iMeter 6 BACnet/IP Application Guide

Version: V1.0

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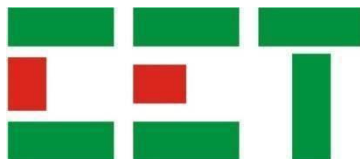
Table of Content

1   Introduction

1.1 Scope

BACnet (Building Automation and Control Networking) protocol is a data communication protocol defined by the ANSI / ASHRAE-135 standard. The iMeter 6 supports the BACnet over IP (BACnet/IP) protocol that allows it to be easily integrated with the building automation control systems with the existing IP infrastructure. This document explains the BACnet/IP configuration, the PICS (Protocol Implementation Conformance Statement), the standard objects list and properties, and a description of the supported BIBBs (BACnet Interoperability Building Blocks) and BACnet services.

1.2 Introduction to BACnet/IP

BACnet protocol is commonly used in building automation systems (BAS) to control the data exchange between different devices and components. BACnet/IP is one of the network technologies supported by BACnet. Using the UDP/IP protocol, BACnet is compatible with the existing IP networks.

The BACnet protocol consists of objects with a collection of different information. Each object has many mandatory and optional properties that contain data related to it.

BACnet operates in a client-server environment. A client issues a service request to a server. As a result, the server sends back the service performance results to the client. BACnet classifies the services into 5 groups.

ANSI / ASHRAE-135 defines a series of standard device profiles. iMeter 6 implements the BACnet Application Specific Controller (B-ASC). This profile defines the device as a controller with limited resources programmability,the ability to provide complete information about any of its BACnet objects and can respond to communication control messages. This profile supports Data Sharing as well as Device and Network Management Service.

For many installations, a BACnet network can be made up of more than one IP subnets. The iMeter 6 may be registered as a foreign device with a remote BACnet Broadcast Management Device (BBMD) to facilitate the sending and receiving of broadcast messages to/from devices accessible by the BBMD. As shown in the following figure, when configured, the iMeter 6 in IP Subnet 3 sends subscription request directly to the BBMD in IP Subnet 2. Once the iMeter 6 has been added as an entry in its Foreign Device Table (FDT), the BBMD is capable of forwarding the broadcast messages from/to the registered iMeter 6.
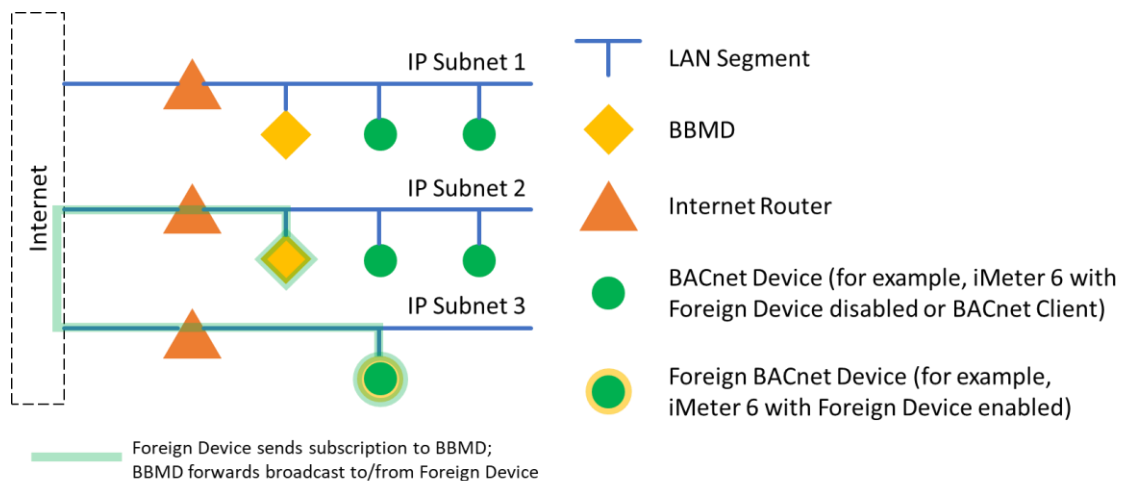
Figure 1 Foreign BACnet Device Registration with BBMD to Receive/Send Broadcast Messages from/to an outside Subnet

2 BACnet/IP Configuration

Before attempting to communicate with the iMeter 6 via BACnet/IP, configure the BACnet/IP Basic settings (including **BACnet/IP Enable**, **Port** and **Device ID**) appropriately based on the customer's specific environment via the Front Panel or Web Interface.

