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GPS Tracker
Communication Protocol
(AT1, AT2, QBIT, AT3, AT4, AT5, AT6,
LG01, LG02, LG02L, LG05, LG300)

Important Revision History

Writer	Date	Version	Audit	Approval	Description
	2018-5-24				Modify example
	2018-6-6	V1.5			Add Sub-protocol Number of 94 packet
	2018-9-10	V1.6			Add open cover alarm
	2019-3-7	V1.9			Add AT6 voltage-battery
	2019-3-8	V2.0			Add AT1 and AT2 voltage-battery
	2019-5-21	V2.2			Add GPS upload mode Add recording packet
	2019-7-8	V2.3			Add LG01 and LG02
	2019-9-2	V2.4			Compatible with 2 bytes in some countries mnc
	2019-11-4	V2.5			Add alarm type
	2020-1-4	V2.6			Add 03 type of 8D packet
	2020-4-20	V2.7			Add LG01 and LG02 voltage-battery
	2020-6-11	V2.8			Add LG05 model
	2023-5-22	V2.9			Add LG300 model and voltage-battery

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i. Protocol Packet Format

Format	Length (Byte)	Description
Start Bit	2	0x78 0x78 (packet length : 1bit) or 0x790x79 (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	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. 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 Information	0x01
GPS Positioning Data (UTC)	0x22
Multiple Bases Extension Information Packet	0x28
Heartbeat Packet	0x23
Alarm Data (UTC)	0x26
LBS Alarm	0x19
Online Command	0x80
Online Command Response of Terminal	0x21
Time Check Packet	0x8A
Information Transmission Packet	0x94
WIFI Communication Protocol	0x2C
Recording package	0x8D

ii. Protocol Packet

2. Login packet

Description:

- Login packet is the information packet connecting the terminal and platform, it can send terminal information to platform.
- If a GPRS connection is established successfully, the terminal will send a first login message 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 reboot automatically after 3 timeouts.

2.1. Login Message Packet

1.		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: IMEI number is 123456789123456, 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 language mark.
Information 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. 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

Example: 78 78 11 01 03 51 60 80 80 77 92 88 22 03 32 01 01 AA 53 36 0D 0A

Time Zone Language

One and a half bits bit15— bit4	15	Time zone value expands 100
	14	
	13	
	12	
	11	
	10	

	9		
	8		
	7		
	6		
	5		
	4		
Lower half bit4-bit0	3	GMT	
	2	No definition	
	1	Language Select Bit	1
	0	Language Select Bit	0

Bit3 0-----Eastern time

1-----Western time

Example: Extended bit: 0x32 0x00 means GMT+8

Calculation method: $8 \times 100 = 800$ converts to HEX: 0X0320

Extended bit: 0x4D 0xD8 means GMT-12:45

Calculation method: $12.45 \times 100 = 1245$ converts to HEX: 0x04 0xDD

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

2.2. Login packet response (server response)

2.	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 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. 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

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

3. 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 login message 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 heartbeat packet is timeout.
- Terminal reboot automatically after 3 timeouts.

3.1. 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	Transformation method: To divide by 100 after convert hexadecimal decimal. Example: 0X01,0X9F, 019F converted to decimal is 415. Divide 415 by 100 get 4.15. 4.15 is the terminal' s voltage level.(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	latter bit 0x01 Chinese 0x02 English
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. 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

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

Terminal Information

One byte is consumed defining for various status information of the mobile phone.

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: Charge On
		0: Charge Off
	Bit1	1: ACC high
		0: ACC Low
	Bit0	1: Defense Activated
		0: Defense Deactivated

3.2. Server Responds 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 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. 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

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

4. GPS Location Packet

Description:

- Data packet used to transmit terminal location
- Upload locating data based on rule after successfully connected and positioned.
- Re-upload locating data after successfully connected.

