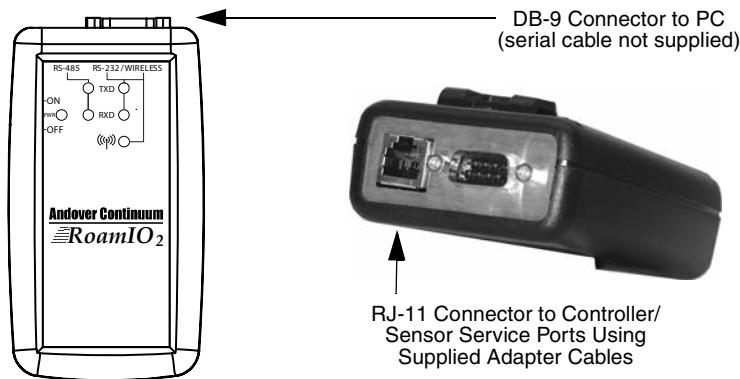
## Connecting to a BACnet Controller

This chapter contains the following topics:

- Connecting the RoamIO<sub>2</sub> to the PC
  - Connect the RoamIO<sub>2</sub> to the PC Using the RS-232 Serial Cable
  - Connect the RoamIO<sub>2</sub> to the PC using Bluetooth
- Connect a RoamIO<sub>2</sub> Cable to the Controller
- Connecting to a Controller using MS/TP (Field Bus)
- Connecting to a Controller using Ethernet

## Connecting the RoamIO<sub>2</sub> to the PC

To connect the RoamIO<sub>2</sub> hardware adapter to a PC, you can connect a serial cable with a DB-9 female connector to the COM1 port (RS-232) on the PC, or you can take advantage of the internal Bluetooth wireless capability.



### **Connect the RoamIO<sub>2</sub> to the PC Using the RS-232 Serial Cable**

Connect the serial cable (not supplied) from a COM port on your PC to the RoamIO<sub>2</sub> hardware adapter.

The connector on the RoamIO<sub>2</sub> is a standard DB-9 male connection with the following pinout assignments.

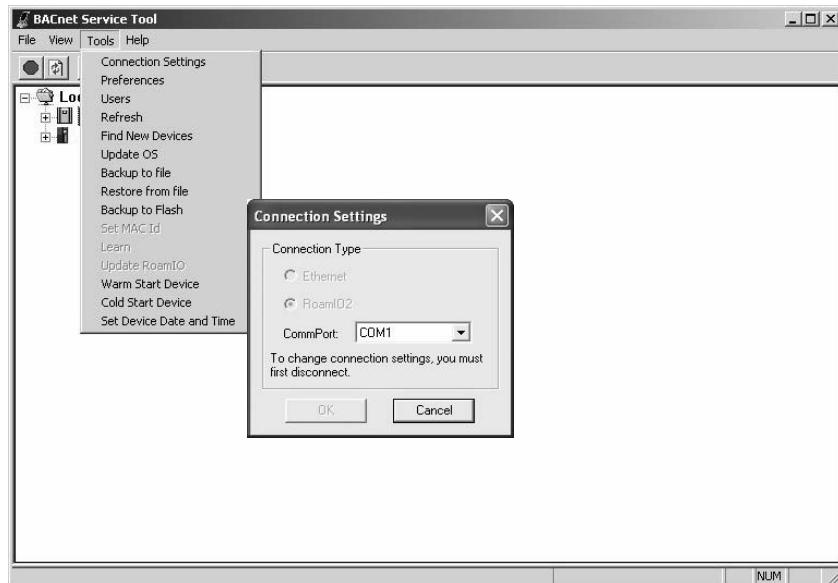
Pin	Signal
2	RXD (Received Data)
3	TXD (Transmitted Data)
5	GND (Ground)

This requires a cable that is not included with the BACnet Service Tool product.

## Activating the RoamIO<sub>2</sub> for a Serial Connection

To activate the RoamIO<sub>2</sub>, perform these steps:

**Step 1:** Log on to the BACnet Service Tool.



**Step 2:** From the BACnet Service Tool toolbar, select the **Tools** menu.

**Step 3:** Select the **Connection Settings** option to display the connections setting dialog.

**Step 4:** Select the **MS/TP** option.

**Step 5:** Select the COM port for your PC's connection to the RoamIO<sub>2</sub> hardware adapter.

**Step 6:** Select the **OK** button to complete the setting.

## ***Connect the RoamIO<sub>2</sub> to the PC using Bluetooth***

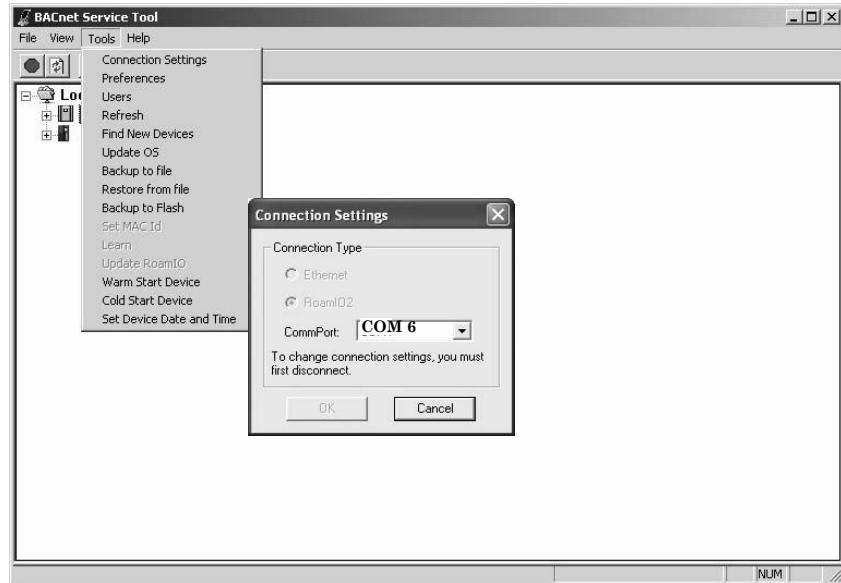
Bluetooth wireless capability is built into the RoamIO<sub>2</sub> hardware adapter. When the unit is powered on, and there is no connector in the DB9 connector, Bluetooth wireless availability is automatic and only needs to be “discovered” by a Bluetooth-enabled PC, running the BACnet Service Tool application.

To set up a wireless connection from the PC to the RoamIO<sub>2</sub> hardware adapter, perform the following steps:

---

**Note:** To change a connection setting, if you are already connected to the network, you must first disconnect (*File--> Disconnect*).

---



---

**Note:** Refer to Chapter 2: Bluetooth Installation and Configuration, for the correct Bluetooth configuration settings.

---

**Step 1:** Log on to the BACnet Service Tool.

**Step 2:** From the BACnet Service Tool toolbar, select the **Tools** menu.

**Step 3:** Select the **Connection Settings** option to display the connection settings dialog.

**Step 4:** Select the COM port number for your PC's wireless serial connection.

**Step 5:** Select the **OK** button to begin the wireless "search" for the RoamIO<sub>2</sub> hardware adapter.

---

**Note:** If your Bluetooth configuration does not have the correct security PIN number (*ACC*), you will be prompted with the following message.



Enter the security PIN number for the RoamIO<sub>2</sub>, which is *ACC*.

---

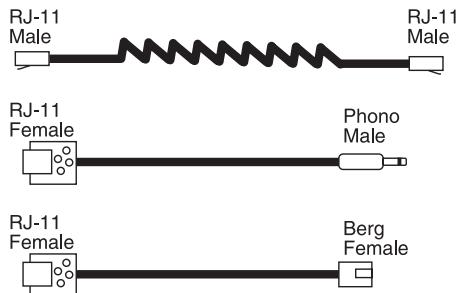
**Step 6:** Select the Connect Button  on the toolbar to make the connection to the attached controller.

A successful connection will display the network of BACnet devices. An unsuccessful connection will result in an error message indicating the cause of the connection problem.

## Connect a RoamIO<sub>2</sub> Cable to the Controller

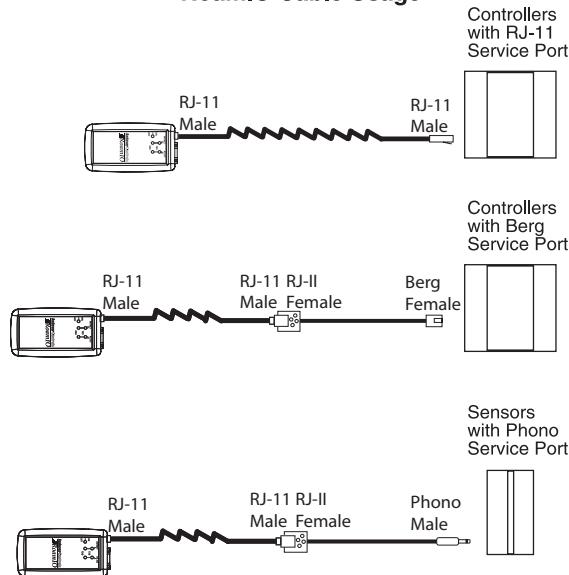
To connect the RoamIO<sub>2</sub> hardware adapter to an Andover Continuum controller's service port, use one or more of the appropriate supplied cables.

**RoamIO Cable Set**



The following illustration shows how to make the cable connections to controllers with specific styles of service ports.

**RoamIO Cable Usage**

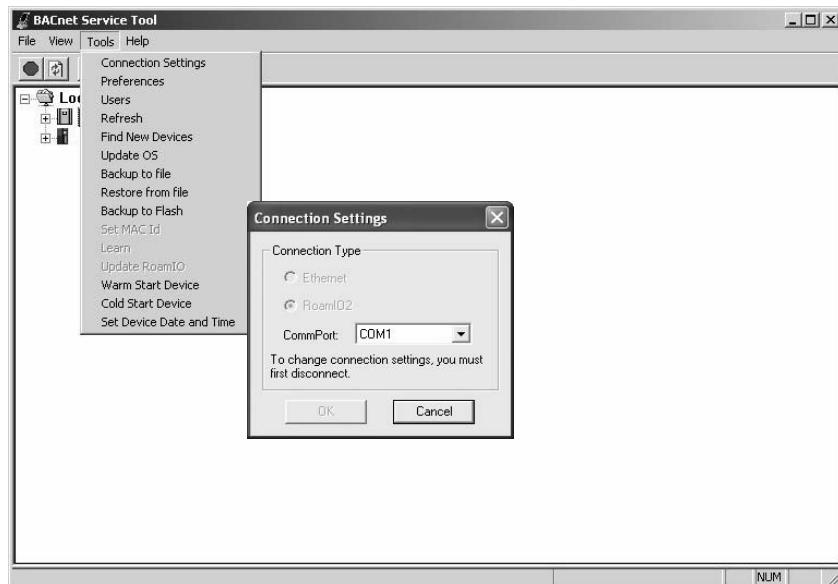


## Connecting to a Controller using MS/TP (Field Bus)

When the RoamIO<sub>2</sub> hardware adapter is correctly connected between the PC and a BACnet controller and powered on, the BACnet Service Tool software can communicate with the BACnet controller.

To set up a connection to a controller on an MS/TP (Field) bus, perform the following steps:

**Note:** To change a connection setting, if you are already connected to a controller, you must first disconnect (*File--> Disconnect*).



**Step 1:** Log on to the BACnet Service Tool.

**Step 2:** From the BACnet Service Tool toolbar, select the **Tools** menu.

**Step 3:** Select the **Connection Settings** option to display the connections dialog.

**Step 4:** Select the **MS/TP** option.

**Step 5:** Select the COM port for your PC's RS-232 serial connection that is connected to the RoamIO<sub>2</sub> hardware adapter.

**Step 6:** Select the **OK** button to complete the setting.

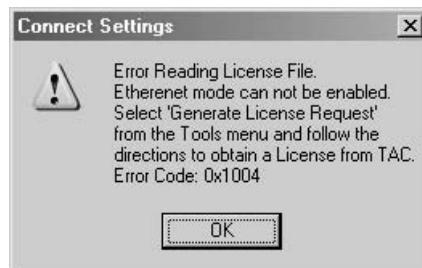
**Step 7:** Select the Connect Button icon  on the toolbar to make the connection.

A successful connection will display the network of BACnet devices. An unsuccessful connection will result in an error message indicating the cause of the connection problem.

## Connecting to a Controller using Ethernet

**Note:** Upon selecting the Ethernet option for the first time, the BACnet Service Tool will check for a valid license file to enable an Ethernet connection.

If the license file is not found, the following message will be displayed and the Ethernet option on the Connection Settings dialog will be disabled.



Refer to the sections below for the procedure on generating a license request with or without a RoamIO<sub>2</sub> hardware adapter connected to your PC.

The following sections include:

- Generating a License Request with the RoamIO<sub>2</sub> Connected
- Generating a License Request without the RoamIO<sub>2</sub> Connected
- Making an Ethernet Connection

## ***Generating a License Request with the RoamIO<sub>2</sub> Connected***

With the RoamIO<sub>2</sub> hardware adapter connected to your PC, you can perform the following steps to make a license request for an Ethernet connection.