If the iMeter 6 is expected to join an outside BACnet network or logical subnet, please configure the BACnet/IP foreign device settings (including **BACnet/IP FD Enable**, **BBMD IP**, **BBMD Port** and **BBMD TTL**).

The iMeter 6 also provides an option to enable password verification (**BACnet/IP PW Enable**) as a protection for the BACnet/IP ReiniatializeDevice and DeviceCommunicationControl services. When BACnet/IP PD is enabled, the password is set to a fixed value of "abcd1234-".

For more information about the BACnet/IP parameters, please refer to the ASHRAE 135-2020 standard.

The new parameter settings will take effect only after the iMeter 6 is rebooted.

2.1 Configuration via Front Panel

Use the iMeter 6's Front Panel to configure the BACnet/IP settings as the following steps:

1. Enter **Setup** > **Advanced** menu.
2. Use <▲▼> button to scroll through the different pages for the advanced setting parameters.
3. On the pages related to BACnet/IP configuration as shown in the following figures, press <↵> button to enter the parameter settings.
4. Enter the Front Panel Password (default is "**000001**") and press <↵>.
5. Use the <▲▼> button to select the desired parameters for configuration.
6. Press <↵> to enter a specific parameter's configuration.
7. After the modification is completed, press <↵> to confirm the setup change.
8. Move to the next parameter to be modified and repeat above steps 6 to 7.
9. Press <↻> to exit the setup procedure. Press **Confirm** when **Save Setup Changes** prompt occurs.
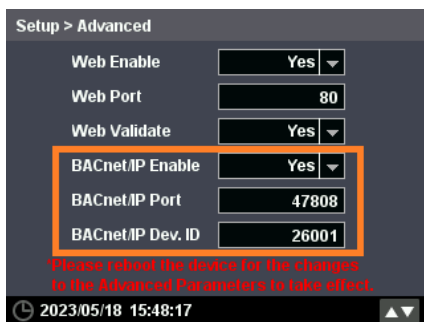
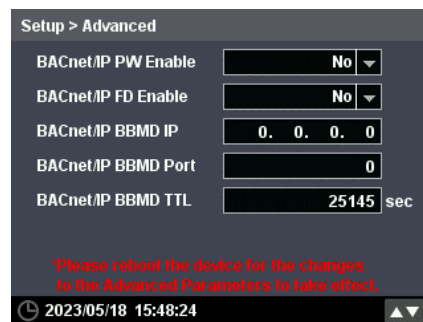**Figure 2 BACnet/IP Basic Settings** **Figure 3 BACnet/IP Advanced Settings**

2.2 Configuration via Web Interface

Use the iMeter 6's Web Interface to configure the BACnet/IP settings as the following steps:

1. Login to the iMeter 6's Web Interface with Username (default is "**operator**", case-sensitive) and Password (default is "**abcd1234-**", case-sensitive).
2. Click **Setup** > **Others** > **Advanced** menu.
3. Configure the BACnet/IP parameters shown in the following screenshot.
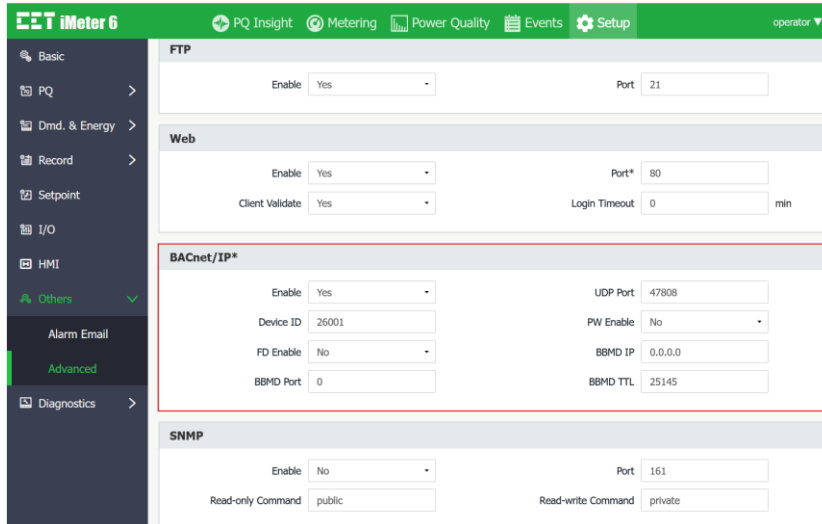
Figure 4 BACnet/IP Parameters on the Web Interface

