SIM7070_SIM7080_SIM7090 Series_GNSS _Application Note

LPWA Module

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About Document

Version History

Version	Date	Owner	What is new
V1.00	2019.10.31	Dong.Liu	First Release
V1.01	2019.11.07	Dong.liu	Add Chapter 4.1.6 XTRA function mode
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Scope

This document applies to the following products

Name	Type	Size(mm)	Comments
SIM7080G	CAT-M/NB	17.6*15.7 *2.3	N/A
SIM7070G/SIM7070E	CAT-M/NB/GPRS	24*24*2.4	N/A
SIM7070G-NG	NB/GPRS	24*24*2.4	N/A
SIM7090G	CAT-M/NB	14.8*12.8*2.0	N/A

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1 Introduction

1.1 Purpose of the document

Based on module AT command manual, this document will introduce GNSS application process.

Developers could understand and develop application quickly and efficiently based on this document.

1.2 Related documents

[1] SIM7070_SIM7080_SIM7090 Series_AT Command Manual

1.3 Conventions and abbreviations

In this document, the GSM engines are referred to as following term:

- ME (Mobile Equipment);
- MS (Mobile Station);
- TA (Terminal Adapter);
- DCE (Data Communication Equipment) or facsimile DCE (FAX modem, FAX board);

In application, controlling device controls the GSM engine by sending AT Command via its serial interface. The controlling device at the other end of the serial line is referred to as following term:

- TE (Terminal Equipment);
- DTE (Data Terminal Equipment) or plainly "the application" which is running on an embedded system;

2 GNSS Introduction

2.1 GNSS

The full name of GNSS is the Global Navigation Satellite System, which refers to all satellite navigation systems, including global, regional and enhanced, such as GPS in the United States, Glonass in Russia, Galileo in Europe, and China. Beidou satellite navigation system, and related augmentation systems, such as WAAS (Wide Area Augmentation System) in the United States, EGNOS (European Geostationary Navigation Overlay System) in Europe, and MSAS (Multifunctional Transportation Satellite Augmentation System) in Japan, etc. Other satellite navigation systems to be built and later. The international GNSS system is a complex system with multiple systems, multiple layers and multiple modes.

2.2 Start-up type

There are three types of GNSS start-up: cold start, warm start, and hot start.

2.2.1 Cold Start

Cold start refers to the process of starting GNSS in an unfamiliar environment until the GNSS contacts the surrounding satellites and calculates the coordinates.

The following conditions are cold start:
1. When using for the first time;
2. When the battery is exhausted and the ephemeris information is lost;
3. Move the receiver to a distance of more than 1000 kilometers in the shutdown state.

That is to say, the cold start is a mandatory start by hardware. The GNSS clears all historical information. The GNSS receiver loses satellite parameters, or the existing parameters are too different from the actual received satellite parameters, which causes the navigator to not work. Re-acquiring the coordinate data provided by the satellite will take a long time because there is no previous information.

2.2.2 Warm Start

Warm start refers to the start of more than 2 hours from the last positioning time. The search time of the star search is between cold start and hot start. GNSS saves the position, almanac and UTC time of the last calculated satellite, but the ephemeris has changed due to the long shutdown time. The saved content is not the data of the current visible satellite. The previous satellite cannot be received and needs to be searched for supplement Location information, so the time to search for stars is longer than hot start, and shorter than cold start.

2.2.3 Hot Start

Hot start means that there is no too much movement to start the GNSS in the place where it was last shut down, but the time from the last positioning must be less than 2 hours. The GNSS saves its last calculated position of the visible satellite, almanac (almanac) and UTC time, After restarting, the GNSS obtains and calculates the latest position of the current satellite based on the saved content. In other words, through software, after some preparatory work such as saving and closing before starting, start.

2.3 XTRA

XTRA (eXTended Receiver Assistance) is a GPS enhancement function provided by Qualcomm, similar to the AGPS function,

Before GPS finds satellites, use the network to download ephemeris data, and then use the data to quickly find available satellites, thereby increasing the speed of searching for stars.

XTRA function settings:

For the setting of XTRA and AGPS, NV4627, 4628 and 4631 correspond to the function switch of XTRA, the setting of download interval and the switch when downloading.

XTRA can predict ephemeris and almanac within 7 days. The information predicted by XTRA is very accurate within 24 hours, but its effectiveness decreases over time.

