White Paper

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Description: The purpose of this paper is to provide the reader a brief overview of how Touché integrates with BACnet and/or Modbus. This document is not intended to be a user's manual or to provide complete instruction on how to effectively use this software. Several screen shots of various pages within the software are included for reference purposes.

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Introduction

BACnet is an open protocol used by most Building Management Systems (BMS) as an interface to other building systems (i.e. Lighting Control Systems). In some instances it is also the primary protocol used within the BMS system. BACnet is a powerful but complex protocol that allows systems manufactured by different manufacturers to “share information.”

At its most basic level a BACnet message is comprised of three basic pieces: a header, a data block and a footer. The header contains information about the message for example: message length, type of message, where the message originated, etc. The data block contains information about the data (i.e. what is the current state of an occupancy sensor) and finally the footer contains the necessary error checking information used by BACnet to ensure that the correct information was received. The makeup of a BACnet message and the procedures used by BACnet compatible equipment is beyond the scope of this paper, but one item is worth mentioning when discussing a BACnet message – it is large. Specifically the header of a BACnet message can be many times the size of the data itself. This is all built into the protocol and is actually what makes BACnet so powerful, but it also makes BACnet slow. This is not a big issue for when controlling HVAC equipment as temperature change by nature is slow.

When controlling lights it is important for devices to respond almost immediately. When a button is pressed on a light switch or an occupancy sensors senses an occupant, we want the lights to change immediately. Using BACnet as the primary communication protocol between lighting control devices would be slow. Touché (like most manufacturers) uses a special protocol between devices to communicate quickly and efficiently. What makes Touché unique is how the system architecture allows systems outside of the lighting control system to interact quickly and efficiently with the lighting control system.

Hardware Overview

The following diagram shows a simple Touché network of devices. In this network all of the devices communicate directly with the Master Interface. Scaled versions of the example network are possible but the concepts are the same when discussing how Touché communicates with other BACnet capable systems. In this example each device communicates with the Master Interface and receives, from the Master Interface, commands; likewise each device responds with its current status. The Master Interface “knows” at all times what the current state of any device is, and what it should be, on the network.

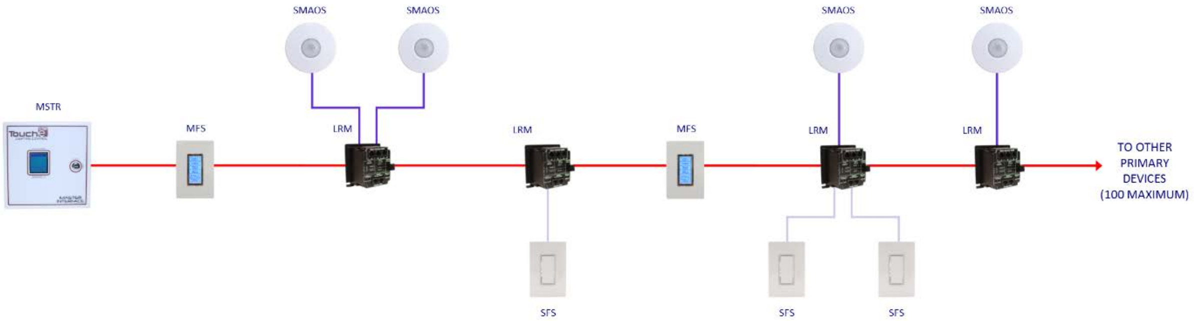


Figure 1: Simple Touché Lighting Control Network

Each Master Interface contains two Ethernet ports. This allows it to communicate with other Master Interfaces or other equipment that is Ethernet capable. The following diagram shows how Touché connects to an Ethernet network.

