GPS Tracker
Communication Protocol

(GT07)

Important revise record

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i. Communication Protocol

Introduction

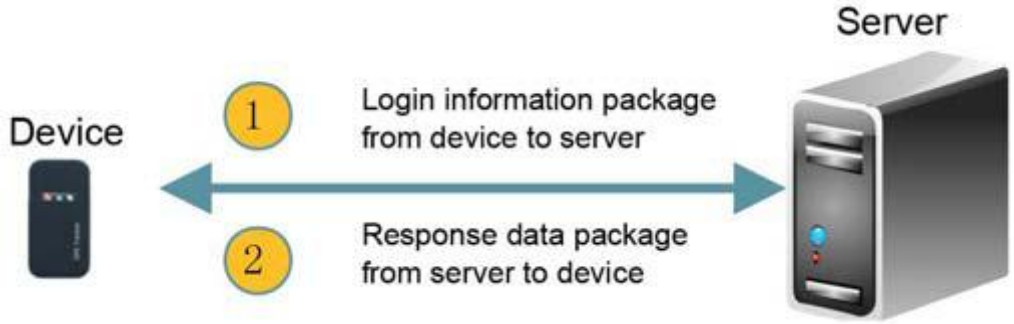
This document defines instructions about interface protocol on application layer of vehicles GPS tracker and location-based service platform. Related interface protocol only applies in the interaction between the platform and the position terminal.

ii. Terms, Definitions

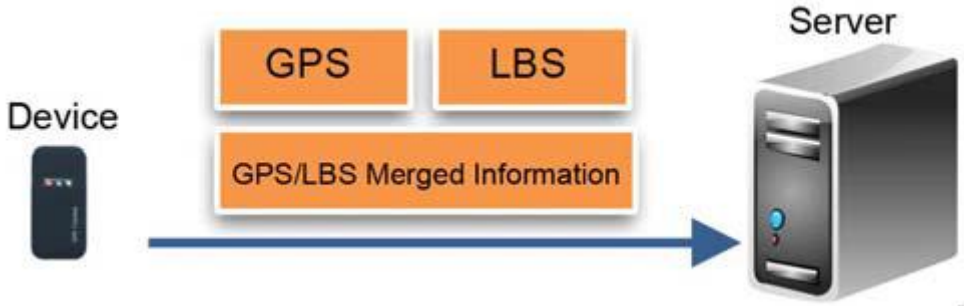
Terms, Abbreviation	Definition in English	Definition in Chinese
CMPP	China Mobile Peer to Peer	中国移动点对点协议
GPS	Global Positioning System	全球卫星定位系统
GSM	Global System for Mobile Communication	全球移动通信系统
GPRS	General Packet Radio Service	通用无线分组业务
TCP	Transport Control Protocol	传输控制协议
LBS	Location Based Services	辅助定位服务
IMEI	International Mobile Equipment Identity	国际移动设备识别码
MCC	Mobile Country Code	移动用户所属国家代号
MNC	Mobile Network Code	移动网号码
LAC	Location Area Code	位置区码
Cell ID	Cell Tower ID	移动基站
UDP	User Datagram Protocol	用户数据报协议
SOS	Save Our Ship/Save Our Souls	遇难求救信号
CRC	Cyclic Redundancy Check	循环冗余校验
NITZ	Network Identity and Time Zone,	时区
GIS	Geographic Information System	地理信息系统

iii. Basic Rules

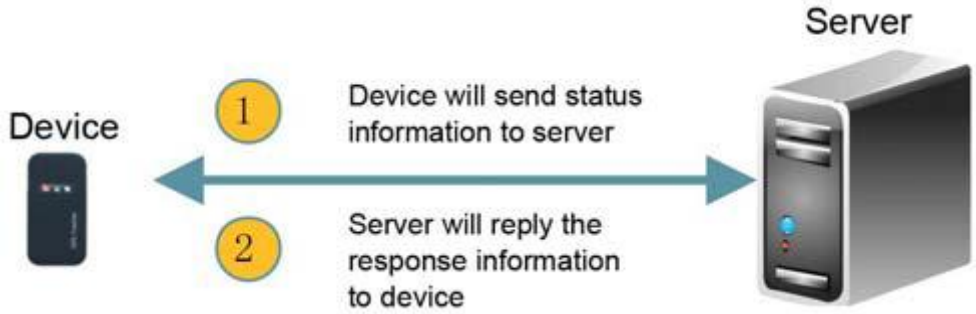
1. The device will send the login message packet to the server by default when GPRS connection is established successfully. Then it will wait for the confirmation from the server.



