PS01704

LoRaWAN RHF3M485 Protocol

V0.6

Document information

Info	Content
Keywords	*RisingHF, Module, Protocol*
Abstract	This document is used to describe the protocol

Content

1 Preface

The application data transmission protocol based on LoRaWAN referred to as LADTP (LoRaWAN Application Data Transmission Protocol) which is defined by RisingHF. The LADTP is used to adapt the LoRaWAN protocol to traditional wired communication protocols such as RS232 / RS485 / Weigand and other communication interfaces, like a data transmission interface converter from wired to wireless.

1.1 Definitions and abbreviations

Acronyms	Description
LAP	RisingHF LoRaWAN Application Protocol
LADTP	RisingHF LoRaWAN Application Data Transmission Protocol
DMU	Data Message Unit, RS485/RS232/Modbus
DFU	Data Forwarding Unit, LoRaWAN Device
LoRa	Semtech Long Range Communication Modulation Technology
LoRaWAN	Long Range Wide Area Network
RS485	A Differential Serial Communication Bus
Modbus	A serial communication protocol

1.2 References

2 LoRaWAN Data Transmission Protocol Format

2.1 Header format

	Bit 7	**Bit6**	**Bit5**	**Bit4**	**Bit 3-0**
Type	1byte				
Header	MF	Rxdone	ETF	IsConfirmed	Cmd
ID	1byte				
Elapsed Time	0/2 Byte				
Payload	...				

Field explanation:
- ➢ Type: Message type. The type of the module is 0x70.
- ➢ Header:
  - ➢ Bit3-0: Command
    - 0: Command for data transmission and Data Address occupies 1 byte.
    - 1: Command for data transmission and Data Address occupies 2 bytes.
    - 2: Command for retransmission request and Data Address occupies 1 byte.
    - 3: Command for retransmission request and Data Address occupies 2 bytes.
    - 4: Command for parameters configuration, only for the application server downlink.
    - 5: Command for heartbeat package, only for module uplink.
    - 6: Command for status inquiry.
    - 7~15: Reserved.
  - ➢ Bit4: IsConfirmed. A flag bit, indicates that whether **the last segmentation packet** need to be sent as 'Confirmed' to notify the application server.
    - 0: The last segmentation is sent as 'Unconfirmed'.
    - 1: The last segmentation is sent as 'Confirmed'.
    - When the last segmentation of the integration packet (HOST data) is sent to application server as 'Confirmed', the flag bit of all the segmentation set as 1 to notify the server.
  - ➢ Bit5: Timestamp flag
    - 0: Timestamp field is empty
    - 1: Timestamp field is not empty
  - ➢ Bit6: Receive completed flag，used to confirm the application layer has finished receiving data in case of 'IsConfirmed' field is 1.
  - ➢ Bit7: segmentation flag
    - 0: If "Data Address" is 0, the data packets do not need to be segmented
    - 0: If "Data Address" is not 0, the packet is the last segmentation of the packet
    - 1: Packet is segmented
- ➢ ID: Indicate the sequence number of the current segmentation packet in the integration packet sent by HOST, and to avoid making confusion between two adjacent packets of data.

> ➢ Elapsed Time: The difference between the sending timestamp of the current LoRa packet and the receiving timestamp of the packet received by RHF3M485 device from host. The function is opened or closed by the ETF flag with 2 bytes length in little-endian mode.
> > 0xFFFF: >131068s   (about 36.4 hours)
> > 0~0xFFFE: 0~131068s   (step length is 2 seconds)
> ➢ Payload：Packet in application with or without segmentation. Refer to Chapter 2.2.2/ 2.2.3/ 2.2.4/ 2.2.5/ 2.2.6 for details.

Example1：When the value of 'Header' is '0x01', it indicates that this is a data transmission packet, and the Data Address occupies 2 bytes.

Example2：When the value of 'Header' is '0x05', it indicates that this is a heartbeat packet.

2.2 Detailed format of command

2.2.1 Command for data transmission

Field	Data Address	Data
Number of bytes	2/1	0~ Variable

Data Address: The start address of this segmentation packet in the module buffer (the buffer is the memory area set in the module to store data sent from Host).

Data Address can be 2 bytes or 1 byte, which can be modified in Bit3-0 of Header.

For example：20 01 02 03 04 05 06 07 08 09 10；

Indicate: Starting from the address in the buffer 0x20, the data is 01 02 03 04 05 06 07 08 09 10.

1. When the flag 'IsConfirmed' is 1, the module sends the last segmentation packet as 'Confirmed', and the other segmentation packets are sent as 'Unconfirmed'.

