PERFECT WIRELESS EXPERIENCE

MTC

GNSS Integration Guide_Android

V1.0

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Contents

Applicable Model

No.	Applicable Model	Description
1	L610 series	NA
2	NL668 series	NA
3	FG132 series	NA
4	MC66x	MC660, MC665

Change History

V1.0 (2024-12-30)	Initial version.

1 About This Document

This document explains how to integrate the GPS function of modules such as L610, NL668, and FG132 on the Android platform (including the importing of the configuration file and GPS Library file).

This document is intended for Android driver and application developers, test engineers, and customers. The Android platform that supports the GPS function is Android 4.0 and later.

2 Overview

2.1 Features

Android devices can establish communication with Fibocom modules through the USB port or physical serial port.

During USB port-based communication, the device will load related drivers and then generate the corresponding control channel and data channel ttyUSB*. The Android HAL layer can realize GPS data transmission/reception through the control channel, data channel ttyUSB*, as well as the physical serial port, as shown in the following figure.

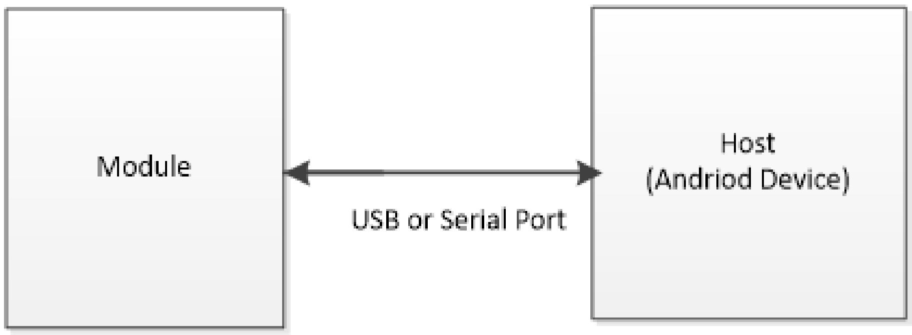


Figure 1. Data transmission channel

2.2 Software Architecture

The following figure shows the Android-based software architecture. The GPS library file provided by Fibocom is located at the HAL layer.

HAL layer software performs GPS control and data reception by accessing the USB port or physical serial port. At the same time, HAL layer software provides an access interface to the upper JNI layer, and the upper-layer application obtains various data provided by the underlying GPS through the Android Framework.

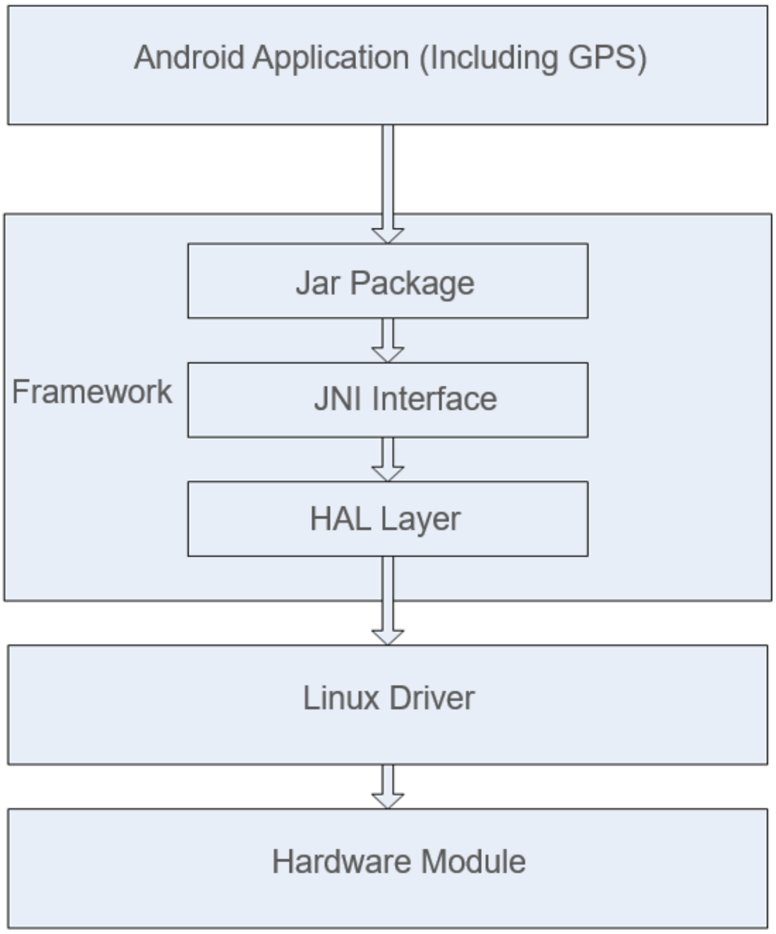


Figure 2. Software framework

3 Usage Method

In the debugging phase, related files must be imported using the ADB debug terminal. After the import is successful, you must restart the device to continue to use the module. Before importing the files, make sure that the ADB environment is normal. Otherwise, the import will fail.

