



B-PAT

Description

(BACnet - Project Address Table)

Version of Description: 1.00
Version of table layout: 1.00
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Author: Uwe Haeseler

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1. Revision Information (Description)

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Dezember 2008, Uwe Haeseler

2. Introduction

In BACnet projects it is very important to avoid BACnet address conflicts. BACnet address rules are more complex than IP address rules. As well as in IP projects it is necessary to plan all BACnet addresses.

Especially in multivendor projects it is important to handle all relevant BACnet address information centrally by one organizer. In this document, the organizer is referred to as the **BACnet administrator**.

An existing and implemented BACnet project is referred to as the **main project**.

When a main project is extended, all extensions to the BACnet system (BACnet networks, IP networks, devices, routers...) are considered to be part of a **sub project**. Once the implementation of the sub project is complete, the sub project becomes part of the main project. During the design and implementation of a brand new BACnet project no main project exist and the new BACnet project starts as a sub project.

A sub project is managed by the **sub project engineer**.

To hold all BACnet address information the BIG-EU developed the **BACnet - Project Address Table (B-PAT)**.

A B-PAT consists of two components:

- B-PAT description (this file)
- B-PAT table (a EXCEL file)

The BACnet administrator and the sub project engineer shall use a B-PAT for the

- planning,
- commissioning, and
- documenting

of BACnet addresses. The BACnet administrator is responsible for overseeing this process.

The B-PAT is used in addition to the EDE project files, which contain information about the BACnet objects of one or more devices.

3. BACnet Addressing Rules – Basics

3.1. BACnet network

The BACnet standard defines also a **BACnet internetwork** as ... *a set of two or more networks interconnected by routers. In a BACnet internetwork, there exists exactly one message path between any two nodes. ...*

A BACnet network is based on a **data link layer (DLL)** and it is addressed by a **network number**.

A BACnet internetwork consists of one or more **BACnet network(s)**.

A BACnet network number shall be:

- (1) unique within the BACnet internetwork, and
- (2) an integer in range 1 to 65.534.

There can be many BACnet networks with the same type of data link within a BACnet internetwork, but there cannot ever more than one BACnet network with a specific network number.

For some data links additional parameters are required:

data link layer	parameter
BACnet/IP	<ul style="list-style-type: none">- UDP port- Usually defined in the range BAC0...BAC9 (decimal range 47.808...47.817)
BACnet MS/TP	<ul style="list-style-type: none">- Baudrate [9.600, 19.200, 38.400, 76.800]- MS/TP Max Master (highest BACnet MAC address on the BACnet MS/TP network that can be used by a master node)
BACnet PTP	<ul style="list-style-type: none">- Baudrate- Phone number (only required for PTP links that utilize modems)

Often, in BACnet projects, there is a "main" BACnet network, referred to as the **BACnet Backbone**.

3.2. BACnet MAC address

The BACnet MAC address is the technical BACnet address of a device and it is used to send messages to devices.

An assigned BACnet MAC address shall be:

- (1) unique on the local BACnet network (does not have to be unique across the whole BACnet internetwork), and
- (2) structure and range depends by the data link layer

data link layer	BACnet MAC address description
BACnet/IP	Hexadecimal calculated by IP Address and port
BACnet MS/TP	MS/TP Master: integer number, in range 0...127 MS/TP Slave: integer number, in range 0...254
BACnet PTP	No MAC address is used on a PTP network.
BACnet Ethernet	The Ethernet MAC address of the network adapter. Depends on the installed hardware (network adapter).
BACnet LonTalk	Hexadecimal calculated by LON Subnet and LON Node - LON Subnet Number in Range 1...255 - LON Node Number Range 1...127
BACnet ARCNET	Integer number, in range 0...254
BACnet virtual	Defined by the vendor. Shall not exceed 6 octets in length.

3.3. BACnet Device

3.3.1. General

Every BACnet device contains exactly one *Device object*. The *Device object* specifies the device's:

- device instance, and
- device name.

Each BACnet device has one BACnet address consisting of:

- a network number, and
- a BACnet MAC address.

The format of the BACnet MAC address depends on the data link layer.

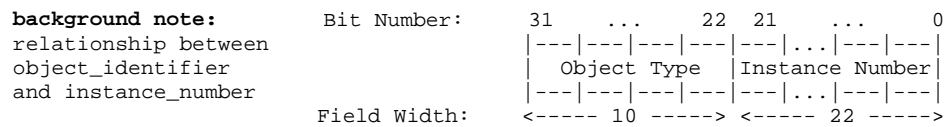
3.3.2. Device Instance Number

A BACnet device is addressed by the *Instance Number*, also named as device instance.

