Version：V2.1.4

Level：Confidential

Shenzhen Concox Information Technology Co., Ltd

GPS Tracker

Communication Protocol

(CT10, JM-LL01,JM-LL02)

Important Revision History

Writer	Date	Version	Audit	Approval	Description
BianYutao	2018-10-20	2.1.0			New edition
Yu Yuxin	2018-12-13	2.1.1			Update battery voltage and percentage table
	2019-12-19	2.1.2			Added support new model JM-LL01
	2020-5-28	2.1.3			Add GPS upload mode
	2020-6-11	2.1.4			Add JM-LL02 model

Content

I. Protocol Packet Format

Format	Length (Byte)	Description
Start Bit	2	0x78 0x78（packet length : 1bit）or 0x79 0x79（packet length : 2 bits）
Packet Length	1(2)	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number	1	Transmission packet type（see the following diagram for details）
Information Content	N	Content is defined by specific application and protocol number
Information Serial Number	2	After the device booted, serial number of data sent later at each time will be automatically added '1'.
Error Check	2	Error check are values (From "Packet Length" to "Information Serial Number") of CRC-ITU. CRC error occur when the received information is calculated, the receiver will ignore and discard the data packet. (See Appendix 1)
Stop Bit	2	Fixed value: 0x0D 0x0A

1.1 Protocol Number

Login Packet	0x01
Heartbeat Packet	0x23
GPS Position Packet（UTC）	0x70
Online Command Packet	0x80
Terminal Response Packet to online Command	0x21
Time Check Packet	0x8A
Information Transmission Packet	0x94

II. Protocol Packet

1. Login packet

Description：

- Login packet is an information packet to connect the terminal and platform, it will send terminal information to platform.
- If a GPRS connection is established successfully, the terminal will send a first login packet to the server and, within five seconds, if the terminal receives a data packet responded by the server, the connection is considered to be a normal connection; if not, the terminal will send login packet again.
- If no packet returned by server within 5 seconds, then the response of login packet is timeout.
- Terminal will reboot automatically after 3 timeouts.

a) **Login Packet**

		Length	Description
Start Bit		2	0x78 0x78
Packet Length		1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x01
Information Content	Terminal ID	8	Example：If IMEI number is 123456789123456，the terminal ID is：0x01 0x23 0x45 0x67 0x89 0x120x34 0x56
	Type Identification Code	2	Distinguish terminal type by type identification code.
	Time Zone Language	2	See the following chart for details of time zone and language mark.
Information Serial Number		2	Serial number of the data sent later at each time will be automatically added ‘1’.
Error Check		2	Error check (From “Packet Length” to “Information Serial Number”), are values of CRC-ITU. If CRC error occur when the received information is calculated, the receiver will ignore and discard this data packet. (See Appendix 1)
Stop Bit		2	Fixed value: 0x0D 0x0A

Example: 78 78 11 01 07 52 53 36 78 90 02 42 70 00 32 01 00 05 12 79 0D 0A

Time Zone & Language

One and a half bits bit15—bit4	15	The value multiply 100 with timezone	
	14		
	13		
	12		
	11		
	10		
	9		
	8		
	7		
	6		
	5		
	4		
Lower half bit4-bit0	3	Timezone Western or Estern	
	2	No Definition	
	1	Language Selection	1
	0	Language Selection	0

Bit3
0: Eastern timezone; 1: Western timezone
Example: If Extended bit is: 0x32 0x00, it means GMT +8:00.
Calculation method: 8*100=800, converts to HEX is: 0x0320

Extended bit: 0x4D 0xD8 means GMT -12:45.
Calculation method: 12.45*100=1245, converts to HEX is: 0x04 0xDD.

Here to save 4 bytes, calculation result left shifted 4 bits and combined eastern time, western time and the language bit.

b) Login packet response（server response）

	Length	Description
Start Bit	2	0x78 0x78
Packet Length	1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number	1	0x01
Information Serial Number	2	Serial number of the data sent later at each time will be automatically added ‘1’.
Error Check	2	Error check (From “Packet Length” to “Information Serial Number”), are values of CRC-ITU. If CRC error occurred when the received information is calculated, the receiver will ignore and discard this data packet. (See Appendix 1)
Stop Bit	2	Fixed value: 0x0D 0x0A

Example： 78 78 05 01 00 05 9F F8 0D 0A

2. Heartbeat Packet

Description：

- Heartbeat packet is a data packet to maintain the connection between the terminal and the server.
- If a GPRS connection is established successfully, the terminal will send a first heartbeat packet to the server and, within five seconds, if the terminal receives a data packet responded by the server, the connection is considered to be a normal connection; the device sends next heartbeat packet according to the heartbeat interval configuration.
- If no packet returned from server within 5 seconds, then the response of heartbeat packet is timeout.
- Terminal reboot automatically after 3 timeouts.

