

Chunghwa Telecom Laboratories

CHT NB-IoT UDP Message Protocol

V1.58

Smart IoT Institute

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Document Revision History Table			
Document Number: Name: Instructions for CHT NB-IoT UDP Message Protocol			
Number	Date of Approval	Version	Revision Content
1.	3.20.2017	1.0	Initial document
2.	3.22.2017	1.1	<p>(1) The Device Key in the request message of equipment is added.</p> <p>(2) The ping message name is changed to HeartBeat message, corresponding to the HeartBeat message of the IoT platform.</p> <p>(3) The period field of the HeartBeat is added to the response message for registration.</p> <p>(4) The Sense Period field name in the response message for registration is modified.</p> <p>(5) The definition of checksum calculation is modified.</p> <p>(6) The shutdown message is removed because no corresponding message is available on the IoT platform.</p>
3.	3.23.2017	1.2	(1) The Length field is added to the Header to show the length of Payload.
4.	3.27.2017	1.3	(1) The encryption method is changed to undecided. It will be updated after the establishment of follow-up standards.
5.	3.28.2017	1.4	(1) The 3.4 message example is added.
6.	3.30.2017	1.5	<p>(1) The name of registration message is changed to the time message. The message content is also changed.</p> <p>(2) The monitoring requests and control requests are modified.</p>
7.	4.06.2017	1.51	<p>(1) The notes for the monitoring request and HeartBeat request messages are added.</p> <p>(2) The report period field is added for the</p>

			HeartBeat request message.
8.	05.04.2017	1.52	(1) The monitoring requests and control requests in the message example in 3.4 are modified.
9.	05.17.2017	1.53	(1) The data type of Device Id is changed to below 8 bytes to meet the scope of Device Id value assigned by the IoT platform. (2) The 3.4 message example is modified.
10.	05.18.2017	1.54	(1) The value is expanded to 8 bytes to correspond with the value of Device Id and modified to 3.4. Content of the message example
11.	07.18.2017	1.55	(1) The uplink and downlink services of the UDP adapter are separated. The Message Id=0xF0~0xFF section is reserved for the UDP adapter.
12.	07.24.2017	1.56	(1) The description about the example for the longitude and latitude carried by the sensor is added.
13.	07.26.2017	1.57	(1) The registration request and registration response message are added.
14.	10.20.2017	1.58	(1) The message modified must not be greater than 1000 bytes. (2) The Header Length is modified to 2 bytes. (3) The customized monitoring request/customized monitoring response/customized control request/customized control response message are added. (4) The content of message example is modified and added.

1. Background information

The NB-IoT module only supports UDP protocol for now. The message communication protocol for the UDP adapter of the terminal and IoT platform must be defined based on the UDP.

2. Application scenario

The demonstration of NB-IoT focuses on fish farm and environmental monitoring. Refer to the following diagram.

