Sensor Hub 2 BLE GATT
API Reference Guide

Document version: 1.0

Contents

BLE GATT API on Sensor Hub 2

The sensor hub 2 provides a Bluetooth Low Energy (BLE) Interface to Mobile Apps. This document explains the BLE GATT API services that the sensor hub 2 offers to a mobile app. With BLE (GATT), we provide a collection of resource (services) rather than a typical API. Each data is a service. Each service contains 2 characteristics: one characteristic is the actual data; another one is the unit. If there is no unit for the data, the syntax still requires the unit characteristic for compatibility. A characteristic can contain zero or more descriptors.

Note: The info in this document is tentative and is subject to change! This guide has faults and a number of defects. Ensure that you have the most current document.

Sensor Hub 2

This guide applies to Sensor Hub 2 (Hardware x.xx and firmware version 0.99.1 or greater).

The sensor hub contains a BACnet server and can connect to a network as a standard BACnet device. The hub also provides a BLE connection that works with an Android or IOS mobile App.

The sensor hub 2 is a standard BACnet device that communicates using BACnet over UDP/IP or BACnet over Ethernet and supports the Version 20 BACnet standard. This BACnet device provides occupant-based and location-based control for the modern office or meeting space. The unit contains an enhanced sensor array and uses logic to combine multiple temperature sensors, a humidity measurement, and occupancy detection within a single sensing device. The sensor hub 2 also supports API connections with MQTT, REST and BLE (GATT).

Each sensor hub includes an embedded web page for initial installation and configuration. This web page is different from the web app that provides a powerful way to configure multiple sensor hubs and create suitable databases using templates.

See the Sensor Hub 2 Catalog Sheet and also the Sensor Hub II Installation and Configuration Guide on the O3Hub.com site.

Related Documents

On O3 Hub.com site, see the following:

- Sensor Hub 2.0 Quick Start and Installation Guide (Available)
- Sensor Hub 2.0 Catalog sheet (Available)
- Sensor Hub 2 Bluetooth (BLE) Application Guide [this document] (Available)
- Sensor Hub 2 MQTT API Application Guide (Coming soon)
- Sensor Hub 2 BACnet Application Guide

- Sensor Hub 2 REST API Application Guide
- Sensor Hub 2 Android and iOS Apps downloads (Available)
- Sensor Hub 2 PICS and BTL Listing

API Conceptual Design

The following figure shows a conceptual design of the software components and the data flow within the sensor hub.

Terms

We prefer the terms topics, resources / services and endpoints. We try to avoid terms such as API calls, API methods, calls, objects, and requests. In an API, an endpoint generally give use us access to a resource.

Getting Started BLE API

It is assumed that you have the sensor hub 2 wired up and installed so that it is communicating. See the O3 Sensor Hub 2 Getting Started Guide on the O3Hub.com page.

Use the 6-digit passkey to pair your mobile phone or other device with the Bluetooth radio on the hub. Confirm that the data is reasonable.

This topic gives an example of how to connect to the Hub over BLE. The content includes a set of conventions or rules so that using the hubs is consistent. By convention, the blue LED ring displays a blink/ swirl pattern and plays the generic ACK sound for a new BLE connection.

Security Information (Disabled for field trials)

From the factory:

- Unit is unlocked. User can connect and make changes. User has the option to enable encryption.
- AES-HMAC. Factory reset puts the hub back into its original state (no encryption).

For details, on the security policy, see the O3Hub.com site. The security scheme offers these features:

- BLE can read and write the Port enable configuration setting.
- The BLE uses a 6-digit passkey for authentication.
- The manufacturing process generates authorization and writes it to the factory database. The data encryption is AES-HMAC.
- BLE can read the public certificate/ key from the factory database generated during manufacturing. BLE can also read and write the HTTP user name and password from the factory database.
- BLE can read and write the JSON Web Token (JWT) that is available for both authorization and secure information exchange. BLE can also read and write the Google Root CA configuration setting.

GAP Profile for Sensor Hub 2

The Generic Access Profile (GAP) defines how BLE-enabled devices can make themselves available and how two devices can establish direct communications. A Bluetooth device can communicate to the outside world through either connecting or broadcasting modes. GAP controls connecting and advertising with BLE-enabled devices.

On the other hand, GATT focuses on the rules for formatting, packaging and sending data. In the BLE network stack, GATT uses the Attribute Protocol (ATT) to define the details of data is exchange between two connected devices.

Advertisement Data

The service name is something like: Sensor Hub II-103001/0010

The sensor hub 2 MAC address is contained in the manufacturer data. For an Android device, a hub MAC is something like: 00:16:XX:XX:XX:XX.

For an iOS device, the device address is stored in the data characteristic of a UUID.

You can listen for the type of device UUID and use filters to help find the device of interest. Send a command that changes the light ring pattern to confirm pairing with the expected device. It is recommended to Write '2' to the Play Light Ring Pattern characteristic and to also play the generic ACK sound (if available) to indicate a successful BLE connection.

When the device is connected to the sensor hub 2, a list of supported UUIDs is available from getUuids() on Android. A connected device can use the Service Discovery Protocol (Android SDP) to find the services a UUID provides.

Connect to a Sensor Hub over BLE

Communicating with the Sensor Hub II using the BLE interface involves the following steps:

1. Ensure your application has adequate permissions.
2. Scan for the Sensor Hub II.
3. Connect to the Sensor Hub II.
4. Verify the connection is with the correct hub,

After you connect to the correct hub, refer to the tables in the API Services Reference and BLE Services Explained sections in this documentation for read and write attributes. Send all values written to the hub as strings in byte array format.

1. Permission requirements

In addition to standard Bluetooth permissions, some operating systems explicitly require enabled location permissions and location services on the user's device.