**Step 1:** From the **Tools** menu, select **Generate License Request**.

**If the RoamIO<sub>2</sub> hardware adapter is connected**, the BACnet Service Tool will validate the serial number on the attached RoamIO<sub>2</sub> hardware adapter and display the following dialog with the serial number displayed in a read-only field.



**Step 2:** Select the **Generate** button to create a License Request Cookie file. The file location and name will be displayed in the dialog as follows:



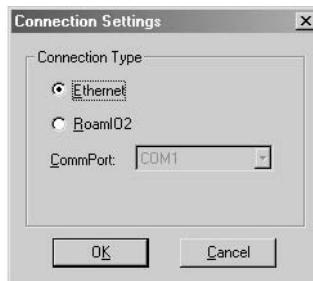
The file format will be:  
*<path>\ROAMIO\<serial number>.req*

**Step 3:** To receive a valid license, attach this file to an email and send it to the TAC address listed in the readme file for this release. Include the following information:

- Your contact information
- Your PO (purchase order) and RA number for this product.

**Step 4:** TAC will respond with a valid license file that must be placed in the same directory as the BACnet Service Tool executable is installed.

**Step 5:** Once the license file is placed in the directory, select **Communication Settings** from the **Tool** drop-down menu to display the following dialog:



**Step 6:** Select Ethernet and click OK. The BACnet Service Tool responds with the following message:



Once the Ethernet mode is enabled, you can make an Ethernet connection. Refer to the section in this chapter, Making an Ethernet Connection.

---

**Note:** To transfer a License to a different PC (desktop, laptop, or Pocket), the BACnet Service Tool software must be installed and a valid License Request Cookie must be generated for the new PC. Refer to the procedure described above.

---

## ***Generating a License Request without the RoamIO<sub>2</sub> Connected***

If a RoamIO<sub>2</sub> hardware adapter is not connected to your PC, you can perform the following steps to make a license request for an Ethernet connection.

**Step 1:** From the **Tools** menu, select **Generate License Request**.

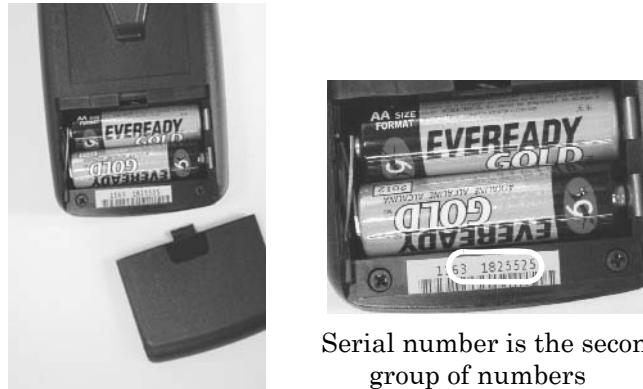
**If the RoamIO<sub>2</sub> hardware adapter is not connected**, the BACnet Service Tool will display the following message.



**Step 2:** Select the OK button to display the following dialog.



**Note:** To obtain the RoamIO<sub>2</sub> hardware adapter serial number, remove the battery cover. The serial number is the second group of numbers (to the right) as shown in the illustration below:



**Step 3:** Enter the serial number and select the **Generate** button to create a License Request Cookie file.



The file location and name will be displayed in the dialog. The file format is as follows:

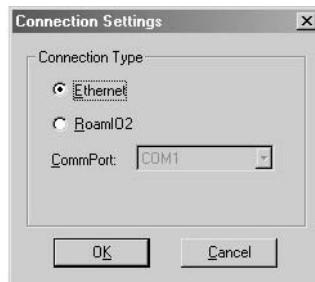
*<path>\ROAMIO\<serial number>.req*

**Step 4:** To receive a valid license, attach this file to an email and send it to the TAC address listed in the readme file for this release. Include the following information:

- Your contact information
- Your PO (purchase order) and RA number for this product.

**Step 5:** TAC will respond with a valid license file that must be placed in the same directory as the BACnet Service Tool executable is installed.

**Step 6:** Once the license file is placed in the directory, select **Communication Settings** from the **Tool** drop-down menu to display the following dialog:



**Step 7:** Select Ethernet and click OK. The BACnet Service Tool responds with the following message:



Once the Ethernet mode is enabled, you can make an Ethernet connection. Refer to the following section in this chapter, Making an Ethernet Connection.

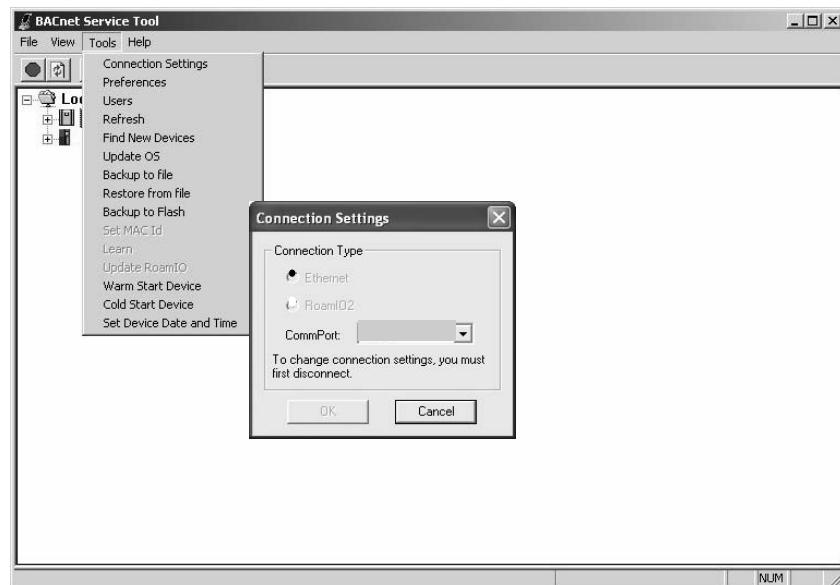
---

**Note:** To transfer a License to a different PC (desktop, laptop, or Pocket), the BACnet Service Tool software must be installed and a valid License Request Cookie must be generated for the new PC. Refer to the procedure described above.

---

## Making an Ethernet Connection

To make an Ethernet connection, perform the following steps:.



- Step 1:** From the BACnet Service Tool toolbar, select the **Tools** menu.
- Step 2:** Select the **Connection Settings** option to display the connections dialog.
- Step 3:** Select the **Ethernet** option.
- Step 4:** Select the **OK** button.
- Step 5:** Select the Connect Button  on the toolbar to make the Ethernet connection to a controller.

A successful connection will display the network of BACnet devices. An unsuccessful connection will result in an error message indicating the cause of the connection problem



# Chapter 4

## BACnet Service Tool Quick-Reference

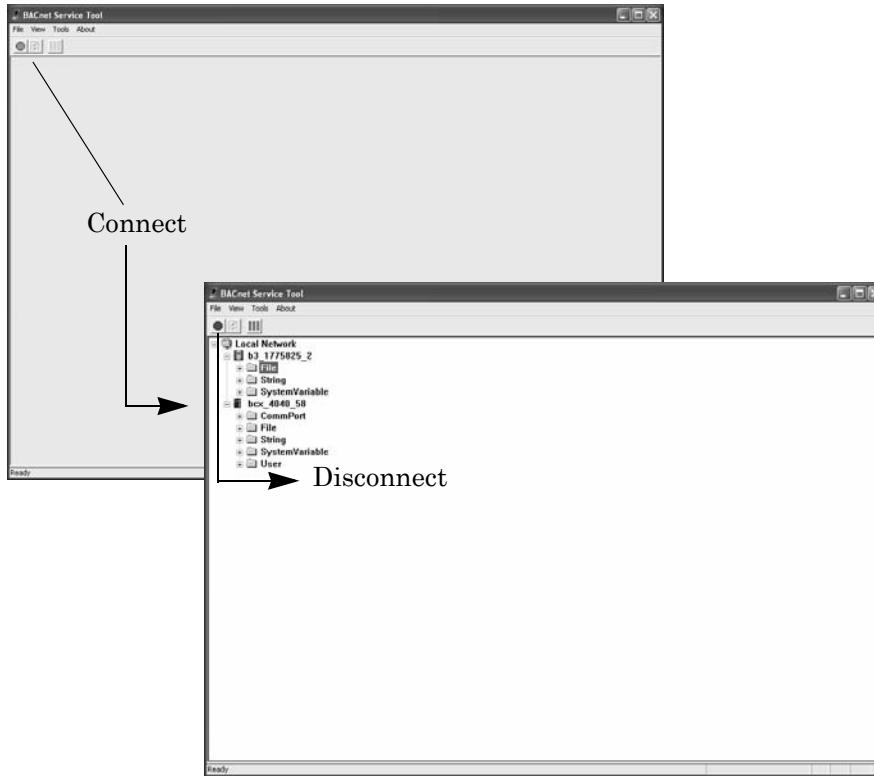
This chapter presents a quick-reference of the BACnet Service Tool graphical user interface and contains the following topics:

- Connecting to a Controller
- File Menu
- View Menu
- Tools Menu
- About Menu

For more detailed descriptions of Service Tool functions, refer to Chapter 6: Using the BACnet Service Tool Software.

## Connecting to a Controller

Once you have started the application and completed the logon, you can connect to the network using the communications configuration you have set up under the **Tools > Connection Setting** dialog.



Selecting the **Green Connect icon** establishes communication with the controller or network connection and you are presented with a “view” of the BACnet Internetwork.

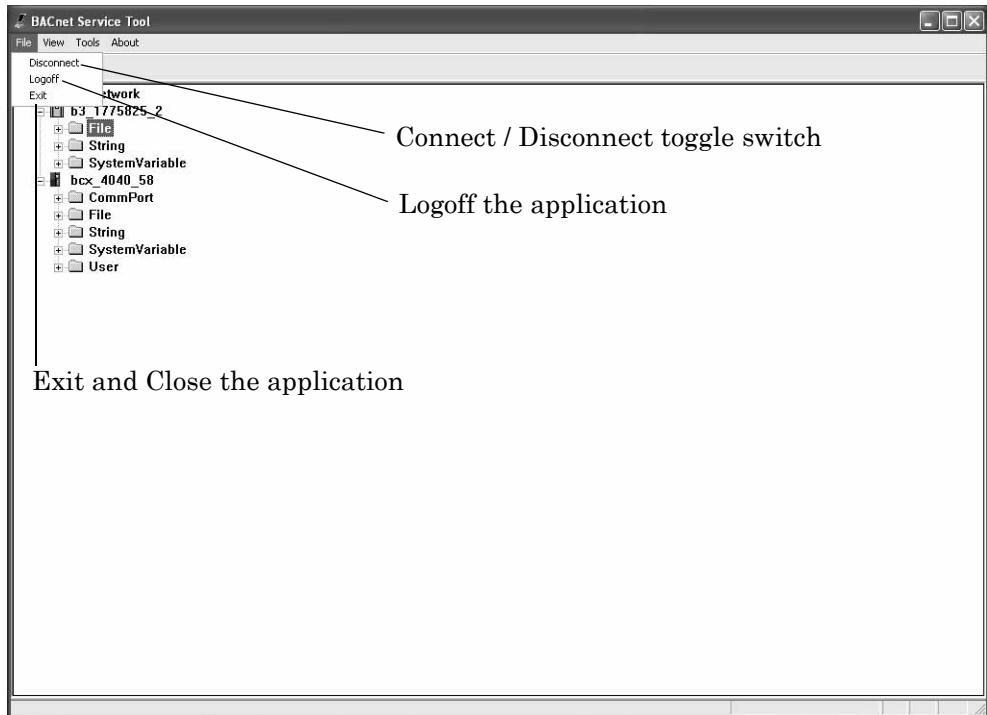
You can disconnect from the network using the **Red Connect icon**.

You also have the option of making the connection from the File dropdown menu and selecting the **Connect** or **Disconnect** option.