a) Heartbeat packet sent by terminal

		Length (Byte)	Description
Start Bit		2	0x78 0x78
Packet Length		1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x23
Information Content	Terminal Information Content	1	See the following diagram for details
	Voltage Level	2	Transform method: convert hexadecimal to decimal and then divide by 100. Example：0X01,0X9F, 019F converted to decimal is 415. Divide 415 by 100 get 4.15. 4.15 is the terminal's voltage level. (Please see appendix for voltage-battery correspondence）
	GSM Signal Strength	1	0x00: no signal; 0x01: extremely weak signal; 0x02: very weak signal; 0x03: good signal; 0x04: strong signal.
	Language/Extended Port Status	2	If latter bit is 0x01: Chinese, else if 0x02 : English
Serial Number		2	Serial number of the data sent later at each time will be automatically added '1'.
Error Check		2	Error check (From "Packet Length" to "Information Serial Number"), are values of CRC-ITU. If CRC error occured when the received information is calculated, the receiver will ignore and discard the data packet. (See Appendix 1)
Stop Bit		2	Fixed value: 0x0D 0x0A

Example： 78 78 0B 23 C0 01 22 04 00 01 00 08 18 72 0D 0A

Terminal Information

One byte is used for defining various status information of the terminal.

Bit		Code Meaning
BYTE	Bit7	1: Oil and electricity disconnected
		0: Oil and electricity connected
	Bit6	1: GPS tracking is on
		0: GPS tracking is off
	Bit3～Bit5	Extended Bit
	Bit2	1: Charging On
		0: Charging Off
	Bit1	1: ACC high
		0: ACC Low
	Bit0	1: Defense Activated
		0: Defense Deactivated

b) Server Respond to the Heartbeat Packet

	Length (Byte)	Description
Start Bit	2	0x780x78
Packet Length	1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number	1	0x23
Serial Number	2	Serial number of the data sent later at each time will be automatically added '1'.
Error Check	2	Error check (From "Packet Length" to "Information Serial Number"), are values of CRC-ITU. If CRC error occurred when the received information is calculated, the receiver will ignore and discard this data packet. (See Appendix 1)
Stop Bit	2	Fixed value: 0x0D 0x0A

Example： 78 78 05 23 01 00 67 0E 0D 0A

3. GPS Position Packet

Description：

- Data packet used to transmit terminal location data
- Upload location data based on configured interval after successfully connected and positioned.
- Re-upload buffered location data after successfully reconnected.

a) Position packet sent by terminal

		Length	Description
Start Bit		2	0x79 0x79
Packet Length		2	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x70
Information Content	Module number 1	2	Module number
	Module length 1	2	Module content length
	Module content 1	M	The module content is subject to the module number
	Module number 2	2	Module number
	Module length 2	2	Module content length
	Module content 2	M	The module content is subject to the module number
	…		…
Serial Number		2	Serial number of the packet sent later at each time will be automatically added ‘1’ while the device is turned on.
Error Check		2	Error check (From “Packet Length” to “Information Serial Number”), are values of CRC-ITU. If CRC error occurred when the received information is calculated, the receiver will ignore and discard this data packet. (See Appendix 1)
Stop Bit		2	Fixed value: 0x0D 0x0A

b) Position packet sent by terminal

Module Number	Module Length		
0x00 0x00	**1**	**Transfer Type**	**0x02： Position Information**
0x00 0x01	8	IMEI (hexadecimal)	
0x00 0x02	8	IMSI (hexadecimal)	
0x00 0x03	10	ICCID (hexadecimal)	
0x00 0x09	1	Number of satellites participating in positioning	Convert from hexadecimal to decimal

