



DTU Management Protocol (IHDMP)

Usage Instructions

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1. About This Document

1.1 Purpose

This document describes how to configure and monitor DTU from user device through a serial port for device commissioning, inspection, and assembly.

1.2 Terms

- DTU: InHand wireless data terminal.
- User device: Device that a user connects to the DTU local serial port and local serial port 2.
- User data: Data that the user device transparently transmits through the DTU.
- Configuration data/Configuration packet: Data that complies with the DTU configuration protocol (IHDMP).
- Short message command packet/Short message command data: Configuration packet that contains the short message sending command. For details, see "[Short message sending command](#)."
- Frame: Unit for calculating the communication data of the serial port. The DTU framing mechanism is as follows: The current data content is considered as a frame when the length of the data received by the serial port exceeds the frame size or the serial port receives no data after the scan interval.
- TLV: Data encapsulation format of variable length.
- Hex: Short for Hexadecimal.
- IHDMP: DTU management protocol independently developed by InHand Networks.

2. Functions

2.1 Requirements

Requirements of reading, configuring, and monitoring the DTU:

DTU configuration is complex after device assembly. Therefore, the user device needs to configure and read the DTU directly to facilitate production commissioning, inspection, and assembly.

The user device also needs to monitor the DTU status to analyze and fix faults and collect traffic statistics. Some users require sending and receiving short messages while using IP data traffic links.

Solution:

The interaction between the user device and DTU is based on a protocol. All data is in the TLV format.

Different tags indicate different [configuration items](#) or [states](#). The serial port can be used to read and write DTU configuration, send and receive short messages, and read the cellular modules state.

The DTU management protocol IHDMP provides the following function:

- Reads and delivers DTU configuration.
- Reads the DTU status.
- Sends and receives short messages.
- Restores default settings.
- Restarts the DTU.

2.2 Configuration Delivery Method

The user device sends configuration packets through the local serial port and local serial port 2. Local serial port 1 provides the 4K cache that stores user data and short message sending command packets. For details about short message sending, see "[Short message sending](#)." Common configuration packets are stored in a 1K cache. Local serial port 2 provides a 1K cache. Note the following points when delivering configuration packets and user data:

Note:

1. The user device cannot put the user data and configuration packet in the same frame for sending.
2. The interval between sending user data and sending a configuration packet and that between sending configuration packets must be greater than the configured serial port scan interval. The local serial port and local serial port 2 are respectively configured with a scan duration by using the InHand DTU configuration tool. The default scan duration is 200 ms.
3. The total length of the configuration data delivered by the user device cannot exceed the configured frame size; otherwise, data may be corrupted due to framing. The local serial port and local serial port 2 are respectively configured with a frame size by using the InHand DTU

configuration tool. The device frame size is 1024 bytes.

4. The DTU does not respond if the configuration data delivered by the user device does not meet the requirements of the IHDMP protocol.

3. Protocol Content

The IHDMP protocol provides the communication specification for the interaction between the user device (host computer) and DTU.

3.1 Data Format

The data exchanged based on the IHDMP protocol is in the Hex format.

3.2 Endian

The data specified by the IHDMP protocol is transmitted based on network endian, that is, big endian.

3.3 Data Packet Format

- Input data of the DTU:

Packet header	Command word	Packet body length	Packet body	CRC16
55 AA 55 AA	1 byte	2 bytes	TLVs	2 bytes

- Output data of the DTU

Packet header	Command word	Packet body length	Packet body	CRC16
AA 55 AA 55	1 byte	2 bytes	TLVs	2 bytes

Note:

The used command word varies depending on different functions. For details, see sections [3.4](#) and [3.5](#). For details about the CRC algorithm, see [Appendix 1: CRC16 Source Code](#). The CRC16 value can be obtained by calling the `byAddCrc16` function.

The CRC performed on the data packets returned by the DTU does not include any command word, whereas the CRC performed on the data packets that the lower device sends to the DTU includes a header, command word, packet body length, and packet body.

The packet body length indicates the length of the packet body, that is, the total length of the data excluding the packet header, command word, packet body length, and CRC. The packet body length is 0 if the packet body is empty.

The packet body is in the TLV format. A configuration packet may include multiple TLVs. For details about the TLV, see [Appendix 2: Configuration Item Tags](#).

Tag	Length	Value
2 bytes	2 bytes	Indefinite

3.4 DTU Control

3.4.1 Detecting the DTU

Command word: **0x03**

User device: **55 AA 55 AA 03 00 00 11 65**

DTU: **AA 55 AA 55 03 00 09 81 2A 00 05 30 63 38 30 31 FB F6**

TLVs: **81 2A 00 05 30 63 38 30 31**

Tag: **81 2A**

Length: **00 05**

Value: **30 63 38 30 31**, indicating the login status and serial port parameters

The first byte **30** indicates no login, and **31** indicates administrator login. The last four bytes indicate the following serial port parameters: baud rate, data bit, check mode, and stop bit. For details about the serial port parameters; see [Appendix 2: Configuration Item Tags](#).

3.4.2 Logging in to the DTU

Command word: **0x05**

User device: **55 AA 55 AA 05 00 11 81 10 00 03 61 64 6D 81 11 00 06 31 32 33 34 35 36 1F 44**

TLVs: **81 10 00 03 61 64 6D 81 11 00 06 31 32 33 34 35 36**, including the following two TLVs:

- 1) User name:

Tag: **81 10**

Length: **00 03**

Value: **61 64 6D**: which is the ASCII code of adm

- 2) Password:

Tag: **81 11**

Length: **00 06**

Value: **31 32 33 34 35 36**, which is the ASCII code of 123456

DTU: **AA 55 AA 55 05 00 01 01 23 C1**

The response only contains a packet body with a length of 1. **01** indicates successful administrator login. **00** indicates no login.

3.4.3 Restarting the DTU

Command word: **0x12**

User device: **55 AA 55 AA 12 00 00 58 BA**

DTU: **AA 55 AA 55 12 00 01 01 23 C1**

The response only contains a packet body with a length of 1.

3.4.4 Activating the DTU for Network Connection

Command word: 0x14

Activate GPRS and connect to the first data center:

User device: 55 AA 55 AA 14 00 05 81 85 00 01 01 48 9E

DTU response: AA 55 AA 55 14 00 00 B8 C9

The response data frame acknowledges activation command reception by the DTU. If no response is received, the DTU is activated and connected. This function is deprecated in many versions.

3.4.5 Reading a Specific Status of the DTU

This command is not supported by some version but is supported by the latest firmware.