2. Scanning for the Sensor Hub II

Scan for the Sensor Hub II without discovering other peripherals, you want to specifically filter for the service UUID '4822'.

3. Connecting to the Sensor Hub II

Connect to the hub using its unique identifier exposed in the scan results (this will be a UUID on iOS and a MAC address on Android). If you want to skip the scanning step in the future, you can save this unique identifier and then connect directly. Once you are connected, verify your connection and then discover services.

4. Verify connection

Verify the hub connection by writing '2' to the Play Light Ring Pattern characteristic. The hub's LED ring on the connected hub should turn blue and display a blink/ swirl pattern.

With a connection, you can read the services and characteristics that you need. Some services have characteristics that support read and write operations.

API Services Reference

This section defines the BLE interface between the Sensor Hub II and Mobile Apps. Hub API services are made available through BLE GATT resources. The BLE GATT (Generic Attribute Profile) provides rules to exchange profile and user data over a BLE connection. The Attribute Protocol provides the underlying framework for the GATT.

The GATT is active after a connection is made between two BLE devices. The GATT server responds to client requests. GATT defines the way that data is transferred back and forth using services and characteristics. A BLE device can connect to only one central device (mobile phone) at a time.

Each data item is formatted as a service. Each service contains two characteristics: one characteristic is the actual data and the other one is the unit. If there is no unit for the data, the unit characteristic is still required for compatibility reasons. The BLE interface uses a UUID identifier defined for each data resource and its associated data and unit characteristics.

Reference Tables

See the BLE Services Explained section for a description of the behavior of each service. These tables follow the grouping used in this section.

Grouping of Services

The characteristics are organized as eight services. The System Configuration content is split into three services: Network Configuration Service, Calibration Configuration Service and System Configuration Service.

The data set contains 80 chars in total.

#	**Groupings**	Service/ Characteristic
1	**Security**	N/A
2	Sensors	14 Chars., 0 Write
3	**Setpoints**	5 Chars., 5 Write
4	**I/O and Indicators**	15 Chars., 15 Write
5	**Sensor Configuration**	11 Chars., 10 Write

6	**Network Configuration**	13 Chars, 8 Write
7	**Calibration Configuration**	13 Chars, 4 Write
8	**System Configuration**	9 Chars, 0 Write
	Mobile Device Data	N/A

The Mobile Device Data Service Table follows the first eight tables but is separate from the 80 characteristic data set.

All of the single Unit Characteristic are removed from the following tables because there are dedicated Global Unit Characteristics. Read means that the application polls the hub while notify means that the hub uses COV and notifies the application when a fresh value is available.

The hub uses an Universally Unique Identifier (UUID) to specify the unique ID for a resource and also for the data and unit characteristics. The UUID is a 128-bit number used to identify information in computer systems. The UUID if the BLE data consists of five hexadecimal groups separated by hyphens that form groupings of 8-4-4-4-12 alphanumeric characters for a total of 36 characters including the four hyphens.

See the BLE Services Explained section for a description of the behavior of each service. These tables follow the grouping used in this section.

Security UUID Table

For functional details, see the Security Table in the BLE Services Explained section.

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Security Service	EFB39360-A7E3-438F-A20D-E9F00E0E22B1				N/A
Password Characteristic	3E11BB74-A208-479D-B9C7-B1DDFBB079B7	Write			N/A
Server Public Key	F3D9351C-F4CA-4BD6-B3EE-AF296FF3D021	Read			N/A
Client Public Key	7A12FF94-6215-4EA4-9E71-1BA2A2F7E463	Write			N/A

Sensors UUID Table

For functional details, see the Sensors Table in the BLE Services Explained section.

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Sensor Data Service	F57793C9-9544-46DC-BFA0-5FD149953C86				Occupant Temperature (AI3)
Occupant Temperature Characteristic	287B7C85-C471-4146-B678-59832B6B4121	Read, Notify		22.36	Present Value of AI3
Occupant Humidity Characteristic	D6A10DF9-7AF1-4CAA-8380-7FB618373397	Read, Notify		38	Present Value of AI6
Space Occupied/Unoccupied Characteristic	72B7F5DE-A24F-4FAB-B0CD-78F0582BDD00	Read, Notify	0, 1	1	Present Value of BI8
Light Level/Intensity Characteristic	EA74FAB1-E7A7-40FA-8EDC-38868EE8BD92	Read, Notify		3	Present Value of AI12
Sound Level Characteristic	1CC2B5DA-9F5F-4307-9544-2EF5464F1FA4	Read, Notify			Present Value of AI17
Motion Sensor Characteristic	292ABE4D-F45B-4AF0-B464-796F09DF41DB	Read, Notify	0, 1		Present Value of BI9
IR Temperature Characteristic	C789F9C6-1224-4670-9375-13D097C08478	Read, Notify			Present Value of AI4
Internal Temperature Characteristic	ECC9A665-6AF4-4144-9D42-35EEFC2E4D49	Read, Notify			Present Value of AI5

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Internal Humidity Characteristic	12CE7390-C4BA-407E-B1CF-E248F84DC398	Read, Notify			Present Value of AI7
Color Temperature Characteristic	71AEE317-F805-4C58-B069-13D08B12D75B	Read, Notify			Present Value of AI13
Light Red Component Characteristic	FF17A806-154A-4E74-81F0-FE0CE1DDAC47	Read, Notify			Present Value of AI14
Light Green Component Characteristic	C1302CA8-6AAE-4F32-ABBB-23D522DD8774	Read, Notify			Present Value of AI15
Light Blue Component Characteristic	7E7458F1-35B2-4AB5-BAE1-2694B6E91794	Read, Notify			Present Value of AI16
Thermal Load Characteristic	6B291913-8382-4663-B407-B1E78DE23AB8	Read, Notify			Present Value of AI18

Setpoints UUID Table

For functional details, see the Setpoint Table in the BLE Services Explained section.