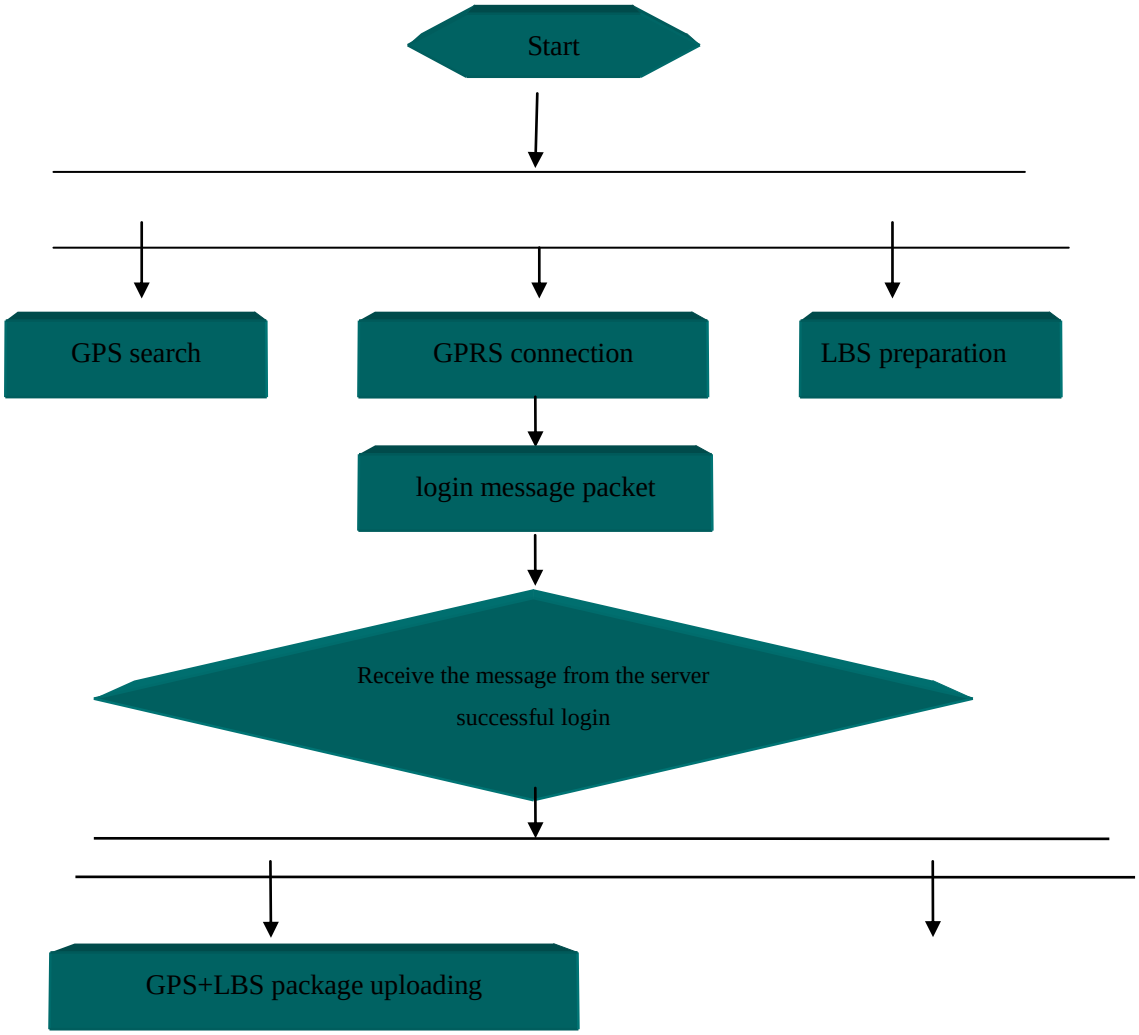
2. In case of the normal connection, the terminal will send a information package of GPS and LBS together or respectively to the server after the GPS information is changed; and the server may set a default protocol for transmission by using commands.



3. To ensure the effectiveness of the connection, the terminal will send status information to the server at regular intervals, and the server will return response data packets to confirm the connection.



GT07 Data Flow Diagram



iv. Data Packet Format

The communication is transferred asynchronously in bytes.

The total length of packets is (10+N) Bytes.

Format	Length(Byte)
Start Bit	2
Packet Length	1
Protocol Number	1
Information Content	N
Information Serial Number	2
Error Check	2
Stop Bit	2

1. Start Bit

Fixed value in HEX 0x78 0x78.

2. Packet Length

Length = Protocol Number + Information Content + Information Serial Number + Error Check, totally (5+N)Bytes, because the Information Content is a variable length field.