Users can update or download the latest XTRA data through the Internet.
Qualcomm provides a free download from the server.
The XTRA file size is very small (about tens of KB, which saves more data than AGPS) and the performance (TTFF, etc.) is close to AGPS, but better than standalone.

3 AT Commands for GNSS

Command	Description
AT+CGNSPWR	GNSS Power Control
AT+CGNSINF	GNSS Navigation Information Parsed From NMEA Sentences
AT+CGNSCOLD	GNSS Cold Start
AT+CGNSWARM	GNSS Warm Start
AT+CGNSHOT	GNSS Hot Start
AT+CGNSMOD	GNSS Work Mode Set
AT+CGNSXTRA	GNSS XTRA Function Open
AT+CGNSCPY	GNSS XTRA File Copy
AT+SGNSCFG	GNSS NMEA Out Configure
AT+SGNSCMD	GNSS NMEA Data Output to AT Port

For detail information, please refer to “SIM7070_SIM7080_SIM7090 Series_AT Command Manual ”.

4 GNSS Examples

4.1 From AP Side

4.1.1 Turn on GNSS and get location information once

```
//Example of Turn on GNSS and get location information once

AT+SGNSCMD=1,0                          //Turn on GNSS and get location information once
OK

+SGNSCMD:
2,05:29:31,31.22213,121.35575,16.62,40.15,30.6
9,0.0,0.0,0x16dfc3dca78,311
```

4.1.2 Configure GNSS output NMEA data to USB's NMEA port

In this way, NMEA data will out to USB's NMEA port, please open NMEA port to receive NMEA data.

```
//Example of Configure GNSS output NMEA data to USB's NMEA port

AT+SGNSCFG="NMEAOUTPORT",1              //Configure GNSS out to USB NMEA port before GNSS power on

OK
AT+SGNSCMD=2,1000,0,1                   //Turn on GNSS and get multiple location information

OK
$GPGSV,3,1,12,03,04,243,32,04,00,000,41,08,17,  //NMEA data output from USB's NMEA port
207,38,09,15,316,40,1*6A
$GPGSV,3,2,12,14,16,162,34,16,63,346,40,21,17,
075,34,23,42,294,43,1*6E
$GPGSV,3,3,12,26,49,034,45,27,60,187,43,31,37,
103,45,22,00,000,,1*67
$GLGSV,3,1,10,10,13,300,22,18,11,027,24,09,48,
```

```
011,34,16,16,079,26,1*79
$GLGSV,3,2,10,20,35,150,29,19,44,068,23,07,27,
233,31,08,28,291,24,1*78
$GLGSV,3,3,10,06,02,191,,01,06,329,,1*7B
$GAGSV,1,1,0,7*43
$PQGSV,1,1,0,1*42
$GPGSA,A,3,14,16,23,26,27,31,,,,,,,1.6,1.3,0.9,1*
23
$GPVTG,,T,,M,0.0,N,0.0,K,A*23
$GPRMC,000203.00,A,3113.32456,N,12121.3366
3,E,0.0,,060180,4.5,W,A,V*78
$GPGGA,000203.00,3113.3245,N,12121.3366,E,1
,06,1.3,5.1,M,9.4,M,,*51
```

4.1.3 Configure GNSS output NMEA data to UART3 port

In this way, NMEA data will out to UART3 port, please open UART3 port to receive NMEA data.

```
//Example of Configure GNSS output NMEA data to UART3 port.

AT+SGNSCFG="NMEAOUTPORT",2          //Configure GNSS out to UART3 NMEA port before GNSS power on

OK
AT+SGNSCMD=2,1000,0,1               //Turn on GNSS and get multiple location information

OK
$GPGSV,3,1,12,03,04,243,32,04,00,000,41,08,17,  //NMEA data output from UART3 port
207,38,09,15,316,40,1*6A
$GPGSV,3,2,12,14,16,162,34,16,63,346,40,21,17,
075,34,23,42,294,43,1*6E
$GPGSV,3,3,12,26,49,034,45,27,60,187,43,31,37,
103,45,22,00,000,,1*67
$GLGSV,3,1,10,10,13,300,22,18,11,027,24,09,48,
011,34,16,16,079,26,1*79
$GLGSV,3,2,10,20,35,150,29,19,44,068,23,07,27,
233,31,08,28,291,24,1*78
$GLGSV,3,3,10,06,02,191,,01,06,329,,1*7B
$GAGSV,1,1,0,7*43
$PQGSV,1,1,0,1*42
$GPGSA,A,3,14,16,23,26,27,31,,,,,,,1.6,1.3,0.9,1*
23
$GPVTG,,T,,M,0.0,N,0.0,K,A*23
$GPRMC,000203.00,A,3113.32456,N,12121.3366
```

```
3,E,0.0,,060180,4.5,W,A,V*78
$GPGGA,000203.00,3113.3245,N,12121.3366,E,1
,06,1.3,5.1,M,9.4,M,,*51
```