3.4.5.1 Example 1: Reading the Device Status

Command word: 0x15

User device: 55 AA 55 AA 15 00 04 81 83 00 00 7D 0D

0x8183 indicates the current device status.

DTU response: AA 55 AA 55 15 00 05 81 83 00 01 01 0D 9C

0x01 indicates that the master station is successfully connected. For details about the parameters that support 0x15 command query, see "[Appendix 3: Status Tags.](#)"

The 0x15 command overlaps the 0x1A command in some respects. Select the proper command as needed.

Reading all states is supported:

Sending by the user device: 55 AA 55 AA 15 00 00 5D 36

3.4.5.2 Example 2: Reading the Disconnection Times of a Data center

1. Reading the disconnection times of the specified data center, e.g. data center No.1

Delivery by the user device: 55 AA 55 AA 15 00 04 83 20 00 00 B8 D4

DTU response: AA 55 AA 55 15 00 06 83 20 00 02 00 01 04 9B

The value in the TLV 83 20 00 02 00 01 is 0x01, indicating one disconnection from the data center.

2. Reading the disconnection times of all data centers

Delivery by the user device: 55 AA 55 AA 15 00 14 83 20 00 00 83 21 00 00 83 22 00 00 83 23 00 00 83 24 00 00 FF 48

DTU response: AA 55 AA 55 15 00 1E 83 20 00 02 00 01 83 21 00 02 00 01 83 22 00 02 00 01 83 23 00 02 00 00 83 24 00 02 00 00 FB 8E

Or:

Sending by the user device: 55 AA 55 AA 15 00 00 5D 36

Extract the corresponding TLV from the TLV group returned by the DTU.

Note:

Disconnection times statistics are collected on the following events: disconnection initiated by the server, connection reset initiated by the server, abnormal network connection, and link disconnection initiated by the operator.

3.4.6 Reading the Current Time of the DTU

This command is not supported by some versions, but is supported by the latest firmware.

Command word: 0x07

Two formats are provided. 0x00 uses the relative time format (relative to January 1, 1970), and 0x01 uses the absolute time format (year-month-day hours:minutes:seconds). The DTU obtains the time from the configured SNTP server through the SNTP protocol. If no SNTP server is configured, the time is obtained from the default SNTP server.

3.4.6.1 Relative time format:

User device: 55 AA 55 AA 07 00 01 00 21 9A

- 1) The DTU returns the following response if the time is valid (the DTU obtains the calibrated time):

AA 55 AA 55 07 00 07 01 54 D3 15 86 01 EF C4 E0

0x01 indicates that the time consisting of the subsequent 6 bytes is valid.

54 D3 15 86: Number of seconds from January 1, 1970 to the current Coordinated Universal Time (UTC). The Greenwich Mean Time (GMT) is used. To use the Beijing time, add 8 x 3600 seconds.

01 EF: Number of milliseconds. 0x1EF = 495 indicates 0.495 seconds.

- 2) The DTU returns the following response if the time is invalid:

AA 55 AA 55 07 00 07 00 00 00 00 00 00 C5 BC

0x00 indicates that the time consisting of the subsequent 6 bytes is invalid. The 6 bytes are filled in with 0x00.

3.4.6.2 Absolute time format:

User device: 55 AA 55 AA 07 00 01 01 A8 8B

- 1) The DTU returns the following response if the time is valid (the DTU obtains the calibrated time):

AA 55 AA 55 07 00 09 01 0F 02 05 0F 02 32 00 27 1B AF

0x01 indicates that the time consisting of the subsequent 8 bytes is valid.

- 0F 02 05:** The format is year-month-day. It indicates (20) February 5, 2015.
- 0F 02 32:** The format is hours:minutes:seconds. It indicates 15:02:32.
- 00 27:** It is expressed by the number of milliseconds. 0x27 = 39 indicates 0.039 seconds.

2) The DTU returns the following response if the time is invalid:

AA 55 AA 55 07 00 08 00 00 00 00 00 00 00 00 6E 69

0x00 indicates that the time consisting of the subsequent 8 bytes is invalid. The 8 bytes are filled in with 0x00.

3.4.7 Sending and Receiving Short Messages

This command is not supported by some versions, but is supported by the latest firmware.

3.4.7.1 Short Message Sending

◆ Overview

The DTU supports the following four types of short messages:

- **Custom English short message**
- **Custom Chinese short message**
- **Standard English short message**
- **Standard Chinese short message**

Each Chinese short message to be sent can contain up to 70 Chinese characters. A long message is sent if there are more than 70 Chinese characters. The long message is divided into several short messages, each of which contains less than 70 Chinese characters. Sending is based on the long message protocol.

Terminal devices that support the long message feature (available in many mobile phone brands) receive a single short message and may pay for the fee of multiple messages. Terminal devices that do not support the long message feature may receive multiple messages. When sending Chinese short messages, the user device encapsulates the UCS2 code (big endian) of Chinese characters in the TLV of the short message content.

Each English short message to be sent can contain up to 160 English characters. A long message is sent if there are more than 160 English characters. The long message is divided into several short messages, each of which contains less than 160 English characters. Sending is based on the long message protocol. When sending English short messages to the DTU, the user device encapsulates the ASCII of the English characters in the TLV of the short message content. According to the 3GPP TS 23.038 standard, English short messages are encoded by GSM7 bit or UCS2 before transmission. To allow each short message to carry user data to the maximum extent to reduce communication costs, DTU sends English short messages encoded by GSM 7bit. The characters with an ASCII ranging from 0 to 127 can be sent. Because GSM 7bit is different from ASCII (for example, @ encoded by ASCII is 0x40, and is 0x00 when being encoded by GSM 7bit), the following characters are displayed as garbled characters among the printed characters with an ASCII ranging from 32 to 126:

Character	ASCII	GSM 7bit Encoding (Binary)
\$	0x24	0000010
@	0x40	0000000
[0x5B	None
\	0x5C	None
]	0x5D	None
^	0x5E	None
_	0x5F	0010001
`	0x60	None
{	0x7B	None
	0x7C	None
}	0x7D	None
~	0x7E	None

It is recommended that the preceding characters be sent using standard Chinese short messages. Common users are advised to use standard English and Chinese short messages.

Note:

The DTU firmware version InDTU3XX_STD_V1.4.3 and later support the long message feature.