3. Protocol Number

Type	Value
Login Message Packet	0x01
GPS Message Packet	0x10
LBS Message Packet	0x11
Combined information package of GPS and LBS	0x12
Status information packet	0x13
Satellite SNR message packet	0x14
String information packet	0x15
Combined information package of GPS, LBS and status	0x16
LBS, query address information by phone number	0x17
LBS extended Message Packet	0x18
Combined information package of LBS and status	0x19
GPS, query address information by phone number	0x1A
Command information sent by the server to the terminal(setting)	0x80
Command information sent by the server to the terminal(querying)	0x81

The new protocol of GT05 has been used 0X01、0x12、0x13、0x16、0X1A etc.

4. Information Serial Number

The serial number of the first GPRS data (including login packet, status packet and data packet such as GPS, LBS) sent after booting is '1', and the serial number of data sent later at each time will be automatically added '1'.

5. Information Contents

The specific contents are determined by the protocol numbers corresponding to different applications.

5.1. Login Message Packet

Format	Information Content		
	Terminal ID	Type Identifier	Reserved extend bit
length	8	2	2

The login message packet is used to be sent to the server with the terminal ID so as to confirm the established connection is normal or not. Two kinds of login message packet: one with extension bit , one without extension bit.

5.1.1. Information Content

5.1.1.1.Terminal ID

The terminal ID applies IMEI number of 15 bits.

Example: if the IMEI is 123456789012345,

the terminal ID is 0x01 0x23 0x45 0x67 0x89 0x01 0x23 0x45.

5.1.1.2. Type Identifier

Type identifier occupied 2 bytes. It can be used for recognizing device type.

E.g.:GT07 version

Type identifier：0x10 0x0B

Note: the server in the present does not detect the device according to the type identifier. Therefore, the present type identifier of GT07 is 0x10 0x0B. It will be changed to 0x10 0x1A later.

5.1.1.3.

One bit:bit15—bit4												Low bit:bit4-bit0			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
The value is the timezone extended to 100 times												Western/ Eastern longitude	No definition current	Language bit 1	Language bit 0

Note：

Bit3 0-------Eastern longitude

1-------Western longitude

Eg: Extension bit value: 0X32 0X00 means the 8th time zone(east),GMT+8:00.

Computing method: 8*100=800, changed to hexadecimal: 0X0320

Extension bit value: 0X4D 0XD8 means the12 and 3/4th time zone(west),GMT-12:45.

Computing method: 12.45*100=1246,changed to hexadecimal: 0X04,0XDD.

5.1.2 Server Response

Eg:

Device to server(here the device ID is 123456789012345)

0x78 0x78	0x11	0x01	0x01 0x23 0x45 0x67 0x89 0x01 0x23 0x45	0x10 0x0B	0x32 0x01	0x00 0x01	0x71 0x93	0x0D 0x0A
Start Bit	Length	Protol NO.	Terminal ID	Identifier	UTC time timezone language	Serial NO.	CRC Verify	End bit

Note: the red one is UTC time,timezone and language extension bit. The server will not deal with these two bits.

Server to device(the response protocol NO. is the same with the protocol NO. sent by device)

0x78 0x78	0x05	0x01	0x00 0x01	0xEB 0x47	0x0D 0x0A
Start Bit	Lenth	Protocl NO.	Serial NO.	CRC Verify	End bit

5.1.3 Function

The type identifier will be sent the first time when the device connects with platform. It is used to help platform recognize different ID.

5.2. GPS information package(0X10)

Format	Content						
	Date/ time	GPS information					Reserved Extend byte
		GPS info length/ Number of satellites involved in locating	Latitude	Longitude	Speed	Status/ Course	
length(Byte)	6	1	4	4	1	2	N

5.2.1. Date and time

format	year	month	day	hour	minute	second
length(Byte)	1	1	1	1	1	1

For example： 15:50:23 March 23,2010.

The value is 0x0A 0x03 0x17 0x0F 0x32 0x17

5.2.2. Length of GPS information, quantity of positioning satellites

1 byte converts to binary is 8 bit, the first 4 bit means GPS info length, the last 4 bit means number of satellite involved in locating.

Note: The length includes 1 byte occupied by itself.

Example: if the value is 0x9C, it means the length of GPS information is 9 Byte and the number of the positioning satellites is 12.

5.2.3. Latitude

Four bytes are consumed, defining the latitude value of location data. The range of the value is 0-162000000, indicating a range of 0 °-90 °. The conversion method thereof is as follow:

converting the value of latitude and longitude output by GPS module into a decimal based on minute; multiplying the converted decimal by 30000; and converting the multiplied result into hexadecimal.