4.1. Location packet sent by terminal

	Length	Description
Start Bit	2	0x78 0x78
Packet Length	1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number	1	0x22 (UTC)

Information Content	Date Time	6	Year (1byte) Month (1byte) Day (1byte) Hour (1byte) Min (1byte) Second (1byte) (converted to a decimal) (Date Time)
	Quantity of GPS information satellites	1	The first character is GPS information length, The second character is positioning satellite number (converted to a decimal)
	Latitude	4	Convert to a decimal and divide 1800000
	Longitude	4	Convert to a decimal and divide 1800000
	Speed	1	Convert to a decimal
	Course, Status	2	Convert to binary number of 16 bits and calculate by bits (see the following diagram)
	MCC	2	Mobile Country Code(MCC) (converted to a decimal)
	MNC	1	Mobile Network Code(MNC)(converted to a decimal)
	LAC	2	Location Area Code (LAC) (converted to a decimal)
	Cell ID	3	Cell Tower ID(Cell ID)(converted to a decimal)
	ACC	1	ACC Status ACC low: 00, ACC high: 01 (not available for 06)
	Data Upload Mode	1	GPS data upload mode (06 series are excluded) 0x00 Upload by 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.).
	GPS Real-time Re-upload	1	0x00 Real time upload 0x01 Re-upload (06 series are excluded)
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. 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

Example: 78 78 22 22 0F 0C 1D 02 33 05 C9 02 7A C8 18 0C 46 58 60 00 14 00 01 CC 00 28 7D 00 1F 71 00

00 01 00 08 20 86 0D 0A

i. Course & Status

Two bytes are consumed, defining the running direction of GPS. The value ranges from 0 °to 360 °measured clockwise from north of 0 °.

BYTE_1	Bit7	0
	Bit6	0
	Bit5	GPS real-time/differential positioning
	Bit4	GPS having been positioning or not
	Bit3	East Longitude, West Longitude
	Bit2	South Latitude, North Latitude
	Bit1	Course
	Bit0	
BYTE_2	Bit7	
	Bit6	
	Bit5	
	Bit4	
	Bit3	
	Bit2	
	Bit1	
	Bit0	

For example: the value is 0x15 0x4C, the corresponding binary is 00010101 01001100,

BYTE_1 Bit7	0	
BYTE_1 Bit6	0	
BYTE_1 Bit5	0 (real time GPS)	
BYTE_1 Bit4	1 (GPS has been positioned)	
BYTE_1 Bit3	0 (East Longitude)	
BYTE_1 Bit2	1 (North Latitude)	
BYTE_1 Bit1	0	→ Course 332 °(0101001100 in Binary, or 332 in decimal)
BYTE_1 Bit0	1	
BYTE_2 Bit7	0	
BYTE_2 Bit6	1	
BYTE_2 Bit5	0	
BYTE_2 Bit4	0	
BYTE_2 Bit3	1	
BYTE_2 Bit2	1	
BYTE_2 Bit1	0	
BYTE_2 Bit0	0	

which means GPS tracking is on, real time GPS, location at north latitude, east longitude and the course is 332 °.

4.2. Server location packet response

Location packet server no response

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5. LBS Multiple Bases Extension Information Packet

- Description
- For transmitting the data packet of transmit position when terminal is not positioning.

a) LBS multiple bases extension information packet sent by terminal

		Length (Byte)	Explain
Start Bit		2	0x78 0x78
Packet Length		1	Length= protocol number +information content+ serial number +error check
Protocol Number		1	0x28
Info Content	Date and Time (UTC)	6	year (1byte) month (1byte) day (1byte) hour (1byte) minute (1byte) second (1byte) (convert to decimal)
	MCC	2	Mobile Country Code
	MNC	1or 2	Mobile Network Code(MNC) Length description see note below
	LAC	2	Mobile Network Code(MNC)
	CI	3	Cell Tower ID(Cell ID)
	RSSI	1	Received Signal Strength Indicator , range from 0x00~0xFF, 0x00weak, 0xFF strongest。
	NLAC1	2	Same as LAC
	NCI1	3	Same as CI
	NRSSI1	1	Same as RSSI
	NLAC2	2	Same as LAC
	NCI2	3	Same as CI
	NRSSI2	1	Same as RSSI
	NLAC3	2	Same as LAC
	NCI3	3	Same as CI
	NRSSI3	1	Same as RSSI
	NLAC4	2	Same as LAC
	NCI4	3	Same as CI
	NRSSI4	1	Same as RSSI
	NLAC5	2	Same as LAC
	NCI5	3	Same as CI
	NRSSI5	1	Same as RSSI
	NLAC6	2	Same as LAC
	NCI6	3	Same as CI
	NRSSI6	1	Same as RSSI
	Time leads	1	Time difference between