Note about sending short messages :

1. The precautions in section 2.2 are also applicable here.
2. Local serial port 1 can cache short message command packets 4K in size and send short messages in non-blocking mode. That is, while sending the first short message, local serial port 1 can receive the short message command packet carried by the second frame, and send the second short message after the first short message is successfully sent. Serial port 1 can receive multiple short message command frames simultaneously. The user device can combine multiple short message command packets into one frame (with a size not greater than the frame size) to be sent to the DTU.
3. Local serial port 2 does not cache short message command packets and sends short messages in blocking mode. That is, local serial port 2 does not receive the short message command packet carried in the second frame until the first short message is successfully sent. Local serial port 2 does not support sending multiple short messages simultaneously. If the short message command data in one received frame contains multiple short message commands, only the first short message is sent.
4. When an English short message is sent, the value in the short message TLV is filled in with the ASCII code of the short message content.
5. When a Chinese short message is sent, the value in the short message content TLV is filled in with the big endian UCS2 code of the short message content.
6. The length of the short message content in the short message command frame cannot exceed 980 bytes.

◆ **Short message sending command**

Command word: 0x13

Short message sending format:

Packet header	Command word	Packet body length	Mobile number TLV	Short message format TLV	Short message content TLV	CRC
55 AA 55 AA	13	2 bytes	Tag: 81 80 Length: Length of the mobile number Value: String	Tag: 81 81 Length: 2 bytes Value: Four types of formats are supported.	Tag: 81 82 Length: Length of the short message body Value: Short message body	2 bytes

Short messages in the following four formats can be sent:

- **0 indicates a custom English short message.**
- **1 indicates a custom Chinese short message.**
- **2 indicates a standard English short message.**
- **3 indicates a standard Chinese short message.**

Example:

Send the standard English short message "1234" to the mobile number 13912345678.

User device: **55 AA 55 AA 13 00 1C 81 80 00 0B 31 33 39 31 32 33 34 35 36 37 38 81 81 00 01 02 81 82 00 04 31 32 33 34 FC DE**

Send the standard Chinese short message "你好" (0x4F 0x60 0x59 0x7D) to the mobile number 13912345678.

User device: **55 AA 55 AA 13 00 1C 81 80 00 0B 31 33 39 31 32 33 34 35 36 37 38 81 81 00 01 03 81 82 00 04 4F 60 59 7D BD 16**

After receiving a short message command packet, the DTU immediately returns an acknowledgment command if the packet is correct (the packet header, command word, data format, and CRC are correct).

Command word: 0x17

Acknowledgment command returned by the DTU: **AA 55 AA 55 17 00 05 81 89 00 01 02 38 72**

The content of the packet body is 1 byte long. 0x02 indicates reception of correct short message data. The DTU does not return a response if the short message command packet is incorrect.

A short message is successfully sent through the GPRS, the DTU sends a response packet to the user device.

Command word: 0x17

Response packet returned by the DTU after short message sending: **AA 55 AA 55 17 00 06 81 89 00 01 00 7B 39**

The content of the packet body is 1 byte long. 0 indicates that the short message fails to be sent, and 1 indicates that the short message is successfully sent.

3.4.7.2 Short message receiving command

The short message receiving format is the same as the short message sending format, except that **55 AA 55 AA** is changed to **AA 55 AA 55**.

Packet header	Command word	Packet body length	Mobile number TLV	Short message format TLV	Short message content TLV	CRC
---------------	--------------	--------------------	-------------------	--------------------------	---------------------------	-----

AA 55 AA 55	13	2 bytes	Tag: 81 80 Length: Length of the mobile number Value: String	Tag: 81 81 Length: 2 bytes Value: Two types of formats are supported.	Tag: 81 82 Length: Length of the short message body Value: Short message body	2 bytes
----------------	----	---------	--	---	--	---------

Short messages in the following two formats can be received:

- **2 indicates a standard English short message.**
- **3 indicates a standard Chinese short message.**

Note:

By default, the short message receiving function is disabled. If you need to enable this function, choose **All Configurations > Work mode > Transmit received SMS to serial port** in the configuration tool and change **Off** to **On**. Alternatively, you can set 0x8187 to 0x01 on the user device.

3.5 DTU Configuration

The user device must log in to the DTU before reading and writing configuration. Login is not required by commands such as status reading, which is described in section 3.4.5.

3.5.1 Reading the DTU Configuration

Command word: 0x02

User device: **55 AA 55 AA 02 00 00 CD 3F**

Response command word: 0x82

Packet header	Command word	Packet body length	TLVs	Version information	CRC
---------------	--------------	--------------------	------	---------------------	-----

DTU: **AA 55 AA 55 82 03 58** 81 00 00 0F 44 47 33 31 32 31 34 30 31 39 38 37 36 37 3849 6E 44
54 55 33 58 58 5F 53 54 44 5F 56 31 2E 32 2E 32 36 20 4D 61 79 20 31 33 20 32 30 31 34 20 31 39 3A
32 31 3A 33 35 06 38

The packet body of the response returned by the DTU includes all the TLVs configured on the DTU. The TLVs are followed by the DTU version information (software version) encoded in ASCII.

Note:

For this special command, the length of the packet body only includes the length of the TLVs, but does not include the length of the version information. In this example, the length of the packet body is 0x0358. For the TLVs, only the 0x8100 tag is listed, and the subsequent TLVs are not listed and indicated by an ellipsis. **49 6E 44 54 55 33 58 58 5F 53 54 44 5F 56 31 2E 32 2E 32 36 20 4D 61 79 20 31 33 20 32 30 31 34 20 31 39 3A 32 31 3A 33 35** indicates the version information, that is "InDTU3XX_STD_V1.2.26 May 13 2014 19:21:35".

3.5.2 Reading the Specified Configuration

The data packet delivered by the user device includes the tag value of the configuration to be read. The length of the TLV is set to 0x0000. The DTU reads the value of the corresponding tag and returns the value to the user device.

Command word: 0x16

Packet header	Command word	Packet body length	TLVs	CRC
---------------	--------------	--------------------	------	-----

For example, the tag 0x0001 (dialed number) is read. For details, see [Appendix 2: Configuration Item Tags](#).

User device: 55 AA 55 AA 16 00 04 00 01 00 00 92 2D

Response command word: 0x16

Packet header	Command word	Packet body length	TLVs	CRC
---------------	--------------	--------------------	------	-----

DTU: AA 55 AA 55 16 00 0C 00 01 00 08 2A 39 39 2A 2A 2A 31 23 AD 0B

The packet body of the response returned by the DTU includes the configured value of the specified tag.