2.3 BACnet/IP Parameters Description

The following table describes the BACnet/IP parameters with the setup range and default values.

BACnet/IP Basic Settings		
Parameter	**Description**	**Range/Options, Default***
BACnet/IP Enable	Enable or disable BACnet/IP connection.	No*, Yes
BACnet/IP Port	UDP port number for BACnet/IP connection.	0 to 65535, 47808* (standard BACnet/IP port)
BACnet/IP Device ID	Unique device ID within the BACnet network where the iMeter 6 resides in.	0 to 4194303, 26001*
BACnet/IP Advanced Settings		
Parameter	**Description**	**Range/Options, Default***
PW Enable	Enable or disable password verification for BACnet/IP DM-RD-B and DM-DCC-B services. If enabled, the password shall be "abcd1234-".	No*, Yes
FD Enable	Enable or disable the configuration for iMeter 6 as a Foreign Device to join an outside B/IP network or logical subnet.	No*, Yes
BBMD IP	IP of the BACnet/IP Broadcast Management Device (BBMD) if BBMD is used.	0.0.0.0*
BBMD Port	Port number for communication with the BBMD.	1 to 65535, 47808*
BBMD TTL	The Time-To-Live for the BBMD keeps an entry for the iMeter 6 in its Foreign Device Table (FDT).	0 to 65535 (s), 25145*

3 PICS (Protocol Implementation Conformance Statement)

Item	Description
Date	May 18, 2023
Vendor Name	CET
Model Name	iMeter 6
Application Software Version	V3.50.00
Firmware Revision	V3.01.01
BACnet Protocol Version	1
BACnet Protocol Revision	22
Product Description	Advanced Power Quality Monitor
Standardized Device Profiles Supported (Annex L)	BACnet Application Specific Controller (B-ASC)
BACnet Interoperability Building Blocks supported (Annex K)	DS-RP-B, DS-RPM-B, DS-WP-B, DS-WPM-B, DM-DOB-B, DM-TS-B, DM-DDB-B, DM-RD-B, DM-DCC-B, NM-FDR-A
Segmentation Capability	Not Supported
Standard Object Type Supported	See Section 4.1
Data Link Layer Options (Annex J)	BACnet/IP, Foreign Device Registration
Static Device Address Binding	None
Networking Options	None
Character Sets Supported	UTF-8

4 Objects and Properties

4.1 Supported Object Types and Properties

Object Type	Optional Property	Writable Property	Function
Device Object	• Description • Local_Time • Local_Date • Location	• Object_Identifier • Number_Of_APDU_Retries • APDU_Timeout • System_Status • Object_Name • Location • Description	• BACnet Device Characteristics
Analog Input Object	• Description • Reliability	N/A	Real-time measurements • Voltage and Current • Power and Power Factor • Sequence and Unbalance • DI Pulse Counters • Demand and Energy • Harmonic measurements
Analog Value Object	• Description	• Present_Value • Out_Of_Service	• Basic settings • Clear operations
Binary Input Object	• Description	N/A	• Digital Input status
Binary Output Object	• Inactive_Text • Active_Text • Description	• Present_Value • Out_Of_Service	• Digital Output status
Large Analog Value Object	• Out_Of_Service	• Present_Value[4] • Out_Of_Service[4]	• Energy • DI Pulse Counters
Network Port Object	• MAC_Address • APDU_Length • BACnet_IP_Mode • IP_Address • BACnet_IP_UDP_Port • IP_Subnet_Mask • IP_Default_Gateway • IP_DNS_Server • FD_BBMD_Address • FD_Subscription_Lifetime • Network_Number • Network_Number_Quality	• BACnet_IP_Mode • FD_Subscription_Lifetime	• Network Port Configuration and Properties

Notes:
1. None of the objects are dynamically creatable using the CreateObject service.
2. None of the objects are dynamically deletable using the DeleteObject service.
3. The proprietary property is not supported on this device.
4. It's required to set the **Out_Of_Service** property of Large Analog Value Object to **TRUE** before writing a value to the **Present_Value** property.