## File Menu

The File Menu offers you the following options:

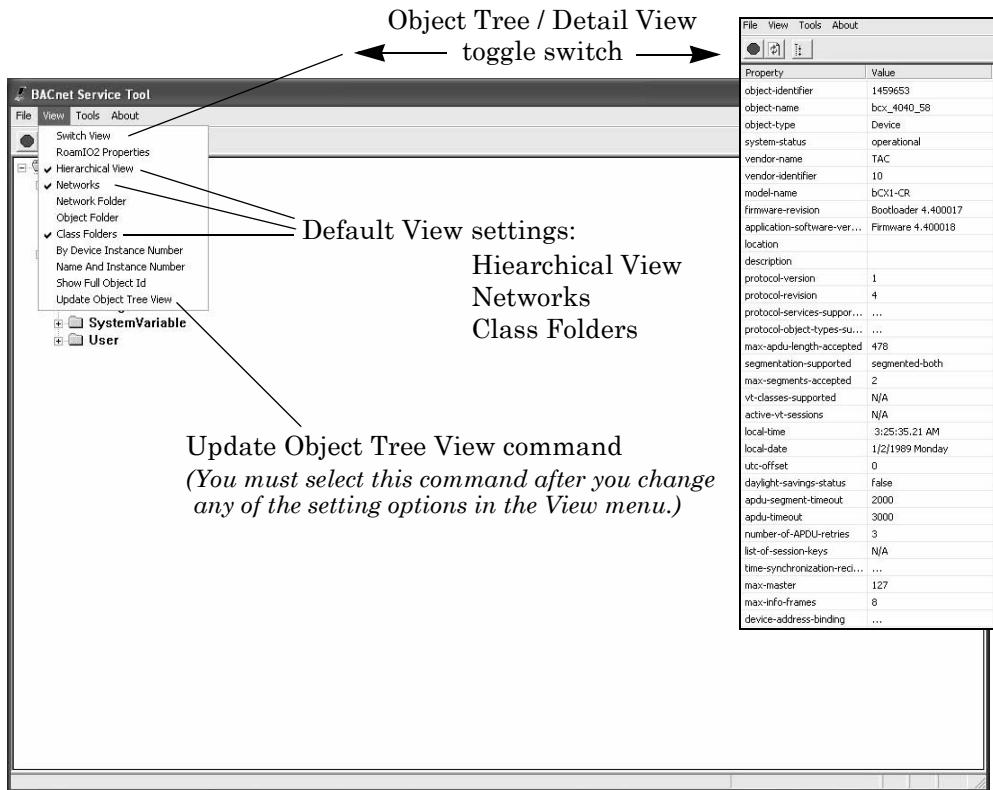
- Connect to the BACnet Internetwork (or Disconnect if you are already connected) via your physical connection to the controller or to the network.
- Logoff the application, but keep it open.
- Exit the application.



## View Menu

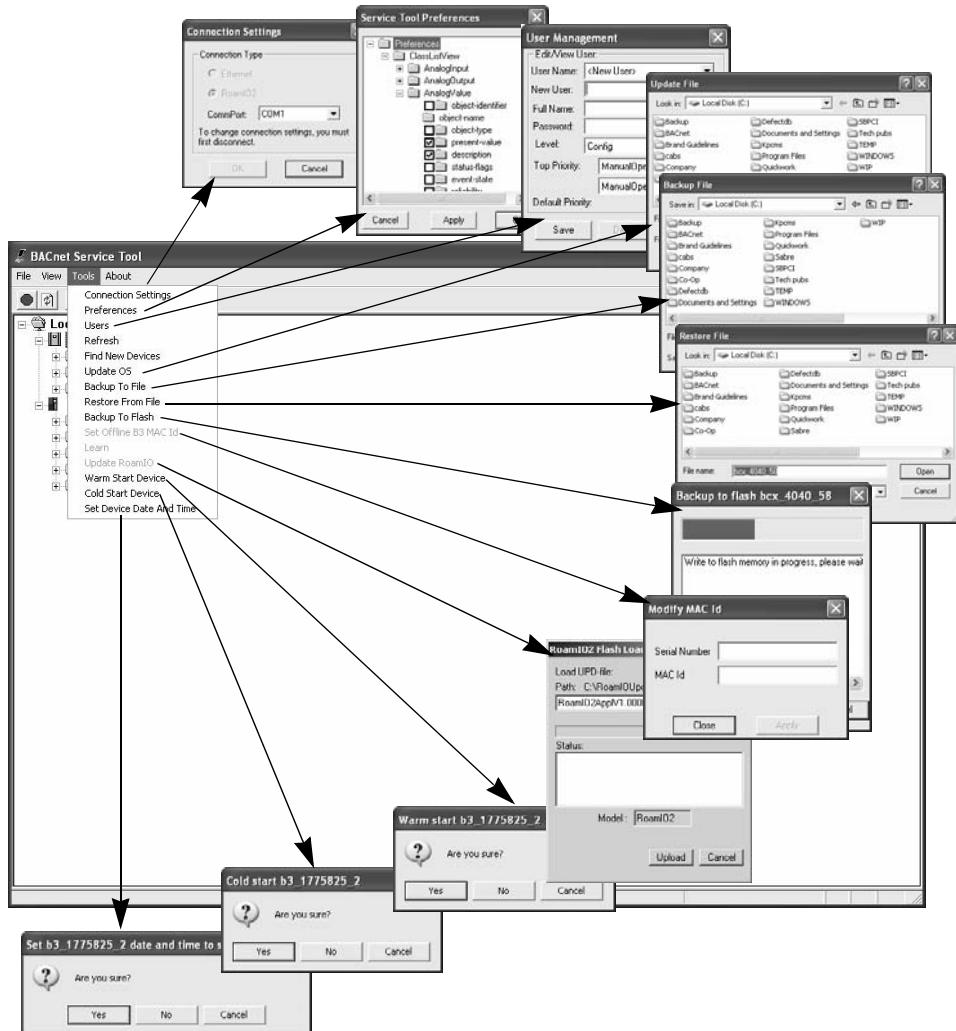
“Views” are a significant concept within the BACnet Service Tool.

Under the View menu, you can select different elements that will appear in your **Object Tree** image of the BACnet Internetwork, as well as perform a **Switch View** to see a more detailed table of any sub-network, controller, class, or object that you have selected.



## Tools Menu

The Tools menu allows you to manage the network and all the devices on the network.



Management capabilities include:

- Setting communication parameters
- Setting class and object property viewing preferences
- Creating and editing users and user level settings
- Refreshing the viewing image
- Finding new devices on the network
- Updating the Operating System (OS) of a controller
- Backing up a controller's configuration information
- Restoring a controller's configuration information
- Backing up a Continuum controller's configuration in RAM to Flash memory
- Setting or changing the MAC ID on Continuum controllers on an MS/TP network

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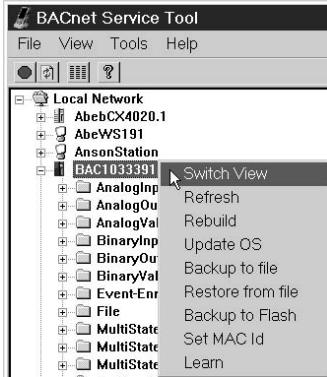
**Warning:** Changing the MAC ID of an MS/TP controller should only be performed during startup and commissioning. Once an MS/TP controller is “learned” into a CyberStation database, changing the MAC ID of that controller will cause the controller to go offline. Since MAC IDs cannot be changed in CyberStation in either Online or Offline editing modes, you will not be able to communicate to a controller whose MAC ID has been changed after it is added to the CyberStation database.

You can change the BACnet Device ID using the tool, but you must also use CyberStation in offline mode to duplicate the change in the CyberStation database.

---

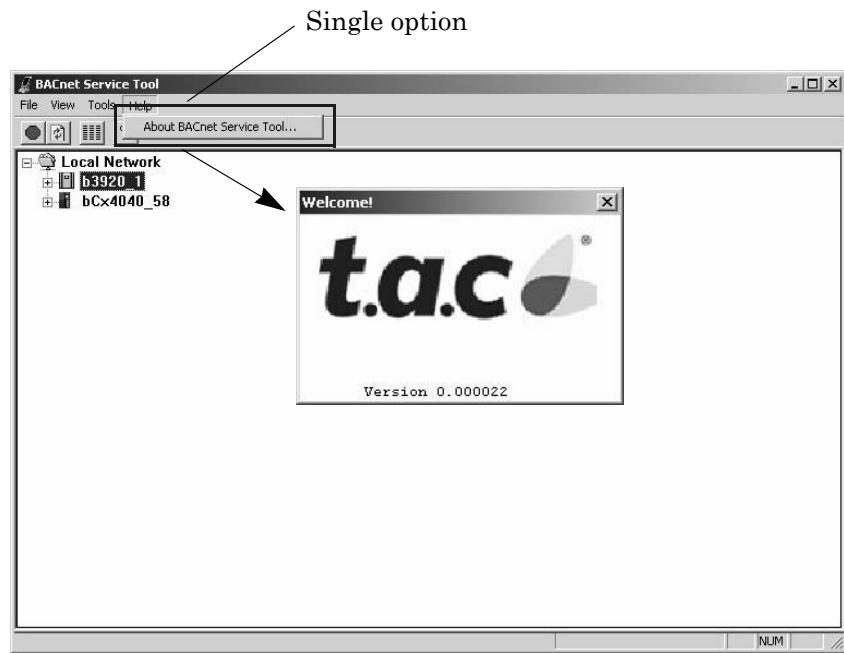
- Searching for new controllers and “learning” about them
- Upgrading the operating system of the RoamIO<sub>2</sub> hardware adapter
- Remotely warm starting a device
- Remotely cold starting a device
- Setting a device's date and time.

In addition to performing these operations from the Tools menu, you can also select a controller or other object and **Right-Click** to display a pop-up menu with the available Tool operations for that controller or object.



## About Menu

Click on the **About** menu to display the one option that enables you to view the version number of the current software.



# Chapter 5

## Using the BACnet Service Tool Software

This chapter contains the following topics:

- BACnet Service Tool Overview
- Configuring and Maintaining BACnet Devices
- Some Typical Use Cases

## BACnet Service Tool Overview

The following section presents an overview on using the BACnet Service Tool's graphical user interface.

### ***Connecting to Your BACnet Network***

From the BACnet Service Tool graphical interface use the green Access button to connect to your BACnet network.



You can also connect using the File drop-down menu (**File -> Connect**).

### ***Disconnecting from the Network***

From the BACnet Service Tool graphical interface, use the red Access button to disconnect from your BACnet network.

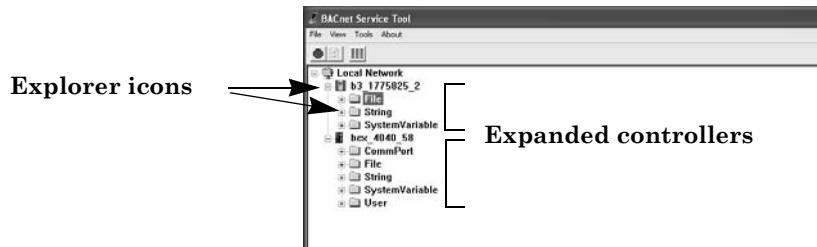


You can also disconnect using the File drop-down menu (**File -> Disconnect**).

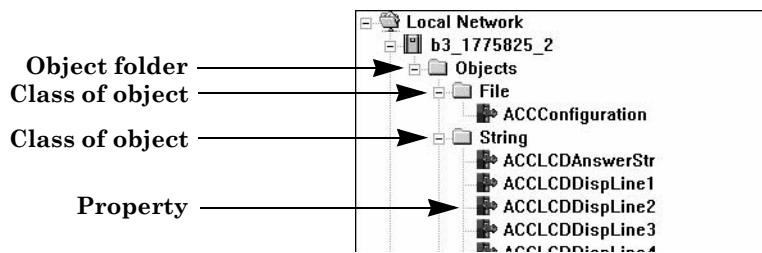
## ***Navigating and Selecting Devices and Objects***

### **The Graphical Interface**

The graphical user interface displays your BACnet network as a hierarchy of devices, using the standard Windows Explorer-type plus (+) and minus (-) icons to indicate when folders can be expanded to reveal additional folders or objects.



Devices may contain a set of object and class folders. You can navigate to a specific device, and continue to expand folders until you reach the specific device-related object or class item you want to review or change.



### **Pop-up Menus**

Once you have selected an item, you can also right-click and display a pop-up menu that lists the choices you have for that specific controller, object, class or item.



Or you can make a selection and use the Tool drop-down menu to perform an action on the controller or object you selected (**Tool -> menu option**).

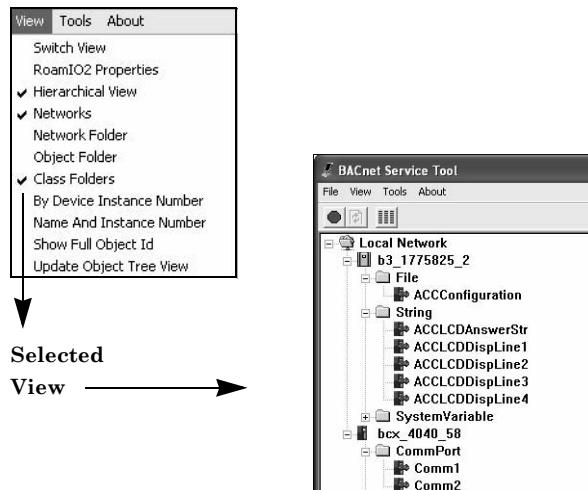
## ***Adjusting the Service Tool's Point of View***

The BACnet Service Tool is capable of displaying the network and associated controllers and objects using different “view settings” that you can turn on or off, depending on the level of detail you want to display.

**Selecting a View** For example, in the illustration below, the selected view is created by selecting the following options from the View drop-down menu:

- Hierarchical
- Networks
- Class Folders

The result is that the graphical display identifies network segments and each controller lists only the class folders associated with that controller.