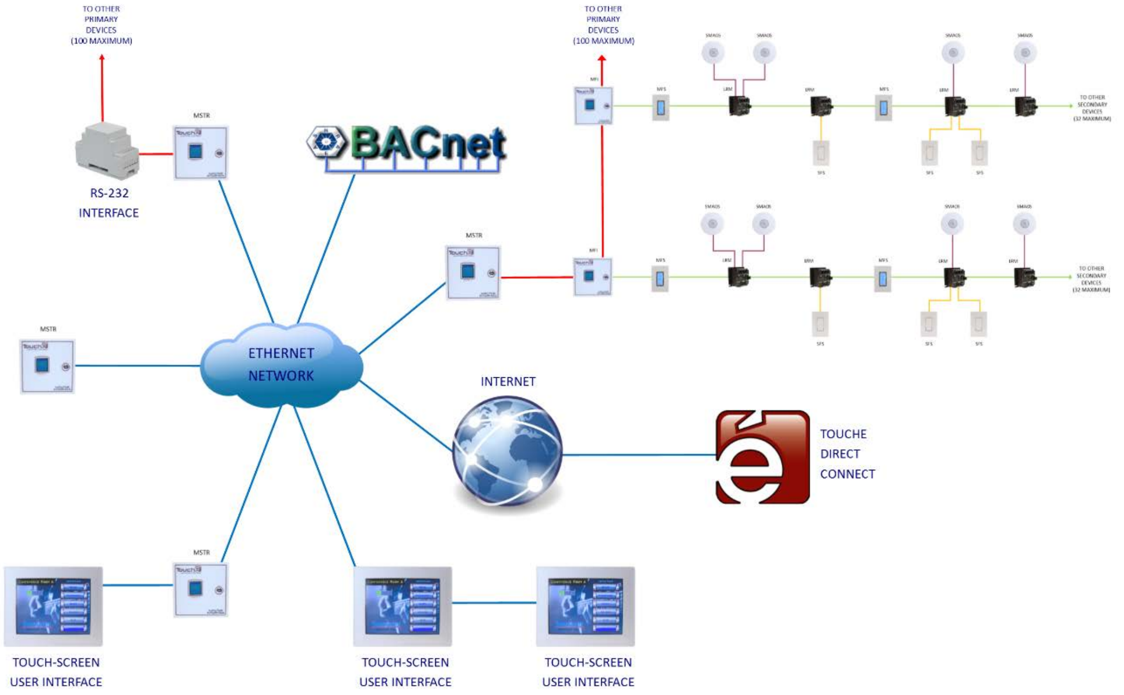

TO OTHER PRIMARY DEVICES (100 MAXIMUM)
RS-232 INTERFACE
MSTR
BACnet
TO OTHER PRIMARY DEVICES (100 MAXIMUM)
MFI
SMADS
MFS
LRM
SFS
TO OTHER SECONDARY DEVICES (32 MAXIMUM)
MSTR
ETHERNET NETWORK
INTERNET
TOUCHE DIRECT CONNECT
TOUCH-SCREEN USER INTERFACE
TOUCH-SCREEN USER INTERFACE
TOUCH-SCREEN USER INTERFACE

Figure 2: Ethernet Connectivity

From this diagram we can see that the connectivity options are nearly limitless. This architecture is what makes Touché so powerful and modular. It is also what makes it so simple to interface with complex protocols like BACnet.

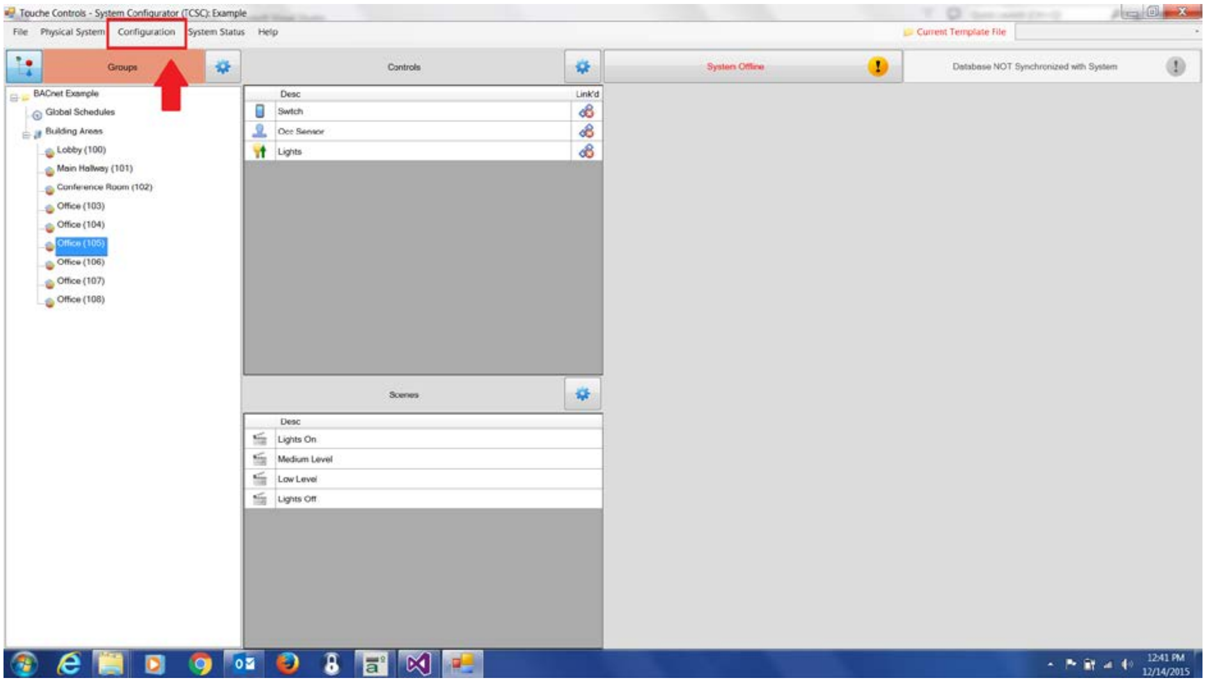
Each Master Interface includes a native BACnet stack that is built into the processor. The same processor that commands and monitors the lighting control system. Touché does NOT use a separate BACnet device to interpret and coordinate control between the lighting control processor and other BACnet capable systems. Having the BACnet stack on the lighting control processor makes coordination simple and eliminates a “mapping” step found on systems that do not include a native BACnet stack.