<table>
<tr><td>0x00 0x0A</td><td>1</td><td>Visible satellites</td><td>Convert from hexadecimal to decimal</td></tr>
<tr><td>0x00 0x0B</td><td>N</td><td>Satellites singal strength</td><td>Each byte represents a satelites signal strength, convert each byte to decimal as the satellite DB value (Reserved)</td></tr>
<tr><td>0x00 0x11</td><td>10</td><td>LBS Main Cell Tower</td><td>MCC(2) MNC(2) LAC(2) CI(3) RSSI(1), Take correspondent length of the byte and convert from hexadecimal to decimal</td></tr>
<tr><td>0x00 0x12</td><td>6*n</td><td>LBS Auxiliary Cell Tower</td><td>LAC(2) CI(3) RSSI(1), Take correspondent length of the byte and convert from hexadecimal to decimal， the length of each auxiliary LBS data is 6 bytes, the total length of 3 groups is 18 bytes (Reserved)</td></tr>
<tr><td>0x00 0x16</td><td>1</td><td>GSM Signal CSQ</td><td>Convert from hexadecimal to decimal</td></tr>
<tr><td>0x00 0x18</td><td>2</td><td>Battery Voltage</td><td>Convert from hexadecimal to decimal and devide by 100</td></tr>
<tr><td>0x00 0x28</td><td>1</td><td>HDOP</td><td>0-25.5, Convert from hexadecimal to decimal and devide by 10</td></tr>
<tr><td>0x00 0x29</td><td>4</td><td>Sequence Number</td><td>GPS Serial number, convert from hexadecimal to decimal</td></tr>
<tr><td>0x00 0x2A</td><td>1</td><td>Input’s Status</td><td>Bit 0-3: Door button status (1/0 Door Open/Close),
Bit 4-7: Tamper button status (1/0 Removal/Installation)
0xff: Failed to get button status</td></tr>
<tr><td>0x00 0x2B</td><td>1</td><td>Boot Reason</td><td>
<table>
<tr><th>Code</th><th colspan="2">Reson</th></tr>
<tr><td>0x00</td><td colspan="2">Non</td></tr>
<tr><td>0x01</td><td colspan="2">Power on automatically when battery connected</td></tr>
<tr><td>0x02</td><td colspan="2">Press button to turn on</td></tr>
<tr><td>0x03</td><td colspan="2">Regular wake up by timer</td></tr>
<tr><td>0x04</td><td colspan="2">Charging to turn on</td></tr>
<tr><td>0x10</td><td colspan="2">Abnormal vibration</td></tr>
<tr><td rowspan="9">0x11~0x7F</td><td>0x11</td><td>Device turn on triggered by Low internal battery event</td></tr>
<tr><td>0x12</td><td>Device turn on triggered by Low external battery event</td></tr>
<tr><td>0x13</td><td>Device turn on triggered by External power cutoff event</td></tr>
<tr><td>0x14</td><td>Device turn on triggered by Removal alarm</td></tr>
<tr><td>0x15</td><td>Device turn on triggered by Sound event</td></tr>
<tr><td>0x20</td><td>Device turn on triggered by external sensor, (Example: door open, device case open etc)</td></tr>
<tr><td>0x30</td><td>Device turn on triggered by Environment abnormal (temperature, humidity, pressure)</td></tr>
<tr><td>0x16</td><td>Device turn on triggered by installation event</td></tr>
<tr><td></td><td></td></tr>
<tr><td>0x80</td><td colspan="2">Mandatorily reboot as device is abnormal</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>0x81</td><td>Device reboot after SCM firmware upgraded successfully by OTA</td></tr>
<tr><td>0x82</td><td>SCM request to judge the distance moved from the last static position</td></tr>
<tr><td>0x83</td><td>Serial port communication abonormal</td></tr>
<tr><td>0x84</td><td>Device reboot by server request.</td></tr>
<tr><td>0xF0</td><td>Switch to static mode</td></tr>
<tr><td>0xF1</td><td>Swtich to sea transportation mode</td></tr>
<tr><td>0xF2</td><td>Switch to land transportation mode</td></tr>
<tr><td>0xF3</td><td>Door close</td></tr>
</table>
</td></tr>
<tr><td>0x00 0x2C</td><td>4</td><td>RTC TIME</td><td>Unix Timestamp</td></tr>
<tr><td>0x00 0x2E</td><td>4</td><td>Mileage statistics</td><td>Convert from hexadecimal to decimal</td></tr>
<tr><td>0x00 0x30</td><td>10</td><td>Reporting mode and parameters of each mode</td><td>Length 1: mode parameters 0-3
Length 1: Real time current mode (this parameter if Mode=1/2/3) 0-3
Length 2: Static mode parameter, 5-1440 min
Length 2: Land transportation mode, 5-1440 min
Length 2: Sea transportation mode parameter 1, 5-1440 min
Length 2: Sea transportation mode parameter 2, 5-1440 min</td></tr>
<tr><td>0x00 0x31</td><td>3</td><td>Geofence trigger parameters</td><td>Length 1: Which ID of the geofence triggered the alarm
Length 1: Circular o rectangular, 0 is circular, 1 is rectangular
Length 1: Enter or Exit geofence, 1 is enter, 2 is exit</td></tr>
<tr><td>0x00 0x33</td><td>18</td><td>GPS Data</td><td>Time and Date (4 Bytes), Timestamp;
Number of GPS satellites (1 Byte), Convert to decimal;
Height (2 Bytes), Convert to decimal to get result, if in binery the highest bit is 1, it means negative, transfer the last 7 bits to decimal to get the height value.
Latitude (4 Bytes), Convert to decimal and devide by 1800000
Longitude (4 Bytes), Convert to decimal and devide by 1800000
Speed (1 Byte), Convert to decimal

Course and Status（2 Bytes）
<table>
<tr><td rowspan="8">BYTE_1</td><td>Bit7</td><td>0</td></tr>
<tr><td>Bit6</td><td>0</td></tr>
<tr><td>Bit5</td><td>GPS real-time/differential positioning</td></tr>
<tr><td>Bit4</td><td>GPS has been positioning or not</td></tr>
<tr><td>Bit3</td><td>East Longitude, West Longitude</td></tr>
<tr><td>Bit2</td><td>South Latitude, North Latitude</td></tr>
<tr><td>Bit1</td><td>Course</td></tr>
</table>
</td></tr>
</table>