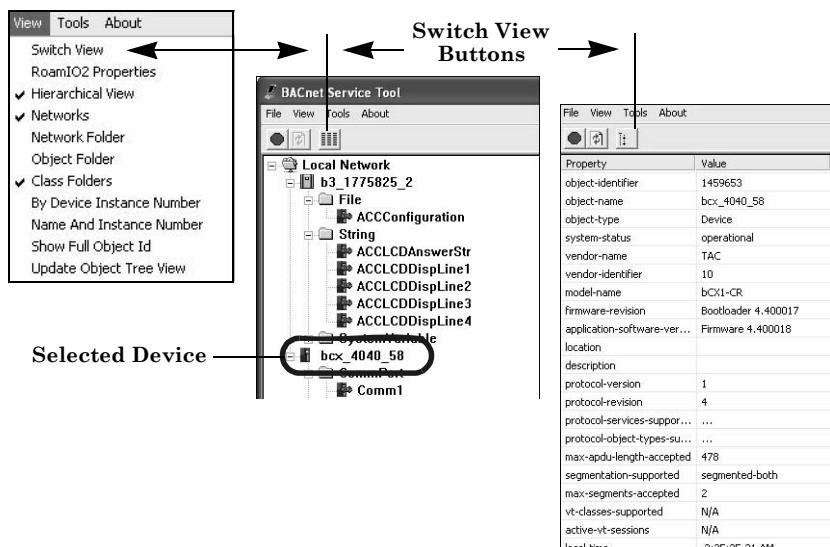
The above view is the **Service Tool's default view**, but you can add or delete selections according to what “view” you work best for you.

---

**Note:** Each time you change a view, making your selections from the View menu, you will need to open the View menu again and select **Update Object Tree View** to execute the new changes.

## Switching to a Detailed View

In addition to changing graphical view, you can select a specific controller or object and use a “Switch View” command to toggle between the graphical view and a detailed table of information listing all the information about the device, folder or object you selected.

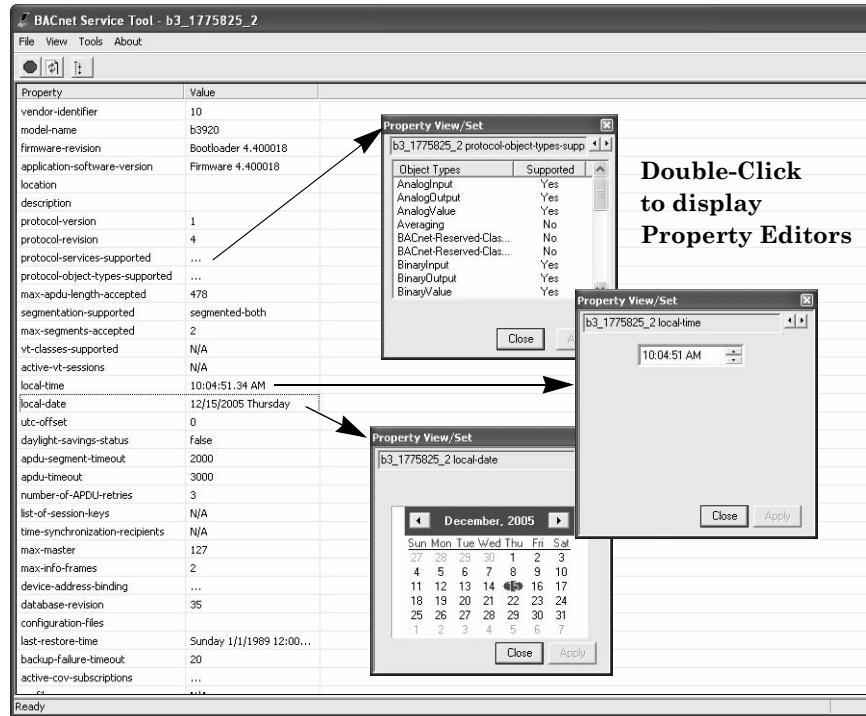


You can switch a view, from graphic to detailed or reverse, using any of the following actions:

- After selecting a controller or object, use the **View** drop-down menu, and select the **Switch View** option.
- Select a controller or object and use the **Switch View icon buttons** on the toolbar.
- Select a controller or object from the graphic view and double-click to display detailed view. (You will need to use one of the methods above to return to the graphic view.)

## Making Changes to Controllers

After selecting a controller, Class folder, or object, perform a “Switch View” to display the detailed table and double-click on an object to bring up the associated property editor (if available), where you can make some of the changes or adjustments normally performed from the CyberStation workstation.



**Double-Click to display Property Editors**

**Note:** Within a detailed table, some properties are information only, such as *vendor identifier* and *model name*, while others, such as *product-object-types-supported* do have editors for changing or adjusting values.

# Configuring and Maintaining BACnet Devices

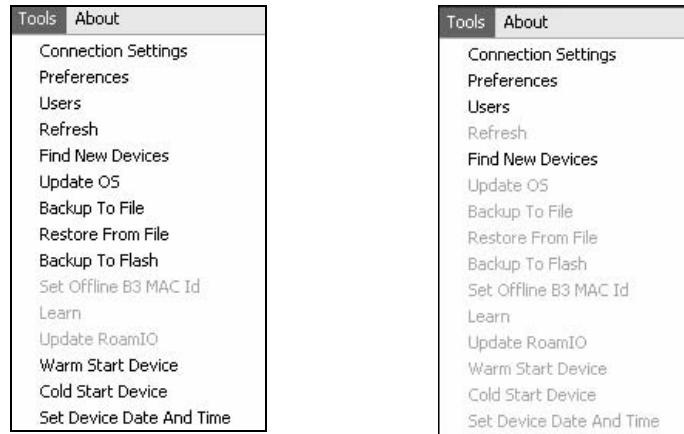
Controller configuration and maintenance actions are available from the **Tools** drop-down menu.

## ***Available and Non-available Tool menu options***

When you display the **Tools** drop-down menu, some options in the menu may be grayed-out, while others appear in normal black text. This difference in available menu options is based on which device or object is selected in the graphical interface.

When a controller is selected, most of the Service Tool options are available. However, when an object is selected, only several options are enabled.

For example, in the illustration below, the first **Tools** menu is displayed when a controller is selected. The second menu is displayed when an object, *BinaryOutput1*, is selected.



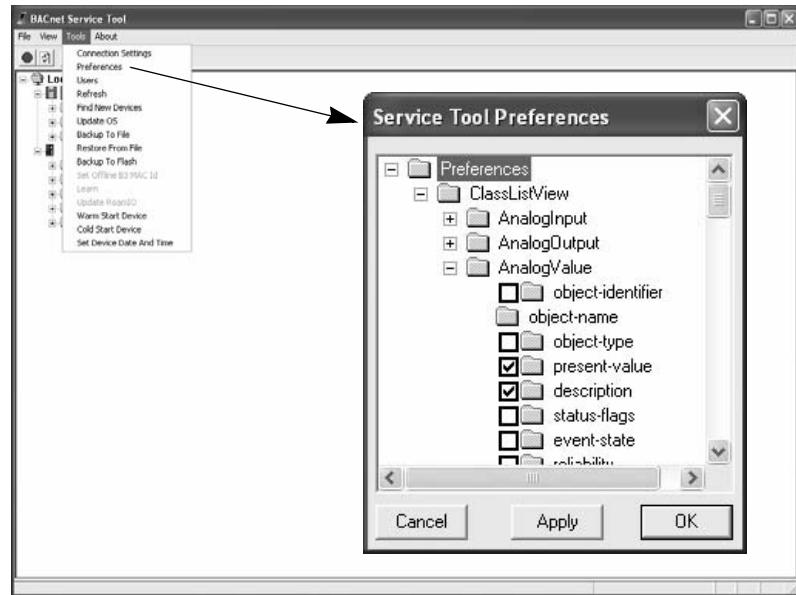
**Available options when selecting a controller**

**Available options when selecting the object *BinaryOutput1***

## Preferences

The **Preferences** option is currently limited to a **Class List View**, which contains folders listing the properties for all supplied and user-defined objects.

From the **Tools** menu, the **Preference** options allows you to select the properties that you want to see when you perform a “Switch View” (refer to “Switching to a Detailed View” on page 63) to display a detailed table of properties for a specific device or object.

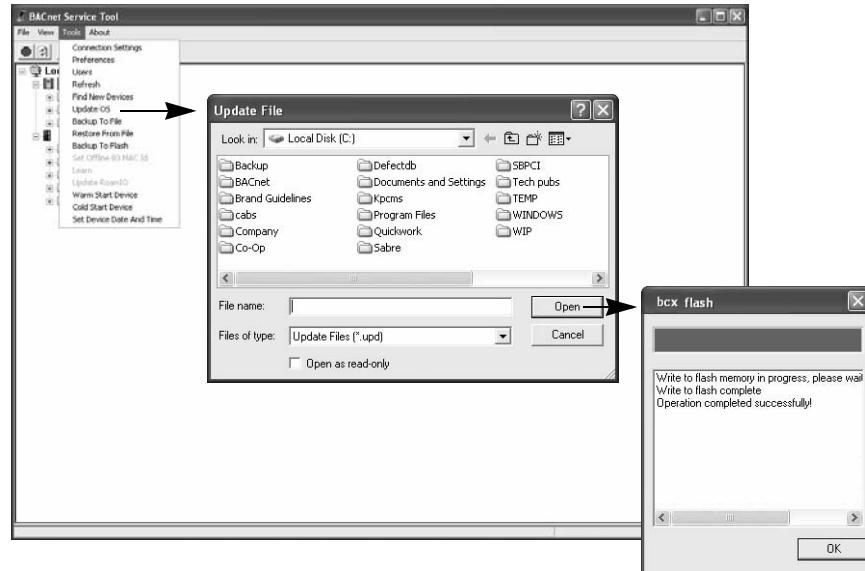


Click on each box in the **Service Tool Preferences** dialog to place or remove a check. Properties that have been checked will appear in the columns of the detailed view of a device.

If you have only selected a specific object and performed a “Switch View”, only the properties for that object will be shown (**Object View**), and your Preference selections will not apply.

## Update OS

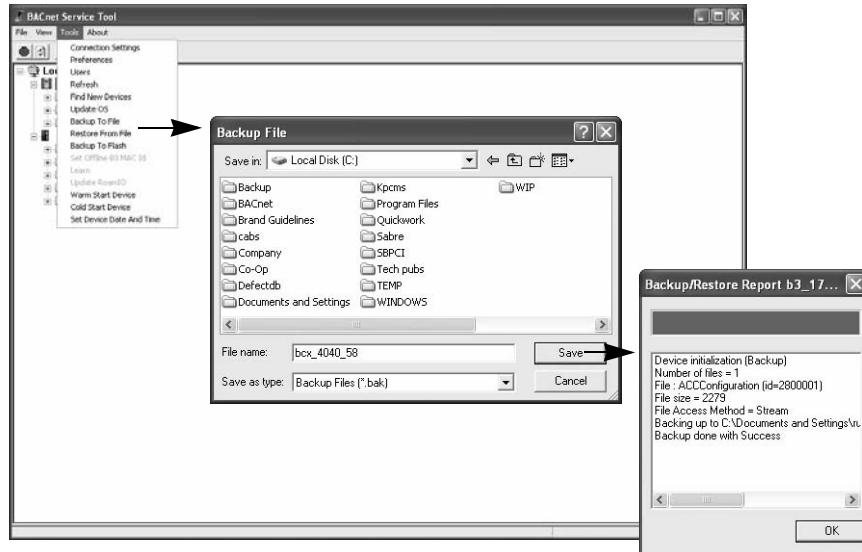
To update the Operating System (OS) of a controller, perform the following steps:



- Step 1:** From the graphical display, select the controller you wish to update.
- Step 2:** From the **Tools** menu, select **Update OS**.
- Step 3:** From the Update File dialog, navigate to the drive and directory where the new update file (.upd) is stored and select the appropriate file.
- Step 4:** Select **Open** to execute the **Flash Loader** dialog. When the process bar is complete, a message will indicate whether the restore action is successful or not.
- Step 5:** Select **OK** to close the dialog.

## Backup To File

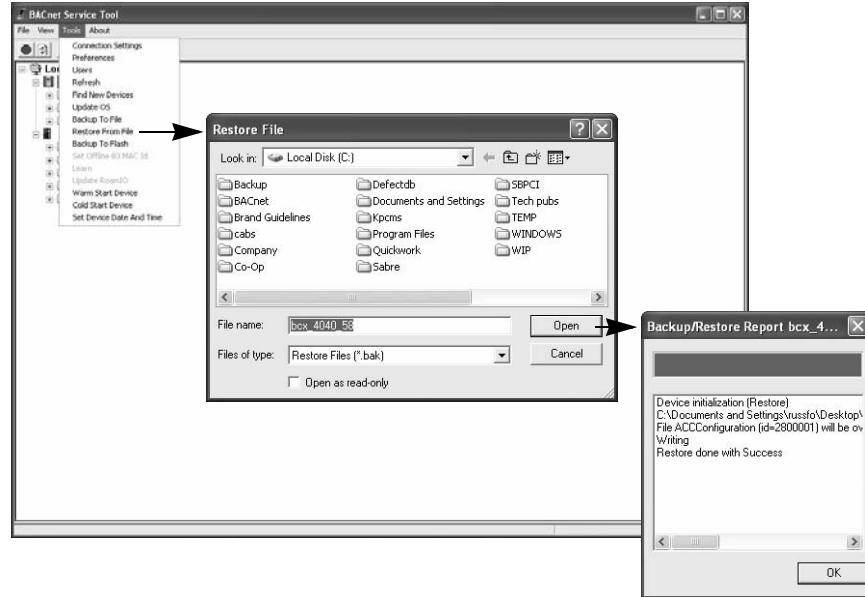
To store the configuration and database information of a controller to a backup file, perform the following steps:



- Step 1:** From the graphical display, select the controller you wish to backup.
- Step 2:** From the **Tools** menu, select **Backup To File**.
- Step 3:** From the Backup/Restore file dialog, navigate to the drive and directory where you want to store the backup files (.bak). You can accept the automatic name of the file provided by the Service Tool, or you can rename the file.
- Step 4:** Select **Save** to execute the **Backup/Restore** dialog. When the process bar is complete, a message will indicate whether the backup is successful or not.
- Step 5:** Select **OK** to close the dialog.