Fibocom provides configuration file and GPS library file (32-bit and 64-bit Android environments). The import method is described as follows.

3.1 Import the gps_cfg.inf Configuration File

The default name of the configuration file is gps_cfg.inf, which is used to configure parameters required by the GPS library. It is generally located in the config subfolder of the version folder, as shown in the following figure.

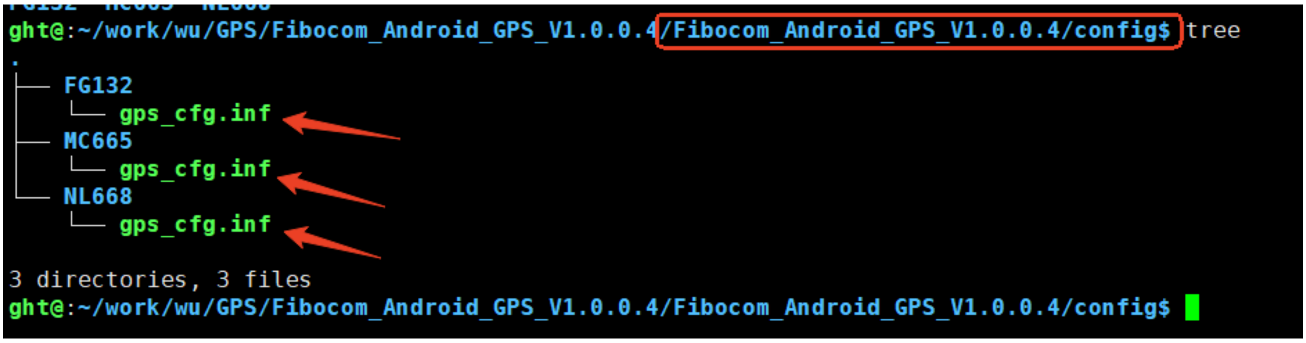


Figure 3. Path of gps_cfg.inf

gps_cfg.inf

```
[MODULE]
; Set the module model. The currently supported values are as follows:
; NL668
; FG132
; MC665
; L610
; The default value is NL668.
#MODULE_TYPE=MC665

; Specify the port for reporting NMEA data, which is closed by default.
; This value should be opened under the guidance of GHT.
#NMEA_PORT_PATH=/dev/ttyUSB2

; Specify the port for sending AT data, which is turned off by default.
; This value should be opened under the guidance of GHT.
#AT_PORT_PATH=/dev/ttyUSB1

; Set the baud rate of the port. The default is 115200
#BAUD_RATE=115200

; Set whether GPS sends and receives AT commands through RIL. Default is 0.
; 0 : GPS sends and receives AT(default).
; 1 : GPS sends and receives AT through RIL.
#GPS_MANAGED_BY_RIL=0

; Create a binder client using C or C++ language.
; 0 : C++ language(default)
; 1 : C language.
#USE_BINDER_C=0

[AT]
; Define the server used by AGPS on your own, the default is:
; AT+GTAGPSSERV="supl.qxwz.com",7276\r
#AGPS_SERVER=AT+GTAGPSSERV="supl.qxwz.com",7276\r
```

Figure 4. Configuration file content

You need to modify **MODULE_TYPE** in the configuration file according to the module type actually used and retain the default settings for other content.

For example, if your module type is MC665, make the modification as follows.