3.5.3 Setting the DTU Configuration

Command word: 0x01

Packet header	Command word	Packet body length	TLVs	CRC
---------------	--------------	--------------------	------	-----

User device: 55 AA 55 AA 01 03 02 00 01 00 08 2A 39 39 2A 2A 2A 31 23 8A D1

In this example, the length of the packet body is 0x0302. For the TLVs, only the 0x0001 tag is listed, and the subsequent TLVs are not listed and indicated by an ellipsis.

Response command word: 0x81

Packet header	Command word	Packet body length	TLVs	CRC
---------------	--------------	--------------------	------	-----

DTU: AA 55 AA 55 81 03 58 81 00 00 0F 44 47 33 31 32 31 34 30 31 39 38 37 36 37 38 06 38

The packet body of the response returned by the DTU includes all the TLVs configured on the DTU. In this example, the length of the packet body is 0x0358. For the TLVs, only the 0x8100 tag is listed, and the subsequent TLVs are not listed and indicated by an ellipsis.

3.5.4 Setting a Single Configuration

Command word: 0x18

Packet header	Command word	Packet body length	TLVs	CRC
---------------	--------------	--------------------	------	-----

Set the configuration with a tag of 0x0001.

User device: 55 AA 55 AA 18 00 0C 00 01 00 08 2A 39 39 2A 2A 2A 31 23 E2 B8

Response command word: 0x18

Packet header	Command word	Packet body length	TLVs	CRC
---------------	--------------	--------------------	------	-----

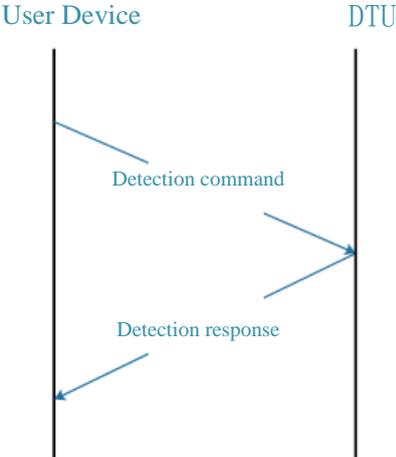
DTU: AA 55 AA 55 18 00 0C 00 01 00 08 2A 39 39 2A 2A 2A 31 23 AD 0B

The packet body of the response returned by the DTU contains the DTU configuration after setting.

4. Process

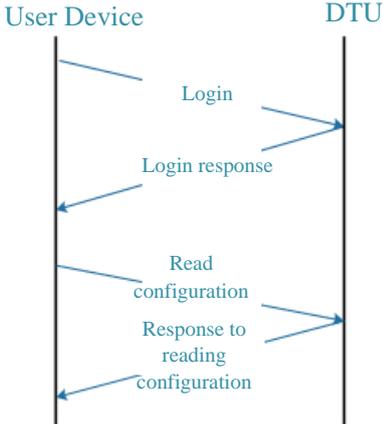
4.1 Detection

Detection can be initiated at any time.



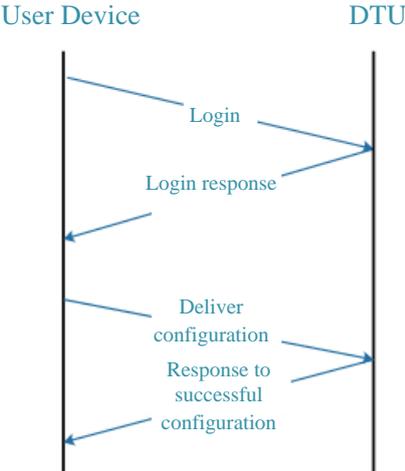
4.2 Reading Configuration

Login is required for reading configuration.



4.3 Delivering Configuration

Login is required for delivering configuration.



5. Appendix

5.1 Appendix 1: CRC16 Source Code

```
const static
unsigned short fcsTab[256] = {
    0x0000, 0x1189, 0x2312, 0x329b, 0x4624, 0x57ad, 0x6536, 0x74bf,
    0x8c48, 0x9dc1, 0xaf5a, 0xbbed, 0xca6c, 0xdbed, 0xe97e, 0xf8f7,
    0x1081, 0x0108, 0x3393, 0x221a, 0x56a5, 0x472c, 0x75b7, 0x643e,
    0x9cc9, 0x8d40, 0xbfdb, 0xae52, 0xdaed, 0xcb64, 0xf9ff, 0xe876,
    0x2102, 0x308b, 0x0210, 0x1399, 0x6726, 0x76af, 0x4434, 0x55bd,
    0xad4a, 0xbcc3, 0x8e58, 0x9fd1, 0xeb6e, 0xfae7, 0xc87c, 0xd9f5,
    0x3183, 0x200a, 0x1291, 0x0318, 0x77a7, 0x662e, 0x54b5, 0x453c,
    0xbdc3, 0xac42, 0x9ed9, 0x8f50, 0xfbef, 0xea66, 0xd8fd, 0xc974,
    0x4204, 0x538d, 0x6116, 0x709f, 0x0420, 0x15a9, 0x2732, 0x36bb,
    0xce4c, 0xdfc5, 0xed5e, 0xfcd7, 0x8868, 0x99e1, 0xab7a, 0xbaf3,
    0x5285, 0x430c, 0x7197, 0x601e, 0x14a1, 0x0528, 0x37b3, 0x263a,
    0xdced, 0xcf44, 0xfddf, 0xec56, 0x98e9, 0x8960, 0xbbfb, 0xaa72,
    0x6306, 0x728f, 0x4014, 0x519d, 0x2522, 0x34ab, 0x0630, 0x17b9,
    0xef4e, 0xfec7, 0xcc5c, 0xdd55, 0xa96a, 0xb8e3, 0x8a78, 0x9bf1,
    0x7387, 0x620e, 0x5095, 0x411c, 0x35a3, 0x242a, 0x16b1, 0x0738,
    0xffcf, 0xee46, 0xdcdd, 0xcd54, 0xb9eb, 0xa862, 0x9af9, 0x8b70,
    0x8408, 0x9581, 0xa71a, 0xb693, 0xc22c, 0xd3a5, 0xe13e, 0xf0b7,
    0x0840, 0x19c9, 0x2b52, 0x3adb, 0x4e64, 0x5fed, 0x6d76, 0x7cff,
    0x9489, 0x8500, 0xb79b, 0xa612, 0xd2ad, 0xc324, 0xf1bf, 0xe036,
    0x18c1, 0x0948, 0x3bd3, 0x2a5a, 0x5ee5, 0x4f6c, 0x7df7, 0x6c7e,
    0xa50a, 0xb483, 0x8618, 0x9791, 0xe32e, 0xf2a7, 0xc03c, 0xd1b5,
    0x2942, 0x38cb, 0x0a50, 0x1bd9, 0x6f66, 0x7eef, 0x4c74, 0x5dfd,
    0xb58b, 0xa402, 0x9699, 0x8710, 0xf3af, 0xe226, 0xd0bd, 0xc134,
    0x39c3, 0x284a, 0x1ad1, 0x0b58, 0x7fe7, 0x6e6e, 0x5cf5, 0x4d7c,
    0xc60c, 0xd785, 0xe51e, 0xf497, 0x8028, 0x91a1, 0xa33a, 0xb2b3,
    0x4a44, 0x5bcd, 0x6956, 0x78df, 0x0c60, 0x1de9, 0x2f72, 0x3efb,
    0xd68d, 0xc704, 0xf59f, 0xe416, 0x90a9, 0x8120, 0xb3bb, 0xa232,
    0x5ac5, 0x4b4c, 0x79d7, 0x685e, 0x1ce1, 0x0d68, 0x3ff3, 0x2e7a,
    0xe70e, 0xf687, 0xc41c, 0xd595, 0xa12a, 0xb0a3, 0x8238, 0x93b1,
    0x6b46, 0x7acf, 0x4854, 0x59dd, 0x2d62, 0x3ceb, 0x0e70, 0x1ff9,
```

```

    0xf78f, 0xe606, 0xd49d, 0xc514, 0xb1ab, 0xa022, 0x92b9, 0x8330,
    0x7bc7, 0x6a4e, 0x58d5, 0x495c, 0x3de3, 0x2c6a, 0x1ef1, 0x0f78
};

/*
 * Calculate a new fcs given the current fcs and the new data.
 */
unsigned short pppfcs16(unsigned short fcs, unsigned char *cp, unsigned short len)
{
    while (len--){
        fcs = (fcs >> 8) ^ fcsTab[(fcs ^ *cp++) & 0xff];
    }

    return (fcs);
}

//This function adds the CRC value to the two bytes following buf.
unsigned char byAddCrc16(unsigned char *cp, unsigned short len)
{
    unsigned short trialfcs;

    /* add on output */
    trialfcs = pppfcs16( 0xFFFF, cp, len );
    trialfcs ^= 0xffff;          /* complement */
    cp[len] = (trialfcs & 0x00ff); /* least significant byte first */
    cp[len+1] = ((trialfcs >> 8) & 0x00ff);

    return 0;
}