Example: 7878
01 0D 02 02 02
28 7D 00 1F 71
00 1F 72 31 28
23 2D 28 7D 00
00 00 00 00 00
00 00 00 00 00
00 00 FF 00 02
4B 0D 0A

Note: To make it compatible for condition that is two bits in countries, the protocol use the highest bit to the MNC

3B 28 10
01 CC 00
3E 28 7D
7D 00 1E
1F 40 18
00 00 00
00 00 00
00 05 B1

the
the MNC
some
update
MCC
identify
length,

when the MCC bit is 1, the length are 2 bits, of old devices in 0, the new 1.
detailed explanation:

bases
no
reply

			actual time of mobile station signal reaches to base station and time of mobile station signal reaches to base station when distance assumed 0	
	Language	2	0x00 0x01 Chinese 0x00 0x02 English	
	Information Serial Number	2	The serial number of the first GPRS data (including status packet and data packet such as GPS, LBS package) sent after booting is '1', and the serial number of data sent later at each time will be automatically added '1'.	
	Error Check	2	The check codes of data in the structure of the protocol, from the Packet Length to the Information Serial Number (including "Packet Length" and "Information Serial Number") , are values of CRC-ITU. CRC error occur when the received information is calculated, the receiver will ignore and discard the data packet.	
	Stop Bit	2	Fixed value: 0x0D 0x0A	
	Byte		Code means	
	Bytes	Bit15	1:MNC length is 2 0:MNC length is 1	
		Bit0-Bit14	MCC information	

highest
MNC
the Bit 15
the past is
devices is
MCC

b)Server
LBS
multiple
bases
packet
response
LBS
multiple
server has
need to

6. WIFI

Information Protocol

WIFI information packet

Description: It is used for transmitting the WIFI data packet received by terminal.

a) WiFi packet sent by terminal

	Length (Byte)	Explain
Start Bit	2	0x78 0x78
Packet Length	1	Length= protocol number +information content+ serial number +error check
Protocol Number	1	0x2C
Info	Date and	6
		year (1byte) month (1byte) day (1byte) hour

Content	Time (UTC)	(1byte)minute(1byte)second(1byte)(convert to decimal)
MCC	2	Mobile Country Code
MNC	1	Mobile Network Code(MNC)
LAC	2	Mobile Network Code(MNC)
CI	3	Cell Tower ID(Cell ID)
RSSI	1	Received Signal Strength Indicator , range from 0x00~0xFF, 0x00weak, 0xFF strongest。
NLAC1	2	Same as LAC
NCI1	3	Same as CI
NRSSI1	1	Same as RSSI
NLAC2	2	Same as LAC
NCI2	3	Same as CI
NRSSI2	1	Same as RSSI
NLAC3	2	Same as LAC
NCI3	3	Same as CI
NRSSI3	1	Same as RSSI
NLAC4	2	Same as LAC
NCI4	3	Same as CI
NRSSI4	1	Same as RSSI
NLAC5	2	Same as LAC
NCI5	3	Same as CI
NRSSI5	1	Same as RSSI
NLAC6	2	Same as LAC
NCI6	3	Same as CI
NRSSI6	1	Same as RSSI
Time leads	1	Time difference between actual time of mobile station signal reaches to base station and time of mobile station signal reaches to base station when distance assumed 0
WiFi quantity	1	Confirm WIFI quantity in the packet, 0: no WIFI detected
WIFI MAC1	6	WIFI MAC of searched signal 1(transmit according to the actual number of searched WIFI. Search one, transmit one ...; search none, then transmit 0)
WIFI strength 1	1	WIFI strength of signal 1
WIFI MAC2	6	Same as above
WIFI strength 2	1	Same as above
...		

Example: 78 78
06 0E 02 2D 35
28 7D 00 1F 71
00 1E 17 25 28
23 1E 28 7D 00
28 7D 00 1F 40
00 00 00 00 00
00 00 FF 02 80
98 B4 5C CC
61 A6 5B 00 1F
0A