## Restore From File

To restore a previously saved configuration file to a controller, perform the following steps:

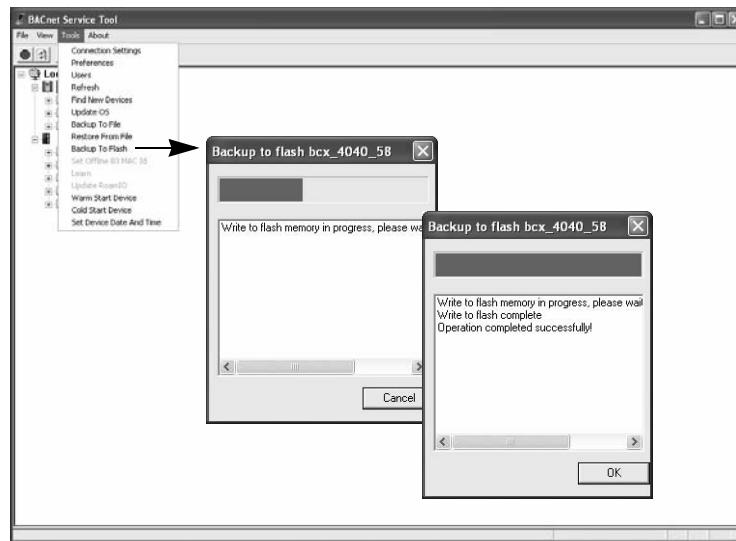


- Step 1:** From the graphical display, select the controller you wish to restore.
- Step 2:** From the **Tools** menu, select **Restore From File**.
- Step 3:** From the Backup/Restore file dialog, navigate to the drive and directory where the backup files (.bak) are stored and select the appropriate file.
- Step 4:** Select **Open** to execute the **Backup/Restore** dialog. When the process bar is complete, a message will indicate whether the restore action is successful or not.
- Step 5:** Select **OK** to close the dialog.

## **Backup to Flash**

In addition to an internal battery for keeping the SDRAM user configuration and database information active, Andover Continuum controllers have non-volatile flash memory for storing user configuration information as a secondary precaution to a power loss, or as a return to a previous user configuration.

To backup a controller's memory into flash memory, perform the following steps:



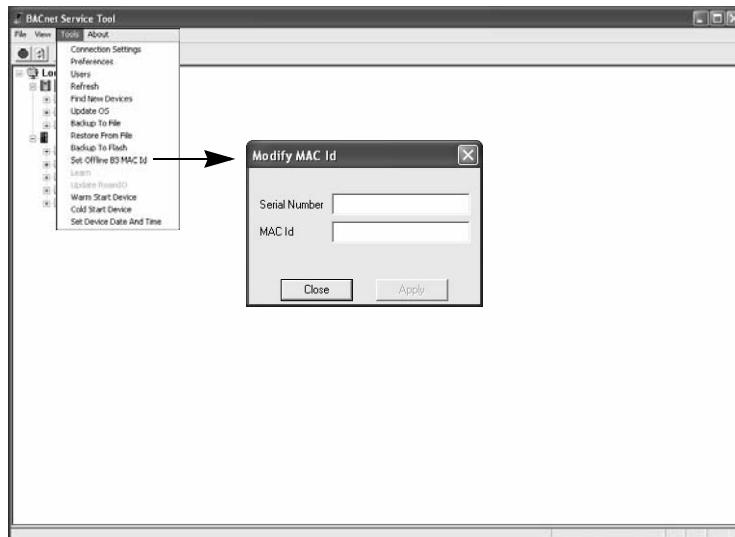
- Step 1:** From the graphical display, select the controller where you wish to perform a backup to flash memory.
- Step 2:** From the **Tools** menu, select **Backup To Flash**. (You can also **right-click** to display the pop-up menu and select **Backup To Flash**).
- Step 3:** From the Backup to flash dialog, you can observe the progress bar of the backup, or select **Cancel** to stop the backup operation. When the progress bar is complete a message will indicate whether or not the operation was successful.
- Step 4:** Select **OK** to close the dialog.

## Set Offline B3 MAC Id

The MAC (Media Access Control) ID address of an Andover Continuum b3 series controller is the networking address used for BACnet (MS/TP) identification and communication. The address range is from 0 to 127.

**Note:** Changing the MAC Id of a BACnet controller should only be performed during startup and commissioning. Once a BACnet controller is *learned* into a CyberStation database, changing the MAC Id of that controller will cause the controller to go offline. Since MAC IDs cannot be changed in CyberStation, in either online or offline editing modes, you will not be able to communicate with a controller whose MAC Id has been changed after it is added to the CyberStation database.

To set a b3 controller's MAC ID address, perform the following steps:

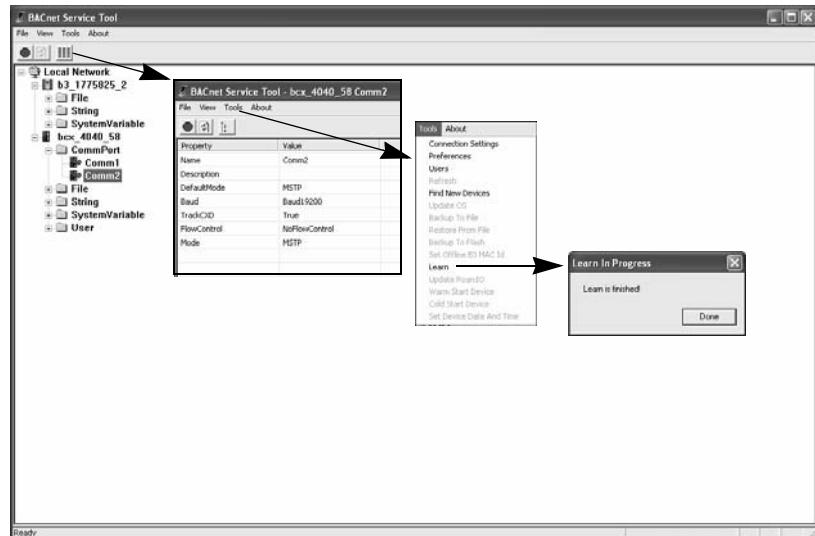


- Step 1:** From the graphical display, select a bCX controller that is connected to the b3 controller that requires an address change.
- Step 2:** From the **Tools** menu, select **Set Offline B3 MAC Id**.
- Step 3:** Enter the serial number of the controller and the new MAC ID
- Step 4:** Select **Apply** to complete the action or **Close** to cancel the request.

## Learn

From the COMM port of a bCX controller, you can execute a “learn” action that allows the controller to record and recognize the other controllers on the same network segment.

To execute a “learn” action, perform the following steps:



**Step 1:** From the graphical display, select the bCX controller where you want to perform a learn action.

**Step 2:** Use the **Switch View icon** to review the details and make sure the COMM port is set to MSTP.

**Step 3:** From the **Tools** menu, select **Learn**.

The Learning in Process dialog will initially display an “In-Process” message, but will change to “Finished” when the Learn action is completed.

**Step 4:** Select **Done** to close the dialog.

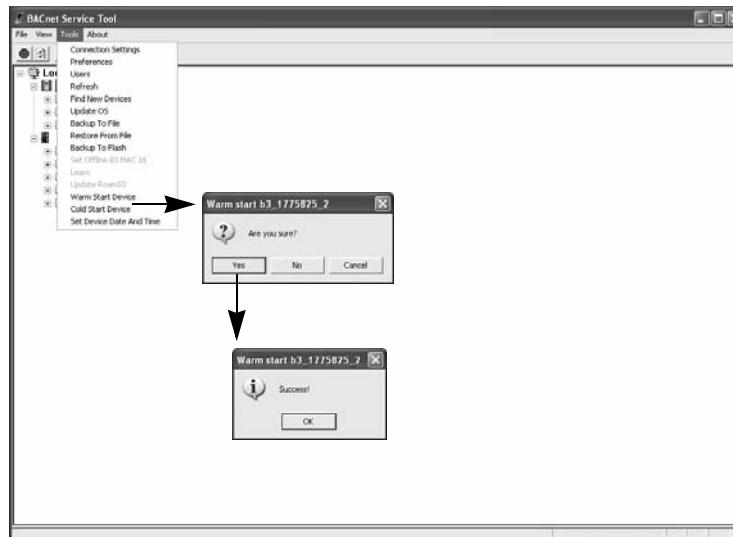
## Update RoamIO

To update the firmware version of the RoamIO<sub>2</sub> hardware adatper, refer to Chapter 2, “Upgrading the RoamIO2 Firmware” on page 27

## Warm Start Device

A warm start is when a controller powers up from a loss of power with a user configuration in place. The user configuration was preserved due to the battery-backed memory when power was lost. Point log data is preserved, Plain English programs are restarted at the same logical line that was being interpreted when the controller shut down, and all user points have their values restored..

To warm start a controller, perform the following steps:

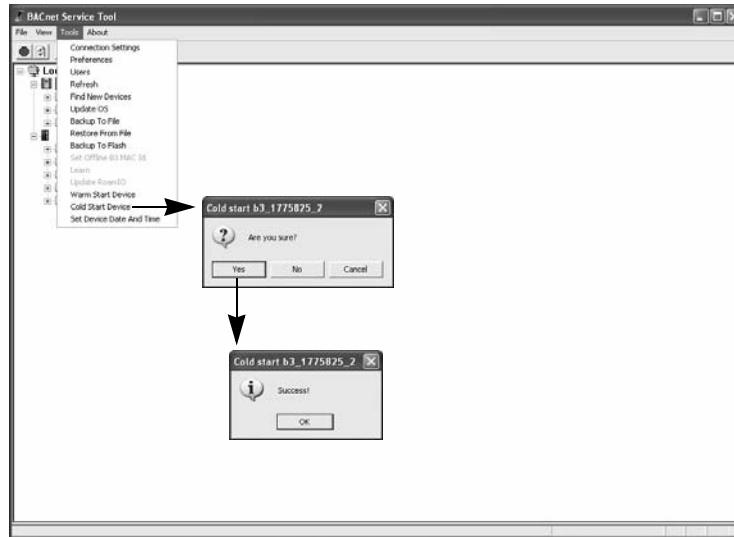


- Step 1:** From the graphical display, select the controller you wish to warm start.
- Step 2:** From the **Tools** menu, select **Warm Start Device**.
- Step 3:** A warm start confirmation dialog is displaye. Select **Yes** to perform the warm start, **No** or **Cancel** to stop the request. A **Success!** message will display to confirm the action.
- Step 4:** Select **OK** to close the Warm Start success dialog.

## ***Cold Start Device***

A cold start is when the controller powers up from reset with no user objects or configuration in place.

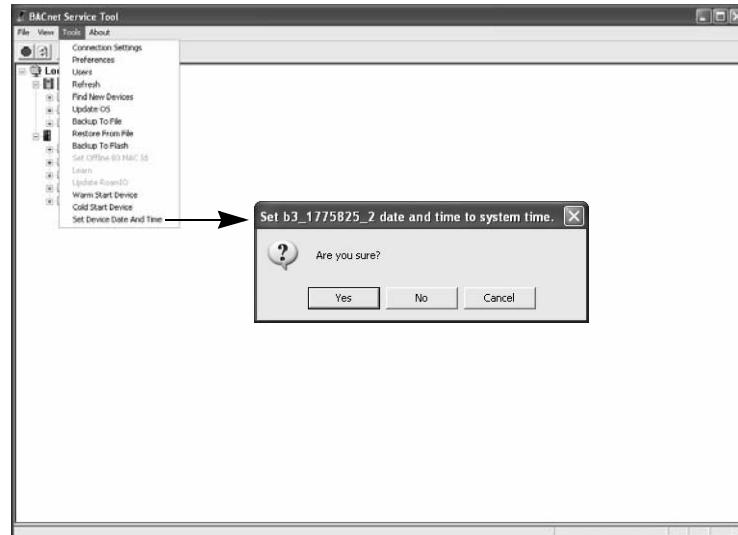
To cold start a controller, perform the following steps:



- Step 1:** From the graphical display, select the controller you wish to cold start.
- Step 2:** From the **Tools** menu, select **Cold Start Device**.
- Step 3:** A cold start confirmation dialog is displayed. Select **Yes** to perform the warm start, **No** or **Cancel** to stop the request. A **Success!** message will display to confirm the action.
- Step 4:** Select **OK** to close the Cold Start success dialog.