4.2 Device Object

Property	Description	O/R/W[1]	Stored	Range/Options, Default*
Object_Identifier	The unique device ID number for the meter in the format of [DEVICE: #].	W	Y	0 to 4194302, 26001*
Object_Name	Unique object name internetwork-wide	W	Y	Up to 32 characters, Simple Server*
Object_Type	Object type	R	--	Device (8)
System_Status	The physical and logical status of the BACnet device	R	--	Operational (0)
Vendor_Name	Manufacturer of the BACnet device	R	--	CET
Vendor_Identifier	BACnet vendor identifier for CET Electric Inc.	R	--	593
Model_Name	Device model number	R	--	iMeter 6
Firmware _Revision	BACnet firmware version, stored in an x.x.x format	R	--	For example, 3.01.01
Application_Software_Version	Meter firmware version, stored in an x.x.x format	R	--	For example, 3.50.00

Protocol_Version	BACnet protocol version	R	--	For example, version 1
Protocol_Revision	BACnet standard minor revision level	R	--	For example, 22
Protocol_Services_Supported	BACnet services supported by the meter	R	--	See note 3
Protocol_Object_Types_Supported	BACnet object types supported by the meter	R	--	See note 4
Object_List	BACnetARRAY of BACnetObjectIdentifier	R	--	See section 4.3 to section 4.8
Max_Apdu_Length_Accepted	Maximum APDU packet size that the meter can accept	R	--	1476*
Segmentation_Supported	The meter does not support segmentation	R	--	NO_SEGMENTATION (3)
Apdu_Timeout	The amount of time in ms before the meter tries to resend a confirmed message that has not been answered	W	Y	0 to 65535 (ms), 3000*
Number_Of_Apdu_Retries	Maximum number of times that an unanswered APDU shall be retransmitted	W	Y	0 to 255, 3*
Device_Address_Binding	A BACnetLIST of BACnetAddressBinding	R	--	The device address binding list is always blank
Database_Revision	A logical revision number for the device's database	R	--	For example, 0
Description	Optional description of the meter	O	Y	Up to 64 characters, Advanced Power Quality Monitor*
Local_Time	The current time on the meter in HH:MM:SS format	O	--	Synchronized with the meter's clock setting
Local_Date	The current date on the meter in YYYY/MM/DD format	O	--	
Location	The physical location of the BACnet device	O	Y	Up to 64 characters, Local*

Notes:
1. O/R/W = Optional, required Readable or required Writable properties. See **Clause 12.1.2 Object Type and Property Conformance** in ANSI / ASHRAE-135-2020.
2. Stored: Y = the value of the property stored in the meter's nonvolatile memory.
3. Supported BACnet services by the meter are:

   --Object Access Services
   - ReadProperty
   - ReadPropertyMultiple
   - WriteProperty
   - WritePropertyMultiple

   --Remote Device Management Services
   - DeviceCommunicationControl
   - ReinitializeDevice
   - TimeSynchronization
   - I-AM
   - Who-Has
   - Who-Is

4. Supported BACnet objects by the meter are:
   - Device object
   - Analog Input object
   - Analog Value object
   - Binary Input object
   - Binary Output object
   - Large Analog Value object
   - Network Port object