			<table><tr><td></td><td>Bit0</td></tr><tr><td rowspan="8">BYTE_2</td><td>Bit7</td></tr><tr><td>Bit6</td></tr><tr><td>Bit5</td></tr><tr><td>Bit4</td></tr><tr><td>Bit3</td></tr><tr><td>Bit2</td></tr><tr><td>Bit1</td></tr><tr><td>Bit0</td></tr></table>
0x00 0x34	N	Report Status	Status code (1 Byte) + Trigger Time (4 Bytes) + Trigger Content Length (1 Byte) + Tigger Content (N Bytes) **Status Code** 0x00 Upload in fixed time interval 0x01 Upload by distance interval 0x02 Inflection point upload 0x03 ACC status upload 0x04 Re-upload the last GPS point when back to static. 0x05 Upload the last effective point when network recovers. 0x06 Update ephemeris and upload GPS data compulsorily 0x07 Upload location when side key triggered 0x08 Upload location after power on 0x09 Unused 0x0A Upload the last longitude and latitude when device is static; time updated 0x0D Upload the last longitude and latitude when device is static 0x0E Gpsdup upload (Upload regularly in a static state.) 0x10 Door Open 0x11 Door Close 0x12 Removal 0x13 Installation 0x14 Enter Geofence 0x15 Exit Geofence 0x16 Environment Abnormal 0x17 Switch to sea transportation mode 0x18 Switch to land transportation mode 0x19 Switch to static mode 0x1A Battery low power 0x1B Overspeed 0x1C Power ON 0x1D Power OFF 0x1E Enter GPS blind area

0x1F Exit GPS blind area
0x20 Vibration
0x21 External power cut off
0x22 Low internal battery
0x23 Device casing is opened

Trigger Time (Unix Timestamp)

Trigger Content Length (If the trigger content length is 0x00, means there is no Trigger Content)

Trigger Content

Status	Length	Remarks
Environ-ment Abnormal	5	Byte3: bit7 Undefined bit6 Undefined bit5 High pressure, 1: abnormal, 0: Normal bit4 Low pressure, 1: abnormal, 0: Normal bit3 High humidity, 1: abnormal, 0: Normal bit2 Low humidity, 1: abnormal, 0: Normal bit1 High temperature, 1: abnormal, 0: Normal bit0 Low temperature, 1: abnormal, 0: Normal Byte2: Length 1, Temperature 8 bit with symbol data, the highest bit below zero is 1 , range -45 to +80 degrees Celsius, Byte1: Length 1, Humidity, Unit in %, Range 0 to 100 Byte0: Length 2, Barometric pressure, Unit in hPa, Range 300 to 1100
Overspeed	1	Convert from hexadecimal to decimal
0x14 Enter Geofence 0x15 Exit Geofence	2	Length 1: Which ID of the geofence triggered the alarm Length 1: Circular o rectangular, 0 is circular, 1 is retangular

<table>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>0x00 0x35</td><td>GPS is Real Time or Buffer</td><td>1</td><td>0x00: Real time position;
0x01: Buffered Position;
0x02: Upload last valid position when currently GPS can’t locate and the LBS is disabled;
0x03: Upload last valid position when currently GPS and LBS both can’t locate;
0x04: Re-upload 0x02 if upload 0x02 was failed last time;
0x05: Re-upload 0x03 if upload 0x03 was failed last time.</td></tr>
<tr><td>0x00 0x36</td><td>WIFI</td><td>n</td><td><table>
<tr><th>Meaning</th><th>Length</th><th>Instruction</th></tr>
<tr><td>WiFi Quantity</td><td>1</td><td>The WiFi Hotspot Quantity searched by the device</td></tr>
<tr><td>WIFI MAC 1</td><td>6</td><td>The MAC address of the WIFI hotspot 1</td></tr>
<tr><td>WIFI Strength 1</td><td>1</td><td>The WIFI hotspot 1 signal strength</td></tr>
<tr><td>WIFI MAC 2</td><td>6</td><td>Same as above</td></tr>
<tr><td>WIFI Strength 2</td><td>1</td><td>Same as above</td></tr>
<tr><td>...</td><td>..</td><td>...</td></tr>
</table></td></tr>
<tr><td>0x10 0x00</td><td>1</td><td>Server need to respond or not</td><td>0x01: Server need to respond the packet
0x00: Server doesn’t need to respond the packet</td></tr>
</table>

4. Online Command

Description：

- Use server online command to control terminal to execute tasks.
- Terminal response results to server.

a) Online command sent by server

		Length	Description
Start Bit		2	0x78 0x78
Length of data bit		1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x80
Information Content	Length of Command	1	=Server flag bit + command content length
	Server Flag Bit	4	Leave for server identification. Terminal receives the original data in Binary in response packet
	Command Content	M	Character string replied in ASCII coding. Command content is compatible with SMS command.
	(Language)	2	Latter bit: 0x01 Chinese, 0x02 English (this bit is not mandatory)
Information Serial Number		2	Serial number of the data sent later at each time will be automatically added '1'.
Check Bit		2	Error check (From "Packet Length" to "Information Serial Number"), are values of CRC-ITU. If CRC error occurred when the received information is calculated, the receiver will ignore and discard this data packet. (See Appendix 1)
Stop Bit		2	Fixed value: 0x0D 0x0A

Example： 78 78 0E 80 08 00 00 00 00 73 6F 73 23 00 01 6D 6A 0D 0A

b) Online command replied by terminal (0x21)

Terminal reply (general commands)

		Length	Description
Start Bit		2	0x79 0x79
Length of data bit		2	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x21
Information Content	Server Flag Bit	4	Leave for server identification. Terminal receives the original data in Binary in response packet
	Content Code	1	0x01 ASCII code 0x02 UTF16-BE code.
	Content	M	Data needed to be sent（according to content code format）
Information Serial Number		2	Serial number of the data sent later at each time will be automatically added '1'.