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Setpoint Service	5040556B-340F-4C6F-B411-448089694628				Temperature Setpoint (AV33)
Temperature Setpoint	32E4381B-1F1D-47AC-AE97-	Read, Write,			Present Value of

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Characteristic	58959678967F	Notify			AV33
Humidity Setpoint Characteristic	85897295-F88A-4883-A068-BBC5935D1412	Read, Write, Notify			N/A
Light Level Setpoint Characteristic	725D3560-BBD3-47BE-920E-7843AEDFB0D5	Read, Write, Notify			N/A
Color Temperature Setpoint Characteristic	8347707C-0001-427C-9588-D4133244F7EF	Read, Write, Notify			N/A
RGB Color Temperature Setpoints Characteristic	6B5BDBBC-52D1-422A-92ED-0CFF25DCB460	Read, Write, Notify			N/A

I/O and Indicators UUID Table

For functional details, see the I/O and Indicators Table in the BLE Services Explained section.

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
I/O and Indicator Service	E05AD2AC-9A01-45F5-A56D-9C3C889D4DC6				Play Light Ring Pattern (MV1)
Play Light Ring Pattern Characteristic	2E2CEFB0-D026-4EC7-8856-8BDD05F9B62E	Read, Write, Notify	0-13	0	Present Value of MV1
Play Light Ring Repeat	49AC79E5-6E7E-	Read,	0 - 999	5	Present

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Characteristic	404F-A1A2-FACB501BD9E9	Write			Value of AV2
Activate Custom Light Ring Colors Characteristic	16C58089-CA5C-45FA-BA85-3A3B1AD3E9ED	Read, Write, Notify	0, 1	1	Present Value of BV7
Set Light Ring Red Characteristic	B42BAC5D-1051-41E6-AFB4-1E16B31574CE	Read, Write, Notify	1 - 255	90	Present Value of AV3
Set Light Ring Green Characteristic	232B1A5D-6E51-470F-9C06-245297856415	Read, Write, Notify	1 - 255	90	Present Value of AV4
Set Light Ring Blue Characteristic	05AE6EFC-84EC-4093-AA98-ECC198F968FD	Read, Write, Notify	1 - 255	90	Present Value of AV5
Set Light Ring Brightness Characteristic	46640823-D37E-4510-BE8E-AF0BF6E0273E	Read, Write, Notify	1 - 100	90	Present Value of AV6
Configure I/O Channel as Input Characteristic	DBB99066-3F23-4F10-A368-DB94E0B833F7	Read, Write, Notify	0, 1	1	N/A
Set COV Notification for Input Channel Characteristic	3CAA9B36-7A58-44E3-99B2-7C55359CFA64	Read, Write, Notify	0, 1	1	COV property of AI1
Configure I/O Channel as Output Characteristic	D7C16204-7347-4146-958E-D0A2D59D7EEA	Read, Write, Notify	0, 1	1	N/A
Read Input Channel Characteristic	2C67EEEE-393E-4C77-9204-83C2F487F8D0	Read, Write, Notify	0, 1	1	Present Value of AI1
Set Output Channel Characteristic	5D4E8DF4-87DD-48DB-BB26-25946D936A32	Read, Write, Notify	0, 1	1	Present Value of AI1

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Send Pronto Code Through I/R Transmitter Characteristic	8153E80B-5AE7-4D1A-8AA5-D5E5BD557283	Read, Write, Notify	0, 1	1	Present Value of MV9
Speaker Volume Characteristic	FC09FC9A-23ED-4867-9C4C-4F34C274F41A	Read, Write, Notify	1 - 100	50	Present Value of AV30
Play Audio File Characteristic	A2895C02-905E-4822-A711-29482675F501	Read, Write, Notify			Present Value of MV28

Sensor Configuration Service UUID Table

For functional details, see the Sensor Configuration Service Table in the BLE Services Explained section.

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Sensor Configuration Service	51E16FF1-20D3-45EC-915C-F18290A893C5				N/A
Set Temperature Unit Characteristic	9BBA2752-A586-433D-98CF-888A5B8B09FC	Read, Write,	C, F	C	N/A
Set Light Unit Characteristic	4A3B5382-2453-46A1-94CA-7F898122E35C	Read, Write,	Lux, cd	Lux	Units property of AI12
Calibrate Occupant Height Temperature Reading Characteristic	D439082B-8008-454E-BB0A-AB62A4104EC8	Read, Write,			Calibration property of AI3

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Assign BACnet Device ID Characteristic	AE79CA8F-A333-4850-84EA-1AD9710FB5A7	Read, Write,		4100080	N/A
Assign BACnet Network Number Characteristic	0C36266F-1667-4B69-95FF-6F55947589E5	Read, Write,		50001	N/A
Change TCP/IP Settings Characteristic	055FA816-E26E-4D82-BB77-456D5DA0D9EE	Read, Write			N/A
TCP/IP Subnet Mask Characteristic	3923BA42-1269-4BF0-9E4C-855182372280	Read, Write			N/A
Update Security Certificate Characteristic	7392E4D1-862B-4A88-9683-7603235C8D2D	Read, Write			N/A
Set Device Name Characteristic	45E7570D-A13A-456E-B8B9-7B4EF6989DB2	Read, Write			N/A
Read Device Serial Number Characteristic	2E888D3C-AEC5-4193-B0F1-4735CAB9AFBD	Read, Write			N/A
Set Web Server URL Characteristic	0C36266F-1667-4B69-95FF-6F55947589E5	Read			N/A

Network Configuration Service UUID Table

For functional details, see the Network Configuration Service Table in the BLE Services Explained section.