48 2C 10
01 CC 00
2D 28 7D
7D 00 1E
1F 72 1C
12 00 00
00 00 00
89 17 44
7B 35 36
A0 04 0D

Information Serial Number	2	The serial number of the first GPRS data (including status packet and data packet such as GPS, LBS package) sent after booting is '1', and the serial number of data sent later at each time will be automatically added '1'.
Error Check	2	The check codes of data in the structure of the protocol, from the Packet Length to the Information Serial Number (including "Packet Length" and "Information Serial Number") , are values of CRC-ITU. CRC error occur when the received information is calculated, the receiver will ignore and discard the data packet.
Stop Bit	2	Fixed value: 0x0D 0x0A

b) WIFI packet responded by sever

WIFI packet server has no need to respond

7. Alarm Packet (GPS)

Description:

- Transmit alarm content defined by terminal
- Server response and parse longitude and latitude into address and re-upload to terminal after receiving the alarm content
- Terminal send address to pre-set SOS number of device.

a) Alarm packet sent by terminal

Alarm packet (Single fence)

ii.		Length	Description
Start Bit		2	0x78 0x78
Packet Length		1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x26 (UTC)
Information Content	Date Time	6	Year (1byte) Month (1byte) Day (1byte) Hour (1byte) Min (1byte) Second (1byte) (converted to a decimal) (Date Time)
	Quantity of GPS information satellites	1	The first character is GPS information length, The second character is positioning satellite number (converted to a decimal)
	Latitude	4	Convert to a decimal and divide 1800000
	Longitude	4	Convert to a decimal and divide 1800000
	Speed	1	Convert to a decimal
	Course, Status	2	Convert to binary number of 16 bits and calculate by bits (see the following diagram) (same as GPS packet, see GPS packet for details)
	LBS length	1	LBS length in total (LBS Length+ MCC+ MNC+LAC+ Cell ID=9) parse is not mandatory, can be skipped
	MCC	2	Mobile Country Code(MCC) (converted to a decimal)
	MNC	1	Mobile Network Code(MNC)(converted to a decimal)
	LAC	2	Location Area Code (LAC) (converted to a decimal)
	Cell ID	3	Cell Tower ID(Cell ID)(converted to a decimal)
	Terminal Information	1	See the following diagram
	Voltage Level	1	0x00: No Power (shutdown) 0x01: Extremely Low Battery (not enough for calling or sending text messages, etc.) 0x02: Very Low Battery (Low Battery Alarm) 0x03: Low Battery (can be used normally) 0x04: Medium 0x05: High 0x06: Very High

	GSM Signal Strength	1	0x00: no signal; 0x01: extremely weak signal; 0x02: very weak signal; 0x03: good signal; 0x04: strong signal.
	Alarm/Language	2	See the following diagram
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. 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

Example: 78 78 25 26 0F 0C 1D 03 0B 26 C9 02 7A C8 18 0C 46 58 60 00 04 00 09 01 CC 00 28 7D 00 1F 71 80 04 04 13 02 00 0C 47 2A 0D 0A

Alarm packet (Multiple fences)

iii.		Length	Description
Start Bit		2	0x78 0x78
Packet Length		1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x27 (UTC)
Information Content	Date Time	6	Year (1byte) Month (1byte) Day (1byte) Hour (1byte) Min (1byte) Second (1byte) (converted to a decimal) (Date Time)
	Quantity of GPS information satellites	1	The first character is GPS information length, The second character is positioning satellite number (converted to a decimal)
	Latitude	4	Convert to a decimal and divide 1800000
	Longitude	4	Convert to a decimal and divide 1800000
	Speed	1	Convert to a decimal
	Course, Status	2	Convert to binary number of 16 bits and calculate by bits (see the following diagram) (same as GPS packet, see GPS packet for details)
	LBS length	1	LBS length in total (LBS Length+ MCC+ MNC+LAC+ Cell ID=9) parse is not mandatory, can be skipped
	MCC	2	Mobile Country Code(MCC) (converted to a decimal)
	MNC	1	Mobile Network Code(MNC)(converted to a decimal)
	LAC	2	Location Area Code (LAC) (converted to a decimal)
	Cell ID	3	Cell Tower ID(Cell ID)(converted to a decimal)
	Terminal Information	1	See the following diagram