4.1.4 Auto report GNSS information every 1s

```
//Example of Auto report GNSS information every 1s

AT+SGNSCFG="OUTURC",1                    //Turn on navigation data URC report.
OK
AT+SGNSCMD=2,1000,0,1                    //Turn on GNSS and get multiple location
                                         information, Auto output GNSS information every
                                         1s
OK

+SGNSCMD:
2,05:29:31,31.22213,121.35575,16.62,40.15,30.6
9,0.0,0.0,0x16dfc3dca78,311

+SGNSCMD:
2,05:29:32,31.22213,121.35575,12.46,35.79,26.3
3,0.0,0.0,0x16dfc3dce60,311

+SGNSCMD:
2,05:29:33,31.22215,121.35575,11.40,39.24,29.78
,0.0,0.0,0x16dfc3dd248,311
```

4.1.5 Configure the GNSS fix mode

```
//Example of Configure the GNSS fix mode

AT+CGNSMOD=1,1,0,0,0                     //Configure GNSS mod GPS+GLO
or
AT+SGNSCFG="MODE",0
OK
…                                        //Reboot
AT+SGNSCFG="NMEAOUTPORT",1               //Configure GNSS out to USB NMEA port before
                                         GNSS power on
OK
```

```
AT+SGNSCMD=2,1000,0,1                    //Turn on GNSS and get multiple location information

OK
$GPGSV,3,1,12,03,04,243,32,04,00,000,41,08,17,207,38,09,15,316,40,1*6A    //On NMEA port
$GPGSV,3,2,12,14,16,162,34,16,63,346,40,21,17,075,34,23,42,294,43,1*6E
$GPGSV,3,3,12,26,49,034,45,27,60,187,43,31,37,103,45,22,00,000,,1*67
$GLGSV,3,1,10,10,13,300,22,18,11,027,24,09,48,011,34,16,16,079,26,1*79
$GLGSV,3,2,10,20,35,150,29,19,44,068,23,07,27,233,31,08,28,291,24,1*78
$GLGSV,3,3,10,06,02,191,,01,06,329,,1*7B
$GAGSV,1,1,0,7*43
$PQGSV,1,1,0,1*42
$GPGSA,A,3,14,16,23,26,27,31,,,,,,,1.6,1.3,0.9,1*23
$GPVTG,,T,,M,0.0,N,0.0,K,A*23
$GPRMC,000203.00,A,3113.32456,N,12121.33663,E,0.0,,060180,4.5,W,A,V*78
$GPGGA,000203.00,3113.3245,N,12121.3366,E,1,06,1.3,5.1,M,9.4,M,,*51
```

4.1.6 Configure GNSS NMEA type

```
//Example of Configure GNSS NEMA type

AT+SGNSCFG="NMEATYPE",255                //Configure GNSS NMEA type, Output all types.
OK
AT+SGNSCFG="NMEAOUTPORT",1               //Configure GNSS out to USB NMEA port before GNSS power on

OK
AT+SGNSCMD=2,1000,0,1                    //Turn on GNSS and get multiple location information

OK
$GPGSV,3,1,12,03,04,243,32,04,00,000,41,08,17,207,38,09,15,316,40,1*6A    //On NMEA port
$GPGSV,3,2,12,14,16,162,34,16,63,346,40,21,17,075,34,23,42,294,43,1*6E
$GPGSV,3,3,12,26,49,034,45,27,60,187,43,31,37,103,45,22,00,000,,1*67
```

```
$GLGSV,3,1,10,10,13,300,22,18,11,027,24,09,48,
011,34,16,16,079,26,1*79
$GLGSV,3,2,10,20,35,150,29,19,44,068,23,07,27,
233,31,08,28,291,24,1*78
$GLGSV,3,3,10,06,02,191,,01,06,329,,1*7B
$GAGSV,1,1,0,7*43
$PQGSV,1,1,0,1*42
$GPGSA,A,3,14,16,23,26,27,31,,,,,,,1.6,1.3,0.9,1*
23
$GPVTG,,T,,M,0.0,N,0.0,K,A*23
$GPRMC,000203.00,A,3113.32456,N,12121.3366
3,E,0.0,,060180,4.5,W,A,V*78
$GPGGA,000203.00,3113.3245,N,12121.3366,E,1
,06,1.3,5.1,M,9.4,M,,*51
```