The device instance shall be:

- (1) unique within the BACnet internetwork, and
- (2) an integer number in range 0 to 4.194.302

Each BACnet object contains a property *Object_Identifier*, which is a combination of its *Object_Type* and its *Instance Number*.



3.3.3. Device Object Name

Each device has a Device Object Name, also called a Device Name.

The Device Name shall be:

- (1) unique within the BACnet internetwork,
- (2) a string.

3.4. Router

A **Router** connects two or more BACnet networks in a BACnet internetwork.

A router is used to connect:

- different data link layers (e.g. BACnet/IP network with MS/TP network), and/or
- same data link layers (e.g. two different BACnet/IP networks).

A router routes from one BACnet network to one or more other BACnet networks.

In the market today, there are different kinds of routers:

- with or without a Device object,
- hardware or software solution for computers,
- with connections to two or more BACnet networks,
- router only or controller router (automation station).

3.5. Special Functions for BACnet/IP Networks: BBMD

3.5.1. Basics

A BACnet Broadcast Management Device (BBMD) provides two functions:

- delivery of BACnet broadcast messages from one IP network to other IP networks, from BBMD to BBMD,
- delivery of BACnet broadcast messages from one IP network to other BACnet devices (Foreign Device), from BBMD to FD.

BBMDs contain two tables:

- a Broadcast Distribution Table (BDT) for identifying peer BBMDs, and
- a Foreign Device Table (FDT) for registered Foreign Devices.

BBMDs are only required if, within a single BACnet/IP network, there are BACnet devices on two or more IP subnets.

3.5.2. BBMD (BACnet Broadcast Management Device)

Rules for BBMDs:

- (1) there shall be at most one BBMD per IP subnet,
- (2) each BBMD device shall have a fixed IP-Address, DHCP is not permitted, and
- (3) the BDT contains the of the containing BBMD and the IP address of each peer BBMD to which it shall forward broadcast messages.

There are two types of BDT:

- **standard BDT** – all BBMD's of the BACnet/IP network are listed in the BDT,
- **asymmetric BDT** – a subset of the BBMD's of the BACnet/IP network are listed in the BDT.

The "standard" BDT is described in the BACnet standard.

The "asymmetric" BDT is not yet described in the BACnet standard but is sometimes necessary, because a hierarchical concept of BBMD structure is acceptable for the project. The BACnet standard is in the process of being changed to allow for this kind of BBMD configuration.

3.5.3. Foreign Device (FD)

A foreign device (FD) is a BACnet/IP devices that resides on an IP subnet that does not contain a BBMD. The FD registers with a BBMD in order to receive broadcasts from the BACnet internetwork.

A FD:

- (1) may reside on an IP subnet with 0 or more other FDs,
- (2) shall register with a single BBMD,
- (3) Should not reside on an IP subnet that contains a BBMD (because it leads to excess network traffic).

3.6. Required Planning Data

3.6.1. BACnet network

- BACnet network number
- Data Link Layer
- Data link layer specific parameters (e.g. IP UDP Port, MS/TP or PTP Baudrate, MS/TP Max Master)

3.6.2. IP Network

- IP Subnet
- Subnet Mask
- Default Gateway
- DHCP supported
- BBMD device
- BBMD parameters

3.6.3. Device

- Device Name
- Device instance
- device description
- vendor ID
- vendor Name
- Location
- Network number main
- Data Link Layer
- BACnet MAC address
- Router Port information
- BBMD/FD information
- Device profile

4. Project Handling

4.1. B-PAT Workflow

4.1.1. General

When there is a new sub project at a BACnet project, the BACnet Administrator has to coordinate the address data of the existing BACnet internetwork and the new BACnet networks with the sub project engineer. To create a new sub project there are three phases:

- (1) planning by the BACnet administrator and the sub project engineer,
- (2) implementation by the sub project engineer,
- (3) revision by the BACnet administrator and the sub project engineer.

BACnet Administrator and sub project engineer work together step by step to find a set of network and device addresses/names, so that there are no address/name conflicts between the existing BACnet main project and the new sub project.

4.1.2. Planning

The result of the planning stage is the design of the BACnet addresses for that sub project, documented in the B-PAT table.