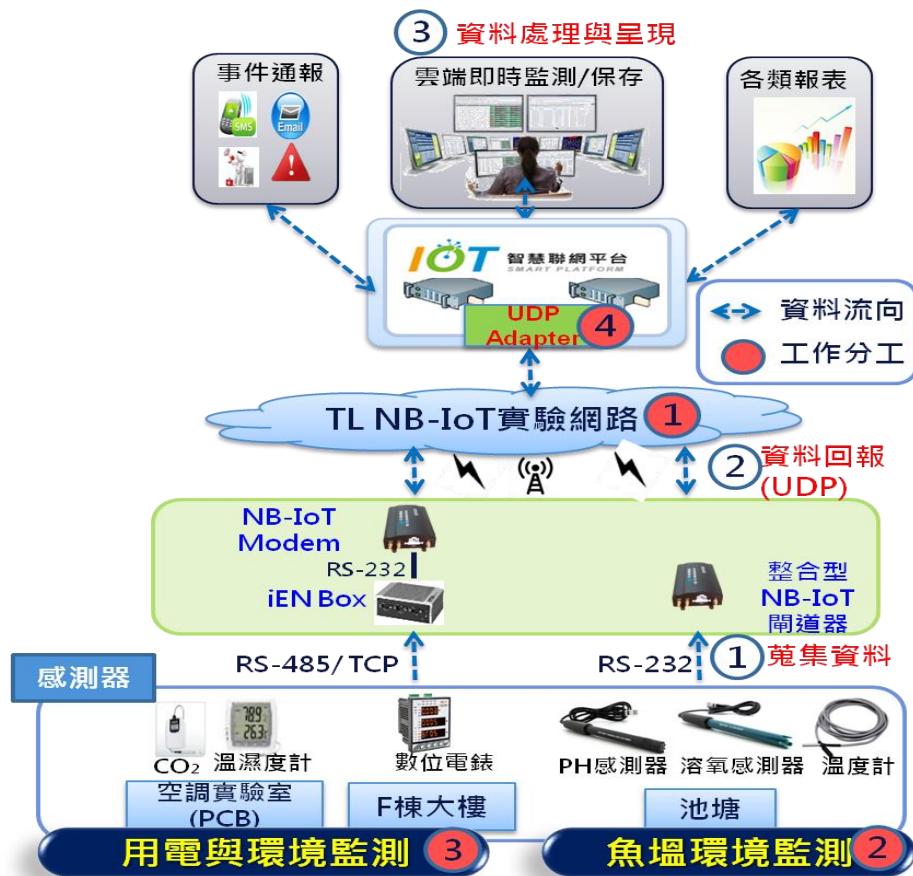


Fig. 1: NB-IoT application scenario diagram

3. Communication protocol

3.1 Message format: The binary package format is adopted. 1000 bytes is the upper limit for the message.

Message Id	Device Id	SN	Length	Payload	Checksum
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- Message Id: It has 1 byte (type: byte). Message Id, namely OP Code, indicates the message category.
- Device Id: It has 8 bytes (type: Int64). It indicates the equipment code, which is the **equipment number of IoT platform**. **Little Endian** is adopted.
- SN: It has 1 byte (type: byte). It indicates the message serial number. **The range is 0~127. The maximum byte (MSB) is used for differentiating message types Request(0x01) or Response(0x00).**
- Length: The length is 2 bytes (type: word). It indicates the payload length.
- Payload: 0~987 byte
 - ◆ **Non-customized type: The Jason format is adopted to meet the parameter setting relative to the IoT platform**, such as the sensor Id. The **device key** is added for the UDP adapter to communicate with the Restful API or MQTT.
 - ◆ **Customized type: Customers can define the payload themselves.** This means that we help customers to transfer the data to the IoT platform or terminal equipment.
- Checksum: The length is 1 byte (type: byte). It indicates the checksum. The **XOR calculation** is conducted for the **Hex value** of Message Id, Device Id, SN, Length and Payload.

The types of field in the message are char, byte, word, int and Int64. The **byte order** is **Little Endian**.

3.2 Message category

Message Id	Message category	Message type	Message description
0x00	Registration request	Request	The equipment submits the registration request.
0x00	Registration response	Response	The platform replies the information on equipment registration.
0x01	Time request	Request	The equipment submits the time request.
0x01	Time response	Response	The platform replies the time

			information of equipment.
0x02	Monitoring request (Note 1)	Request	The equipment reports the collected sensing data to the platform.
0x02	Monitoring response	Response	The platform replies that it has received the sensing data.
0x03	Control request	Request	The platform sends the control command to the equipment to carry out the operation.
0x03	Control response	Response	The equipment replies the platform that it has received the control command.
0x04	HeartBeat request (Note 2)	Request	The equipment reports the HeartBeat regularly for the platform to understand the health status of equipment.
0x04	HeartBeat response	Response	The platform replies that it has received the Heartbeat request from the equipment.
0xA2	Customized monitoring request	Request	The equipment reports the sensing data collected to the platform. (Customers can define the payload themselves.)
0xA2	Customized monitoring response	Response	The platform replies that it has received the sensing data. (Customers can define the payload themselves.)
0xA3	Customized control request	Request	The platform sends the customized control request to the equipment to carry out the operation. (Customers can define the payload themselves.)
0xA3	Customized control response	Response	The equipment replies the platform that it has received the customized control command. (Customers can define the payload themselves.)
0xF0~0xFF	Reserved for the UDP adapter	0xF0~0xFF	It is reserved for the UDP adapter.

(Note 1) The default sending cycle for the monitoring request message is 30 seconds.

(Note 2) The HeartBeat request is an optional message. It is sent when necessary. The default sending cycle is 180 seconds.

3.3 Message description

(1) Registration request: The Payload contains the Device Info field.

Registration request (0x00)	Request (Equipment request)	Length: N bytes	Note
Message Id	Message category	byte, 0x00	The equipment submits the registration request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of the IoT platform. The user can enter 0 (default) when the terminal has no Device Id at the beginning.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x01
Length	Payload length	word	
Device Info	Equipment information	char[]	The Device Info adopts the Jason format and it includes the Product Code and Serial Id. The Product Code refers to the product code of the IoT platform. The user may enter a string containing English letters, numbers or underscore. The Serial Id refers to the product serial number of the IoT platform. IMEI can be used for the car head unit.
Checksum	Checksum	byte	

(Note) The following is the instruction for the example of registration request:

```
{"pid":"TLC500","sn":"358709050129802"}
```

“pid” refers to the product code and “sn” refers to the serial number of product.