Check Bit	2	Error check (From “Packet Length” to “Information Serial Number”), are values of CRC-ITU. If CRC error occurred when the received information is calculated, the receiver will ignore and discard the data packet. (See Appendix 1)
Stop Bit	2	Fixed value:0x0D 0x0A

Example：79 79 00 9D 21 00 00 00 00 01 42 61 74 74 65 72 79 3A 34 2E 31 36 56 2C 4E 4F 52 4D 41 4C 3B 20 47 50 52 53 3A 4C 69 6E 6B 20 55 70 3B 20 47 53 4D 20 53 69 67 6E 61 6C 20 4C 65 76 65 6C 3A 53 74 72 6F 6E 67 3B 20 47 50 53 3A 53 65 61 72 63 68 69 6E 67 20 73 61 74 65 6C 6C 69 74 65 2C 20 53 56 53 20 55 73 65 64 20 69 6E 20 66 69 78 3A 30 28 30 29 2C 20 47 50 53 20 53 69 67 6E 61 6C 20 4C 65 76 65 6C 3A 3B 20 41 43 43 3A 4F 46 46 3B 20 44 65 66 65 6E 73 65 3A 4F 46 46 00 2E 26 DF 0D 0A

5. Time Calibration Packet

Description：

- Used for the device to calibrate time when it's powered on and sending request to the server, it fix the time error when device powed on but haven't been positioned.
- Server responde with a correct format of UTC time

a) Time request sent by terminal

	Length (Byte)	Description
Start Bit	2	0x78 0x78
Packet Length	1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number	1	0x8A
Serial Number	2	Serial number of data sent later at each time will be automatically added '1'.
Error Check	2	Error check (From "Packet Length" to "Information Serial Number"), are values of CRC-ITU. If CRC error occurred when the received information is calculated, the receiver will ignore and discard this data packet. (See Appendix 1)
Stop Bit	2	Fixed value: 0x0D 0x0A

Example： 78 78 05 8A 00 06 88 29 0D 0A

b) Server response time information

		Length	Description
Start Bit		2	0x78 0x78
Packet Length		1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x8A (UTC)
Information Content	Date Time	6	Year（1byte）Month（1byte）Day（1byte）Hour（1byte）Min（1byte）Second（1byte）（converted to a decimal）(Date Time
Serial Number		2	Serial number of the data sent later at each time will be automatically added '1'.
Error Check		2	Error check (From "Packet Length" to "Information Serial Number"), are values of CRC-ITU. If CRC error occurred when the received information is calculated, the receiver will ignore and discard this data packet. (See Appendix 1)
Stop Bit		2	Fixed value: 0x0D0x0A

Example： 78 78 0B 8A 0F 0C 1D 00 00 15 00 06 F0 86 0D 0A

6. Information Transmission Packet

Description：

- Terminal transmits all types of non-position data.

a) Information transmission packet sent by terminal

		Length	Description
Start Bit		2	0x79 0x79
Length of packet		2	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x94
Information Content	Information Type （Sub-protocol Number）	1	00 External power voltage 01~03（Customized） 04 Terminal status synchronization 05 Door status 08 Self-detection parameters 0A ICCID 0x11 Vibration times（customized） 0x22 Device status information ……to add
	Data Content	N	Different information type results in different transmission content. See the following for details.
Information Serial Number		2	Serial number of the data sent later at each time will be automatically added ‘1’.
Check Bit		2	Error check (From “Packet Length” to “Information Serial Number”), are values of CRC-ITU. If CRC error occurred when the received information is calculated, the receiver will ignore and discard this data packet. (See Appendix 1)
Stop Bit		2	Fixed value: 0x0D 0x0A

Example：79 79 00 7F 94 04 41 4C 4D 31 3D 43 34 3B 41 4C 4D 32 3D 43 43 3B 41 4C 4D 33 3D 34 43 3B 53 54 41 31 3D 43 30 3B 44 59 44 3D 30 31 3B 53 4F 53 3D 2C 2C 3B 43 45 4E 54 45 52 3D 3B 46 45 4E 43 45 3D 46 65 6E 63 65 2C 4F 4E 2C 30 2C 32 33 2E 31 31 31 38 30 39 2C 31 31 34 2E 34 30 39 32 36 34 2C 34 30 30 2C 49 4E 20 6F 72 20 4F 55 54 2C 30 3B 4D 49 46 49 3D 4D 49 46 49 2C 4F 46 46 00 0A 06 1E 0D 0A

Transmitted information content

When type is 00，the bit transmit external battery. This bit is two-digit hexadecimal value. Hexadecimal value converted to decimal value and divide 100

Example：0X04, 0X9F, 049F converted to decimal is 101183，then divide 100 is 11.83, which means external voltage is 11.83V

When type is 04, the bit transmits information of terminal status synchronization. The bit length is extended and transmit in ASCII code. Parse method: Extract the transmiting content and covert it to ASCII, then follow

the below content identifier table to decode one by one.