	Voltage Level	1	0x00: No Power (shutdown) 0x01: Extremely Low Battery (not enough for calling or sending text messages, etc.) 0x02: Very Low Battery (Low Battery Alarm) 0x03: Low Battery (can be used normally) 0x04: Medium 0x05: High 0x06: Very High
	GSM Signal Strength	1	0x00: no signal; 0x01: extremely weak signal; 0x02: very weak signal; 0x03: good signal; 0x04: strong signal.
	Alarm/Language	2	See the following diagram
	Fence Number	1	Valid bit for fence alarm.1 for fence 1, 2 for fence 2..... FF is invalid.
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. 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

i. Terminal Information

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	100: SOS
		011: Low Battery Alarm
		010: Power Cut Alarm
		001:Vibration Alarm
	Bit2	000: Normal
		1: Charging
	Bit1	0: Not Charge
		1: ACC high
	Bit0	0: ACC Low
		1: Defense Activated
		0: Defense Deactivated

i. Alarm language

Byte 1	0x00: normal
	0x01: SOS
	0x02: Power cut alarm
	0x03: Vibration alarm
	0x04: Enter fence alarm
	0x05: Exit fence alarm
	0x06: Over speed alarm
	0x09: Displacement alarm
	0x0A: Enter GPS dead zone alarm
	0x0B: Exit GPS dead zone alarm
	0x0C: Power on alarm
	0x0D: GPS First fix notice
	0x0E: Low battery alarm
	0x0F: Low battery protection alarm
	0x10: SIM change notice
	0x11: Power off alarm
	0x12: Airplane mode alarm
	0x13: Disassemble alarm
	0x14: Door alarm
	0x15: Low battery and shutdown alarm
	0x16: Sound control alarm
	0x17: Pseudo base-station alarm
	0x18: Open cover alarm
	0x19: Internal low Battery Alarm
	0x20: Sleep mode alarm
	0x24: Insert charger alarm
	0x28: Offline pre- alarm
	0x32: Pull alarm
Byte 2	0x01: Chinese
	0x02: English
	0x00: Platform has no need to reply

b) Alarm packet response of server

	Length	Description
Start Bit	2	0x78 0x78
Packet Length	1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number	1	0x26 (UTC)

Information 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. 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

Example: 78 78 05 26 00 1C 9D 86 0D 0A

8. Alarm Packet (LBS)

Description:

- Transmit alarm content defined by terminal
- Server response and parse longitude and latitude into address and re-upload to terminal after receiving the alarm content
- Terminal send address to pre-set SOS number of device.

a) Alarm packet sent by terminal

Alarm packet

iv.		Length	Description
Start Bit		2	0x78 0x78
Packet Length		1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number		1	0x19 (UTC)
	MCC	2	Mobile Country Code(MCC) (converted to a decimal)
	MNC	1	Mobile Network Code(MNC)(converted to a decimal)
	LAC	2	Location Area Code (LAC) (converted to a decimal)
	Cell ID	3	Cell Tower ID(Cell ID)(converted to a decimal)
	Terminal Information	1	See the following diagram
	Voltage Level	1	0x00: No Power (shutdown) 0x01: Extremely Low Battery (not enough for calling or sending text messages, etc.) 0x02: Very Low Battery (Low Battery Alarm) 0x03: Low Battery (can be used normally) 0x04: Medium 0x05: High 0x06: Very High
	GSM Signal Strength	1	0x00: no signal; 0x01: extremely weak signal; 0x02: very weak signal; 0x03: good signal; 0x04: strong signal.
	Alarm/Language	2	See the following diagram
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. 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

Example: 78 78 12 19 01 CC 00 28 7D 00 1F 71 20 04 04 01 01 00 94 6C 89 0D 0A

ii. Terminal Information

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	100: SOS
		011: Low Battery Alarm
		010: Power Cut Alarm
		001:Vibration Alarm
		000: Normal
	Bit2	1: Charging
		0: Not Charge
	Bit1	1: ACC high
		0: ACC Low
	Bit0	1: Defense Activated
		0: Defense Deactivated

ii. Alarm language

Byte 1	0x00: normal
	0x01: SOS
	0x02: Power cut alarm
	0x03: Vibration alarm
	0x04:Enter fence alarm
	0x05:Exit fence alarm
	0x06 Over speed alarm
	0x09 Displacement alarm
	0x0A Enter GPS dead zone alarm
	0x0B Exit GPS dead zone alarm
	0x0C Power on alarm
	0x0D GPS First fix notice
	0x0E External Low battery alarm
	0x0F Low battery protection alarm
	0x10 SIM change notice
	0x11 Power off alarm
	0x12 Airplane mode alarm
	0x13 Disassemble alarm
	0x14 Door alarm
	0x15 Low battery and shutdown alarm