## ***Set Device Date and Time***

To set a controller's date and time to match the system date and time of your PC, perform the following steps:



**Step 1:** From the graphical display, select the controller where you wish to set the date and time.

**Step 2:** From the **Tools** menu, select **Set Device Date and Time**.

**Step 3:** The Service Tools responds with a confirmation dialog that asks you to confirm this action (**Yes** or **No** button), or gives you the option to **Cancel** this request.

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**Note:** After selecting, **Yes**, **No**, or **Cancel**, the action is complete and no other dialog is displayed.

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## Some Typical Use Cases

The BACnet Service Tool allows you to drill-down the heirachy tree of BACnet devices, view property values of objects and perform some of the administrative functions available on the Andover Continuum CyberStation product.

The following sections provide some information and examples on what you can do with the Service Tool. These examples only represent a small sampling of the administrative actions you can perform.

### ***Simple and Complex Properties***

To help you understand what you can do with the Service Tool, there is one simple statement to remember:

*The BACnet Service Tool allows you to edit simple properties, but not complex properties.*

A simple property is one that has a single value, while a complex property is one that has more than one value that can be changed. Of course, there are always exceptions to general rules. Within the Service Tool, there are two complex properties that you can change, *event-enable* and *limit-enable*.



**event-enable**

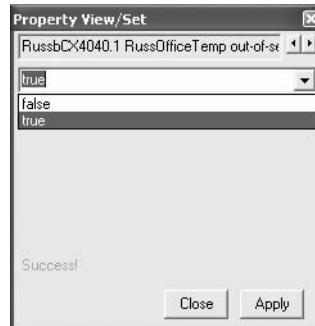


**limit-enable**

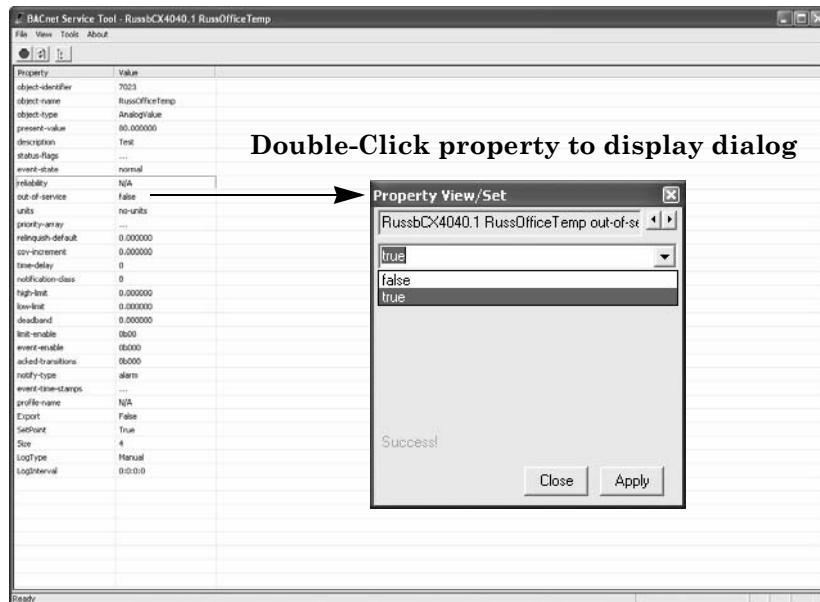
**Exception: Two complex properties that can be edited**

The Event-enable property has two values, *Event Transitions* and *Send*. The limit-enable property also has two values, *Limit-Enable* and *Value*.

This differs from a simple property, such as the out-of-service property, that only has one value that can be changed.



**Selecting Properties** Properties are selected from the detailed view of an object and by double-clicking on the property, a PropertyView/Set dialog is displayed where you can change or just view the current setting and options.



**Problems** In some cases, property values are displayed in the dialog and even thought you can change the value and hit the **Apply** button, the value does not change in the table. In other cases, you may not be able to bring up the Property View/Set dialog after double-clicking on the property.

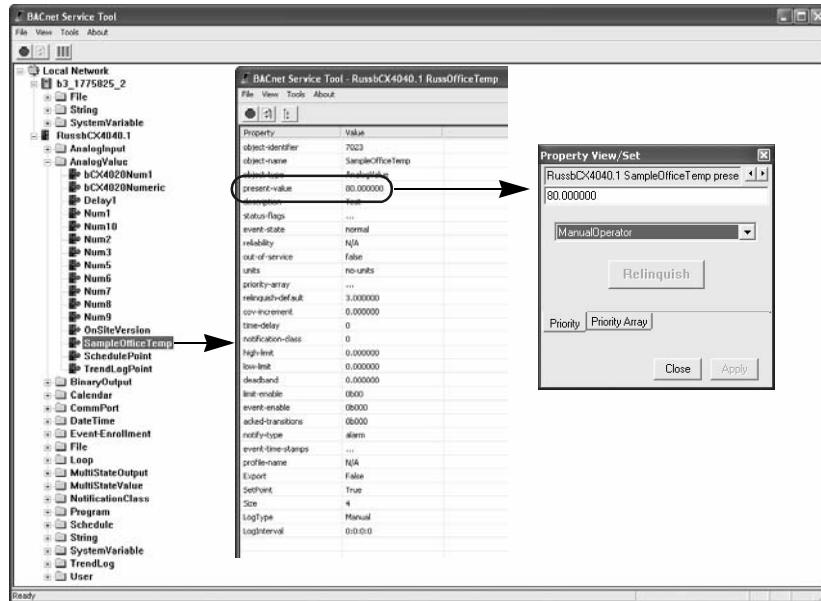
This can occur for one of two reasons:

- Your access privilege is not set high enough to change this property.
- The property value is set on the controller from CyberStation and cannot be changed using the Service Tool.

If you encounter this situation, check your security level to see if you are authorized to change a property value, or consult with your system administrator.

## Adjusting a Temperature Setpoint

One very typical example of using the Service Tool is to change or adjust a temperature setpoint. To adjust a temperature setpoint, perform the following steps:



- Step 1:** From the Service Tool graphical interface, make sure the **View** menu setting includes Class folders.
- Step 2:** Navigate to the device that controls the area where you want to change the setpoint, click on the + sign to display the Class folders
- Step 3:** Select the **AnalogValue** folder and click on the + sign to display the folder's objects.
- Step 4:** Navigate to the object that represents the office or room you are attempting to change. In this example it is *SampleOfficeTemp*. **Double-click** on the object to switch to a detailed table view.
- Step 5:** From the detailed view table, **double-click the present-value** property to display the Property View/Set dialog. *(In this example, this value has a BACnet priority level setting)*

of 8 (*ManualOperator*), which means you should have a level setting of 8 or higher to perform this change.)

**Step 6:** Type the new setting into the value display area and click on the **Apply** button to make the change.

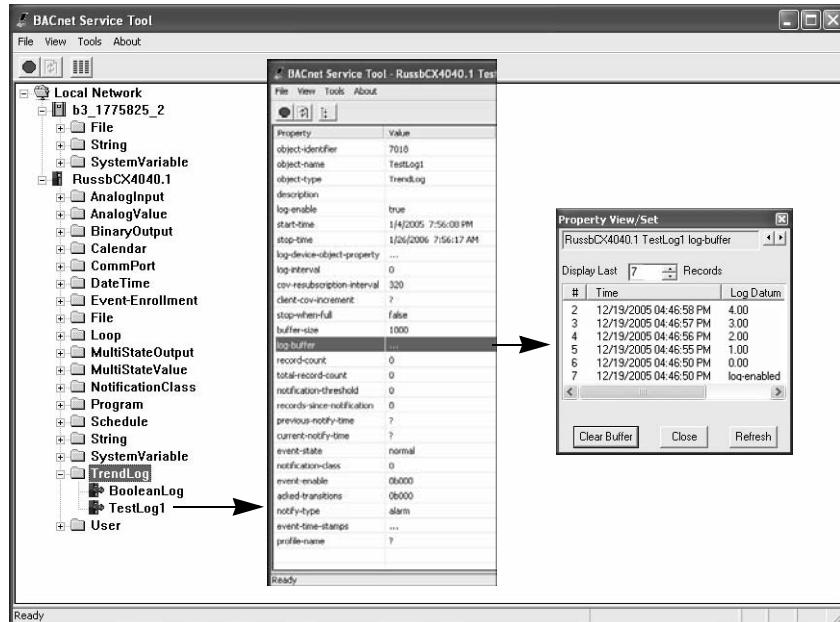
**Step 7:** A success message should appear in the dialog and the table should be updated with the new value. **Close** the dialog to complete this task.

In this example, we only changed the setpoint of the current temperature. We could have changed the *high-limit* and *low-limit* values to adjust the temperature range of operation or we could have changed other objects that would have adusted how the controller functions.

## Viewing a Trend Log Buffer

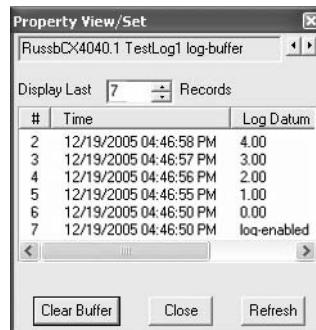
Another common task is to view the history of events in a trend log buffer. If a system administrator has defined an AnalogValue to capture changes in a unit of value, such as ohms, relative humidity, watts, etc., these events can be logged and listed as an object in a Class folder (**TrendLog** is the folder name in this example).

To view a trend log buffer, perform the following steps:



- Step 1:** From the Service Tool graphical interface, make sure the **View** menu setting includes Class folders.
- Step 2:** Navigate to the device where the trend logging is taking place, click on the + sign to display the Class folders.
- Step 3:** Select the **TrendLog** folder and click on the + sign to display the folder's objects.
- Step 4:** Navigate to the object that represents the trend logging event you are looking for. In this example it is *TestLog1*. Double-click on the object to switch to a detailed table view.

**Step 5:** From the detailed view table, **double-click the log-buffer** property to display the Property View/Set dialog .



**Step 6:** View the contents. This dialog gives you three options.

- You can **Clear** the buffer and erase the contents
- You can **Close** the dialog
- You can **Refresh** the buffer and possibly display additional data that may have been captured while this dialog was open.

**Step 7:** **Close** the dialog to complete this task.

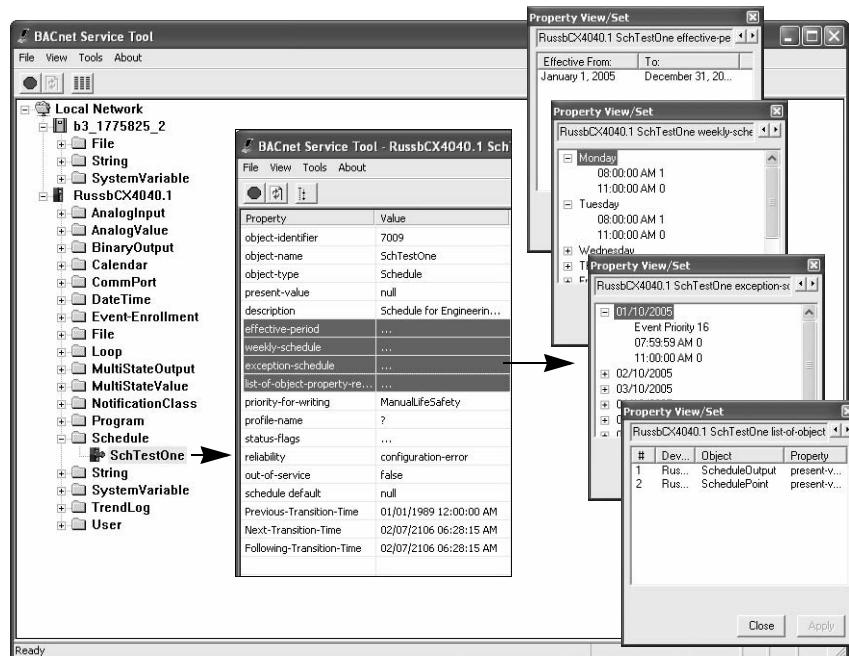
## Viewing a Schedule of Events

Viewing the particular details of schedule of events is another common task that you can perform using the Service Tool. An example of a schedule of events would include automatically changing high and low temperature setpoints at different times of the day, with some exceptions for weekends and holidays.