4.3 Analog Input Object List

Instance ID	Object Name	Units	Range
0	Ua	V	
1	Ub	V	
2	Uc	V	
3	Uln average	V	
4	Uab	V	
5	Ubc	V	
6	Uca	V	
7	Ull average	V	
8	Ia	A	
9	Ib	A	
10	Ic	A	
11	I average	A	
12	Pa	W	
13	Pb	W	
14	Pc	W	
15	P Total	W	
16	Qa	var	
17	Qb	var	
18	Qc	var	
19	Q Total	var	
20	Sa	VA	
21	Sb	VA	
22	Sc	VA	
23	S Total	VA	
24	PFa		
25	PFb		
26	PFc		
27	PF Total		
28	Frequency	Hz	
29	I4 Measured	A	
30	In Calculated	A	
31	Ung	V	
32	AI		
33	Ir (Calculated)	A	
34	U1 (Positive Sequence Voltage)	V	
35	U2 (Negative Sequence Voltage)	V	
36	U0 (Zero Sequence Voltage)	V	
37	I1 (Positive Sequence Current)	A	
38	I2 (Negative Sequence Current)	A	
39	I0 (Zero Sequence Current)	A	
40	U0 Unbalance	%	
41	I0 Unbalance	%	
42	U2 Unbalance	%	
43	I2 Unbalance	%	
44	Ua (3P4W)/Uab (3P3W) Angle	°	
45	Ub (3P4W)/Ubc (3P3W) Angle	°	
46	Uc (3P4W)/Uca (3P3W) Angle	°	
47	Ia Angle	°	
48	Ib Angle	°	
49	Ic Angle	°	
50	Device Operating Time (Running Hours)	h	
51	DI1 Pulse Counter		0 to 999,999,999
52	DI2 Pulse Counter		0 to 999,999,999
53	DI3 Pulse Counter		0 to 999,999,999
54	DI4 Pulse Counter		0 to 999,999,999
55	DI5 Pulse Counter		0 to 999,999,999
56	DI6 Pulse Counter		0 to 999,999,999
57	Ull average Demand	V	
58	P Total Demand	W	
59	Q Total Demand	var	
60	S Total Demand	VA	
61	Ia Demand	A	
62	Ib Demand	A	

63	Ic Demand	A	
64	I average Demand	A	
65	Ull average This Max. Demand	V	
66	P Total This Max. Demand	W	
67	Q Total This Max. Demand	var	
68	S Total This Max. Demand	VA	
69	Ia This Max. Demand	A	
70	Ib This Max. Demand	A	
71	Ic This Max. Demand	A	
72	I average This Max. Demand	A	
73	Ua (3P4W)/Uab (3P3W) THD	%	
74	Ub (3P4W)/Ubc (3P3W) THD	%	
75	Uc (3P4W)/Uca (3P3W) THD	%	
76	Ia THD	%	
77	Ib THD	%	
78	Ic THD	%	
79	I4 THD	%	
80	Ia K-Factor		
81	Ib K-Factor		
82	Ic K-Factor		
83	Ia TDD	%	
84	Ib TDD	%	
85	Ic TDD	%	
86	Ua (3P4W)/Uab (3P3W) Crest Factor		
87	Ub (3P4W)/Ubc (3P3W) Crest Factor		
88	Uc (3P4W)/Uca (3P3W) Crest Factor		
89	Ia Crest Factor		
90	Ib Crest Factor		
91	Ic Crest Factor		
92	dPFa		
93	dPFb		
94	dPFc		
95	dPF Total		
96	Interval kWh Import	kWh	0 to 1,000,000,000.00
97	Interval kWh Export	kWh	0 to 1,000,000,000.00
98	Interval kvarh Import	kvarh	0 to 1,000,000,000.00
99	Interval kvarh Export	kvarh	0 to 1,000,000,000.00
100	Interval kVAh Total	kVAh	0 to 1,000,000,000.00
101	kWh Import	kWh	0 to 1,000,000,000.00
102	kWh Export	kWh	0 to 1,000,000,000.00
103	kWh Net	kWh	0 to 1,000,000,000.00
104	kWh Total	kWh	0 to 1,000,000,000.00
105	kvarh Import	kvarh	0 to 1,000,000,000.00
106	kvarh Export	kvarh	0 to 1,000,000,000.00
107	kvarh Net	kvarh	0 to 1,000,000,000.00
108	kvarh Total	kvarh	0 to 1,000,000,000.00
109	kVAh Total	kVAh	0 to 1,000,000,000.00
110	kvarh Q1	kvarh	0 to 1,000,000,000.00
111	kvarh Q2	kvarh	0 to 1,000,000,000.00
112	kvarh Q3	kvarh	0 to 1,000,000,000.00
113	kvarh Q4	kvarh	0 to 1,000,000,000.00
114	kWh Import of T1	kWh	0 to 1,000,000,000.00
115	kWh Import of T2	kWh	0 to 1,000,000,000.00
116	kWh Import of T3	kWh	0 to 1,000,000,000.00
117	kWh Import of T4	kWh	0 to 1,000,000,000.00
118	kWh Import of T5	kWh	0 to 1,000,000,000.00
119	kWh Import of T6	kWh	0 to 1,000,000,000.00
120	kWh Import of T7	kWh	0 to 1,000,000,000.00
121	kWh Import of T8	kWh	0 to 1,000,000,000.00