Touché uses BACnet/IP as the platform to connect with other BACnet capable systems because it is the fastest form of BACnet communication, it is simple to wire (a single Cat5 cable), and it is expandable without additional wiring. All of the devices in the Touché lighting control system are available through the Master Interface. Output devices like relays and dimmers can be commanded on or off (or to a level if it is a dimmer). Input devices like occupancy sensors report the current occupancy state. Only devices that are exposed to BACnet appear as an available BACnet point.

Software Overview

The integration of software and hardware is what makes Touché's BACnet integration so easy to implement. The following is an example of how a lighting control device is exposed to BACnet and then how it is implemented. BACnet is not an add-on item in the Touché solution. As demonstrated from a hardware perspective earlier, BACnet is integrated seamlessly into the configuration software.

The following figure shows a typical screen of the configuration software when a project has been opened. On the main title bar there is a menu item labeled "Configuration". This menu item has items that allow multiple devices to be configured simultaneously. Since BACnet is integrated at the "system level", the configuration for BACnet is included under this menu item.



Desc	Link'd
Switch	
Occ Sensor	
Lights	

Desc
Lights On
Medium Level
Low Level
Lights Off

Figure 3: Main Configuration Window

BACnet is an External Interface. In other words BACnet is a protocol that allows the Touché system to interface with devices (or a system) that is external to the lighting control system. Touché has several different external interfacing options: BACnet, Modbus, RS-232, etc. To set up the external interfacing with another system select Configuration -> External Interfacing from the main menu (see Figure 4 on the next page).

