CATL Communication between Battery System and SCADA

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Introduction

This document describes communication protocol between C ATL battery system and SCADA.
The protocol this document describes is ModBus TCP/IP.
SCADA act as the client, the battery system is the server.
Both client and server clarify their IP address.
All the information is transmitted through Internet (Big Endian).
During communication, CAN bus must be active.
CATL reserves the right such as updating and modifying this document.

Communication protocol

Modbus TCP/IP

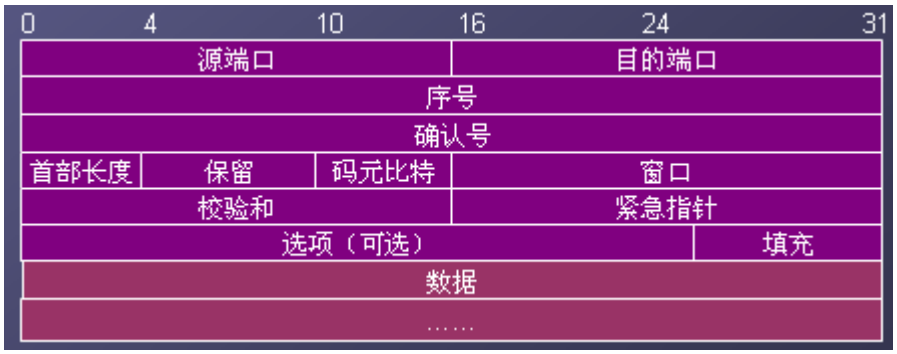
Communication baud rate

10M/100M self-adjusting

Physical layer

Physical layer:IEEE802.3，RJ45 connector with 5 or above 5 type cables

TCP message format



In the Ethernet, maximum transportation unit is 1500 char (8 bit length), in a IP package, it can transport a maximum 1480 char except IP head(20 char). In TCP package, it can transport maximum 1460 char except TCP head (20 char)

Address distribution

Float name	IP address	Sub-net mask	Gateway	Port
server（BMS）	192.1.1.10x	255.255.255.0	192.168.1.1	502
client（SCADA）	192.1.1.xxx	255.255.255.0	192.168.1.1	

Application layer message format

As the device receives a frame of TCP message, it extracts the Modbus TCP/IP data segment.
Data segment format as below:

Transaction process identifier	Protocol identifier	Data length	Address	Function code	Byte quantity	Data
2 byte	2 byte	2 byte	1 byte	1 byte	1 byte	N byte

Transaction process identifier（byte0，byte1）——0
Protocol identifier（byte2，byte3）——0
Length segment（byte4 is low byte，byte5 is high byte）—— It means the overall data length (address + function code + data) following.
Address（byte6）—— It means the address of the guest computer being addressed; this protocol specified the address of guest computer is 64H.
Function code（byte7）—— Order the server computer being addressed guest to finish required action. Function code as noted in the table below.
Data （byte8~xx）—— Data field, includes data guest terminal needs to finish some specified function, and includes uploaded data during servicing.

Function code introduction:

Function code (hexadecimal)	Definition	Function description
0x03H	Read multiple registers	client computer reads data of guest computer
0x10H	Write multiple registers	client computer modifies data of guest computer
0x06H	Write single register	client computer modifies data of guest computer

Data format definition

Data type	Ratio factor	Range	Offset	Actual span	Data quantity	Comment
Overall voltage	0.1V/bit	0 ~10000	0	0 ~ 1000V	2BYTE	
Charge/ discharge current	0.1A/bit	0 ~ 40000	-20000	-2000 ~ 2000A	2BYTE	Negative current means PCS is charging the battery system, Positive current means PCS is discharging battery system
Allowed charge/ discharge current	0.1A/bit	0 ~ 40000	0	-2000 ~ 2000A	2BYTE	Charge: - Discharge:+
Capacity	0.1AH/bit	0 ~ 60000	0	0 ~ 6000Ah	2BYTE	
Energy	0.1kWh/bit	0 ~ 60000	0	0 ~ 6000kWh	2BYTE	
SOC	0.1%/bit	0 ~ 1000	0	0 ~ 100%	2BYTE	
SOH	0.1%/bit	0 ~ 1000	0	0 ~ 100%	2BYTE	
Single cell temperature	1℃/bit	0 ~ 250	-50	-50 ~ 200℃	1BYTE	
Single cell voltage	0.001V/bit	0 ~5000	0	0 ~ 5V	2BYTE	
Temperature difference between cells	1℃/bit	0 ~ 250	0	0 ~ 250℃	1BYTE	
Voltage difference between cells	0.001V/bit	0 ~5000	0	0 ~ 5V	2BYTE	
SOC difference	0.1%/bit	0 ~ 1000	0	0 ~ 100%	2BYTE	
Power	0.1kW/bit	0 ~ 40000	-20000	-2000 ~ 2000kW	2BYTE	
Power factor	0.01/bit	0 ~ 100	0	0 ~ 1	1BYTE	
Efficiency	1%/bit	0 ~ 100	0	0 ~ 100%	1BYTE	
Life signal	1/bit	0 ~ 15	0	0 ~ 15	1BYTE	
Accumulated charge/ discharge energy	0.1kWh/bit	0 ~ 4294967295	0	0~429496729kWh	4BYTE	