(2) Registration response: The Payload contains the Status to Device Key fields.

Registration response (0x00)	Response (Response from the platform)	Length: 32 bytes	Note

Message Id	Message category	byte, 0x00	The platform responds to the time request.
Device Id	Equipment code	Int64	The length is 8 bytes. The IoT platform provides the Device Id to the equipment for storage. Therefore, it would be easier to send messages later on.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x00
Length	Payload length	word	
Status	Registration reply	byte	0: Registration fails; 1: Registration is completed successfully.
Device Key	Device key	byte[18]	This is a device key under the device management of the project for which the IoT platform belongs to.
Checksum	Checksum	byte	

(3) Time request: The Payload contains the Cipher field.

Time request (0x01)	Request (Equipment request)	Length: 14 bytes	Note
Message Id	Message category	byte, 0x01	The equipment submits the time request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x01
Length	Payload length	word	
Cipher	This field indicates whether to conduct the encryption.	byte	0x00: Not encrypted; 0x01: Encrypted.
Checksum	Checksum	byte	

(4) Time response: The Payload contains the Status to Unix Time fields.

Time response (0x01)	Response (Response from the platform)	Length: 18 bytes	Note
Message Id	Message category	byte, 0x01	The platform responds to the time request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x00
Length	Payload length	word	
Status	Status response	byte	0x00: The time request is successful (not encrypted). 0x01: The time request is successful (encryption required). All payloads for sending messages later on are encrypted during transmission. (The encryption method is yet to be determined.) 0x02~0xFF: This indicates a failure of the time requests.
Unix Time	Platform time	int	The length is 4 bytes. This indicates the total number of seconds from January 1st, 1970 at 0:0:0 until now (based on UTC).
Checksum	Checksum	byte	

(5) Monitoring request: The Payload contains fields from the Device Key to Raw Data.

Monitoring request (0x02)	Request (Equipment request)	Length: N bytes	Note
Message Id	Message category	byte, 0x02	The equipment submits the monitoring request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial	byte	Serial number: 0~127, MSB:0x01

	number		
Length	Payload length	word	
Device Key	Device key	byte[18]	This is a device key under the device management of the project for which the IoT platform belongs to.
Sensor Time	This indicates the time that the sensing data is generated.	int	The length is 4 bytes. This indicates the total number of seconds from January 1st, 1970 at 0:0:0 until now (based on UTC).
Raw Data	Sensing data	char[]	It adopts the Jason format and contains the Sensor Id and Sensor Value. The Sensor Id refers to the sensor ID of IoT platform. The user may enter a string containing English letters, numbers or underscore. If more than 1 sensor value is available, the values must be separated by commas.
Checksum	Checksum	byte	

(Note) The following explains the example for the longitude and latitude carried by the sensor:

```
{"id":"Speed","lat":"24.955838","lon":"121.167930","value":["0","60"]}
```

The user can add “lat” and “lon” attributes to carry the latitude and longitude information. The user can use the “value” attribute to carry multiple values separated by comma. The first parameter in this example is positioning status (1: Effective positioning, 0: Ineffective positioning, 9: Device error). The second parameter is GPS speed (km/hr).

(6) Monitoring response: No Payload.

Monitoring response (0x02)	Response (Response from the platform)	Length: 13 bytes	Note
Message Id	Message category	byte, 0x02	The platform responds to the monitoring request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.

SN	Message serial number	byte	Serial number: 0~127, MSB:0x00
Length	Payload length	word, 0x00	
Checksum	Checksum	byte	

(7) Control request: The Payload contains the Cmd Data field.

Control request (0x03)	Request (Platform request)	Length: N bytes	Note
Message Id	Message category	byte, 0x03	The platform submits the control request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x01
Length	Payload length	word	
Cmd Data	Command data	char[]	It adopts the Jason format and contains the Sensor Id and command parameter. The Sensor Id refers to the sensor ID of IoT platform. The user may enter a string containing English letters, numbers or underscore. If more than 1 parameter is available, the parameters must be separated by commas.
Checksum	Checksum	byte	

(Note 1) UDP Adapter: Refer to the sensing data protocol (Rawdata) of the IoT platform website (<https://iot.cht.com.tw/iot/developer/mqtt>) to decipher the command and parameter before sending the data to the equipment end.