Definition of content identifier

Definition	Identifier
Alarm Bit 1	ALM1
Alarm Bit 2	ALM2
Alarm Bit 3	ALM3
Alarm Bit 4	ALM4
Status Bit 1	STA1
SOS Number	SOS
Centre Number	CENTER
GeoFence	FENCE
Fuel/Electricity Cutoff Status	DYD
Mode	MODE
IMSI	IMSI
ICCID	ICCID
Log in successfully	STARTTIME
Number of login packets	LOGINPACKET
Reboot times	RESTART

✧ **ALM1 Definition (Status）**

Bit	Definition	Mark
bit7	Vibration Alarm	1 : ON 0: OFF
bit6	Network Alarm	1 : ON 0: OFF
bit5	Phone Alarm	1 : ON 0: OFF
bit4	SMS Alarm	1 : ON 0: OFF
bit3	Displacement Alarm	1 : ON 0: OFF
bit2	Network Alarm	1 : ON 0: OFF
bit1	Phone Alarm	1 : ON 0: OFF
bit0	SMS Alarm	1 : ON 0: OFF

✧ **ALM2 Definition (Status）**

Bit	Definition	Mark
bit7	Low Internal Battery Alarm	1 : ON 0: OFF
bit6	Network Alarm	1 : ON 0: OFF
bit5	Phone Alarm	1 : ON 0: OFF
bit4	SMS Alarm	1 : ON 0: OFF
bit3	Low External Battery Alarm	1 : ON 0: OFF
bit2	Network Alarm	1 : ON 0: OFF
bit1	Phone Alarm	1 : ON 0: OFF
bit0	SMS Alarm	1 : ON 0: OFF

✧ **ALM3 Definition (Status）**

Bit	Definition	Mark
bit7	Overspeed Alarm	1 : ON 0: OFF
bit6	Network Alarm	1 : ON 0: OFF
bit5	Phone Alarm	1 : ON 0: OFF
bit4	SMS Alarm	1 : ON 0: OFF
bit3	Power Off Alarm	1 : ON 0: OFF
bit2	Network Alarm	1 : ON 0: OFF
bit1	Phone Alarm	1 : ON 0: OFF
bit0	SMS Alarm	1 : ON 0: OFF

✧ **ALM4 Definition (Status）**

Bit	Definition	Mark
bit7	SOS Alarm	1 : ON 0: OFF
bit6	Network Alarm	1 : ON 0: OFF
bit5	Phone Alarm	1 : ON 0: OFF
bit4	SMS Alarm	1 : ON 0: OFF
bit3	Sound Alarm	1 : ON 0: OFF
bit2	Network Alarm	1 : ON 0: OFF
bit1	Phone Alarm	1 : ON 0: OFF
bit0	SMS Alarm	1 : ON 0: OFF

✧ **STA1 Definition (Status）**

Bit	**Definition**	Mark
bit7	Arm Status	1 : Armed 0: Disarmed
bit6	Automatically Arm	1 : ON 0: OFF
bit5	Manually Arm	1 : ON 0: OFF
bit4	Remotely Disarm	1 : ON 0: OFF
bit3	To Be Defined	
bit2	To Be Defined	
bit1	Anti-removal button	1 : pressed 0: released
bit0	Anti-removal Alarm Status	1 : ON 0: OFF

✧ **Fuel/Electricity Status Definition**

Bit	**Definition**	Mark
bit7	Undefined	
bit6	Undefined	
bit5	Undefined	
bit4	Undefined	
bit3	Deferred execution caused by overspeed	1:Valid bit 0: Invalid bit
bit2	Deferred execution	1:Valid bit 0: Invalid bit

	caused by un-located GPS	
bit1	Oil/Electricity cutoff	1:Valid bit 0: Invalid bit
bit0	Oil/Electricity connection	1:Valid bit 0: Invalid bit

- ✧ SOS definition：adopt ASCII to transmit（use "," to separate if has multiple SOS numbers）
- ✧ Center number definition：adopt ASCII to transmit
- ✧ GeoFence definition：adopt ASCII to transmit
- ✧ Mode：adopt ASCII to transmit (separate parameters by "，")

Example：**ALM1=FF; ALM2=FF; ALM3=FF; STA1=CO ；DYD=01；SOS=12345，2345，5678；CENTER=987654; FENCE= FENCE,ON,0,-22.277120,-113.516763,5,IN,1； MODE= MODE,1,20,500**

Note：Not all contents are transmitted and please parse based on bits. Different products upload different contents.