From the Service Tool, you can view the following:

- The overall time period of the schedule of an event
- The specific weekly schedule of event occurrences
- The time exceptions for an event
- The list of object property references that trigger, or are affected by, an event

To view the schedule details of an event, perform the following steps:



- Step 1:** From the Service Tool graphical interface, make sure the **View** menu setting includes Class folders.
- Step 2:** Navigate to the device where the schedule object has been defined and click on the + sign to display the Class folders.
- Step 3:** Select the **Schedule** folder and click on the + sign to display the folder's objects.
- Step 4:** **Navigate to the object** that represents the event you are looking for. In this example it is *SchTestOne*. **Double-click** on the object to switch to a detailed table view.
- Step 5:** From the detailed table, you can view the Property View/Set dialog on one or more of the following by double-clicking on the property.
  - *effective-period* defines the duration of a scheduled event
  - *weekly-schedule* defines the specific dates and times that an event is triggered
  - *exception-schedule* defines the date and time exceptions to a schedule
  - *list-of-objects-property-references* defines what defined objects and values are associated with an event.

# Appendix A

## What Is BACnet?

This appendix contains the following topics:

- Introduction
- BACnet - Knowing the Terminology
- BACnet and Andover Continuum
- Routers, Gateways, BBMDs, and Foreign Devices

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## Introduction

BACnet® stands for Building Automation and Control Network. It is a communication protocol developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE).

BACnet integrates products made by different manufacturers into a single-building automated control system. This means that, as long as they meet ANSI/ASHRAE Standard 135-2004, products from different manufacturers can communicate with each other over a network. These different products include controllers, workstations, actuators, and sensors. In the BACnet world, each of these products is known as a *device*.

BACnet is a common network technology that facilitates communication among many different networked systems.

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**Note:** If you do not already have the *ANSI/ASHRAE Standard 1350-2004 BACnet — A Data Communication Protocol for Building Automation and Control Networks*, you can get it from the web site, <http://www.bacnet.org/>.

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BACnet support is integrated into Andover Continuum products, such as the BACnet service tool and Continuum CyberStation, in a way that ensures transparency and “sameness” in the user experience. Viewing and configuring networks, controllers, classes, objects, and properties in BACnet are similar. These BACnet elements are integrated into the “look and feel” of Andover Continuum products — for example, application viewers, explorer trees, list views, object/point editors, graphics editors.

Our proprietary Plain English (PE) programming language is used to program Andover Continuum BACnet devices. Some BACnet functions and features have been added to PE, allowing you to query and change points on other BACnet third-party devices. Through programming and the user interfaces of Andover Continuum products, Continuum’s implementation of BACnet allows you to manipulate Continuum/Infinity points that subsequently operates a BACnet device and vice versa.

For more information on integration, please see the section, *BACnet and Andover Continuum*, later in this appendix.

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**Note:** Andover Continuum's integration of BACnet is fully documented in the Continuum online help, the *Andover Continuum CyberStation Configurator's Guide*, 30-3001-781, the *Introducing BACnet for the Continuum User Guide*, 30-3001-863, and the *Plain English Language Reference*, 30-3001-872.

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## BACnet - Knowing the Terminology

This section provides brief descriptions of the following fundamental BACnet components and terms:

- Network
- Internetwork
- Device
- Profile
- Object
- Property
- Service
- Broadcast
- PICS
- BIBBs
- Command Priority

For routers and BACnet Broadcast Management Devices (BBMDs), see the section, *Routers, Gateways, BBMDs, and Foreign Devices*, later in this appendix.

### **What Is a BACnet Network?**

A BACnet *network* is a transport (LAN or WAN) that carries data from device to device, within a network and between networks. A BACnet network can be a high-speed backbone network:

- Ethernet
- BACnet/IP

And it can be a fieldbus network:

- Master-Slave/Token-Passing (MS/TP)
- ARCnet
- LonTalk

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**Note:** Since many BACnet devices are located across the network on smaller subnetworks, the term *Internetwork* is often used in BACnet literature to describe an entire network of BACnet devices.

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## **What Are BACnet Devices?**

A BACnet *device* conforms to the BACnet standard and can serve as a:

- Building controller
- Field controller
- Router
- Gateway
- End device, such as a sensor or actuator.

Devices are networked together in a building as peer-to-peer devices, slave devices, or master/slave devices.

## **How Are Devices Identified?**

Every device can be identified by:

- A *device identifier*, which is an *instance number* that is unique to that device across many different networks that comprise a BACnet system. (See also *What Is an Internetwork?*.). A device instance number can be 1 to 4194303.
- A *network number* that is unique to the network to which the device belongs. A network can be numbered 1 to 65535.

- A *MAC address number* that is unique only within its own network. The following table lists ranges of MAC address numbers for some BACnet networks:

**MAC Address Numbers**

Network	Number Range
MS/TP	1 to 254
ARCNET	1 to 255
Ethernet	1 to 281 474 976 710 655

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**Note:** A MAC address is typically read from a DIP switch or from non-volatile memory. Some devices auto-assign MAC addresses when the devices are placed on the network.

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BACnet devices can have input/output functionality or no input/output functionality.

## What Are Device Profiles?

The BACnet standard identifies six device types, also known as *device profiles*. These are:

- BACnet Operator Workstation (B-OWS)
- BACnet Building Controller (B-BC)
- BACnet Advanced Application Controller (B-AAC)
- BACnet Application Specific Controller (B-ASC)
- BACnet Smart Actuator (B-SA)
- BACnet Smart Sensor (B-SS)

For a list of Andover Continuum BACnet devices, please see the section, *BACnet and Andover Continuum*, later in this appendix.

## What Are BACnet Objects?

BACnet *objects* are the logical representation of system data. Objects represent data that originates in physical inputs, physical outputs, or software processes — for example, single physical points or logical groupings/collections of points, which perform a specific function. Objects standardize the organization of data to facilitate the exchange of data between the products of different manufacturers.

Each object possesses a number of properties. The BACnet standard provides the following standard objects:

- Accumulator
- Analog\_Input
- Analog\_Output
- Analog\_Value
- Averaging
- Binary\_Input
- Binary\_Output
- Binary\_Value
- Calendar
- Command
- Device
- Event\_Enrollment
- File
- Group
- Life\_Safety\_Point
- Life\_Safety\_Zone
- Loop
- Multi\_State\_Input
- Multi\_State\_Output
- Multi\_State\_Value
- Notification\_Class (supported as an EventNotification object)
- Program
- Pulse Converter
- Schedule
- Trend Log

Individual manufacturers may implement their own proprietary object types, as long as they conform to the BACnet standard.

For a list of BACnet objects supported in Andover Continuum products, please see the section, *BACnet and Andover Continuum*, later in this appendix.

## How Are Objects Identified?

Each object has a numerical *object identifier* comprising an *object type* and an *instance number*, as follows:

- Object types 0 to 127 are reserved to identify standard BACnet objects.
- Object types 128 to 1023 are used to identify proprietary objects.
- BACnet devices support object types up to a limit of 4194303 instances. (As you know from the device section, instance numbers can be 1 to 4194303.)

## What Are BACnet Properties?

Objects are examined and controlled by a set of *properties* that belong to each object. A property contains the smallest piece of BACnet information, and it has a name and a value. For example, a property named *high\_limit* can hold a value of 78.0. A property can be written and/or read, and can provide command control.

For every object, the BACnet standard requires some properties, while others are optional. Still other properties can be proprietary to a manufacturer. Required properties must be implemented for each object type. Optional properties need not be implemented, but if they are, they must conform to the BACnet standard.

Each BACnet Device object contains properties that can be used to verify communications, identify the vendor, identify software and firmware revision, and other characteristics of the device. The device object's properties represent the externally visible characteristics of a BACnet device.

## How Are Properties Identified?

Each property has a *property identifier*, which is a number. Properties 0 to 511 are reserved as standard, though only 166 properties are currently defined in the BACnet standard. Properties 512 and higher are unique to a manufacturer's proprietary properties.

For example, TAC (Andover Continuum) has three proprietary properties:

- 512 — PreviousTransitionTime
- 513 — NextTransitionTime
- 514 — FollowingTransitionTime

The Device object property, *Vendor ID*, is used to identify the manufacturer.

## What Are Complex Properties?

Information not available for Beta.

## What Are BACnet Services?

BACnet services are essentially the messages that BACnet devices send to each other. Services can:

- Read and write the property values of one or more objects.
- Send notifications of alarms and special events.
- Read and write files.

Services follow a basic client/server model. A BACnet client is a device that requests a service. A BACnet server is a device that performs a service. (See also *What Are BACnet Broadcasts?*)

The following table lists the major categories of BACnet services:

### BACnet Service Categories

Category	Service
Alarm and Event	Performs alarm routing and event notification
File Access	Accesses and manipulates files contained in devices.
Object Access	Reads and writes properties, creates and deletes objects, and manipulates lists of data
Remote Device Management	Remotely monitors and controls devices.
Virtual Terminal	Establishes, for a client user, a connection to an application program server in another BACnet device.

## What Are BIBBs?

*BACnet Interoperability Building Blocks (BIBBs)* are collections of BACnet services. They represent the next detailed layer of service components. BIBBs are grouped into the following five major categories:

- Data Sharing
- Alarm and Event Management
- Scheduling
- Trending
- Device and Network Management

Different combinations of BIBBs apply to each type (profile) of BACnet device — B-OWS, B-BC, B-AAC, B-ASC, B-SA, B-SS. For example, the following table summarizes the BIBB services provided for a B-BC type of device.

### Example: BIBBs for a B-BC Type Device

BIBB Category	Capabilities & Services Provided for a B-BC
Data Sharing	<ul style="list-style-type: none"> <li>● Provides values of any of its BACnet objects</li> <li>● Retrieves values of BACnet objects from other devices.</li> <li>● Modifies some/all of its BACnet objects by another device</li> <li>● Modifies some BACnet objects in other devices.</li> </ul>

### Example: BIBBs for a B-BC Type Device

BIBB Category	Capabilities & Services Provided for a B-BC
Alarm and Event Management	<ul style="list-style-type: none"> <li>Generates alarm/event notifications and directs them to recipients.</li> <li>Maintains a list of unacknowledged alarms/events.</li> <li>Notifies other recipients that the acknowledgement has been received.</li> <li>Adjusts alarm/event parameters.</li> </ul>
Scheduling	<ul style="list-style-type: none"> <li>Schedules output actions, both in the local device, and in other devices, both binary and analog, based on the date and time.</li> </ul>
Trending	<ul style="list-style-type: none"> <li>Collects and delivers time/value pairs.</li> </ul>
Device and Network Management	<ul style="list-style-type: none"> <li>Responds to queries about its status.</li> <li>Responds to requests for information about any of its objects.</li> <li>Responds to communication control messages.</li> <li>Synchronizes its internal clock upon request.</li> <li>Uploads its configuration and allows it to be subsequently restored.</li> <li>Commands half-routers to establish and terminate connections.</li> </ul>

See also: *What Are BACnet Services?*

## What Are BACnet Broadcasts?

A BACnet *broadcast* is a User Datagram Protocol (UDP) broadcast that carries messages (or *services*) from one device to another. These broadcasts, for example, can be:

- A query from a device that seeks to discover the existence of other devices and their objects. In the BACnet world, this is known as a *Who-Is* broadcast.
- An announcement from a device that informs other devices of its existence, identifying itself and its objects. In the BACnet world, this is known as an *I-Am* broadcast.
- Broadcasts that deliver alarm messages to devices.

- Broadcasts that inform other devices that the value of one or more objects/points has changed. In the BACnet world, these are known as *Change Of Value (COV)* messages.

Broadcasts are sent and received through a UDP port on each device. Each device on a network has a unique UDP port number. The default port number is [0xBAC0]. They are also sent using an IP *router* and a *BACnet Broadcast Management Device (BBMD)*.

For more information on routers and BBMDs, please see the section, *Routers, Gateways, BBMDs, and Foreign Devices*, later in this appendix. See also: *What Are BACnet Services?*

## ***What Is BACnet Command Priority?***

In an Andover Continuum building control system, an object may be manipulated by a number of different entities. The current value of an object is set by several applications and other sources.

Each application has a well-defined function that it needs to perform. When the actions of two or more applications conflict, with regard to the value of an object property, there is a need to arbitrate between them.

Arbitration ensures that several program and non-program sources can properly manipulate the value of the same object. For example, a start/stop program may command a particular BinaryOutput to turn ON, while a demand-metering program may command the same BinaryOutput to turn OFF. In this case, the OFF takes precedence. However, an operator might override the demand-metering program and force the BinaryOutput ON, in which case the ON takes precedence.

## ***The Command Priority Process***

In BACnet, arbitration is provided by a process known as *command priority*, which assigns varying levels of priorities to commanding entities throughout the system. Each object that contains a "commandable" property is responsible for acting on prioritized commands, in the order of their established priorities.

Implementation of the command priority process in an Andover Continuum system involves the following command priority properties:

- **Commandable Property** — Each object that supports command priorities has one or more properties that are known as *commandable properties*. The value of these properties is controlled by the command priority process.
- **Priority\_Array** — BACnet has established a set of 16 priority levels, known as the priority array, which consists of commands or NULLs, in an order of decreasing priority. The highest priority (lowest array priority level) with a non-NUL value is the active command. If a priority level holds a value of NULL, then the next non-NUL is assigned to the object.
- **Relinquish\_Default** — When all priority levels in the priority array become NULL, the value of *Relinquish Default* is assigned to the commandable property. You set the value of Relinquish Default when you configure the BACnet object.