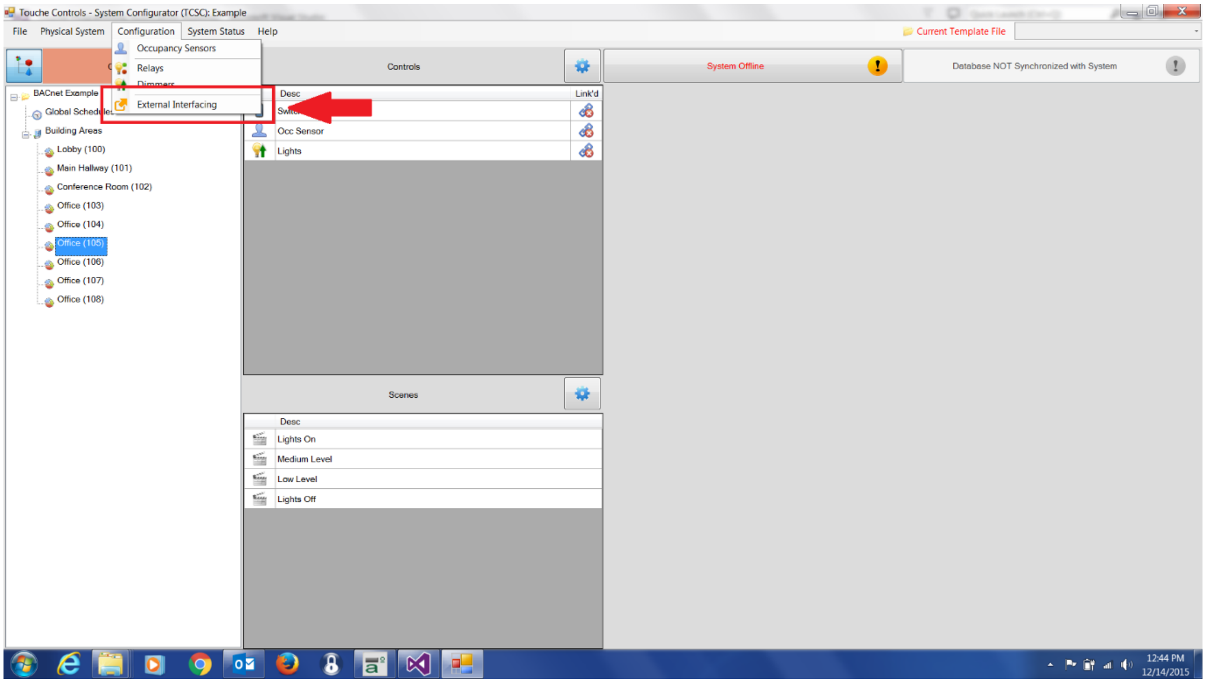
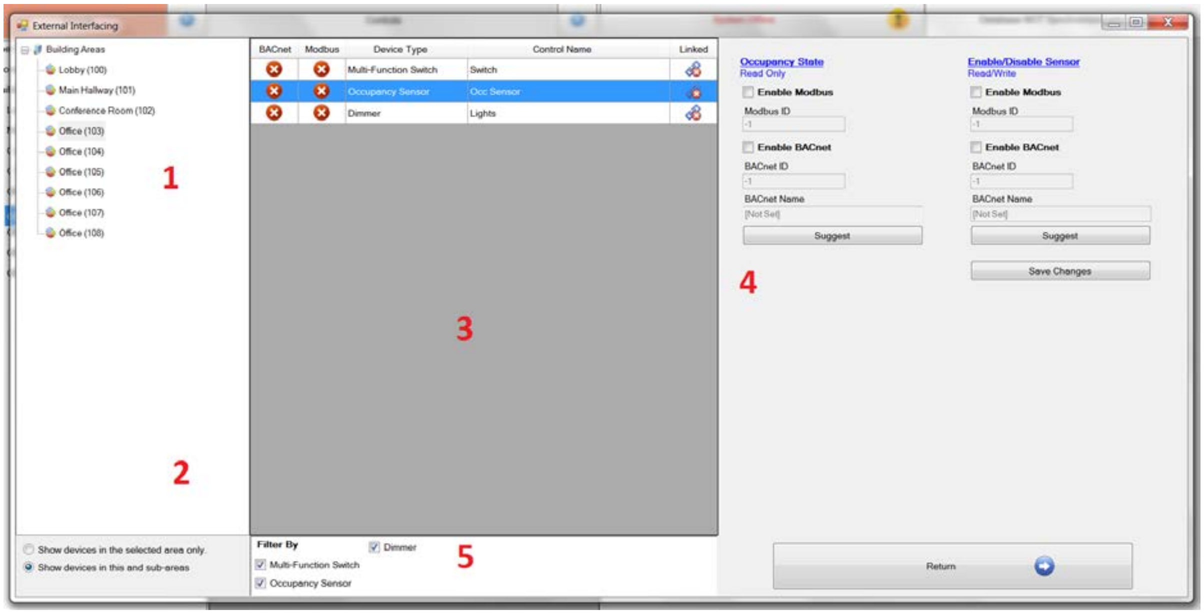


Figure 4: Selecting External Interfacing



BACnet	Modbus	Device Type	Control Name	Linked
☒	☒	Multi-Function Switch	Switch	
☒	☒	Occupancy Sensor	Occ Sensor	
☒	☒	Dimmer	Lights	

○ Show devices in the selected area only
● Show devices in this and sub-areas

Filter By
☑ Multi-Function Switch
☑ Occupancy Sensor
☑ Dimmer

Occupancy State: □ Enable Modbus, Modbus ID -1, □ Enable BACnet, BACnet ID -1, BACnet Name [Not Set]