When type is 05， this bit transmit external IO detection(door checking). Transmission is hexadecimal.

Bit	**Definition**	Mark
bit7	To Be Defined	
bit6	To Be Defined	
bit5	To Be Defined	
bit4	To Be Defined	
bit3	To Be Defined	
bit2	IO Status	1: High, 0: Low
bit1	Triggering Status	1: High triggering, 0 : Low triggering
bit0	Door Status	1 : ON, 0: OFF

When type is 06, the bit will transmit terminal Self-checking parameters information. The position length is extended and transmit in ASCII code.

When the type is 09, this bit transmits satellite status information, which is hexadecimal.

GPS module status	1	0x00 No such function, 0x01 Searching for satellites, 0x02 2D positioning, 0x03 3D positioning, 0x04 Sleeping
GPS positioning stars	1	The number of GPS positioning satellites (amount of transmission intensity depends on the number of satellites)
GPS1 strength	1	Signal strength 1 of positioning satellites
GPS2 strength	1	Signal strength 2 of positioning satellites
……		

Number of GPS satellites which are visible but not positioning	1	Number of GPS satellites which are visible but not positioning (amount of transmission intensity depends on the number of satellites)
Visible GPS1 strength	1	Signal strength 1 of visible satellites
Visible GPS2 strength	1	Signal strength 2 of visible satellites
……		
Beidou module status	1	0x00 No such function, 0x01 Searching for satellites, 0x02 2D positioning, 0x03 3D positioning, 0x04 Sleeping
Beidou positioning stars	1	The number of Beidou positioning satellites (amount of transmission intensity depends on the number of satellites)
Beidou 1 strength	1	Signal strength 1 of positioning satellites
Beidou 2strength	1	Signal strength 2 of positioning satellites
……		
Number of Beidou satellites which are visible but not positioning	1	Number of Beidou satellites which are visible but not positioning (amount of transmission intensity depends on the number of satellites)
Visible Beidou 1 strength	1	Signal strength 1 of visible satellites
Visible Beidou 2 strength	1	Signal strength 2 of visible satellites
……		
Extended length	1	It's reserved for adding new functions in future, when is still not added, it marks 0x00.
Extension bits	N	It changes according to the Extended length, this bit doesn't exist when Extended length is 0x00,

When the type is 0A, this bit transmits ICCID information, which is hexadecimal.

IMEI	8	E.g IMEI is 123456789123456， then terminal ID is：0x01 0x23 0x45 0x67 0x89 0x12 0x34 0x56
IMSI	8	E.g ： IMSI is 123456789123456，then terminal ID is：0x01 0x23 0x45 0x67 0x89 0x12 0x34 0x56
ICCID	10	E.g ： ICCID is 12345123456789123456，then terminal ID is：0X12 0x34 0x51 0x23 0x45 0x67 0x89 0x12 0x34 0x56

When the type is 0x11, this bit transmits the times of vibration which has two hexadecimal digits.

When the type is 0x22, transmit 2-bit device abnormal status information

Bit	**Definition**	Mark
bit7	Low voltage	
bit6	high voltage	
bit5	Low temperature	
bit4	high temperature	
bit3	Exit geofence	
bit2	Enter geofence	
bit1	Open door/Close door	
bit0	Removal/Installation	**1/0**

Bit	**Definition**	Mark
bit7	Reserved	
bit6	Reserved	
bit5	Reserved	
bit4	Reserved	
bit3	Reserved	
bit2	Low battery	**1/0**
bit1	Low humidity	**1/0**
bit0	High humidity	**1/0**