```

5.2 Appendix 2: Configuration Item Tags

Group	Name	Tag	Length	Format	Value
Local serial port	Baud rate of serial port 1	0x0011	2	Hex	{9600,300,600,1200,2400,4800,9600,14400,19200,38400,56000,57600,115200}; Different values indicate different baud rates in the table. The value ranges from 0x00 to 0x0C. For example, 19200 is indicated by 0x0008. The 300, 600, and 56000 baud rates are not supported by DTU3XX.
	Data bit of serial port 1	0x0012	1	Hex	The content is indicated by data bits. For example, 8 is indicated by 0x08. Only the 8-bit format is supported by DTU3XX.
	Stop bit of serial port 1	0x0013	1	Hex	0x00 indicates one stop bit. 0x01 indicates 1.5 stop bits. 0x02 indicates two stop bits.
	Parity bit of serial port 1	0x0014	1	Hex	0x00 indicates no parity check. 0x01 indicates odd parity check. 0x02 indicates even parity check.
	Scan interval of serial port 1	0x0015	2	Hex	The unit is 100 ms. The value ranges from 1 to 100. For example, if the scan interval is set to 200 ms, the content is 0x02. The program determines framing based on the configured serial port scan interval.
	Data response timeout of serial port 1	0x0017	1	Hex	The value ranges from 1 to 255, in seconds.
	Frame size of serial port 1	0x8118	6	Hex	The value ranges from 10 to 1024, in bytes. For example, if the frame size is set to 500 bytes, the content is 0x01F4. Framing is implemented if data exceeding the frame size is received during the serial port scan interval.
	Flow control of serial port 1	0x0007	1	Hex	0x00 (default) indicates that flow control is disabled, and 0x01 indicates that flow control is enabled. Only some versions such as InDTU325 support flow control.
Local serial port 2	Baud rate of serial port 2	0x815C	2	Hex	{9600,300,600,1200,2400,4800,9600,14400,19200,38400,56000,57600,115200}; Different values indicate different baud rates in the table. For example, 19200 is indicated by 0x0008. The 300, 600, and 56000 baud rates are not supported by DTU3XX. The baud rate is only used by the TCP_SERVER function. When the TCP_SERVER function is disabled, serial port

Group	Name	Tag	Length	Format	Value
					2 is used as a maintenance port and its baud rate is invariably 115200.
	Data bit of serial port 2	0x815D	1	Hex	The content is indicated by data bits. For example, 8 is indicated by 0x08. Only the 8-bit format is supported by DTU3XX.
	Stop bit of serial port 2	0x815E	1	Hex	0x00 indicates one stop bit. 0x01 indicates 1.5 stop bits. 0x02 indicates two stop bits.
	Parity bit of serial port 2	0x815F	1	Hex	0x00 indicates no parity check. 0x01 indicates odd parity check. 0x02 indicates even parity check.
	Scan interval of serial port 2	0x8160	2	Hex	The unit is 100 ms. The value ranges from 1 to 100. For example, if the scan interval is set to 200 ms, the content is 0x02. The program determines framing based on the configured serial port scan interval.
	Data response timeout of serial port 2	0x8162	1	Hex	The value ranges from 1 to 255, in seconds.
	Frame size of serial port 2	0x8161	6	Hex	The value ranges from 10 to 1024, in bytes. For example, if the frame size is set to 500 bytes, the content is 0x01F4.
DTU working mode	Connection type	0x001E	1	Hex	0x00 indicates persistent connection (real-time and online), and 0x01 indicates short connection (on-demand dialing).
	Phone activation	0x8005	1	Hex	0x00 indicates not using phone activation, and 0x01 indicates using phone activation.
	SMS activation	0x8006	1	Hex	0x00 indicates not using short message activation, and 0x01 indicates using short message activation.
	Data activation	0x8007	1	Hex	0x00 indicates not using data activation, and 0x01 indicates using data activation.
	Auto active interval	0x8008	2	Hex	The value ranges from 5 to 1440, in minutes. For example, the parameter value is 0x05 if activation is performed every 5 minutes.
	Auto offline interval	0x8009	1	Hex	The value ranges from 1 to 60, in minutes. For example, the parameter value is 0x0A if the serial port is disconnected because no data is received within 10 minutes.
	GPRS and SMS selection	0x818A	1	Hex	0x00 (default) indicates the GPRS mode, and 0x01 indicates the SMS mode.
	Short message receiving on the local serial port	0x8187	1	Hex	0x00 (default) indicates that this function is disabled, and 0x01 indicates that this function is enabled. For details, see section 3.4.7.
	DTU configuration mode	0x818B	1	Hex	0x00 (default) indicates that the configuration data is detected by frame, and 0x01 indicates that the configuration data is detected by flow.
GPRS	Auto dial	0x0006	1	Hex	0x01 (default) indicates that auto dial is enabled, and 0x00 indicates that auto dial is disabled. In the latter case, DTU supports