	0x16 Sound control alarm
	0x17 Pseudo base-station alarm
	0x18 Open cover alarm
	0x19 Internal low Battery Alarm
	0x20 Sleep mode alarm
	0x24 Insert charger alarm
	0x28 Offline pre- alarm
	0x32 Pull alarm
Byte 2	0x01 Chinese 0x02 English 0x00 Platform has no need to reply

b) Alarm packet response of server

	Length	Description
Start Bit	2	0x78 0x78
Packet Length	1	Length = Protocol Number + Information Content + Information Serial Number + Error Check
Protocol Number	1	0x26 (UTC)
Information 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. 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

Example: 78 78 05 26 00 1C 9D 86 0D 0A

9. Online Command

Description:

- Use server online command to control terminal to execute task.
- 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 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. 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

Example :

The bellowing two both works :

Without language bit : 78 78 0E 80 08 00 00 00 00 73 6F 73 23 00 01 6D 6A 0D 0A

With language bit: 78 78 10 80 08 00 00 00 00 73 6F 73 23 00 02 00 01 9A 17 0D 0A

b) Online command replied by terminal (0x21)

Terminal reply (general command)

		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 ASC II code 0x02 UTF16-BE code.
	Content	M	Data needed to be sent (according to content code format)

Information Serial Number	2	Serial number of 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. 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

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

10. Time Packet

Description:

Used for checking time request sent by terminal to server

Generally, it is not mandatory to response as the device can calibrate the time by GPS :

Server can response with a UTC time if needed

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. 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: 0x0D0x0A

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	Year (1byte) Month (1byte) Day (1byte) Hour (1byte) Min (1byte) Second (1byte) (converted to a decimal) (Date Time
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. 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: 0x0D0x0A

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

11. 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 (custom) 04 terminal status synchronization 05door status 08 self-detection parameters 0A iccidto add
	Data Content	N	Different information type results in different transmission content. See the following for details.
Information Serial Number		2	Serial number of 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. 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:0x0D0x0A

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 extended. Transmission is ASCII code.

Definition of content identifier

Definition	Identifier
Alarm Bit 1	ALM1
Alarm Bit 2	ALM2
Alarm Bit 3	ALM3
Status Bit 1	STA1
SOS Number	SOS
Center Number	CENTER
Fence	FENCE
Fuel/Electricity Cutoff Status	DYD
Mode	MODE

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 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 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

STA1 Definition (Status)

Bit	Definition	Mark
bit7	Arm Status	1 Arm 0 Disarm
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	Dis-assembly switch OFF	1 ON 0 OFF
bit0	Dis-assembly 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	1Valid bit 0 Invalid bit
bit2	Deferred execution caused by GPS unlocated	1Valid bit 0 Invalid bit
bit1	Oil/Electricity cutoff	1Valid bit 0 Invalid bit
bit0	Oil/Electricity connection	1Valid bit 0 Invalid bit

SOS definition: adopt ASCII to transmit (use “,” to separate if multiple SOS numbers)

Center number definition: adopt ASCII to transmit

Fence 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

Notice: 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 08, the bit will transmit terminal Self-checking parameters information. The position length is extended and ASCII code transmitted.

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

IMEI	8	eg: If IMEI is 123456789123456, the terminal ID is: 0x01 0x23 0x45 0x67 0x89 0x12 0x34 0x56
IMSI	8	eg: If IMSI is 123456789123456, the terminal ID is: 0x01 0x23 0x45 0x67 0x89 0x12 0x34 0x56
ICCID	10	eg: If ICCID is 12345123456789123456, the terminal ID is: 0x12 0x34 0x51 0x23 0x45 0x67 0x89 0x12 0x34 0x56

b) Server Response Information Transmission Packet

Server no Response

12. Large File Transfer

- Used to transfer large files, such as voice files
- Terminal send data to server by adopting the 8D protocol; server send data to terminal by adopting the 90 protocol. Both protocols' format are the same.
- Terminal space is limited, therefore, free space needs to be check before data sent to terminal by server.

a) Terminal transfers the file to the server (8D)