b) Server Response Information Transmission Packet

Server no no to responde

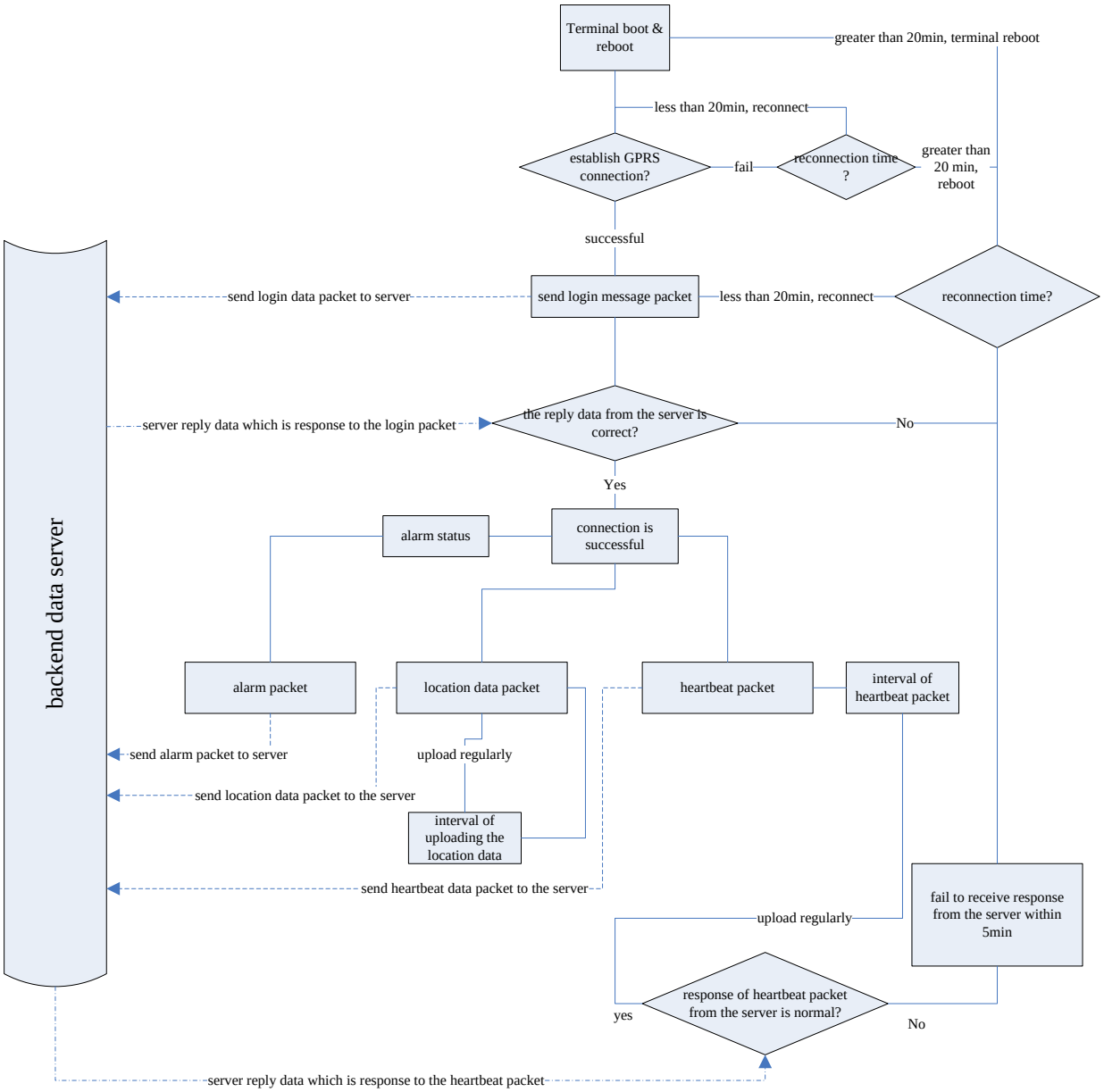
7. Appendix

1) code fragment of the CRC-ITU lookup table algorithm implemented based on C language

```
staticconstU16crctab16[]=
{
    0X0000, 0X1189, 0X2312, 0X329B, 0X4624, 0X57AD, 0X6536, 0X74BF,
    0X8C48, 0X9DC1, 0XAF5A, 0XBED3, 0XCA6C, 0XDBE5, 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,
    0XBDCB, 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,
    0XDECD, 0XCF44, 0XFDDF, 0XEC56, 0X98E9, 0X8960, 0XBBFB, 0XAA72,
    0X6306, 0X728F, 0X4014, 0X519D, 0X2522, 0X34AB, 0X0630, 0X17B9,
    0XEF4E, 0XFEC7, 0XCC5C, 0XDDD5, 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 the 16-bit CRC of data with predetermined length.
U16 GetCrc16(const U8* pData, int nLength)
{
    U16  fcs  =  0xffff;            //  initialization
    while(nLength>0){
        fcs = (fcs >> 8) ^ crctab16[(fcs ^ *pData) & 0xff];
        nLength--;
        pData++;
    }
    return  ~fcs;           //  negated
}
```

2) Data Flow Diagram



3) Voltage-Battery correspondence of Heartbeat Packet

CT10

Percentage	Voltage（V）	Percentage	Voltage（V）
100%	V≥4.13	45%	3.78≤V＜3.8
95%	4.09≤V＜4.13	40%	3.76≤V＜3.78
90%	4.06≤V＜4.09	35%	3.75≤V＜3.76
85%	4.02≤V＜4.06	30%	3.74≤V＜3.75
80%	3.96≤V＜4.02	25%	3.73≤V＜3.74
75%	3.93≤V＜3.96	20%	3.71≤V＜3.73
70%	3.9≤V＜3.93	15%	3.67≤V＜3.71
65%	3.87≤V＜3.9	10%	3.62≤V＜3.67
60%	3.84≤V＜3.87	5%	3.55≤V＜3.62
55%	3.82≤V＜3.84	0%	V＜3.55
50%	3.8≤V＜3.82	-	

LL01

Battery Percentage (%)	Voltage
100	4.13
90	4.08
80	4
70	3.91
60	3.87
50	3.81
40	3.78
30	3.75
20	3.73
10	3.7
5	3.60
0	3.55

LL02

Battery Percentage (/%)	Voltage
100	4.00
80	3.84
60	3.76
40	3.70
20	3.65
5	3.60
1	3.58