(8) Control response: No Payload.

Control response (0x03)	Response (Equipment response)	Length: 13 bytes	Note
Message Id	Message category	byte, 0x03	The equipment responds to the control request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.

SN	Message serial number	byte	Serial number: 0~127, MSB:0x00
Length	Payload length	word, 0x00	
Checksum	Checksum	byte	

(9) HeartBeat request: The Payload contains the Device Key.

HeartBeat request (0x04)	Request (Equipment request)	Length: 33 bytes	Note
Message Id	Message category	byte, 0x04	The equipment submits the HeartBeat request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x01
Length	Payload length	word	
Device Key	Device key	byte[18]	This is a device key under the device management of the project for which the IoT platform belongs to.
Report Period	Report period	word	The length is 2 bytes. This refers to the Heartbeat report period (unit: second). It is set to 180 seconds by default.
Checksum	Checksum	byte	

(10) HeartBeat Response: No Payload.

HeartBeat response (0x04)	Response (Response from the platform)	Length: 13 bytes	Note
Message Id	Message category	byte, 0x04	The platform responds to the HeartBeat request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x00
Length	Payload length	word, 0x00	

Checksum	Checksum	byte	
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- (11) Customized monitoring request: **Customers can define the payload themselves.**

Monitoring request (0xA2)	Request (Equipment request)	Length: N bytes	Note
Message Id	Message category	byte, 0xA2	The equipment submits the monitoring request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x01
Length	Payload length	word	
Device Key	Device key	byte[18]	This is a device key under the device management of the project for which the IoT platform belongs to.
Payload		byte[N]	Customers define this themselves.
Checksum	Checksum	byte	

- (12) Customized monitoring response: **Customers can define the payload themselves.**

Monitoring response (0xA2)	Response (Response from the platform)	Length: N bytes	Note
Message Id	Message category	byte, 0xA2	The platform responds to the monitoring request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x00
Length	Payload length	word, 0x00	
Payload		byte[N]	Customers define this themselves.
Checksum	Checksum	byte	

- (13) Customized control request: **Customers can define the payload themselves.**

Control request (0xA3)	Request (Platform request)	Length: N bytes	Note
Message Id	Message category	byte, 0xA3	The platform submits the control request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x01
Length	Payload length	word	
Payload		byte[N]	Customers define this themselves.
Checksum	Checksum	byte	

(14) Customized control response: **Customers can define the payload themselves.**

Control response (0xA3)	Response (Equipment response)	Length: N bytes	Note
Message Id	Message category	byte, 0xA3	The equipment responds to the control request.
Device Id	Equipment code	Int64	The length is 8 bytes. It is the equipment number of IoT platform.
SN	Message serial number	byte	Serial number: 0~127, MSB:0x00
Length	Payload length	word, 0x00	
Payload		byte[N]	Customers define this themselves.
Checksum	Checksum	byte	

3.4 Message example

The following message is displayed by the **Hex value. int adopts the Little Endian** (low byte at the front and high byte at the back).

I. Registration request (0x00):

(1) Message Id: 0x00

(2) Device Id: 4387025529 = 0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00

(3) SN: **0x80(MSB=1)**

(4) Length: **0x27,0x00 (payload length)**

(5) Device Info:

{"pid":"TLC500","sn":"358709050129802"}=0x7B,0x22,0x70,0x69,0x64,
0x22,0x3A,0x22,0x54,0x4C,0x43,0x35,0x30,0x30,0x22,0x2C,0x22,0x73,0x6E,
0x22,0x3A,0x22,0x33,0x35,0x38,0x37,0x30,0x39,0x30,0x35,0x30,0x31,0x32,0
x39,0x38,0x30,0x32,0x22,0x7D

(6) Chksum: 0x05

II. Registration response (0x00):

(1) Message Id: 0x00

(2) Device Id: 4387025529 =0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00

(3) SN: **0x00(MSB=0)**

(4) Length: **0x13,0x00 (payload length)**

(5) Status: 0x01

(6) Device Key:

1234567890ABCDEFGH=0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39,0x
30,0x41,0x42,0x43,0x44,0x45,0x46,0x47,0x48

(7) Chksum: 0xA8

III. Time request (0x01):

(1) Message Id: 0x01

(2) Device Id: 4387025529 =0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00

(3) SN: **0x80(MSB=1)**

(4) Length: **0x01,0x00 (payload length)**

(5) Cipher:0x00

(6) Chksum: 0x33

IV. Time reply (0x01):

(1) Message Id:0x01

(2) Device Id:4387025529 =0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00