BMS Address Distribution Rules

SBMS NO	Register address	Byte quantity	Variable description	Comment
BMS	0x0000-0x3FF	2048	BMS data	Battery system data

Message detailed definition

Server computer (BMS) register address definition

a) MBMS (MBMS warning data)

Register address	Data quantity	Description	Comment
0x0000	2	Cell over voltage warning	1,2,3 means warning level of single cell voltage exceeds set value, 0 means normal
0x0001	2	Cell under voltage warning	1,2,3 means warning level of single cell voltage below set value, 0 means normal
0x0002	2	Cell over temperature warning	1,2,3 means warning level of single cell temperature exceeds set value, 0 means normal
0x0003	2	Cell low temperature warning	1,2,3 means warning level of single cell temperature below set value, 0 means normal
0x0004	2	Over charge current warning	1,2,3 means warning level of single cell current exceeds set value, 0 means normal
0x0005	2	Over discharge current warning	1,2,3 means warning level of single cell discharge current exceeds set value, 0 means normal
0x0006	2	Reserve	reserve
0x0007	2	Reserve	reserve
0x0008	2	Low SOC warning	1,2,3 means warning level of SOC below set value, 0 means normal
0x0009	2	Reserve	reserve
0x000A	2	Reserve	reserve
0x000B	2	Low insulation warning	1,2,3 means warning level of low insulation, 0 means normal
0x000C	2	Pack over voltage warning	1,2,3 means warning level of pack over voltage, 0 means normal
0x000D	2	Pack under voltage warning	1,2,3 means warning level of pack under voltage, 0 means normal

0x000F	2	Warning of internal communication error	1 means there is communication error 0 means normal
0x0010	2	Warning of extreme cell temperature	1 means cell temperature exceeds limited value 0 means normal
0x0011	2	Warning of extreme cell voltage	1 means cell voltage exceeds limited value 0 means normal
0x0012-0x001F	xx		Reserve

b) General MBMS Data

Register address	Byte quantity	Description	Comment
0x0020	2	Overall voltage-measurement	Current DC voltage
0x0021	2	Current	Current DC charge/discharge current
0x0022	2	SOC	Current SOC data
0x0023	2	SOH	Current SOH data
0x0024	2	Maximum cell voltage	Current maximum cell voltage
0x0025	2	Minimum cell voltage	Current minimum cell voltage
0x0026	2	Average cell voltage	Current average cell voltage
0x0027	2	Maximum cell temperature	Current highest cell temperature
0x0028	2	Minimum cell temperature	Current lowest cell temperature
0x0029	2	Average cell temperature	Current average cell temperature
0x002A	2	Allowed maximum charge current	Current allowed highest charge current
0x002B	2	Allowed maximum discharge current	Current allowed lowest discharge current
0x002C	2	Highest environmental temperature	Current highest environmental temperature
0x002D	2	Lowest environmental temperature	Current lowest environmental temperature
0x002E	2	Average environmental temperature	Current average environmental temperature
0x002F	2	Life signal	Battery system life signal (0-15)
0x0030	2	Environmental humidity	Current environmental humidity
0x0031-0x007F	xx	Reserve	Reserve
0x0080	2	Allowed maximum charge voltage	Current allowed highest charge voltage

0x0081	2	Allowed minimum discharge voltage	Current allowed minimum discharge voltage
0x0082-0x03ff	xx	Reserve	Reserve

Message data format example

If host computer needs to read data of register x0420~0x0432 (19 registers, 38 byte data in total), data format between host computer and guest computer is shown below:

1. Client computer reads server computer operation data：

Transaction process identifier	Protocol identifier	Length segment	System address	Function code	High byte of starting register address	Low byte of starting register address	High byte of starting register address	Low byte of register quantity
00H 00H	00H 00H	00H 06H	64H	03H	04H	20H	00H	13H

2. Data from sever computer to client computer：

Transaction process identifier	Protocol identifier	Length segment	System address	Function code	Byte quantity	High byte of register data(0x0420)	Low byte of register data(0x0420)
00H 00H	00H 00H	00H 29H	64H	03H	26H	xxH	xxH

High byte of register data(0x0421)	Low byte of register data(0x0421)	Register… high byte of data	Register… low byte of data	High byte of register data(0x0422)	Low byte of register data(0x0422)
xxH	xxH	xxH	xxH	xxH	xxH

Note: Length segment means byte quantity behind the length segment, data byte quantity means byte quantity of returning register data.

Each reading doesn't exceed 127 address (254 byte), if over 127 address, it needs to be read more than 1 time.

Host computer read data of guest computer, can set time cycle per importance of data, minimum cycle is greater than 20 ms.

Error Frame Format

Transaction process identifier	Protocol identifier	Length segment	System address	Function code	Error code
00H 00H	00H 00H	Original xx	64H	Original function	Refer to the

				code+128	table below

Error Code

Error Code	Description
0x01	non-support function code
0x02	No CAN communication
0x03	Exceed transmitting 127 register address
0x04	error
0x05~0xff	Spare