Group	Name	Tag	Length	Format	Value
dialing parameter					dialing only when DM SMS is activated. Use the default value unless otherwise specified.
	Dialed number	0x0001	32	ASCII	Dialed number encoded by ASCII. For example, when it is set to 12345, the content is 0x3132333435.
	Access point number (APN)	0x0002	32	ASCII	APN encoded by ASCII.
	Dialing user name	0x0003	32	ASCII	Dialing user name encoded by ASCII.
	Dialing password	0x0004	32	ASCII	Dialing password encoded by ASCII.
	PPP echo interval	0x8003	2	Hex	The value ranges from 30 to 3600, in seconds. The parameter value is 0x0032 when the PPP echo interval is 50 seconds. Use the default value unless otherwise specified.
	Redial interval	0x8116	2	Hex	The value ranges from 0 to 3600, in seconds. The parameter value is 0x003C when the PPP echo interval is 60 seconds. Use the default value unless otherwise specified.
	Maximum redial times	0x8117	1	Hex	It indicates the maximum attempts that the DTU can make to redial the detection module before the DTU restarts. The value ranges from 1 to 10.
	Authenticat ion mode	0x818D	1	Hex	0x00 (default) indicates automatic authentication, 0x01 indicates PAP authentication, and 0x02 indicates CHAP authentication. In the program of the latest standard version, the automatic logic uses PAP authentication. If PAP authentication fails, CHAP authentication is used. If CHAP authentication fails, PAP authentication is used again. This process is repeated.
Support platform setting	SMS center number	0x800B	16	ASCII	SMS center number encoded by ASCII. In the program of the latest standard version, the SMS center number can be automatically read from the SIM card. If the SMS center number is successfully read from the SIM card, the number is used. If reading fails, the number set here is used.
Application center setting	DTU ID	0x0023	16	ASCII	DTU ID encoded by ASCII (used by the DC protocol).
	Applicatio n center address	0x0019	6	Hex	The Hex consists of six bits. The first four bits indicate an IP address, and the last two bits indicate a port. If the address is 1.2.3.4.1024, the parameter value is 0x010203040400. To set an IP address, you need to set an empty domain name.
	Applicatio n center domain	0x8123	32	ASCII	Domain name encoded by ASCII. To set a domain name, set the IP address to 0.0.0.0.

Group	Name	Tag	Length	Format	Value
	name				
	Application center link mode	0x001A	1	Hex	0x00 indicates TCP only; 0x01 indicates UDP only; 0x03 indicates DCUDP; 0x04 indicates DCTCP; 0x05 indicates Modbus bridge; 0x06 indicates conversion from 101 to SMS.
	Maximum retransmission times	0x0018	1	Hex	The value ranges from 1 to 5.
	Forced DC heartbeat	0x819E	1	Hex	0x00 (default) indicates that this function is disabled, whereby the DC heartbeat is not sent if data is received during the heartbeat interval. 0x01 indicates that this function is enabled.
	Application center heartbeat interval (in minutes)	0x8004	1	Hex	The value ranges from 0 to 60, in minutes.
	Application center heartbeat interval (in seconds)	0x801F	1	Hex	The value ranges from 0 to 60, in seconds.
	DNS1	0x8019	4	Hex	If it is set to 8.8.8.8, the parameter value is 0x08080808.
	DNS2	0x801A	4	Hex	If it is set to 8.8.8.8, the parameter value is 0x08080808.
	SNTP server IP address	0x81CF	4	Hex	If it is set to 8.8.8.8, the parameter value is 0x08080808.
	Exchange local serial ports	0x8068	1	Hex	0x00 (default) indicates that this function is disabled, and 0x01 indicates that this function is enabled. By default, the application center uses serial port 1, and the TCP server uses serial port 2. After exchange, the application center uses serial port 2, and the TCP server uses serial port 1.
	TCP server listening port	0x8018	5	ASCII	The value ranges from 0 to 65535. 0 indicates that the TCP server function is disabled. If it is set to 6666, the parameter value is 0x36363636
Multi-connection policy	Application center address of extension 1	0x800D	6	Hex	The Hex consists of six bits. The first four bits indicate an IP address, and the last two bits indicate a port. If the address is 1.2.3.4.1024, the parameter value is 0x010203040400. To set an IP address, you need to set an empty domain name.
	Application center domain name of extension 1	0x8124	32	ASCII	Domain name encoded by ASCII. To set a domain name, set the IP address to 0.0.0.0.
	Application center address of extension	0x800F	6	Hex	The Hex consists of six bits. The first four bits indicate an IP address, and the last two bits indicate a port. If the address is 1.2.3.4.1024, the parameter value is 0x010203040400. To set