Example: 22º32.7658'=(22X60+32.7658)X3000=40582974, then converted into a hexadecimal number

40582974(Decimal)= 26B3F3E(Hexadecimal)

at last the value is 0x02 0x6B 0x3F 0x3E.

5.2.4. Longitude

Four bytes are consumed, defining the longitude value of location data. The range of the value is 0-324000000, indicating a range of 0°-180°.

The conversion method herein is same to the method mentioned in Latitude (see section 5.2.1.6).

5.2.5. Speed

One byte is consumed, defining the running Speed of GPS. The value ranges from 0x00 to 0xFF indicating a range from 0 to 225km/h.

5.2.6. 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°.

One byte is composed of eight binary. In the first byte, the first six binary represents status. The last two binary and the whole eight binary in the second byte (10 binary in total) represents course.

The first byte						The second byte									
8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
No definition	No definition	Real time/Different GPS	GPS located or not	East longitude /West longitude	South latitude/ North latitude	Course									

0：South latitude　　1：North latitude

0：East longitude　　1：West longitude

0：GPS has not located　　1：GPS has located

0：Real time GPS　　1：Different GPS

Note: The status information refers to the status in a certain time

For example: 0x05 0x4C convert to binary 00001010 1001100, representing GPS has located、 real time GPS、north longitude、east latitude、Course 332°

5.2.7. Reserved bit

Reserved bytes is N as 2 bytes.

The first Byte								The second Byte							
8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1

No	definition	No	definition	No	definition	No	definition	No	definition	No	definition	No	definition	Choose language bit 1	Choose language bit 0

5.2.8. Server response

Server response as:

The server response after received the data package from device（10 Byte）					
Start bit	Data length	Protocol No.	Information serial No.	Verify bit	End bit
2	1	1	2	2	2

5.2.9. Function

Device can connect with the Sever , and upload the GPS position after GPS is fixed.

5.2.10. Example

Upload：78 78 19 10 0B 03 1A 0B 1B 31 CC 02 7A C7 FD 0C 46 57 BF 01 15 21 00 01 00 1C C6 07 0D 0A

Received：78 78 05 10 00 1D DC 78 0D 0A

GT07 does not own GPS packet to upload.

5.3. LBS information package(0X11)

Format	Content					
	Date &Time	LBS information				Reserved extend byte
		MCC	MNC	LAC	Cell ID	
Length(Byte)	6	2	1	2	3	N

5.3.1 Date & Time

The same as corresponding format in part of GPS information.

5.3.2 MCC

Affiliated country code of mobile user is Mobile Country Code (MCC). MMC of China is 460(decimal)

Value ranges from 0x0000 to 0x03E7

MMC of China is 0x01 0xCC (460 decimal convert to hex)

5.3.3. MNC

China Mobile Network Code (MNC) is 0x00

5.3.4. LAC

Location Area Code (LAC) is included in LAI. It is composed of 2 bytes with hex code, ranges from 0x0001－0xFFFE(not include 0x0001 and 0xFFFE). One location area can contain one or more areas.

5.3.5. CI（Cell ID）

Cell Tower ID (Cell ID) ranges from 0x000000 to 0xFFFFFF

5.3.6. Reserved bit

Reserved bit is 2 bytes, the definition same as GPS data package.

5.3.7. Server response

Server response as

The server response after received the data package from device（10 Byte）					
Start bit	Data length	Protocol No.	Information serial No.	Verify bit	End bit
2	1	1	2	2	2

5.3.8. Function

Server and device connected, and transfer LBS position after LBS fixed.
The default value to upload LBS is every 2 minutes.

5.3.9. Example

Upload：78 78 15 11 00 00 00 00 00 00 01 CC 00 26 6A 00 1D F1 00 01 00 18 91 88 0D 0A
Received：78 78 05 11 00 18 D1 09 0D 0A
GT07 does not own LBS message package packet to upload.

5.4. GPS、LBS Combined information (0X12)

Format	Content											
	Data &Time	GPS info						LBS info				Reserved bit
		GPS info length/ Number of satellites involved in locating	Latitude	Longitude	Speed	Course/Status	Reserved bit	MCC	MNC	LAC	Cell ID	
Length (Byte)	6	1	4	4	1	2	M	2	1	2	3	N

As for each parameter, please refer to previous explanation.