1 Terminal send to the server

		Length (Byte)	Explain
Start Bit		2	0x79 0x79
Packet length		2	Length= protocol number +information content+ serial number +error check
Protocol Number		1	0x8D
Info Content	File Type	1	0x00 voice file(monitoring) 0x01 voice file(SOS) 0x02 intercom voice file 0x03 Upload TCP instruction recording file
	File Length	4	Length of transferred file
	File Error Check Type	1	when error check type is "00", use CRC check to transfer file when error check type is "01", use MD5check to transfer file

	File Error Check	N	when error check type is “00” , use CRC check to transfer file. The length is 2 bytes. when error check type is “01” ,use MD5check to transfer file.The length is 16 bytes.
	Start Bit	4	start position bytes number of split-transmitting
	Current Content Length	2	Data length behind start position of split-transmitting
	Content	M	Data packet after split
	Flag Bit	N	File type is the type of transferred file when file type is 00 voice file (monitoring), the position length is 6 bytes. Start date and coding method of monitoring is the same as location packet. when file type is 01 voice file (SOS), the position length is 2 bytes. Bytes are the same with the corresponding SOS alarm packet serial number. when file type is 02 voice file (income), the position length is 6 bytes. Start date and coding method of monitoring is the same as location packet. When the file type is 03, upload the TCP instruction recording file, and upload the service identification ID uniformly. The number of bytes is 6 bytes. The first 4 digits are the server flag and the last two digits are the transmission sequence number.
Information Serial Number		2	The serial number of the first GPRS data (including status packet and data packet such as GPS, LBS package) sent after booting is ‘1’, and the serial number of data sent later at each time will be automatically added ‘1’.
Error Check		2	The check codes of data in the structure of the protocol, from the Packet Length to the Information Serial Number (including “Packet Length” and “Information Serial Number”) , are values of CRC-ITU. CRC error occur when the received information is calculated, the receiver will ignore and discard the data packet.
Stop Bit		2	Fixed value: 0x0D 0x0A