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Network Configuration Service	E03D645C-3F2B-4693-A2FB-99840EE2581D				N/A
Network Type Characteristic		Read, Write	Static, DHCP		N/A
Gateway IP Characteristic	265D3029-4B73-444A-B48D-5016AB25A659	Read, Write			N/A
DNS IP Characteristic	D1035EB0-C93D-4C20-A4B2-C2E44D91C903	Read, Write			N/A
BACnet Protocol Characteristic	61ABFC55-7A00-4B9B-93C9-1770356EDC8F	Read, Write			
BACnet UDP Number Characteristic	67358E4B-C841-4E6F-9822-EC92E388A4A3	Read, Write			
MQTT Status Characteristic	0457F00C-87E1-45F0-85E1-EFDD7AB7DFF4	Read, Write			
MQTT Broker IP/URL Characteristic	E7592CDA-46EE-4D87-9D0D-9BB25B2C3059	Read, Write			
MQTT Port Characteristic	1850B75D-4299-4E9D-896E-D19B1E2183C2	Read, Write			
Ethernet MAC Address 1 Characteristic	D7AE5B6F-C8DD-4ADD-A75A-28F4038528FA	Read			
Ethernet MAC Address 2 Characteristic	C417C455-C003-445A-ADA4-F203F0DA2F2A	Read			
Ethernet 1 Status Characteristic	73678CA9-B639-459E-890A-6E3B38962B2F	Read			
Ethernet 2 Status	ECD1CC9F-7A8E-4B4F-	Read			

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Characteristic	8BD2-8E7B13258F87				
Connectivity Characteristic	56456172-DDD7-4E75-83D7-C2D0D6B796EE	Read, Notify			

Calibration Configuration Service UUID Table

For functional details, see the Calibration Configuration Service Table in the BLE Services Explained section.

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Calibration Configuration Service	B7F17A09-768B-4E44-B466-5B03B3C0B9C8 => 5526A99E-7975-42FF-A27B-94D5A1AD9986				Two objects:
Temperature Calibration Characteristic	B3997D46-DEF4-43DE-B82F-DEB04B059C17	Read, Write,			Occupant Temperature (AI3) - Calibration property
Light Calibration Level Characteristic	F4F909E4-8F4B-4A78-9874-D3A403E5F4A2	Read, Write,			Any of User Set Point 1-4, AV34 to AV37
Motion Sensitivity Characteristic	CCDCE4F9-F8AD-40A4-97C5-43D895981814	Read, Write,			Motion Sensitivity AV23
Acoustic Sensitivity	88456249-05F8-4434-9C7C-	Read, Write,			Occupancy Acoustic

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Characteristic	61E1A9A0D5B0				Sensitivity AV24
Acoustic Activity Level Characteristic	8A22BEA5-F786-4E1A-8454-B1A373D1F8E2	Read, Notify			
Acoustic Retrigger Period Characteristic	B06D391E-F793-4295-9BA5-8AB1ACE71457	Read			
Acoustic Baseline Update Period Characteristic	261D878C-1772-4ADD-805F-CDC678E4B384	Read			
Acoustic Occupancy	5953C91C-8ECB-4991-AE13-6E619B005DF3	Read			
Inactivity Period Characteristic	8988EEAA-574E-4447-A974-525B877DF4EB	Read			
Sound Repeats Characteristic	E5421778-0829-4EA1-A1D1-318124EBE6B0	Read			
Send IR Code Characteristic	0F9999E0-A683-437F-ABD3-3A94605E1623	Read			
IR Repeats Characteristic	0605CDA9-92F6-4FAA-9290-F499F1FB2882	Read			
Programmable IR Code 1 Characteristic	FAAB8651-24B2-425D-B098-D4A2A4058154	Read			

System Configuration Service UUID Table

For functional details, see the System Configuration Service Table in the BLE Services Explained section.

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
System Configuration Service	D72CE428-BA8C-4061-B6DE-6F682736FE08				N/A
Active POST Status Mode Characteristic	C40793BF-D4D5-425D-92A6-23394309762A	Read			N/A
Enable BLE Characteristic	20C4C970-151B-4126-9A40-E5789ED9C681	Read			N/A
Bluetooth Maximum Transmit Power Characteristic	F470D1D6-2333-43AD-BC15-89BBAC2669D5	Read			N/A
Model Number Characteristic	8050C59A-170E-4206-848A-07EFB78C14BA	Read		??	N/A
BLE Beacon ID Characteristic	038F5653-BE86-4200-8F07-34CDD9D41577	Read			N/A
Bootloader Version Characteristic	727924C6-7329-4425-BB81-B77E96AD4E2D	Read			N/A
Firmware Version Characteristic	9C25EE45-44BE-47B3-B0C4-16DB6EE79799	Read			N/A
Kernel Version Characteristic	6E7BF0B1-B0A6-4AB4-856F-	Read			N/A

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
	7432A905EFCD				
Power Characteristic	6F7F66C4-EDE8-471C-A4FE-0D1126415DAF	Read			N/A

Mobile Device Data Service UUID Table

For functional details, see the System Configuration Service Table in the BLE Services Explained section.

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
Mobile Device Data Service	107C17CE-8A03-4DDC-ABB1-43FC9F34605A => 76A136D4-29FC-4217-B358-9BFF4D6601CE				N/A
Disconnect Mobile Device Characteristic	5207F99E-5B02-4760-A220-678594939FF0	Write		33:56:84:A3:10:58 Input the Mac of the device to disconnect	N/A
Reset Hub Characteristic	411225B6-82F0-4E5D-B980-E2099E9DD53F	Write		1	N/A
Device Alias Characteristic	411225B6-82F0-4E5D-B980-E2099E9DD53F	Write		Alice's iPhone	N/A

Other Services

Service/ Characteristic	UUID	Access	Range	Example	BACnet Reference
MQTT Broker Type Characteristic	6C479A4C-6AE6-4FB1-BFF1-17D4D7F5B9F2	Read, Write	Default, Custom	String	N/A
Web Service ID Characteristic	33922E43-CE1E-4243-9F30-F19D6A9C29DA	Write		A string such as uO1lmQrqB184Pal	N/A

BLE Services Explained

This section describes the function of the BLE services and also mentions related objects and supplements the information contained in the API Services Reference section. These tables provides a more detailed treatment of the function of a service from a HVAC perspective. The intention is to explain the inner workings of the sensor hub 2 to a technical audience with minimal HVAC experience.