5.4.1. Example:

Upload: 78 78 21 12 0C 01 0C 0F 15 1F CF 02 7A C8 84 0C 46 57 EC 00 14 00 01 CC 00 28 7D 00 1F 72 00 01 00 0F 53 A0 0D 0A

Extension bit M=0；Extension bit N=2

5.5. Status information (0X13)

Format	Content			
	Device information	Voltage degree	GSM signal strength degree	Reserved extend byte
Length(Byte)	1	1	1	N

5.5.1. Device information

Occupying 1 byte and representing each information of the device. Regard 1 byte as 8bits, the lowest bit is 0, the highest is 7. In the process of the data transmitting, the high one comes first and the low one follows. Each bit represents the detailed meaning as follows:

High bit							Low bit
7	6	5	4	3	2	1	0

0 bit	0：Disarm 1：Arm
First bit	0：Low ACC 1：High ACC
Second bit	No definition
Third bit/Fourth bit/Fifth bi	000：Normal 001：Vibration alarm 101：Enter geo-fence 110：Exit geo-fence
Sixth bit	0：GPS has not located 1：GPS has located
Seventh bit	1：No definition

Note: The status information refers to the status in a certain time

Example：0x4B，converts to binary 01001011

which means fortified ON/high ACC/vibration alarm/GPS has located/ petrol/electricity on.

101：Enter geo-fence

110：Exit geo-fence

Voltage degree:

Decimal, range from 0-6

0：Lowest power and power off

1：No enough power to dial a call or send messages.

2：Low power and alarm

3：Lower power but can work normally

3~6：Work in good condition

5.5.2. GSM signal strength degree:

0x00：No signal

0x01：Weaker signal

0x02：Weak signal
0x03：Good signal
0x04：Strong signal

5.5.3. Reserved bit

Reserved bit is 2 bytes, same definition as GPS data package.

5.5.4. Server response

Server response as

The server response after received the data package from device（10 Byte）					
Start bit	Data length	Protocol No.	Information serial No.	Check bit	End bit
2	1	1	2	2	2

5.5.5. Function

Server and device connected, and transfer device battery status data package.
he default value of uploading status data package is every 3 minutes.

5.5.6. Example

Upload：78 78 0A 13 40 06 04 00 01 00 1F C4 39 0D 0A
Received：78 78 05 13 00 1F 10 0E 0D 0A

5.6. GPS/LBS/Status combined information package(0X16)

Format	Information content															
	Date&time	GPS information						LBS info						Status info		
		GPS info length/Number of satellites involved in locating	Latitude	Longitude	Speed	Course/Status	Reserved extend bit	LBS length	MCC	MNC	LAC	Cell ID	Reserved extend bit	Device info content	Voltage degree	GSM signal degree
Length(Byte)	6	1	4	4	1	2	M	1	2	1	2	3	N	1	1	1

As for each parameter, please refer to previous explanation

It combines GPS info/ LBS info and status info. What need to notice is that LBS info here has been increased length (includes 1 byte occupied by itself.).Server should make a response when receive package of GPS/Status combined info.
Note: Reserved extend bit M=0; Reserved extend bit N=0;

In this process, GPS+LBS+Status package is used for alarm package. Extend bit hold[1] is language format bit; Extend bit hold[0] is alarm type.

Type	Parameter

Vibration alarm	0x03
Enter Geo-fence alarm	0x04
Exit Geo-fence alarm	0x05

5.6.1. Server response

Ask for Chinese address or English address according to the extended command, it will get different data package.

Chinese data package：

Command package from server to the device（15+M+N Byte）									
Start bit	Length	Protocol NO.	Information content				Serial NO.	Check bit	End bit
			Command length	Server flag bit	Information content	Reserved extend bit			
2	1	1	1	4	M	0	2	2	2

The protocol number of asking for detail Chinese address information is: 0X17.

Content Information：

Format	Content Information			
	Command length	Server flag bit	Command content	Reserved extend bit
Length(Byte)	1	4	M	0

Command format：ADDRESS&&address information&&phone number##

Chinese address information send as Unicode.

Currently there is no English address sending from server. English address should be sent from device by SMS.

Add to two bits for long English address or in other languages. Note: Only corresponding length of data bit with protocol number of reply address information has been changed as two bits.

Package of server send to the device（15+M+N Byte）									
Start bit	Length	Protocol NO.	Information content				Serial No.	Check bit	End bit
			Command length	Server flag bit	Command content	Reserved extend bit			
2	2	1	2	4	M	0	2	2	2

The protocol number of asking for detail English address information is: 0X96.

5.6.2. Function

When there is vibration alarm, enter/exit the Geo-fence and GPS is located, the device will send this status package of alarm status and location information to the server.