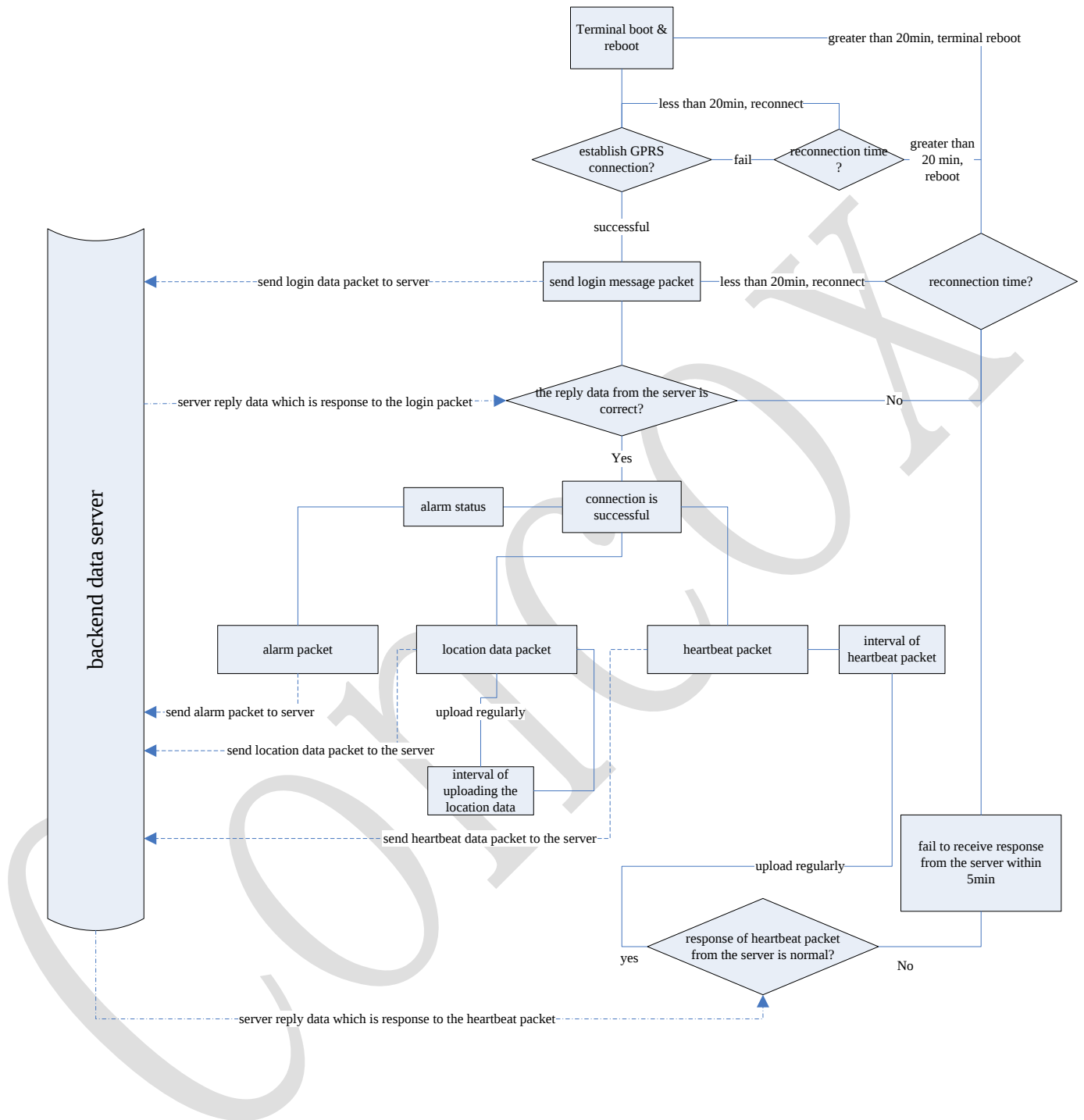
iii. Appendix

1. Code fragment of the CRC-ITU lookup table algorithm implemented based on C language

```
static constU16crctab16[]={
{
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,0XAC42,0X9ED9,0X8F50,0XFBF7,0XEA66,0XD8FD,0XC974,
0X4204,0X538D,0X6116,0X709F,0X0420,0X15A9,0X2732,0X36BB,
0XCE4C,0XD5C5,0XE5E5,0XFCD7,0X8868,0X99E1,0XAB7A,0XBAF3,
0X5285,0X430C,0X7197,0X601E,0X14A1,0X0528,0X37B3,0X263A,
0XDECD,0XCF44,0XFDDE,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,0X6D76,0X7CFE,
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.
U16GetCrc16(constU8*pData,intnLength)
{
U16fcs=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 (GT710)

Battery Percentage (/%)	Voltage
100	≥ 2.93
90	2.88
80	2.82
70	2.77
60	2.7
50	2.66
40	2.6
30	2.55
20	2.4
10	2.3
0	2

4. Voltage-Battery Correspondence of Heartbeat Packet (AT1/AT2)

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

5. Voltage-Battery Correspondence of Heartbeat Packet (QBIT)

Battery Percentage (/%)	Voltage
100	4.08
80	3.90
60	3.78
40	3.7
20	3.64
5	3.59
1	3.58

6. Voltage-Battery Correspondence of Heartbeat Packet (AT4)

Battery Percentage (/%)	Voltage
100	≥ 4.05
90	> 4
80	> 3.92

70	>3.85
60	>3.79
50	>3.74
40	>3.7
30	>3.67
20	>3.63
5	>3.59

7. Voltage-Battery Correspondence of Heartbeat Packet (AT3)

Battery Percentage (/%)	Voltage
100	3.6
90	3.5
80	3.4
70	3.3
60	3.2
50	3.1
40	3
30	2.9
20	2.8
10	2.7
0	2.6

8. Voltage-Battery Correspondence of Heartbeat Packet (AT6)

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

9. Voltage-Battery Correspondence of Heartbeat Packet (LG01\LG02)

Battery Percentage (/%)	Voltage
------------------------------	---------

100	2.93
90	2.88
80	2.82
70	2.77
60	2.7
50	2.66
40	2.6
30	2.55
20	2.4
10	2.3
0	2

10. Voltage-Battery Correspondence of Heartbeat Packet (LG05)

Battery Percentage (%)	Voltage
100	4.1
90	4.0
80	3.95
70	3.85
60	3.8
50	3.74
40	3.71
30	3.68
20	3.65
10	3.6
0	3.55

11. Voltage-Battery Correspondence of Heartbeat Packet (LG300)

Battery Percentage (%)	Voltage
100	3.9
95	3.85
90	3.8
85	3.75
80	3.7
75	3.65
70	3.6
60	3.55
50	3.5
40	3.45
30	3.4
20	3.35
10	3.3

1	3.25
0	3.2

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