4.4 Analog Value Object List

Instance ID	Object Name	Present_Value Range/Options
0	PT Primary	1 to 1,000,000 (V), 100*
1	PT Secondary	1 to 1,500 (V), 100*

2	CT Primary	1 to 30,000 (A), 5*
3	CT Secondary	1 to 50 (A), 5*
4	I4 Primary	1 to 30,000 (A), 5*
5	I4 Secondary	1 to 50 (A), 5*
6	Wiring Mode	0=3P4W*, 1=DEMO, 2=3P3W, 3=1P2W L-N, 4=1P2W L-L, 5=1P3W L-L-N
7	Secondary Ull Nominal	100 to 700 (V), 415*
8	Nominal Frequency	0=50Hz*, 1=60Hz
9	PF Convention	0=IEC*, 1=IEEE, 2=-IEEE*
10	kVA Calculation	0=Vector*, 1=Scalar
11	HD Calculation	0=Fundamental*, 1=RMS
12	Demand Period	1 to 60 (minutes), 15*
13	Number of Sliding Windows	1 to 15, 1*
14	EN Period	5 to 60 (minutes), 60*
15	Clear This Max. Demand	Writing "0xFF00" to the Present_Value property to reset This Max. Demand to "0"
16	Clear All Energy	Writing "0xFF00" to the Present_Value property to clear all 3-Phase, Total Energy Measurement, TOU Energy and Interval Energy Measurements
17	Clear DI1 Pulse Counter	Writing "0xFF00" to the Present_Value property to clear DI1 Pulse Counter
18	Clear DI2 Pulse Counter	Writing "0xFF00" to the Present_Value property to clear DI2 Pulse Counter
19	Clear DI3 Pulse Counter	Writing "0xFF00" to the Present_Value property to clear DI3 Pulse Counter
20	Clear DI4 Pulse Counter	Writing "0xFF00" to the Present_Value property to clear DI4 Pulse Counter
21	Clear DI5 Pulse Counter	Writing "0xFF00" to the Present_Value property to clear DI5 Pulse Counter
22	Clear DI6 Pulse Counter	Writing "0xFF00" to the Present_Value property to clear DI6 Pulse Counter
23	Clear Device Operating Time	Writing "0xFF00" to the Present_Value property to clear the Device Operating Time

4.5 Binary Input Object List

Instance ID	Object Name	Present_Value Range
0	DI1	0=Inactive, 1=Active
1	DI2	0=Inactive, 1=Active
2	DI3	0=Inactive, 1=Active
3	DI4	0=Inactive, 1=Active
4	DI5	0=Inactive, 1=Active
5	DI6	0=Inactive, 1=Active

4.6 Binary Output Object List

Instance ID	Object Name	Present_Value Range
0	DO1	0=Inactive, 1=Active
1	DO2	0=Inactive, 1=Active
2	DO3	0=Inactive, 1=Active

4.7 Large Analog Value Object List

Instance ID	Object Name	Units	Range
0	kWh Import	kWh	0 to 1,000,000,000.00
1	kWh Export	kWh	0 to 1,000,000,000.00
2	kWh Net	kWh	0 to 1,000,000,000.00
3	kWh Total	kWh	0 to 1,000,000,000.00
4	kvarh Import	kvarh	0 to 1,000,000,000.00
5	kvarh Export	kvarh	0 to 1,000,000,000.00
6	kvarh Net	kvarh	0 to 1,000,000,000.00
7	kvarh Total	kvarh	0 to 1,000,000,000.00
8	kVAh Total	kVAh	0 to 1,000,000,000.00
9	kvarh Q1	kvarh	0 to 1,000,000,000.00