Group	Name	Tag	Length	Format	Value
	2				an IP address, you need to set an empty domain name.
	Application center domain name of extension 2	0x8125	32	ASCII	Domain name encoded by ASCII. To set a domain name, set the IP address to 0.0.0.0.
	Application center address of extension 3	0x8011	6	Hex	The Hex consists of six bits. The first four bits indicate an IP address, and the last two bits indicate a port. If the address is 1.2.3.4.1024, the parameter value is 0x010203040400. To set an IP address, you need to set an empty domain name.
	Application center domain name of extension 3	0x8126	32	ASCII	Domain name encoded by ASCII. To set a domain name, set the IP address to 0.0.0.0.
	Application center address of extension 4	0x8013	6	Hex	The Hex consists of six bits. The first four bits indicate an IP address, and the last two bits indicate a port. If the address is 1.2.3.4.1024, the parameter value is 0x010203040400. To set an IP address, you need to set an empty domain name.
	Application center domain name of extension 4	0x8127	32	ASCII	Domain name encoded by ASCII. To set a domain name, set the IP address to 0.0.0.0.
Multi-connection policy	Minimum reconnection interval	0x8015	4	ASCII	The value ranges from 15 to 60, in seconds. The parameter value is 0x3135 when it is set to 15 seconds.
	Maximum reconnection interval	0x8016	4	ASCII	The value ranges from 15 to 60, in seconds. The parameter value is 0x3135 when it is set to 15 seconds. The maximum reconnection interval must be greater than or equal to the minimum reconnection interval. It is used during TCP reconnection.
	Polling mode	0x8017	1	ASCII	Y or y indicates multi-data center polling, whereas N or other values indicates multi-data center parallel.
Other configuration	Maximum login times	0x801B	1	Hex	The value ranges from 0 to 255. The data center is reconnected when the login times exceed this value.
	Allow remote telnet or not	0x8163	1	Hex	0x00 indicates starting the remote console, and 0x01 indicates closing the remote console. This function is not supported by DTU3XX.
	Debug mode	0x801D	1	Hex	0x00 (default) indicates disabling log output; 0x01 indicates log output by local serial port 1; 0x02 indicates log output by local serial port 2; 0x03 indicates log output by local serial port 5.

Group	Name	Tag	Length	Format	Value
	Debug level	0x8069	1	Hex	0x00 (default) indicates displaying detailed log; 0x01 indicates displaying Chinese brief log; 0x02 indicates displaying English brief log.
	Low power consumption	0x8165	1	Hex	The value ranges from 1 to 8. The value indicates the number of GPRS upstream and downstream channels. 0x01 indicates one upstream channel and one downstream channel, with the lowest power consumption, which is applicable in scenarios with high requirements of power consumption and a relatively small amount of data. 0x08 indicates five upstream channels and three downstream channels, which is applicable in scenarios with no power consumption requirements and with a relatively large amount of data.
Network management platform setting	Product SN	0x8100	16	ASCII	It is a unique and invariable value of each DTU and cannot be modified.
	Work mode	0x810B	1	Hex	0x00 indicates disabling the DM platform; 0x01 indicates SMS only; 0x02 indicates SMS+IP address.
	Trusted number list (numbers are separated by commas)	0x810D	64	ASCII	Trusted number encoded by ASCII. If you need to set the trusted numbers of multiple network management platforms, separate the numbers with commas (,), for example, 15901003379,15901003379. The maximum length is 64 bytes.
	Device ID	0x8101	4	Hex	It is a unique and invariable value of each DTU and cannot be modified.
	Platform address	0x810E	6	Hex	The Hex consists of six bits. The first four bits indicate an IP address, and the last two bits indicate a port. If the address is 1.2.3.4.1024, the parameter value is 0x010203040400.
	Heartbeat interval of the network management platform	0x8105	2	Hex	The value ranges from 30 to 600, in seconds.
ICMP parameter setting	ICMP host	0x8119	4	Hex	The four-bit Hex indicates the four segments of an IP address.
	Maximum ICMP lost packets	0x8115	1	Hex	The value ranges from 3 to 60.
	ICMP detection interval	0x811A	2	Hex	The value ranges from 30 to 3600, in seconds.
	Forced ICMP detection	0x819D	1	Hex	0x00 (default) indicates that this function is disabled, and 0x01 indicates that this function is enabled. With this function disabled, counting restarts when network data is received. An ICMP detection packet is sent when the ICMP detection interval is reached. Dialing is performed again when the maximum number of

Group	Name	Tag	Length	Format	Value
					ICMP lost packets is reached. With this function enabled, an ICMP detection packet is sent when the ICMP detection interval is reached, regardless of whether network data is received. Dialing is performed again when the maximum number of ICMP lost packets is reached.
Custom frame	Login frame type	0x8174	1	Hex	0x00 indicates ASCII; 0x01 indicates the Hex format; 0x02 indicates a DC-formatted packet.
	Login frame	0x811D	64	Depends on the content	Enter any characters when ASCII is set. When the Hex format is set, every two bytes form 1-byte data. For example, the two bytes 0x31 and 0x32 form the 1-byte data 0x12. In the Hex format, the maximum length of sent data is $64/2 = 32$ bytes. This parameter does not need to be set during DC setting because DC has its format.
	Login response frame type	0x8175	1	Hex	0x00 indicates ASCII; 0x01 indicates the Hex format; 0x02 indicates a DC-formatted packet.
	Login response frame	0x811E	64	Depends on the content	Enter any characters when ASCII is set. When the Hex format is set, every two bytes form 1-byte data. For example, the two bytes 0x31 and 0x32 form the 1-byte data 0x12. In the Hex format, the maximum length of sent data is $64/2 = 32$ bytes. This parameter does not need to be set during DC setting because DC has its format.
	Heartbeat frame type	0x8178	1	Hex	0x00 indicates ASCII; 0x01 indicates the Hex format; 0x02 indicates a DC-formatted packet.
	Heartbeat frame	0x8121	64	Depends on the content	Enter any characters when ASCII is set. When the Hex format is set, every two bytes form 1-byte data. For example, the two bytes 0x31 and 0x32 form the 1-byte data 0x12. In the Hex format, the maximum length of sent data is $64/2 = 32$ bytes. This parameter does not need to be set during DC setting because DC has its format.
	Heartbeat response frame type	0x8179	1	Hex	0x00 indicates ASCII; 0x01 indicates the Hex format; 0x02 indicates a DC-formatted packet.
	Heartbeat response frame	0x8122	64	Depends on the content	Enter any characters when ASCII is set. When the Hex format is set, every two bytes form 1-byte data. For example, the two bytes 0x31 and 0x32 form the 1-byte data 0x12. In the Hex format, the maximum length of sent data is $64/2 = 32$ bytes. This parameter does not need to be set during DC setting because DC has its format.
	Logout frame type	0x8176	1	Hex	0x00 indicates ASCII; 0x01 indicates the Hex format; 0x02 indicates a DC-formatted packet.
	Logout frame	0x811F	64	Depends on the content	Enter any characters when ASCII is set. When the Hex format is set, every two bytes form 1-byte data. For example, the two bytes 0x31 and 0x32 form the 1-byte data 0x12. In the Hex format, the maximum length of sent