    If the module receives the ack data returned by the LoRaWAN server and receives the command of receiving completion of the application layer, the module will clears all the segmentation of this packet in the buffer and start to segment the next packet from host and transmit the segmentation in queue;

    If the module receives the ack data returned by the LoRaWAN server and receives a request retransmission command from the application layer, the module retransmits the data as required.

    If the module receives only the ack data which does not contain the data of the application layer returned by the server, it will judge that the application layer does not receive the complete data and will resend until it can receive the data from the application server.

    If the module does not receive any data from gateway, then decrease the data rate and do retransmission of the last segmentation. If the device still couldn't receive confirmation message after retry for 6 times, it will judge that the network is disconnected. If the module receives the reply at some time, it will re-segment and retransmission with the biggest data rate. The last sub-packet is still sent as 'Confirmed'. If the device still couldn't receive any reply, then it means the device has lost the connection to the network, with the current data is being cached and is being continuously sent again. But the oldest previous data would be overwritten by the newest one when the buffer is overflow.

2. If the flag 'IsConfirmed' is 0, the module sends all the segmentations as 'Unconfirmed'. Then the module will wait for receiving data before timeout set before. If it is out of time, the module will judge that the application has received completely, and start to send the next packet from Host.

2.2.2 Command for retransmission request

Field	Data Address	Length	…	…	Data Address	Length
Number of bytes	2/1	1	...	...	2/1	1

Data Address can be 2 bytes or 1 byte, which can be modified in Bit3-0 of Header.

For example：10 6 20 10

Indicate that the following two sections of data packets are missing, requesting retransmission: 6 bytes starting at address 0x10 in the buffer and 16 bytes starting at 0x20.

Take module uplink as an example:

After the application received the last one segmentation of one packet from the module, the integration analysis would be done according to the ID, segmentation tag, Data Address and data. If the application server finds the current packet is not integrated, it will send a retransmission command with setting retransmission Flag in Header and also the address of segmentation needed to be retransmitted. The module will retransmit the data after receiving this command.

2.2.3 Command for parameters configuration

Items	Field	Number of bytes	value
Period	Type	1	0x01
	Data	2	…
Baundrate	Type	1	0x02
	Data	2	…
Parity	Type	1	0x03
	Data	1	…
Databits	Type	1	0x04
	Data	1	…
IsConfirmed	Type	1	0x05
	Data	1	…
IsReply	Type	1	0x06
	Data	1	…
Timeout	Type	1	0x07
	Data	1	…
IsSendTimeStap	Type	1	0x08
	Data	1	…
	…	…	…
Other definitions	Type	1	…
	Data	Variable	…

The command format are explained below:

The format of the field is represented by Type + Data.

If the value of Type is '0x01', it means the next data is 'Period', occupies 1 byte.
If the value of Type is '0x02', it means the next data is 'Baudrate', occupies 2 bytes.
If the value of Type is '0x03', it means the next data is 'Parity', occupies 1 byte.
If the value of Type is '0x04', it means the next data is 'Databits', occupies 1 byte.
If the value of Type is '0x05', it means the next data is 'IsConfirmed', occupies 1 byte.
If the value of Type is '0x06', it means the next data is 'IsReply', occupies 1 byte.
If the value of Type is '0x07', it means the next data is 'Timeout', occupies 1 byte.
If the value of Type is '0x08', it means the next data is 'IsSendTimeStap', occupies 1 byte.

Application layer or the module depends on the type defined here to decode and recognize the configuration information. It is easy to recognize and expand. The application server cannot rely on the order of the command to parse the data. The server parses the data type by analyzing the 'Type' and parses all the data in turn.

Type	Number of bytes	Items	Explanation
0x01	2	Period	Configuration field. Indicate the period of heartbeat of the module (little-endian). Fox example：30 00 (0x0030) means the period is 48min. Default value: 02 00 (0x0002), indicate the period is 2min.
0x02	2	Baudrate	Configuration field. Indicate the baud rate of the serial port of the module (little-endian). Fox example: B0 04 (0x04B0), so the baud rate is 1200bps. Default value: 60 09 (0x0960), indicate the baud rate is 2400bps.
0x03	1	Parity	Configuration field. Indicate the parity mode of the serial port of the module. None: 0x00 Odd: 0x01 Even: 0x02 Default value: 0x01.
0x04	1	Databits	Configuration field. Indicate the data bits of the serial port of the module. Data bits: 0x07(7 bits), 0x08(8bits), 0x09(bits) Default value: 0x08.
0x05	1	IsConfirmed	Configuration field. Indicate that whether the module sends the last segmentation as 'Confirmed'. Unconfirmed: 0x00. Confirmed: 0x01 Default value: 0x00
0x06	1	IsReply	Configuration field. Indicate whether the module replies to the device about the busy status or overwrites the previous data stored in the buffer before. Overwrite: 0x00. Reply: 0x01 Default: 0x00
0x07	1	Timeout	Configuration field. Indicate the timeout to wait for replying from the server. The field is valid only when 'IsConfirmed' is '0x00'. 0x00: 6s. 0x01: 8s. 0x02: 10s. 0x03: 12s. 0x04: 14s. 0x05: 16s. 0x06: 18s. 0x07: 20s. Default value: 0x01.