5.7. GPS/ checking location information via phone number package (0X1A)

Format	Content			
	Date	GPS information	Phone number	Reserved extend bit

	&Time	GPS info length/Number of satellites involved in locating	Latigude	Longitude	Speed	Course/Status	21	N
Length (Byte)	6	1	4	4	1	2		

Compared to the GPS information package, the format is same; only add checking location via phone number package.

5.7.1. Server response

Ask for Chinese address or English address according to the extended command, it will get different data package.

Chinese data package：

Command package from server to the device（15+M+N Byte）									
Start bit	Length	Protocol NO.	Content of information				Serial NO.	Check bit	End bit
			Command length	Server flag bit	Command content	Reserved extend bit			
2	1	1	1	4	M	0	2	2	2

The protocol number of asking for detail Chinese address information is: 0X1A.

Content Information：

Format	Content Information			
	Command length	Server flag bit	Command content	Reserved extend bit
Length(Byte)	1	4	M	0

Command format：ADDRESS&&address information&&phone number##

Chinese address information send as Unicode.

Add to two bits for long English address or in other languages. Note: Only corresponding length of data bit with protocol number of reply address information has been changed as two bits.

Package of server send to the device（15+M+N Byte）									
Start bit	Length	Protocol NO.	Content of information				Serial No.	Check bit	End bit
			Command length	Server flag bit	Command content	Reserved extend bit			
2	2	1	2	4	M	0	2	2	2

The protocol number of asking for detail English address information is: 0X9A.

5.7.2. Function

When activating GPS via SMS command and asking location information, the device will send this data package.

5.8. Command from server to device

Format	Content of information			
	Command length	Server flag bit	Command contant	Reserved extend bit
Length(Byte)	1	4	M	N

Protocol No：0x80

The response command sending from device to server, whose data package format is the same as the format of "command sending from server to device" , protocol NO. is different, with"0x80"or "0x81". 0x80 means setting command, 0x81 means checking command.

Note: Reserved extended bit N=0

5.8.1 Command length

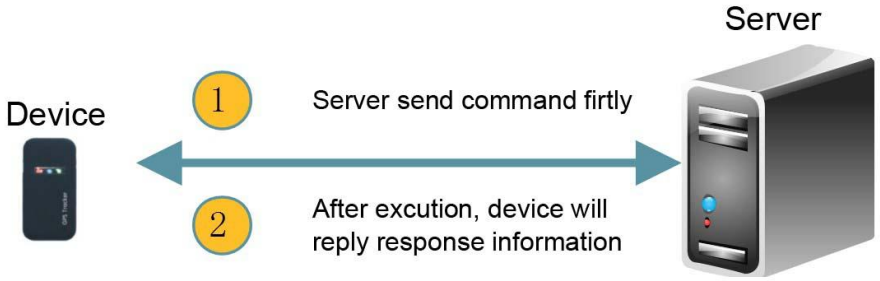
Show with byte, OxOA, means command content occupy 10 bytes

5.8.2. Server flag bit

Left to the server for identification, device will receive data from a binary package stood in the back to return.

5.8.3. Command content

Show with ASCⅡ character string, command connent is compatible with sms command.



5.8.4. Check position information

Command format:

DWXX,000000#

Function description:

Command of acquiring position information.. Both cellphone user and SMS server can acquire position information with this command.

If successful, it will reply: DWXX=Lat: <South/North latitude>, Course: < >, speed: < >, Date& time: < >

If failed, it will reply: DWXX=Command Error!

e.g:

Lat:N23d5.1708m,Lon: E114d23.6212m,Course:120,Speed:53.02;DateTime:08-09-12 14:52:36

Meaning: North Lat 23°5.1708', East Lon114°23.6212', Course:120°,speed: 53.02 Km/h, Date&time: 14:52:36 12th Sep 2008

Note：If device failed in location，it will reply：Lat:,Lon:, Course:,Speed:,DateTime:-:

5.8.5. Cutting Oil and Electricity

Sending by the server

DYD,000000#

Function Description: cutting off the vehicle oil-electric control circuit

Returned by the terminal:

if successful, return

DYD=Success!

if failed, return

DYD=Unvalued Fix 或 DYD=Speed Limit, Speed 40km/h

5.8.6. Connecting Oil and Electricity

Sending by the server

HFYD,000000#

Function Description: connecting the vehicle oil-electric control circuit

Returned by the terminal:

if successful, return

HFYD=Success!

if failed, return

HFYD=Fail!

5.8.7 Server send checking address information

Command content：ADDRESS,address information,phone number

Note：Chinese address content will be sent via GB2312 code.

5.8.8 Reserved extend bit

Currently the reserved extend bit from server to device is N=0.