## Command Values and NULLs

A priority level in the priority array may have a commanded value or a NULL value. A NULL value means there is no existing command at that priority. An object continuously monitors (polls) the entire priority array to locate the entry with the highest non-NUL value, then sets the commandable property to this value.

## Relinquishing a Command

A commanding entity (application program or operator, for example) may issue a command to an object's commandable property, or it may relinquish a command issued earlier. Relinquishing is a write operation, similar to the command itself, except that the value of NULL is commanded. That is, relinquishing a command places a NULL value in the priority array, corresponding to the appropriate priority. (You may override and relinquish a commanded value.)

## The 16-Element BACnet Command Priority Array

In the 16-level BACnet priority array, the top two priorities are related to personnel safety. Five of the 16 priority levels have been assigned a priority. However, the remaining 11 levels are designated as "available" for possible future use. These priorities are:

- 1 — Manual Life Safety
- 2 — Automatic Life Safety
- 3 — Priority 3, available
- 4 — Priority 4, available
- 5 — Critical Equipment Control
- 6 — Minimum On Off
- 7 — Priority 7, available
- 8 — Manual Operator
- 9 — Priority 9, available
- 10 — Priority 10, available
- 11 — Priority 11, available
- 12 — Priority 12, available
- 13 — Priority 13, available
- 14 — Priority 14, available
- 15 — Priority 15, available
- 16 — Priority 16, available

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**Note:** If an attempt is made to command a property for which a priority level has not been specified, a default priority level of 16 (the lowest priority) is assumed. If an attempt is made to command a property that is not commandable with a specified priority level, the priority shall be ignored.

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For more information on Andover Continuum's implementation of BACnet command priority, please see the Continuum online help and the *Andover Continuum CyberStation Configurator's Guide*, 30-3001-781.

## **What Are BACnet PICS?**

*BACnet Protocol Implementation Conformance Statements (PICS)* are detailed descriptions of a device's inherent BACnet capabilities.

PICS can:

- Tell a potential user what objects and BACnet services a device supports.
- Detail the type of communications network, the baud rate, the range of values each object property expects.
- Specify whether a property is either writeable or just read-only.
- Assess the level of interoperability between devices.

PICS are available from each BACnet manufacturer.

## BACnet and Andover Continuum

As you learned in the *Introduction* section earlier in this appendix, BACnet support is integrated into Andover Continuum products — both software and hardware — in a way that ensures transparency and “sameness” in the user experience. Creating, viewing, finding, and configuring BACnet networks, controllers, classes, objects, and properties is very similar to the ways you would do these things without BACnet. The BACnet elements are integrated into the “look and feel” of Andover Continuum products — for example, application viewers, explorer trees, list views, object/point editors, graphics editors, and the proprietary Plain English programming language.

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**Note:** Andover Continuum’s integration of BACnet is fully documented in the Continuum online help, the *Andover Continuum CyberStation Configurator’s Guide*, 30-3001-781, the *Introducing BACnet for the Continuum User Guide*, 30-3001-863, and the *Plain English Language Reference*, 30-3001-872.

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## ***Andover Continuum vs. BACnet Terminology – a Roadmap***

When working with Andover Continuum’s implementation of BACnet, the following tips may help you “map” Continuum/Infinity terminology to BACnet terminology:

- An ***attribute*** in the Continuum/Infinity world is a ***property*** in the BACnet world.
- A ***point*** in the Continuum/Infinity world is an ***object*** in the BACnet world.
- A ***controller*** in the Continuum/Infinity world is a ***device*** in the BACnet world.
- An ***alarm*** in the Continuum/Infinity world is an ***event*** in the BACnet world.
- The term ***digital*** in the Continuum/Infinity world generally means ***binary*** in the BACnet world.
- The term ***class*** (as in *class object*) means the same in both worlds.

## Andover Continuum BACnet Devices

Andover Continuum BACnet devices are “native” BACnet, meaning that they can interoperate directly with other manufacturers’ (third-party) BACnet devices. They inherently represent internal data in BACnet format and use BACnet messaging to communicate. Andover Continuum BACnet devices can be connected to a BACnet system without requiring a gateway device or software driver to translate to and from proprietary protocols.

The following table lists Andover Continuum BACnet devices and matches them with their respective BACnet device profile.

**Andover Continuum BACnet Devices**

Andover Continuum Device	Profile
CyberStation workstation	B-OWS
bCX1 (4040) controller	B-BC
bCX1 (4000) router	Other
b4920 system controller	B-AAC
b3xxx equipment controller	B-AAC
RoamIO <sub>2</sub> hardware adapter	Not applicable

## How BACnet Devices Are Created in Andover Continuum

An Andover Continuum BACnet device (BACnet class object Device) is first created as a Continuum InfinityController object or an InfinityInfinetCtrlr object.

For example, when an InfinityController object is created, and it is designated as a b4920 or bCX1 4040, it automatically becomes a Device object when it appears in the BACnet section of Continuum’s tree-view structure, known as the *Continuum Explorer*. In fact, in Continuum Explorer you can see the InfinityController object residing in the Infinity view and its Device object equivalent residing in the BACnet view.

Third-party BACnet devices are absorbed into a Continuum system and appear as Device objects only in the BACnet view.

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**Note:** For complete information on Continuum Explorer and creating, finding, and viewing Andover Continuum and third-party BACnet devices, please see the Continuum online help and the *Andover Continuum CyberStation Configurator's Guide*, 30-3001-781.

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## ***BACnet Objects in Andover Continuum***

Andover Continuum supports the following BACnet class objects. Continuum editors are also available for creating and modifying these BACnet objects. The Continuum object name appears on the right.

### **BACnet Objects Supported in Andover Continuum**

<b>BACnet Object Name</b>	<b>Supported?</b>	<b>Continuum Name</b>
Accumulator	No	N/A
Analog_Input	Yes	AnalogInput
Analog_Output	Yes	AnalogOutput
Analog_Value	Yes	AnalogValue
Averaging	No	N/A
Binary_Input	Yes	BinaryInput
Binary_Output	Yes	BinaryOutput
Binary_Value	Yes	BinaryValue
Calendar	Yes	Calendar
Command	No	N/A
Device	Yes	Device
Event_Enrollment	Yes	EventEnrollment
File	Yes	File
Group	Yes	Group
Life_Safety_Point	No	N/A
Life_Safety_Zone	No	N/A
Loop	Yes	Loop
Multi_State_Input	Yes	MultistateInput
Multi_State_Output	Yes	MultistateOutput
Multi_State_Value	Yes	MultistateValue
Notification_Class	Yes	EventNotification
Program	Yes	Program

## BACnet Objects Supported in Andover Continuum

BACnet Object Name	Supported?	Continuum Name
Pulse Converter	No	N/A
Schedule	Yes	Schedule
Trend Log	Yes	TrendLog

## How BACnet Objects Are Created in Andover Continuum

You may create and/or modify BACnet objects in an Andover Continuum system. Most of these objects are first created as Continuum/Infinity objects, and depending how they are configured, they are automatically transformed into BACnet objects when they are created on an Andover Continuum BACnet controller, such as a bCX1 4040.

For example, when a Continuum InfinityInput object is created on an Andover Continuum BACnet controller, and the input type is “voltage,” it automatically becomes an AnalogInput object when it appears in the BACnet section of Continuum’s tree-view structure, the *Continuum Explorer*.

Most BACnet objects are created as Continuum/Infinity objects on an Andover Continuum BACnet controller, as follows:

- AnalogInput (created as an InfinityInput)
- AnalogOutput (created as an InfinityOutput)
- AnalogValue (created as an InfinityNumeric)
- BinaryInput (created as an InfinityInput)
- BinaryOutput (created as an InfinityOutput)
- BinaryValue (created as an InfinityNumeric)
- Device (created as an InfinityController or InfinityInfinetController)
- EventEnrollment (created as an AlarmEnrollment)
- MultistateInput (created as an InfinityInput)
- MultistateOutput (created as an InfinityOutput)
- MultistateValue (created as an InfinityNumeric)
- Notification\_Class (created as an EventNotification)

Third-party BACnet objects are absorbed into a Continuum system and appear only in the BACnet view.

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**Note:** For complete information on Continuum Explorer and creating, finding, and viewing Andover Continuum and third-party BACnet objects, please see the Continuum online help and the *Andover Continuum CyberStation Configurator's Guide*, 30-3001-781.

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## **BACnet Class Object Folders**

Just as Continuum/Infinity objects appear in class object folders in Continuum Explorer's Infinity view, so too do BACnet objects appear in BACnet class object folders in the BACnet view, regardless of whether they reside on Andover Continuum or third-party BACnet devices.

A class object folder, typically created for each device, contains all the objects residing on that device for that class. For example, a class folder named *InfinityNumeric* would contain InfinityNumeric objects residing with its respective Infinity controller. On the BACnet side, the equivalent class folder, named *AnalogValue*, would reside with its respective BACnet device. For example, the Infinity view might have an *InfinityInfinetCtrlr* class folder, while on the BACnet view the folder would be named *Device*.

## ***BACnet Properties and Andover Continuum***

As you recall from earlier in this appendix, every BACnet object has many BACnet standard properties (and sometimes proprietary properties). The BACnet standard defines the names of standard properties. Andover Continuum implements these properties (or subsets of these properties) in its object editors and its Plain English (PE) programming language, compliant with the BACnet standard.

However, property names used in Andover Continuum and in Plain English differ slightly, just as Continuum object names differ slightly. This maintains the same functional “look and feel” in the integration of BACnet into Andover Continuum products.

The following table shows some examples of how the BACnet standard property names may differ from the way they appear to Continuum internally and in Plain English programs, as well as they way they appear in the Continuum user interface (object editors).

### Variations of Property Names in Andover Continuum

BACnet Standard Property Name	Internal Continuum and PE Program Name	Continuum User Interface Name
Event_State	EventState	Event State
Object_Name	ObjectName	Name
Out_Of_Service	OutOfService	Out of Service
Present_Value	Value	Present Value
Description	Description	Description

For more information please see *Introducing BACnet - A Guide for the Continuum User*, 30-3001-863, and the *Plain English Language Reference*, 30-3001-872.

## Routers, Gateways, BBMDs, and Foreign Devices

This section describes some other types of BACnet devices:

- Routers
- Gateways
- BACnet Broadcast Management Devices (BBMDs)
- Foreign devices

### ***Routers and Gateways***

A *router* (or *IP router*) is a BACnet device, such as the Andover Continuum bCX1 4000, that facilitates the exchange of data between different types of BACnet networks — MS/TP, BACnet/IP, Ethernet, and so on. A router is simply a “pass through” device. It does not change the data format or the content of the message. This exchange of broadcast messages between networks, using a router, requires a BACnet Broadcast Management Device (BBMD) — one BBMD per network. (For more information on BBMDs, please see the section, *BBMDs and Foreign Devices*, below.)

A *gateway* is a BACnet device that facilitates exchange of data between devices on a BACnet network and devices on a non-BACnet network so that BACnet and non-BACnet information can be shared. While a router simply passes information from one network to another, a gateway takes the data from one device, analyzes it, translates the data into another data protocol (BACnet or non-BACnet), then delivers it. This ensures the recipient device understands the message.

Physically, a gateway can take one of the following forms:

- Internal: This is typically a board or module inside a device.
- External hardware/software: This is typically an external hardware interface box combined with a software translator.
- Software: This is typically a software translator on a PC.

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**Note:** These exchanges of data, via routers and gateways, are also known as *internetworking*.

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## ***BBMDs and Foreign Devices***

A *BBMD* is a workstation (B-OWS) specially designated to ensure that broadcast messages are delivered, via one or more routers, between BACnet networks. (See also the sections: *Routers and Gateways*, and *What Are BACnet Broadcasts?*)

Each network must have a BBMD. Each BBMD maintains two internal tables:

- Broadcast Distribution Table (BDT)
- Foreign Device Table (FDT)

These tables essentially allow different networks to know about the existence of each other and each other's devices. They must know about each other before broadcast messages can be routed.

A BDT maintains a list of other BBMDs located on other "foreign" networks. If a "foreign" BBMD is added to a BDT, then it becomes *registered* in the "local" BBMD. During this process, not only does that "foreign" BBMD get registered, but all the BBMDs listed in its "foreign" BDT also get registered. This means the local network knows about the foreign network *and* all the networks that the foreign network knows about.

An FDT maintains a list of foreign devices. A *foreign device* is simply the identity of a device residing on another BACnet network. When a foreign device is added to an FDT, then it also becomes registered with the "local" BBMD.

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**Note:** In Andover Continuum CyberStation, you can designate and register BBMDs, as well as register foreign devices, so that broadcast messages are routed among BACnet networks. For more information, please see the Continuum online help, the *Continuum CyberStation Configurator's Guide*, 30-3001-781, and *Introducing BACnet - A Guide for the Continuum User*, 30-3001-863.

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## Appendix A: What Is BACnet?



**BACnet Service Tool User's Guide**  
**Document Number 30-3001-910**  
**Revision A**