- (1) The sub project engineer gives the BACnet administrator information about
 - planned data link layers,
 - expected number of devices at which locations,
 - data exchange: free form.
- (2) The BACnet administrator gives the following information back to the sub project engineer:
 - BACnet network numbers,
 - IP subnet numbers or ranges,
 - BBMD device numbers,
 - device names or project rules for names,
 - data exchange: free form or/and B-PAT table.
- (3) The sub project engineer plans everything in the B-PAT table with the required data of the sub project included providing as much detail as possible. The sub project engineer gives the updated B-PAT back to the BACnet administrator.
 - data exchange: B-PAT table.
- (4) The BACnet administrator integrates the planned sub project data into the main project data and checks it all. If all of the required data is correct and as complete as possible, the next phase (implementation) can start. Otherwise, the B-PAT table has to be reworked by the sub project engineer.
 - data exchange: B-PAT table.

4.1.3. Implementation

The sub project engineer uses all of the design information from the B-PAT table to create the networks and configure devices using the appropriate engineering tool(s).

All changes made to the design during the implementation phase shall be noted in an updated B-PAT. Relevant address changes should be confirmed by the BACnet administrator before commissioning the devices.

4.1.4. Revision

The sub project engineer gives the B-PAT file developed in the implementation phase to the BACnet administrator. The BACnet administrator merges this information into the main project file and checks it for possible address/name collisions.

4.2. General Tips for BACnet Addressing in Projects

- (1) Never change an object's address (device, input, output...) after another system integrator has completed a different part of the project (Graphics, Programs...) that references those BACnet objects. If you do, you will destroy his work.
- (2) Do not forget to verify the correctness of the BACnet addressing, otherwise network conflicts may result in intermittent communications within the BACnet internetwork.
- (3) Independent of the BACnet address rules, it makes sense to determine a set of rules for naming BACnet devices for each project, to ensure that the names follow a consistent structure. This structure may be different in every project but must provide unique names within a given project.
- (4) BACnet/IP networks are easier to manage if DHCP is not used for permanently installed devices (such as controllers).

5. B-PAT Table with Excel

5.1. General

The B-PAT table exists of 5 sheets:

- 0-General
- 1-BACnet network
- 2-IP-Network
- 3-Device
- 4-Vendor&Other

Sheets 0, 1, 2 and 3 are for project data, sheet 4 is reserved for parameters and macro data.

5.2. General Rules for Table Handling

- (1) There is only one central B-PAT table per project.
- (2) The standard filename structure for the central B-PAT table is (replace *cursive* parts with project date/details):
“B-PAT *project name* yyyy-mm-dd.xls”
- (3) The standard filename structure for sub project B-PAT tables with additions/modifications to the central B-PAT is (replace *cursive* parts with project date/details):
“B-PAT *project name* yyyy-mm-dd *project sub project name* yyyy-mm-dd”

(The first date is the original date of current central B-PAT file; the second date is the date of engineer’s change / additions.)
- (4) No columns shall be deleted from the table or add to the table, otherwise merging of different B-PAT tables is difficult.
- (5) Do not change any coloured lines.
- (6) Do not colour lines by yourself to mark changes, instead use the column “Last Changes” to indicate changes.
- (7) There are cells for:
 - Manual inputs (white)
 - Manual inputs with wrong values (red)
 - No inputs (grey)
 - Calculated values (green)
- (8) There are some checks for ranges, format, double data, etc. The checks are:
 - Automatically performed for a cell, after data is changed that cell, and
 - After pressing the button “Check all!” for the sheet.

5.3. Sheets

5.3.1. Sheet 0-general

There are two sections of the B-PAT sheet 0-general: main and sub project information. In the centrally handled B-PAT table, the sub project section shall be empty. When the project engineer of a sub project provides a B-PAT table, the information for the sub project should be in the sub project section.

The B-PAT layout version shall be noted, because the B-PAT table structure may be developed in future.

Project Information

- Project name
- System integrator name
- BACnet administrator name
- Last change
- B-PAT macro version
- B-PAT layout version

Sub Project Information

- sub project name
- sub system integrator
- sub project engineer
- last change

Also there are some comments and a colour legend.