Description Table for API Services

The hub uses BACnet objects to the provide the underlying behaviors reflected in the BLE services. The tables include information on related BACnet objects. Some services may contain a link to an additional explanation that is too long to include in the table.

See the tables in the API Services Reference section for the available BLE services. The Description tables use the same grouping scheme as the Reference tables.

Security Table

This table provides additional information to the table in the API Services Reference section.

Service/ Characteristic	UUID	BACnet Reference
Security Service	EFB39360-A7E3-438F-A20D-E9F00E0E22B1	N/A
Password Characteristic	3E11BB74-A208-479D-B9C7-B1DDFBB079B7	N/A
Server Public Key	F3D9351C-F4CA-4BD6-B3EE-AF296FF3D021	N/A
Client Public Key	7A12FF94-6215-4EA4-9E71-1BA2A2F7E463	N/A

Sensors Table

This table provides additional information to the table in API Services Reference section.

Service/ Characteristic	UUID	BACnet Reference
Sensor Data Service	F57793C9-9544-46DC-BFA0-5FD149953C86	Occupant Temperature (AI3)
Occupant Temperature Characteristic	287B7C85-C471-4146-B678-59832B6B4121	Present Value of AI3
	Temperature -40 to 125 C at occupant height nominally at 1m (3 ft) above floor. Calculated room temperature at 1 m (3 ft) above the floor. This is composite value taken from the hub's two internal temperature sensors and the infrared temperature sensor. Range –40°C to 125°C(–40°F to 257°F). Related: Setting the units (°C", "°F", "°K") field effects all three temperatures (Occupant, IR, Internal) . Comment: For optimal accuracy, calibrate the temperature to a specific reference point in the room. See "BLE Services Explained" on the previous page for more details.	
Occupant Humidity Characteristic	D6A10DF9-7AF1-4CAA-8380-7FB618373397	Present Value of AI6
	Relative humidity measured within the remote hub (0 - 100%). Comment: The relative humidity (0-100%) is calculated at the same point as the occupant temperature.	
Space Occupied/Unoccupied Characteristic	72B7F5DE-A24F-4FAB-B0CD-78F0582BDD00	Present Value of BI8

Service/ Characteristic	UUID	BACnet Reference
	Occupancy value (0 means unoccupied, non-zero means occupied) Comment: A binary value indicating whether the area around the hub is occupied or unoccupied. See "BLE Services Explained" on page 23 below for more details about how occupancy is determined.	
Light Level/Intensity Characteristic	EA74FAB1-E7A7-40FA-8EDC-38868EE8BD92	Present Value of AI12
	Light intensity (0 - 65535 Lux ??or foot-candles (FC)) .	
Sound Level Characteristic	1CC2B5DA-9F5F-4307-9544-2EF5464F1FA4	Present Value of AI17
	Unfiltered ambient audio levels (0–120 dB) across the entire spectrum reported in dB SPL scale (decibels sound pressure level). . Read-only.	
Motion Sensor Characteristic	292ABE4D-F45B-4AF0-B464-796F09DF41DB	Present Value of BI9
	?? Binary value indicating whether the motion (PIR) sensor was tripped in the last five seconds Related Objects: This value flips from true/false based on whether Sound Level (Acoustic Activity Level) is greater than or less than the ???Occupancy Acoustic Sensitivity value.	
IR Temperature Characteristic	C789F9C6-1224-4670-9375-13D097C08478	Present Value of AI4
	Average temperature of all room surfaces in the sensor's field of view, read from the hub's IR sensor. Related Objects: Setting the units (°C", "°F", "°K") field effects all three temperatures (Occupant, IR, Internal) Comment: The temperature range is read directly from IR sensor in centigrade is -40°C to 125°C (-40°F to 257°F).	
Internal Temperature Characteristic	ECC9A665-6AF4-4144-9D42-35EEFC2E4D49	Present Value of AI5

Service/ Characteristic	UUID	BACnet Reference
	Temperature C read from internal temperature reference (-40 to 125) Related Objects: Setting the units (°C", "°F", "°K") field effects all three temperatures (Occupant, IR, Internal) Comment: Temperature at the sensor hub unit	
Internal Humidity Characteristic	12CE7390-C4BA-407E-B1CF-E248F84DC398	Present Value of AI7
	Relative humidity measured within the remote hub (0 to 100%) Comment: Relative humidity at the sensor hub unit	
Color Temperature Characteristic	71AEE317-F805-4C58-B069-13D08B12D75B	Present Value of AI13
	Color temperature in degrees Kelvin (0 to 65535)	
Light Red Component Characteristic	FF17A806-154A-4E74-81F0-FE0CE1DDAC47	Present Value of AI14
	Red component of the light (no units but scaled from 0 to 65535.	
Light Green Component Characteristic	C1302CA8-6AAE-4F32-ABBB-23D522DD8774	Present Value of AI15
	Green component of the light (no units but scaled from 0 to 65535.	
Light Blue Component Characteristic	7E7458F1-35B2-4AB5-BAE1-2694B6E91794	Present Value of AI16
	Blue component of the light (no units but scaled from 0 to 65535.	
Thermal Load Characteristic	6B291913-8382-4663-B407-B1E78DE23AB8	Present Value of AI18

Occupancy States Explained

A state change from unoccupied to occupied is triggered when motion is detected in the room, or by a combination of motion and sound. Sound alone does not trigger a state change.