10	kvarh Q2	kvarh	0 to 1,000,000,000.00
11	kvarh Q3	kvarh	0 to 1,000,000,000.00
12	kvarh Q4	kvarh	0 to 1,000,000,000.00
13	kWh Import of T1	kWh	0 to 1,000,000,000.00
14	kWh Import of T2	kWh	0 to 1,000,000,000.00
15	kWh Import of T3	kWh	0 to 1,000,000,000.00
16	kWh Import of T4	kWh	0 to 1,000,000,000.00
17	kWh Import of T5	kWh	0 to 1,000,000,000.00
18	kWh Import of T6	kWh	0 to 1,000,000,000.00
19	kWh Import of T7	kWh	0 to 1,000,000,000.00
20	kWh Import of T8	kWh	0 to 1,000,000,000.00
21	Interval kWh Import	kWh	0 to 1,000,000,000.00
22	Interval kWh Export	kWh	0 to 1,000,000,000.00
23	Interval kvarh Import	kvarh	0 to 1,000,000,000.00
24	Interval kvarh Export	kvarh	0 to 1,000,000,000.00
25	Interval kVAh Total	kVAh	0 to 1,000,000,000.00
26	DI1 Pulse Counter		0 to 999,999,999
27	DI2 Pulse Counter		0 to 999,999,999
28	DI3 Pulse Counter		0 to 999,999,999
29	DI4 Pulse Counter		0 to 999,999,999
30	DI5 Pulse Counter		0 to 999,999,999
31	DI6 Pulse Counter		0 to 999,999,999

4.8 Network Port Object List

Instance ID	Object Name	Comment
1	BACnet/IP Port	--

5   BIBBs and Services

5.1 BACnet Interoperability Building Blocks (BIBBs)

The following table describes the BACnet services supported by the BACnet interoperability building blocks of the iMeter 6. For more information, please refer to Annex K of the ANSI / ASHRAE-135-2020 standard.

BIBB	Description
Data Sharing Service	
DS-RP-B	Data Sharing-ReadProperty-B (Provider/Server)
DS-RPM-B	Data Sharing-ReadPropertyMultiple-B (Provider/Server)
DS-WP-B	Data Sharing-WriteProperty-B (Provider/Server)
DS-WPM-B	Data Sharing-WritePropertyMultiple-B (Provider/Server)
Device and Network Management Service	
DM-DOB-B	Device Management-Dynamic Object Binding-B (Provider/Server)
DM-TS-B	Device Management-TimeSynchronization-B (Provider/Server)
DM-DDB-B	Device Management-Dynamic Device Binding-B (Provider/Server)
DM-RD-B	Device Management-ReinitializeDevice-B (Provider/Server). Password verification can be enabled/disabled (default is disabled), please refer to Section 2
DM-DCC-B	Device Management-DeviceCommunicationControl-B (Provider/Server). Password verification can be enabled/disabled (default is disabled), please refer to Section 2
NM-FDR-A	Network Management-Foreign Device Registration-A.

5.2 Data Sharing Services

Data Sharing services allow a BACnet client to access any of the iMeter 6's BACnet objects' properties or modify some of its BACnet objects. A typical Data Sharing request that a BACnet client may make to a BACnet server such as iMeter 6 is ReadProperty, which allows a single property of a single object to be read.

5.3 Device and Network Management Services

Device and Network Management services allow the iMeter 6 to discover other BACnet devices (Who-Is and I-Am services), discover objects within devices (Who-Has service), establish and re-establish communications (DeviceCommunicationControl service), synchronize time (TimeSynchronization service) and re-initialize the iMeter 6's program (ReinitializeDevice service).

The iMeter 6 is capable of being registered as a foreign device to join a BACnet/IP network or logical subnet where the BACnet Broadcast Management Devices (BBMDs) exist. To implement that, the Foreign Device Register (FDR) mode shall be enabled, and the proper parameters for BBMD IP Address, BBMD UDP port and BBMD TTL shall be configured on the iMeter 6 as described in Section 2.