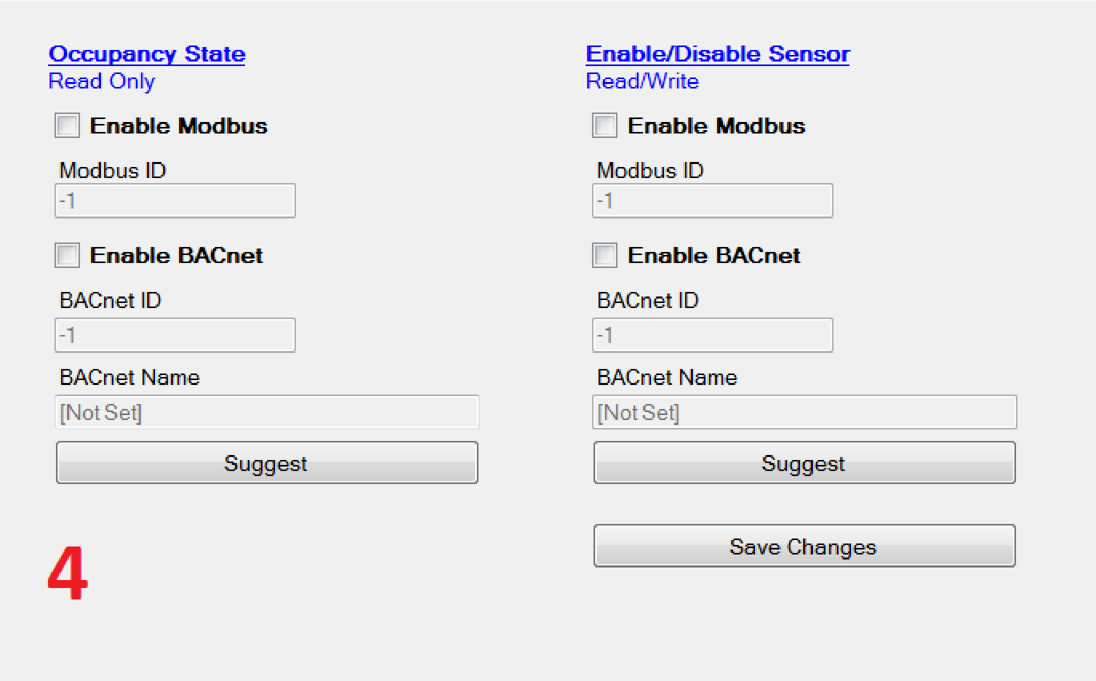
Enable/Disable Sensor: □ Enable Modbus, Modbus ID -1, □ Enable BACnet, BACnet ID -1, BACnet Name [Not Set]

Figure 5: BACnet and Modbus Configuration Window

Figure 5 shows the window that will appear after External Interfacing has been chosen. This window is broken up in to six parts:

1. **Building Area Tree:** The tree of available areas in a building. This tree matches the tree on the main window. It shows all of the user defined areas and sub-areas of the building under control.

2. **Area Filter:** These are two radio buttons that filter out what areas are to be included and not included in the device list. There are two options: the first Radio Button, when selected, only shows the devices in the selected building area of the Building Tree; the second radio button includes all areas in the selected tree and all lower level areas. For example, if you want to include all devices for the entire building, you would select “Building Areas” in the building tree and the second radio button.
3. **Device List:** This portion of the window lists all of the devices that meet the filter conditions of items 2 and 5. The devices are listed in spreadsheet type format. There are five columns to this spreadsheet. The first and second columns show if this device is exposed to BACnet and Modbus respectively. The third column is the name of the device that was chosen by the programmer. The forth column displays the device type (i.e. Switch, Occ Sensor, etc). The fifth column shows whether the device is currently linked or not. Linking connects the real world device to the virtual device created in this program. If it is not linked then no action will result.
4. **BACnet and Modbus Configuration Window:** This area allows each device to be configured for either BACnet and/or Modbus. Depending on the device type (i.e. switch, sensors, etc.) this window will provide the available options for integration with either protocol. In this example an occupancy sensor can report back the current occupancy state (occupied or un-occupied) and can be enabled or disabled remotely by either protocol. More on this later.
5. **Device Filter:** This region of the window presents all available device types. Only the device type filters included in the selected area will be presented for selection. In other words, if there are no occupancy sensors in the selected Building Area then there will not be a checkbox to filter them out.



Occupancy State
Read Only

☐ Enable Modbus

Modbus ID: -1

☐ Enable BACnet

BACnet ID: -1

BACnet Name: [Not Set]

Enable/Disable Sensor
Read/Write

☐ Enable Modbus

Modbus ID: -1

☐ Enable BACnet

BACnet ID: -1

BACnet Name: [Not Set]

Figure 6: Example Configuration Parameters of an Occupancy Sensor

If we zoom in on area four we see the different properties of both a Modbus register and a BACnet point for the selected device (in this case an Occupancy Sensor). In this example we are setting up a BACnet point so we will just explain those details now. It is important to notice though, that both protocols are represented in a very similar fashion. The Touché solution is able to do this because all of the protocol specific setup is done behind the scenes in the configuration software – only possible with an integral stack.

If we want to expose the occupancy state of a particular area to BACnet; we simply check the Enable BACnet checkbox for occupancy state. We can then enter the BACnet Tag and a BACnet Name. These two parameters will be presented to the BMS system when the BMS system queries our system for available and exposed BACnet points. If the “Suggest Button” is pressed then the name used in the lighting control system will automatically be used as the BACnet name.

Integration was never simpler.