When either motion or sound is detected in the room, the occupancy state is extended. This sound level must be above the baseline audio level that the sensor hub has previously established. In addition, new sounds that fall outside of the Occupancy Audio Retrigger Period value are not allowed to extend the occupancy state. This feature reduces artificial extension of the occupancy state due to background noise.

The sensor hub reports a room as unoccupied if no motion or sound is detected after a set amount of time (Occupancy Inactivity Period). This sound level has to be below the baseline audio level that the sensor hub has previously established. You can change the Occupancy Inactivity Period.

Setpoints Table

This table provides additional information to the table in the API Services Reference section.

Service/ Characteristic	UUID	BACnet Reference
Setpoint Service	5040556B-340F-4C6F-B411-448089694628	Temperature Setpoint (AV33)
Temperature Setpoint Characteristic	32E4381B-1F1D-47AC-AE97-58959678967F	Present Value of AV33
Humidity Setpoint Characteristic	85897295-F88A-4883-A068-BBC5935D1412	N/A
Light Level Setpoint Characteristic	725D3560-BBD3-47BE-920E-7843AEDFB0D5	N/A

Service/ Characteristic	UUID	BACnet Reference
Color Temperature Setpoint Characteristic	8347707C-0001-427C-9588-D4133244F7EF	N/A
RGB Color Temperature Setpoints Characteristic	6B5BDBBC-52D1-422A-92ED-0CFF25DCB460	N/A

I/O and Indicators Table

This table provides additional information to the table in the API Services Reference section.

Service/ Characteristic	UUID	BACnet Reference
I/O and Indicator Service	E05AD2AC-9A01-45F5-A56D-9C3C889D4DC6	Play Light Ring Pattern (MV1)
Play Light Ring Pattern Characteristic	2E2CEFB0-D026-4EC7-8856-8BDD05F9B62E	Present Value of MV1 Present Value of BV7
	The light ring can play pre-defined patterns or light up with custom colors by using the RGB control registers. Patterns can be repeated. Comment: Values from ?0? 1-13. The MV object stores specific	

Service/ Characteristic	UUID	BACnet Reference
	states that trigger the LED ring to display the following default light patterns: 1 (idle), 2 (Blue Swirl), 3 (Fast Blue Swirl), 4 (Power On), 5 (Occupancy Active), 6 (Got Request), 7 (Heating Active), 8 (Cooling Active), 9 (Don't Understand), 10 (Error), 11 (Alarm), 12 (Christmas), 13 (Awake and Waiting), 14 (Power On Alternate), 15 (Occupancy Active Alternate) The present value of Activate Custom Light Ring Colors Characteristic overrides this light ring pattern setting. Create GCL programming in a PG object to add an accompanying audio component for a pattern. See the "BLE Services Explained" on page 23 table for the complete list of light ring patterns.	
Play Light Ring Repeat Characteristic	49AC79E5-6E7E-404F-A1A2-FACB501BD9E9	Present Value of AV2
	Indicates how many times the pattern triggered by Play Light Ring Pattern repeats.	
Activate Custom Light Ring Colors Characteristic	16C58089-CA5C-45FA-BA85-3A3B1AD3E9ED	Present Value of BV7
	Set to either on or off with a default of 50%. Sets the light ring to the custom color defined by the Set Light Ring (Red, Green, Blue) Characteristics Overrides MV1 (light ring pattern)	AV3, AV4, AV5
Set Light Ring Red Characteristic	B42BAC5D-1051-41E6-AFB4-1E16B31574CE	Present Value of AV3
	Set light ring Red to a value between 1-100% Only valid if Activate Custom Light Ring Colors is set to true	
Set Light Ring	232B1A5D-6E51-470F-9C06-245297856415	Present

Service/ Characteristic	UUID	BACnet Reference
Green Characteristic		Value of AV4
	Set light ring Green to a value between 1-100% Only valid if Activate Custom Light Ring Colors is set to true	
Set Light Ring Blue Characteristic	05AE6EFC-84EC-4093-AA98-ECC198F968FD	Present Value of AV5
	Set light ring Blue to a value between 1-100% Only valid if Activate Custom Light Ring Colors is set to true	
Set Light Ring Brightness Characteristic	46640823-D37E-4510-BE8E-AF0BF6E0273E	Present Value of AV6
	Set light ring brightness to a value between 1-100% Comment: Default is 50%.	
Configure I/O Channel as Input Characteristic	DBB99066-3F23-4F10-A368-DB94E0B833F7	N/A
Set COV Notification for Input Channel Characteristic	3CAA9B36-7A58-44E3-99B2-7C55359CFA64	COV property of AI1
Configure I/O Channel as Output Characteristic	D7C16204-7347-4146-958E-D0A2D59D7EEA	N/A

Service/ Characteristic	UUID	BACnet Reference
Read Input Channel Characteristic	2C67EEEE-393E-4C77-9204-83C2F487F8D0	Present Value of AI1
Set Output Channel Characteristic	5D4E8DF4-87DD-48DB-BB26-25946D936A32	Present Value of AI1
Send Pronto Code Through I/R Transmitter Characteristic	8153E80B-5AE7-4D1A-8AA5-D5E5BD557283	Present Value of MV9
Speaker Volume Characteristic	FC09FC9A-23ED-4867-9C4C-4F34C274F41A	Present Value of AV30
Play Audio File Characteristic	A2895C02-905E-4822-A711-29482675F501	Present Value of MV28

Sensor Hub Light Ring Pattern States Explained

This table lists the states defined by the Light Ring Patterns MIC object. When the Light Ring Pattern object receives a new state value, the specified light ring pattern displays.