5.3.2. Sheet 1-BACnet network

This sheet contains entries about BACnet networks.

issue	entry	Description	Check
BACnet network number	manual	range 1 to 65.534	Automatically: - network range If <i>__unique</i> in 2.headline and after "Check all!": - double network number
data link layer	manual choice	---	---
IP UDP port	manual choice	Only required for - BACnet/IP	---
MS/TP or PTP baudrate	manual choice	Only required for - BACnet MS/TP - BACnet PTP	---
MS/TP max master	manual	Only required for - BACnet MS/TP	---
remarks	manual	Project specific text about location, functionality...	---
last change	manual	Date of last change of this line	---

5.3.3. Sheet 2-IP network

This sheet contains entries about IP networks. There are three sections on this sheet:

- (1) IP network,
- (2) BBMD device, and
- (3) asymmetric BBMD tables.

issue	entry	Description	Check
(1) IP subnet	manual	Network IP number	If <i>IPunique</i> in 3. headline and after “Check all!”: - double network number - network structure
(1) subnet mask	manual	Network IP subnet mask	If <i>IP</i> in 3. headline and after “Check all!”: - network structure
(1) default gateway	manual	Network IP default gateway	If <i>IPunique</i> in 3. headline and after “Check all!”: - double network number - network structure
(1) DHCP supported	manual choice	range [yes, no]	---
(2) BBMD device	manual	device IP number	---
(2) max. entries in BDT table	manual	Integer number, depends by the vendor	---
(3) BDT table entries	manual choice	range [standard, asymmetric]	---
(3) asymmetric BBMD tables	manual	One column per BBMD, add so much columns as required by yourself! A column contains one BDT table.	If <i>IPunique</i> in 3. headline and after “Check all!”: - double network number - network structure

5.3.4. Sheet 3-device

This sheet contains entries about BACnet devices. All of the information for the BACnet/IP devices should be filled out on this page, to reduce the risk of IP conflicts.

There are 6 sections on this sheet:

- (1) BACnet device (all are properties of the device object)
- (2) main network
- (3) router port1
- (4) router port2
- (5) router port3
- (6) other information

issue	entry	Description	Check
(1) device name	manual	range [0 to 4.194.302]	If <i>__unique</i> in 3. headline and after "Check all!": - double name
(1) device instance	manual	---	Automatically: - instance range If <i>__unique</i> in 3. headline and after "Check all!": - double number
(1) device description	manual	---	----
(1) vendor ID	manual	---	----
(1) vendor name	calculated	---	---
(1) location	manual	installation location of the device	---
(2) network number main	manual choice	Network number of the BACnet Backbone	---
(2) data dink layer	calculated	---	---
(2) address	manual	Base for BACnet MAC address depended by the data link layer or phone number for data link layer PTP.	If <i>IPunique_net</i> in 3. headline and after "Check all!": - double number - address structure depended by DDL

issue	entry	Description	Check
(2) BACnet MAC address	calculated	---	---
(3) network number port1	manually choice	Network number of port 1	If <i>__unique</i> in 3. headline and after “Check all!”: - double number in port columns
(3) data link layer	calculated	Data link type of port 1	---
(3) address	manually	MAC address of port 1	If <i>IPunique_net</i> in 3. headline and after “Check all!”: - double number - address structure depended by DDL
(4) network number port2	manually choice	Network number of port 2 (if present)	If <i>__unique</i> in 3. headline then: - double number in port columns
(4) data link layer	calculated	Data link type of port 2 (if present)	---
(4) address	manually	MAC address of port 2 (if present)	If <i>IPunique_net</i> in 3. headline and after “Check all!”: - double number - address structure depended by DDL
(5) network number port3	manually choice	Network number of port 3 (if present)	If <i>__unique</i> in 3. headline and after “Check all!”: - double number in port columns
(5) data link layer	calculated	Data link type of port 3 (if present)	---
(5) address	manually	MAC address of port 3 (if present)	If <i>IPunique_net</i> in 3. headline and after “Check all!”: - double number - address structure depended by DDL
(6) BBMD / FD	manually choice	range [BBMD, FD]	---

issue	entry	Description	Check
(6) FD to BBMD address	manually	IP address of the registered BBMD (entered only if the device is a FD)	If <i>IP</i> in 3. headline and after “Check all!”: - IP network structure
(6) device profile	manually choice	BACnet device profile	---
(6) function type	manually choice	Main technological function of the device.	---
(6) vendor specific address	manually	If a vendor uses a proprietary address for the device, it shall be noted here.	---
(6) last change	manually	Date of last change of this line	---
(6) consecutive number	manually	Useful for sort or merge algorithm, shall be unique for this sheet. Shall be not changed.	---

5.3.5. Sheet 4-vendor&other

The sheet holds basic data for checks and calculation. Only the following columns should be updated only by the BACnet administrator, none should be updated by the sub project engineer:

- (1) vendor ID
- (2) vendor name
- (3) function type

To edit the sheet you need the password: “B-PAT”