0x08	1	IsSendTimeStap	Configuration field. Indicate whether the uplink contains the timestamp data. No: 0x00. Yes: 0x01. Default value: 0x00.

2.2.4 Command for heartbeat package

The data frames of command for heartbeat packet have two formats:
- ➢ Without any configuration data, the length of payload is 0.
- ➢ With some configuration data, the format is the same as the command of parameters configuration.

The case of uplink of heartbeat:

a. After the module power on or reset.

b. After the command of parameters configuration sends from AS and the module is set up, the module should immediately return the heartbeat packet with the configuration data.

2.2.5 Command for status inquiry

Uplink:

Payload contains the data like "Type 0+Data 0+ … + Type n+Data n",details as follows:

Downlink:

1. If none, the module returns the status data according to a predetermined collection of 'Type'.
2. If not none, the module returns the status data according to the selected 'Type'.

DFU Uplink Type/Data List:

Items	Field	Number of bytes	Value
LORA	Type	1	0x10
	The total number of packages sent by Lora	4	
	The total number of bytes sent by Lora	4	
	Downlink RSSI	1	
	Downlink SNR	1	
DMU	Type	1	0x11
	The total number of packages received by DFU from DMU	4	
	The total number of bytes received by DFU from DMU	4	
DFU	Type	1	0x12
	The total number of subcontracts in DFU	4	

Items	Field	Number of bytes	Value
	The total bytes of subcontracts in DFU	4	
BAT	Type	1	0x13
	Battery voltage or supply voltage	2	
UPTIME	Type	1	0x14
	Running time	4	

DFU Uplink Type/Data details:

Type	Number of bytes	Items	Explanation
0x10	12	LORA	The total number of packages sent by Lora: Sent by Lora Mac layer The total number of bytes sent by Lora: Sent by Lora Mac layer, unit: bytes $$\mathbf{RSSI = -180 + rssi\ dBm}$$ $$\mathbf{SNR = \frac{snr[2's\ complement]}{4}\ dB}$$
0x11	8	DMU	The total number of packages received by DFU from DMU The total number of bytes received by DFU from DMU, unit: byte
0x12	8	DFU	The total number of subcontracts in DFU The total bytes of subcontracts in DFU, unit: byte
0x13	1	BAT	Battery voltage or supply voltage,. Unit: 0.005V 0~327.675V
0x14	4	UPTIME	The running time of the module. Unit: second 0 ~ 4294967295s

Note：

Uplink RSSI/SNR: The module could get these value by 'LinkCheckRequest' MAC command.

Downlink RSSI/SNR: The status of the last data packet received by the module.

When the application server needs to query the status information of the current module, the command for status inquiry is used to send to the module. Then the module will return the current status information to the application server for system management optimization or fault diagnosis.

2.3 Reply to host exception status

According to the application layer IsReply field configuration to determine whether to reply, when the reply is 'busy', to comply with the transfer protocol of the DMU, reply an exception status command.

3 Packet example

Has been given in the above article

Revision

V0.6 2017-11-25
  + Errata

V0.5 2017-06-27
  + Delete the Lora Downlink RSSI and SNR
  + Change the value of Even to 0x02 from 0x10.

V0.4 2017-05-15
  + Add the 'IsConfirmed' bit in Header
  + Confirm the default value of all the configuration parameters.

V0.3 2017-04-18
  + Re-typesetting, add preface
  + Add 'ETF' bit in Header
  + Rename 'Start Index' as 'Data Address'
  + Add definitions about DMU and DFU
  + Refinement of configuration parameters and status query command

V0.2 2017-04-17
  + Add a byte as 'Type' before Header
  + Change the command field to 4 bytes.
  + Add command of parameter configuration, heartbeat and status inquiry
  + Adjust the format of Header

V0.1 2017-04-11
  + Creation

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