State	Pattern Name	Description	Suggested Use	Factory Colors
1	Idle/Off	No ring pattern displays.		None
2	Swirl	Single spot of light spins around the ring once before the ring flashes twice. Ends with a prolonged flash that lasts for 2 seconds. When a BLE connection is established with a specific hub., the convention is to displays the State 2 swirl pattern and to also play the generic ACK sound. This convention ensures the connection iwas established with the intended sensor hub.		Blue
3	Fast Swirl	A faster version of the Swirl sequence.		Blue
4	Power On	Spins a single spot of light around the ring 3 times.	When the sensor hub powers on.	Green
5	Occupancy Triggered	Spins a single spot of light around the ring 3 times.	When occupancy is detected in the room.	White
6	Request Received	The ring flashes 3 times in a sequence that lasts for 2 seconds.	To confirm receipt of a room command.	Green
7	Heating Active	The entire ring fades in and out.	When the room is heating.	Red
8	Cooling Active	The entire ring fades in and out.	When the room is cooling.	Blue

State	Pattern Name	Description	Suggested Use	Factory Colors
9	Request Not Understood	The ring flashes 4 times followed by a prolonged light flash that lasts for 2 seconds.		Yellow
10	Error Condition	The entire ring flashes 8 times.		Red
11	Alarm Condition	Flashes alternate between both halves of the ring, for a total of 16 flashes.		Red
12	Christmas	The entire ring flashes and alternates between 2 colors. This sequence repeats 8 times.		Red and Green
13	Awake	The entire ring lights up and stays lit while a spot of more intense light in the same color travels around the ring twice.		Blue
14	Power On (Alternate)	3 spots of light spin around once before the ring flashes twice. The entire ring then lights up and stays lit for 2 seconds. When the sensor hub powers on.		Violet, Blue and Yellow
15	Occupancy Triggered (Alternate)	3 spots of light spin around once, followed by a sequence where a light spot travels down each half of the ring to the point where the 2 ring halves meet before moving back to their point of origin.	When occupancy is detected in the room.	Violet and Cyan

Sensor Configuration Service Table

This table provides additional information to the table in the API Services Reference section.

Service/ Characteristic	UUID	BACnet Reference
Sensor Configuration Service	51E16FF1-20D3-45EC-915C-F18290A893C5	N/A
Set Temperature Unit Characteristic	9BBA2752-A586-433D-98CF-888A5B8B09FC	N/A
	Available units are C, F, K Related Objects: Setting the units field effects all three temperatures (Occupant, IR, Internal)	
Set Light Unit Characteristic	4A3B5382-2453-46A1-94CA-7F898122E35C	Units property of AI12
Calibrate Occupant Height Temperature Reading Characteristic	D439082B-8008-454E-BB0A-AB62A4104EC8	Calibration property of AI3
Assign BACnet Device ID Characteristic	AE79CA8F-A333-4850-84EA-1AD9710FB5A7	N/A
Assign BACnet Network Number Characteristic	0C36266F-1667-4B69-95FF-6F55947589E5	
Change TCP/IP Settings Characteristic	055FA816-E26E-4D82-BB77-456D5DA0D9EE	N/A
TCP/IP Subnet Mask Characteristic	3923BA42-1269-4BF0-9E4C-855182372280	N/A

Service/ Characteristic	UUID	BACnet Reference
Update Security Certificate Characteristic	7392E4D1-862B-4A88-9683-7603235C8D2D	N/A
Set Device Name Characteristic	45E7570D-A13A-456E-B8B9-7B4EF6989DB2	N/A
	Accepts an alphanumeric string name for this ??sensor hub.	
Read Device Serial Number Characteristic	2E888D3C-AEC5-4193-B0F1-4735CAB9AFBD	N/A
Set Web Server URL Characteristic	0C36266F-1667-4B69-95FF-6F55947589E5	N/A

Network Configuration Service Table

This table provides additional information to the table in the API Services Reference section.

Service/ Characteristic	UUID	BACnet Reference
Network Configuration Service	E03D645C-3F2B-4693-A2FB-99840EE2581D	N/A
Network Type Characteristic		N/A
Gateway IP Characteristic	265D3029-4B73-444A-B48D-5016AB25A659	N/A
DNS IP Characteristic	D1035EB0-C93D-4C20-A4B2-C2E44D91C903	N/A

Service/ Characteristic	UUID	BACnet Reference
BACnet Protocol Characteristic	61ABFC55-7A00-4B9B-93C9-1770356EDC8F	
BACnet UDP Number Characteristic	67358E4B-C841-4E6F-9822-EC92E388A4A3	
MQTT Status Characteristic	0457F00C-87E1-45F0-85E1-EFDD7AB7DFF4	
MQTT Broker IP/URL Characteristic	E7592CDA-46EE-4D87-9D0D-9BB25B2C3059	
MQTT Port Characteristic	1850B75D-4299-4E9D-896E-D19B1E2183C2	
Ethernet MAC Address 1 Characteristic	D7AE5B6F-C8DD-4ADD-A75A-28F4038528FA	
Ethernet MAC Address 2 Characteristic	C417C455-C003-445A-ADA4-F203F0DA2F2A	
Ethernet 1 Status Characteristic	73678CA9-B639-459E-890A-6E3B38962B2F	
Ethernet 2 Status Characteristic	ECD1CC9F-7A8E-4B4F-8BD2-8E7B13258F87	
Connectivity Characteristic	56456172-DDD7-4E75-83D7-C2D0D6B796EE	

Calibration Configuration Service Table

This table provides additional information to the table in the API Services Reference section.