The explanation of login data package and status data package

1.If GPRS connection successful, the device will send first login data package to server. Receiving feedback package in 10 seconds will be considered as normal, it starts sending position data(GPS,LBS information package), and 5 minutes later status package follows circularly and the time interval is 5 minutes.

2. If the GPRS connection failed,device can not send login data package.When GPRS connection fails for 3 times, device will activate timed-restarting function。（ Note: The restart process will activate once after 20 minutes. If device connect with server and receiving feedback data

package to login data successfully in 20 minutes， the timed-restarting function will be disabled automatically.）

3. If there is no feedback package sent from server in 10 seconds, after device sends login data or status data package, it will be considered as failure to connect. In this case, device will activate the GPS data backup function, disconnect the current GPRS connection, reconnect to the server and send login data package.

4. If connection is considers as abnormal, reconnect to send login data package or status data package but not receiving feedback data package in 3 times, device will activate timed-restarting function.(Note: The restart process will activate once after 10 minutes. If device connect with server and receiving feedback data package in this 10 minutes, the timed-restarting function will be disabled automatically.)

5.Server will not reply feedback data package to device which has not been registered.

6. If the device has not been inserted in any sim card, it will not activate GPRS connection, and will not restart automatically. While if the device installed SIM card but without GPRS activated, it will restart automatically after more than twenty minutes.

6. Error-Checking

Device or server can judge the accuracy of data received with identifying code. Sometimes, because of the electronic noise or other interference, data will be changed a little in the transit process. In this case, identifying code can make sure the core or associated core do nothing with such kind of wrong data, which will strengthen the security and efficiency of system. This identifying code adopts CRC-ITU identifying method. The CRC-ITU value is from "Package Length' to "Information Serial Number" in the protocol (including "Package Length" and "Information Serial Number ").
If the receiver receives CRC wrong calculating information, then ignore it and discard this data package.

7. End bit

Fixed value by hexadecimal 0x0D 0x0A.

8. Appendix A: the look-up table method of CRC-ITU and C language code snippets

```
static const U16 crctab16[] =
{
    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 16 bits CRC of the given length data.
U16 GetCrc16(const U8* pData, int nLength)
{
    U16  fcs  =  0xffff;            //  Initialize
    while(nLength>0){
        fcs = (fcs >> 8) ^ crctab16[(fcs ^ *pData) & 0xff];
        nLength--;
        pData++;
    }
    return  ~fcs;           //  Negate}
```

9. Appendix B: Communication Protocol Data Package snippet example

The following data is intercepted from the communication between device and server. The data is hexadecimal. Send means what sending from the device. Receive means what the server replies:

Send : 78 78 11 01 03 53 41 34 14 69 12 10 10 0B 32 01 00 02 CE 97 0D 0A

Receive : 78 78 05 01 00 02 EB 47 0D 0A

Send：78 78 21 12 0B 05 1B 09 30 12 CF 02 7A C8 15 0C 46 57 8F 00 14 00 01 CC 00 26 6A 00 1E 17 00 02 00 03 94 9C 0D 0A

Send: 78 78 0A 13 40 06 03 00 02 00 16 86 40 0D 0A

Receive : 78 78 05 13 00 16 8D CF 0D 0A

Send : 78 78 2E 1A 0B 05 19 08 2D 27 CA 02 7A C8 4E 0C 46 58 28 00 14 9D 31 32 35 32 30 31 33 34 31 34 36 39 31 32 31 31 00 00 00 00 00 00 01 00 12 E1 FF 0D 0A

Receive : 78 78 80 17 7A 00 00 00 01 41 44 44 52 45 53 53 26 26 7C BE 78 6E 5B 9A 4F 4D 00 3A 5E 7F 4E 1C 77 01 60 E0 5D DE 5E 02 4E 91 5C 71 89 7F 8D EF 00 2E 65 87 53 4E 4E 00 8D EF 00 28 00 4E 00 32 00 33 00 2E 00 31 00 31 00 31 00 37 00 32 00 2C 00 45 00 31 00 31 00 34 00 2E 00 34 00 30 00 39 00 32 00 36 00 29 26 26 31 32 35 32 30 31 33 34 31 34 36 39 31 32 31 31 00 00 00 00 00 23 23 00 12 76 2E 0D 0A

Send : 78 78 25 16 0B 05 1B 09 35 23 CF 02 7A C8 36 0C 46 57 B3 00 14 00 09 01 CC 00 26 6A 00 1E 17 40 05 04 00 02 00 08 D7 B1 0D 0A