- (3) SN: 0x00(MSB=0)
- (4) Length: 0x05,0x00(payload length)
- (5) Staus: 0x00
- (6) Unix time: 1490602012=0x1C,0xC8,0xD8,0x58
- (7) Chksum: 0xE3

V. Monitoring request (0x02):

- (1) Message Id: 0x02
- (2) Device Id: 4387025529 =0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00
- (3) SN: 0x80(MSB=1)
- (4) Length: 0x35,0x00(payload length)
- (5) Device Key:
1234567890ABCDEFGH=0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39,0x30,0x41,0x42,0x43,0x44,0x45,0x46,0x47,0x48
- (6) Sensor Time: 1493715588=0x84,0x4A,0x08,0x59
- (7) Raw Data:
{ "id": "SEN1", "value": ["25.68"] } =0x7B,0x22,0x69,0x64,0x22,0x3A,0x22,0x53,0x45,0x4E,0x31,0x22,0x2C,0x22,0x76,0x61,0x6C,0x75,0x65,0x22,0x3A,0x5B,0x22,0x32,0x35,0x2E,0x36,0x38,0x22,0x5D,0x7D
- (8) Chksum: 0x96

VI. Monitoring response (0x02):

- (1) Message Id: 0x02
- (2) Device Id: 4387025529 =0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00
- (3) SN: 0x00(MSB=0)
- (4) Length: 0x00,0x00(payload length)
- (5) Chksum: 0xB1

VII. Control request (0x03):

- (1) Message Id: 0x03
- (2) Device Id:4387025529 = 0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00
- (3) SN: 0x80(MSB=1)
- (4) Length: 0x1F,0x00 (payload length)
- (5) Cmd Data:
{ "id": "SEN2", "cmd": ["10", "30"] } =0x7B,0x22,0x69,0x64,0x22,0x3A,0x22,0x53,0x45,0x4E,0x32,0x22,0x2C,0x22,0x63,0x6D,0x64,0x22,0x3A,0x5B,0x22,0x31,0x30,0x22,0x2C,0x22,0x33,0x30,0x22,0x5D,0x7D
- (6) Chksum: 0x20

VIII. Control response (0x03):

- (1) Message Id: 0x03
- (2) Device Id: 4387025529 =0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00
- (3) SN: 0x00(MSB=0)
- (4) Length: 0x00,0x00(payload length)
- (5) Chksum: 0xB0

IX. HeartBeat request (0x04):

- (1) Message Id: 0x04
- (2) Device Id: 4387025529 =0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00
- (3) SN: 0x80(MSB=1)
- (4) Length: 0x14,0x00(payload length)
- (5) Device Key:
1234567890ABCDEFGH=0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39,0x30,0x41,0x42,0x43,0x44,0x45,0x46,0x47,0x48
- (6) Report Period: 0xB4,0x00
- (7) Chksum: 0x9E

X. HeartBeat response (0x04):

- (1) Message Id: 0x04
- (2) Device Id: 4387025529 =0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00
- (3) SN: 0x00(MSB=0)
- (4) Length: 0x00,0x00(payload length)
- (5) Chksum: 0xB7

XI. Customized monitoring request (0xA2):

- (1) Message Id: 0xA2
- (2) Device Id:4387025529 = 0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00
- (3) SN:0x80(MSB=1)
- (4) Length:0x1C,0x00(payload length)
- (5) Device Key:
1234567890ABCDEFGH=
0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39,0x30,0x41,0x42,0x43,0x44,0x45,0x46,0x47,0x48
- (6) Payload:
0123456789= 0x30,0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39
- (7) Chksum: 0x85

XII. Customized monitoring response (0xA2):

(1) Message Id: 0xA2

(2) Device Id:4387025529 = 0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00

(3) SN: 0x00(MSB=0)

(4) Length: 0x0A,0x00(payload length)

(5) Payload:

0123456789= 0x30,0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39

(6) Chksum: 0x1A

XIII. Customized control request (0xA3):

(1) Message Id: 0xA3

(2) Device Id:4387025529 = 0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00

(3) SN: 0x80(MSB=1)

(4) Length: 0x0A,0x00 (payload length)

(5) Payload:

0123456789= 0x30,0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39

(6) Chksum: 0x9B

XIV. Customized control response (0xA3):

(1) Message Id: 0xA3

(2) Device Id:4387025529 = 0x79,0xB2,0x7C,0x05,0x01, 0x00,0x00,0x00

(3) SN: 0x00(MSB=0)

(4) Length: 0x0A,0x00(payload length)

(5) Payload:

0123456789= 0x30,0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39

(6) Chksum: 0x1B