4.1.7 XTRA function mode

It provides enhanced standalone performance, and eliminates the need to demodulate the GPS signal for ephemeris, almanac, iono, UTC, or health.

Normally requires -144 dBm or stronger for all SVs in view.

TTFF can be reduced by 18 to 30 sec (or more in harsh signal environments)

```
//Example of XTRA function mode

AT+CNACT=0,1                                    //Registration network
OK

+APP PDP: ACTIVE
AT+CLTS=1                                       //Time synchronization
OK
AT+HTTPTOFS="http://iot2.xtracloud.net/xtra3    //XTRA file server:
gr_72h.bin","/customer/Xtra3.bin"               1. iot1.xtracloud.net
                                                2. iot2.xtracloud.net
                                                3. iot3.xtracloud.net
                                                XTRA file:
                                                1. GPS + GLO : xtra3gr_72h.bin
                                                2. GPS + BDS : xtra3gc_72h.bin
                                                3. GPS + GAL : xtra3ge_72h.bin
                                                4. GPS + QZSS : xtra3gj_72h.bin
                                                5. GPS : xtra3g_72h.bin
```

```
OK

+HTTPTOFS: 200,14943
AT+CGNSCPY                                  //Copy XTRA file
+CGNSCPY: 0

OK
AT+CGNSXTRA                                 //Query XTRA file validity and import Data
OK
AT+CGNSXTRA=1                               //Open XTRA function
OK
AT+SGNSCFG="NMEAOUTPORT",1                  //Configure GNSS out to USB NMEA port before
                                            GNSS power on
OK
AT+SGNSCMD=2,1000,0,1                       //Start GNSS
OK
```

4.2 From Modem Side

4.2.1 Open GNSS function

```
//Example of Open GNSS.

AT+CGNSPWR=1                                //Turn on GNSS power(UART or USB AT port)
OK
AT+CGNSINF                                  //Read GNSS navigation information
+CGNSINF:
1,1,20191024051848.000,31.221946,121.355565
,3.417,0.00,,0,,1.4,1.7,0.9,,6,,12.4,12.0

OK
```

4.2.2 XTRA function mode

It provides enhanced standalone performance, and eliminates the need to demodulate the GPS signal for ephemeris, almanac, iono, UTC, or health.

Normally requires -144 dBm or stronger for all SVs in view.

TTFF can be reduced by 18 to 30 sec (or more in harsh signal environments)

//Example of XTRA function mode	
AT+CNACT=0,1	//Activate network, Activate 0th PDP.
OK	
+APP PDP: 0,ACTIVE	
AT+CLTS=1	//Time synchronization
OK	
AT+HTTPTOFS="http://iot2.xtracloud.net/xtra3gr_72h.bin","/customer/Xtra3.bin"	//XTRA file server: 1. iot1.xtracloud.net 2. iot2.xtracloud.net 3. iot3.xtracloud.net XTRA file: 1. GPS+GLO: xtra3gr_72h.bin 2. GPS+BDS: xtra3gc_72h.bin 3. GPS+GAL: xtra3ge_72h.bin 4. GPS+QZSS: xtra3gj_72h.bin 5. GPS: xtra3g_72h.bin
OK	
+HTTPTOFS: 200,14943	
AT+CGNSCPY	//Copy XTRA file
+CGNSCPY: 0	
OK	
AT+CGNSXTRA	//Query XTRA file validity and import Data
OK	
AT+CGNSXTRA=1	//Open XTRA function
OK	
AT+CGNSCOLD	//Cold start GNSS
OK	Aid XTRA file success
+CGNSXTRA: 0	