Receive : 78 78 E3 17 DD 00 00 00 01 41 44 44 52 45 53 53 26 26 5E 7F 4E 1C 77 01 60 E0 5D DE 5E 02 4E 91 5C 71 89 7F 8D EF 00 2E 65 87 53 4E 4E 00 8D EF 00 2E 62 95 8D 44 59 27 53 A6 FF 08 60 E0 5D DE FF 09 96 44 8F D1 00 2E 60 E0 5D DE 5E 02 59 16 55 46 62 95 8D 44 67 0D 52 A1 4E 2D 5F C3 96 44 8F D1 00 2E 00 28 00 4E 00 32 00 33 00 2E 00 31 00 31 00 31 00 37 00 31 00 2C 00 45 00 31 00 31 00 34 00 2E 00 34 00 30 00 39 00 32 00 30 00 29 00 2C 00 31 00 31 00 2D 00 30 00 35 00 2D 00 32 00 37 00 20 00 30 00 39 00 3A 00 35 00 33 00 3A 00 33 00 35 26 26 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 23 23 00 01 31 21 0D 0A

The meaning of all the commands can be found in the protocol.

10. Appendix C: Complete format of information package

A. Data package from device to server

Login data package（18 Byte）								
Start bit	Data bit length	Protocol number	Device ID	Device identification code	Extend bit	Information serial number	Check bit	End bit
2	1	1	8	2	2	2	2	2

GPS package(26+N Byte)												
Start bit	data bit length	Protocol number	Information content						Information serial number	Check bit	End bit
			Date &time	GPS information							
				GPS information length, Number of Satellites involved in locating	latitude	Longitude	Speed	Course, status	Reserved bit			
2	1	1	6	1	4	4	1	2	N	2	2	2

LBS package （23+N Byte）											
Start bit	Data bit length	Protocol number	Information content						Information serial number	Check bit	End bit
			Date& time	LBS information				Reserved extend bit			
				MCC	MNC	LAC	Cell ID				
2	1	1	6	2	1	2	3	N	2	2	2

LBS complete information package（42+N Byte）																							
start bit	Data bit length	Protocol number	Information content																		Information serial number	Check bit	End bit
			Date/time	LBS information																	Reserved Extend bit			
				MCC	MNC	LAC	MCI	MCISS	NCI1	NCISS1	NCI2	NCISS2	NCI3	NCISS3	NCI4	NCISS4	NCI5	NCISS5	NCI6	NCISS6				
2	1	1	6	2	1	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	N	2	2	2

GPS/LBS Information package（34+M+N Byte）																	
Star bit	Data bit length	Protocol number	Information content											Information serial number	Check bit	End bit
			Date&time	GPS information						LBS information				Reserved extend bit			
				GPS information length, Number of Satellites involved in locating	Latitude	Longitude	Speed	Course,status	Reserved bit	MCC	MNC	LAC	Cell ID				
2	1	1	6	1	4	4	1	2	M	2	1	2	3	N	2	2	2

Status package（13+N Byte）									
Start bit	Data bit length	Protocol number	Information content				Information serial number	Check bit	End bit
			Device information content	Voltage degree	GSM signal strength degree	Reserved bit			
2	1	1	1	1	1	N	2	2	2

Satellite SNR information（11+M+N Byte）

Start bit	Data bit length	Protocol number	Information content			Information serial number	Check bit	End bit
			Number of Satellites involved in locating	Satellite SNR 1 2 3 …… n	Reserved extend bit			
2	1	1	1	M	N	2	2	2

Feedback information from device to server（15+M+N Byte）									
Start bit	Data bit length	Protocol number	Character string content				Information serial number	Varifying bit	end bit
			Command length	Server flag	Command content	Reserved bit			
2	1	1	1	4	M	N	2	2	2

GPS、LBS status package（40+M+N+L Byte）																					
Start bit	Data bit length	Protocol number	Information content																Reserved bit	Information Serial NO.	Identifying bit	End bit
			Date& time	GPS information						LBS information						Status information						
				GPS information length Number of Satellites involved in locating	latitude	Longitude	Speed	Course, status	Reserved bit	LBS length	MCC	MNC	LAC	Cell ID	Reserved bit	Device information content	Voltage degree	GSM signal strength degree				
2	1	1	6	1	4	4	1	2	M	1	2	1	2	3	N	1	1	1	L	2	2	2

B. Data package from server to device

Feedback package sending from server to device after receiving status package（10 Byte）					
Start bit	Data bit length	Protocol number	Information serial number	Check bit	End bit
2	1	1	2	2	2

Command package sending from server to terminal（15+M+N Byte）									
Start bit	Data bit length	Protocol number	Information content				Information serial number	Check bit	End bit
			Content length	Server flag	Command content	Reserved bit			
2	1	1	1	4	M	N	2	2	2