Group	Name	Tag	Length	Format	Value
					data is $64/2 = 32$ bytes. This parameter does not need to be set during DC setting because DC has its format.
	Logout response frame type	0x8177	1	Hex	0x00 indicates ASCII; 0x01 indicates the Hex format; 0x02 indicates a DC-formatted packet.
	Logout response frame	0x8120	64	Depends on the content	Enter any characters when ASCII is set. When the Hex format is set, every two bytes form 1-byte data. For example, the two bytes 0x31 and 0x32 form the 1-byte data 0x12. In the Hex format, the maximum length of sent data is $64/2 = 32$ bytes. This parameter does not need to be set during DC setting because DC has its format.
SMS related	SMS number	0x8180	16	ASCII	Mobile number for sending and receiving short messages, encoded by ASCII.
	Short message type	0x8181	1	Hex	0x00 indicates custom English short message; 0x01 indicates custom Chinese short message; 0x02 indicates standard English short message; 0x03 indicates standard Chinese short message.
	Short message content	0x8182	140/160	Depends on the content	ASCII is adopted for English short messages, and the maximum length is 160 bytes. Unicode encoding is adopted for Chinese short messages, and the maximum length is 140 bytes. The Chinese standard short message "你好" occupies 4 bytes (0x4F 0x60 0x59 0x7D).
	Short message receipt	0x8189	1	Hex	0x00 indicates that sending fails; 0x01 indicates that sending is successful; 0x02 indicates that the correct short message data frame is received.

5.3 Appendix 3: Status Tags

Group	Name	Tag	Length	Content Format	Description
Protocol of the earlier version	Current DTU working status	0x8183	1	Hex	0x01 indicates that initialization is in progress; 0x02 indicates that dialing is in progress; 0x03 indicates that dialing is successful but the data center is not connected; 0x04 indicates that the master station is successfully connected.
	Signal value (CSQ)	0x8184	1	Hex	The value ranges from 0 to 31 or is 99 (indicating no signal). 0x1F indicates that CSQ is 31.
Physical layer status	IMEI	0x81CA	15	ASCII	IMEI with a one-to-one mapping relationship with the communication module.
	IMSI	0x81CB	15	ASCII	IMSI with a one-to-one mapping relationship with the SIM card.
	ICCID	0x81D0	20	ASCII	ICCID with a one-to-one mapping

Group	Name	Tag	Length	Content Format	Description
					relationship with the SIM card (marked on the back of the SIM card).
	Signal value (CSQ)	0x819F	2	Hex	The value ranges from 0 to 31 or is 99 (indicating no signal). 0x001F indicates that CSQ is 31.
	Frequency band	0x81A0	2	Hex	The optional values are 900, 1800, and 2100.
	Registration status	0x81A1	2	Hex	0x00 indicates that registration is not performed; 0x01 indicates that registration is completed (local); 0x05 indicates that registration is completed (roaming).
	MCC	0x81A3	2	Hex	Mobile country code of the current operator of the DTU. It is 460 (0x01CC) for China.
	MNC	0x81A4	2	Hex	Mobile network code of the current operator, for example, 00. 460 indicates China Mobile.
	LAC	0x81A5	2	Hex	Location area code of the network base station where the DTU is located.
	Cell ID	0x81A2	2	Hex	Sector code of the network base station where the DTU is located.
	Restart information	0x81A6	2	Hex	0x00 indicates hard restart, and 0x01 indicates soft restart.
Network layer status	Authentication mode	0x81A7	2	Hex	0x00 indicates PAP authentication, and 0x01 indicates CHAP authentication.
	IP address	0x81A8	4	Hex	The 4-byte Hex indicates the four segments of the IP address obtained during DTU dialing.
	Received traffic	0x81A9	4	Hex	Total number of received bytes of IP packets.
	Sent traffic	0x81AA	4	Hex	Total number of sent bytes of IP packets.
	LCP delay	0x81AC	2	Hex	Real-time delay of LCP.
	PPP status	0x81AD	2	Hex	0x00 indicates failed dialing, and 0x01 indicates successful dialing.
	Ping delay	0x81AB	2	Hex	Real-time delay of ping.
	Ping packet loss rate	0x81AE	2	Hex	Ping packet loss rate.
Application layer status	Connection status of data center 1	0x81B1	2	Hex	0x00 indicates that the data center is not connected, and 0x01 indicates that the data center is connected.
	Delay of data center 1	0x81AF	2	Hex	Real-time delay of DC heartbeat packets.
	Packet loss rate of data center 1	0x81B0	2	Hex	Packet loss rate of DC heartbeat packets.
	Connection status of data center 2	0x81B4	2	Hex	0x00 indicates that the data center is not connected, and 0x01 indicates that the data center is connected.
	Delay of data center 2	0x81B2	2	Hex	Real-time delay of DC heartbeat packets.
	Packet loss	0x81B3	2	Hex	Packet loss rate of DC heartbeat

Group	Name	Tag	Length	Content Format	Description
	rate of data center 2				packets.
	Connection status of data center 3	0x81B7	2	Hex	0x00 indicates that the data center is not connected, and 0x01 indicates that the data center is connected.
	Delay of data center 3	0x81B5	2	Hex	Real-time delay of DC heartbeat packets.
	Packet loss rate of data center 3	0x81B6	2	Hex	Packet loss rate of DC heartbeat packets.
	Connection status of data center 4	0x81BA	2	Hex	0x00 indicates that the data center is not connected, and 0x01 indicates that the data center is connected.
	Delay of data center 4	0x81B8	2	Hex	Real-time delay of DC heartbeat packets.
	Packet loss rate of data center 4	0x81B9	2	Hex	Packet loss rate of DC heartbeat packets.
	Connection status of data center 5	0x81BD	2	Hex	0x00 indicates that the data center is not connected, and 0x01 indicates that the data center is connected.
	Delay of data center 5	0x81BB	2	Hex	Real-time delay of DC heartbeat packets.
	Packet loss rate of data center 5	0x81BC	2	Hex	Packet loss rate of DC heartbeat packets.
	Reconnection times of data center 1	0x8320	2	Hex	Times of reconnection after disconnection from data center 1.
	Reconnection times of data center 2	0x8321	2	Hex	Times of reconnection after disconnection from data center 2.
	Reconnection times of data center 3	0x8322	2	Hex	Times of reconnection after disconnection from data center 3.
	Reconnection times of data center 4	0x8323	2	Hex	Times of reconnection after disconnection from data center 4.
	Reconnection times of data center 5	0x8324	2	Hex	Times of reconnection after disconnection from data center 5.