Service/ Characteristic	UUID	BACnet Reference	
Calibration	B7F17A09-768B-4E44-B466-5B03B3C0B9C8 =>	Two objects:	

Service/ Characteristic	UUID	BACnet Reference	
Configuration Service	5526A99E-7975-42FF-A27B-94D5A1AD9986		
Temperature Calibration Characteristic	B3997D46-DEF4-43DE-B82F-DEB04B059C17	Occupant Temperature (AI3) - Calibration property	
	Enter the current temperature value measured 1 meter below the sensor hub. Comment: Value is the measured temperature and NOT an offset that you calculate between the two values. This differs from the calculated offset approach used in the sensor hub 1.		
Light Calibration Level Characteristic	F4F909E4-8F4B-4A78-9874-D3A403E5F4A2	Any of User Set Point 1-4, AV34 to AV37	
	Preferred value that displays for the current reading. The light measurement ues reflected light rather than transmitted light. This placeholder value is readable from the hub. The units are LUX or foot-candles (FC).		
Motion Sensitivity Characteristic	CCDCE4F9-F8AD-40A4-97C5-43D895981814	Motion Sensitivity AV23	
	Effects the amount of movement needed to set theMotion value to True. PIR motion sensor sensitivity is expressed as a percentage (0–100%), with 100% = maximum sensitivity, and 0% = minimum sensitivity. Default value is 80%. May need adjusting based on room size and layout.		

Service/ Characteristic	UUID	BACnet Reference	
Acoustic Sensitivity Characteristic	88456249-05F8-4434-9C7C-61E1A9A0D5B0	Occupancy Acoustic Sensitivity AV24	
	Effects how much the room sound level (loudness) must exceed the background level before the room is considered occupied. This aparameter is the sensitivity of the audio portion of the occupancy algorithm, expressed as a percentage (0–100%), with 100% = maximum sensitivity, and 0% = minimum sensitivity. Default value is 80%. Related Object: Acoustic Occupancy		
Acoustic Activity Level Characteristic	8A22BEA5-F786-4E1A-8454-B1A373D1F8E2	??AV26	
	When no motion and no audio activity are detected, this parameter sets the amount of time that the hub waits before returning to the unoccupied state. Default value is 300 seconds (5 minutes). Comment: If a room is empty, it waits for this latch time to expire before turning the lights Off.		
Acoustic Retrigger Period Characteristic	B06D391E-F793-4295-9BA5-8AB1ACE71457	AV25	
	The amount of time after motion detection that activity sounds can cause the hub to remain in the occupied state. Default value is 1200 seconds (20 minutes). Measured from most recent motion detection event. Comment: Sets time for a retrigger to occur. This parameter sets the time to listen before deciding that a room is unoccupied . If motion is detected, then the count is reset.		

Service/ Characteristic	UUID	BACnet Reference	
Acoustic Baseline Update Period Characteristic	261D878C-1772-4ADD-805F-CDC678E4B384	AV27	
	Measures the average sound level (loudness) of an empty room within a time window. If motion is detected indicating occupancy, then the baseline stops updating. The range is 0-???x seconds with a default of 30 Comment: This parameter is the update period for the baseline microphone levels. During periods when there are no occupants, the baseline microphone levels are periodically updated in order to account for environmental changes. The default is 30 seconds.		
Acoustic Occupancy	5953C91C-8ECB-4991-AE13-6E619B005DF3	BI11	
	This binary True/False value indicates whether the sound level within the last five seconds was high enough to indicate occupancy. Related Objects: ??This value flips from True/False based on whether Acoustic Activity Level is above or below the current Acoustic Baseline value. This binary value uses the acoustic characteristics to help determine if someone is in the room.		
Inactivity Period Characteristic	8988EEAA-574E-4447-A974-525B877DF4EB	??	
Sound Repeats Characteristic	E5421778-0829-4EA1-A1D1-318124EBE6B0		
	Sets how many times to play a sound. The range of values is 0 to 255 with a default of xx. 0 indicates		

Service/ Characteristic	UUID	BACnet Reference	
	indefinite repeats until changed.		
Send IR Code Characteristic	0F9999E0-A683-437F-ABD3-3A94605E1623		
	Send Pronto code through I/R transmitter control codes for commercial A/V equipment and other equipment that uses IR remote control. A value can be loaded into a sensor and then sent out when needed. Plays one of Programmable IR Code 1 to 12. Idle is 0.		
IR Repeats Characteristic	0605CDA9-92F6-4FAA-9290-F499F1FB2882		
	Sets the number of times to repeat the selected IR code triggered by Send IR Code Characteristic. The range is 0-255 with a default of xx.		
Programmable IR Code 1 Characteristic	FAAB8651-24B2-425D-B098-D4A2A4058154	???CSV11	
	Contains IR Pronto code 1.		

Calibrating the Sensor Hub Temperature

The sensor hub Occupant Temperature reading needs to be calibrated to match a reference room temperature. After calibration, the accuracy of the hub's temperature sensor is ± 0.5 degrees when measured within a band ± 5 degrees from the calibrated temperature.

To calibrate the temperature:

Set the measured calibration temperature in the Calibration property of AI3 Temperature Calibration. For example, the measured calibration temperature might be 21°C and the Present Value property of AI3 Occupant temperature might be 22°C. With the sensor hub 2, you do not need to calculate and set an offset value. In this example, you would enter the measured value of 21°C.

Mobile Device Data Service Table

This table provides additional information to the table in the API Services Reference section.

Service/ Characteristic	UUID	BACnet Reference
Mobile Device Data Service	107C17CE-8A03-4DDC-ABB1-43FC9F34605A => 76A136D4-29FC-4217-B358-9BFF4D6601CE	N/A
Disconnect Mobile Device Characteristic	5207F99E-5B02-4760-A220-678594939FF0	N/A
	Comment: 33:56:84: A3:10:58 Input the Mac of the device to disconnect	
Reset Hub Characteristic	411225B6-82F0-4E5D-B980-E2099E9DD53F	N/A
	Comment: 1	
Device Alias Characteristic	411225B6-82F0-4E5D-B980-E2099E9DD53F	N/A
	Comment: Alice's iPhone	