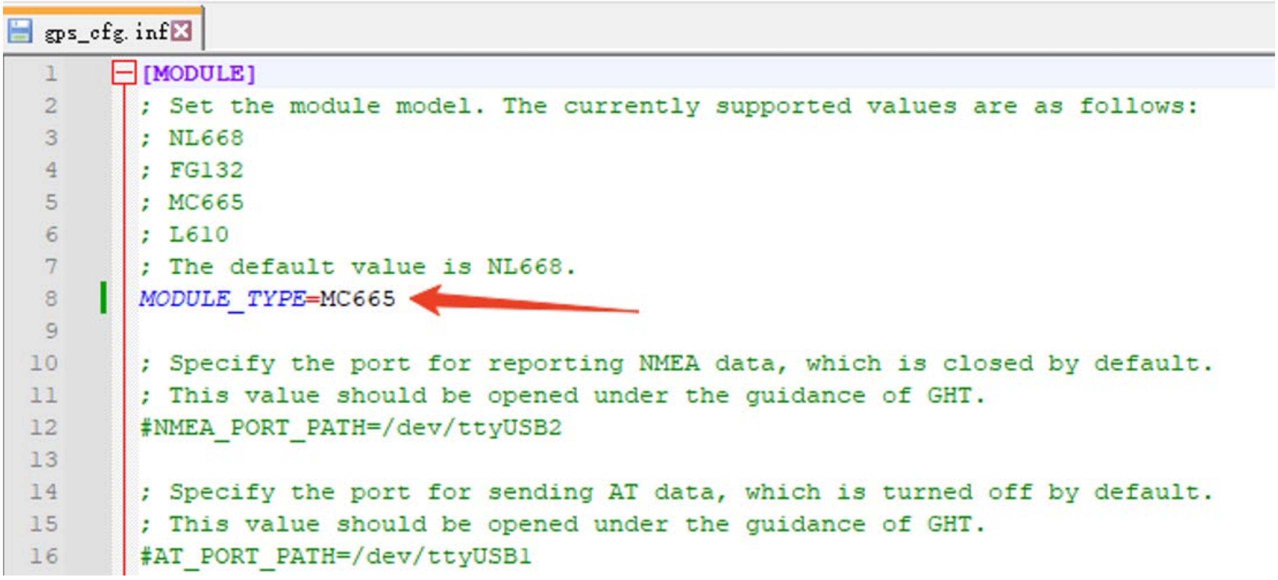


Figure 5. Modify MODULE_TYPE

After the modification, import the configuration file to the /vendor/etc/ path using the following commands:

```
adb root
adb remount
adb push <path_to_gps_cfg.inf> /vendor/etc/gps_cfg.inf
```

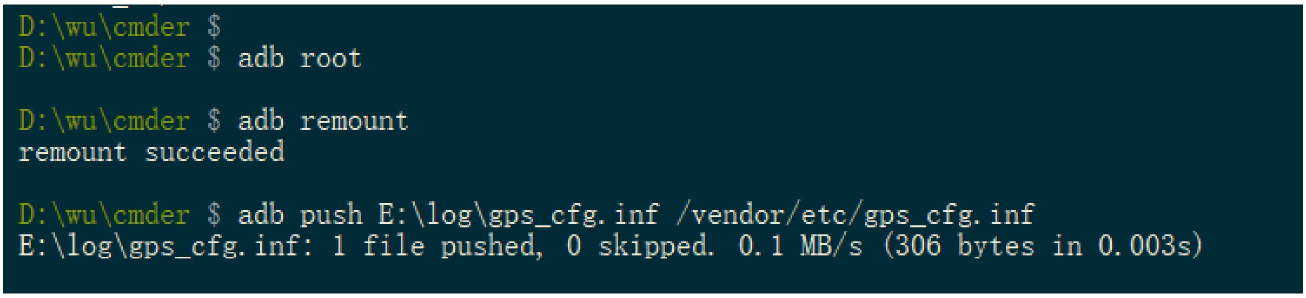


Figure 6. Push configuration file

3.2 Import the gps.default.so Library File

gps.default.so is the most important GPS library file. It is located in the bin subfolder of the version folder, as shown in the figure below. You can choose a library file based on your Android version.

Figure 7. Library path of gps.default.so

For different Android devices, import the gps.default.so library file into different paths. The following table provides the details.

Table 1. Path of GPS library in Android

Android Version	Android Bit (32/64-bit)	Path
Android 4 to 7	32-bit	/system/lib/hw
	64-bit	/system/lib64/hw
Android 8 and later	32-bit	/vendor/lib/hw
	64-bit	/vendor/lib64/hw

The import commands are as follows (taking /vendor/lib64/hw/ as an example):

```
adb root
adb remount
adb push <path_to_gps.default.so>
```

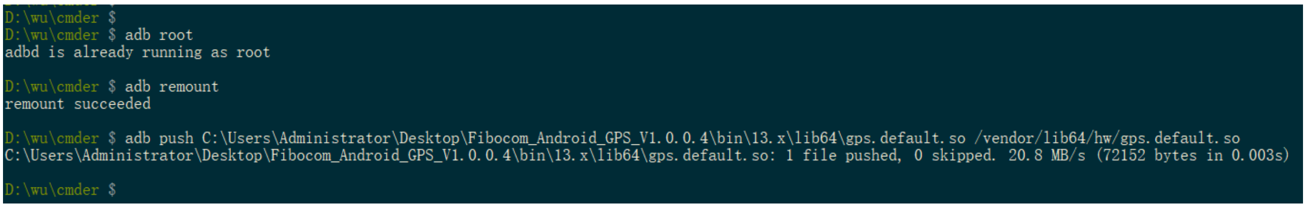


Figure 8. Push the gps.default.so library

- The names of 32-bit and 64-bit library files are the same. You need to distinguish them during file importing.
- The names of the configuration file and library file cannot be modified arbitrarily. Otherwise, the loading will fail.
- The import path and file name cannot contain Chinese characters. Otherwise, the import will fail.

3.3 Query GPS Library Version

After importing the above files, restart the Android device, and then send the following command:

```
adb shell
getprop|grep gps
```

If the GPS library runs successfully, the "gps.fibocom.version" attribute will appear, which is the version number of the GPS library, as shown in the following figure.

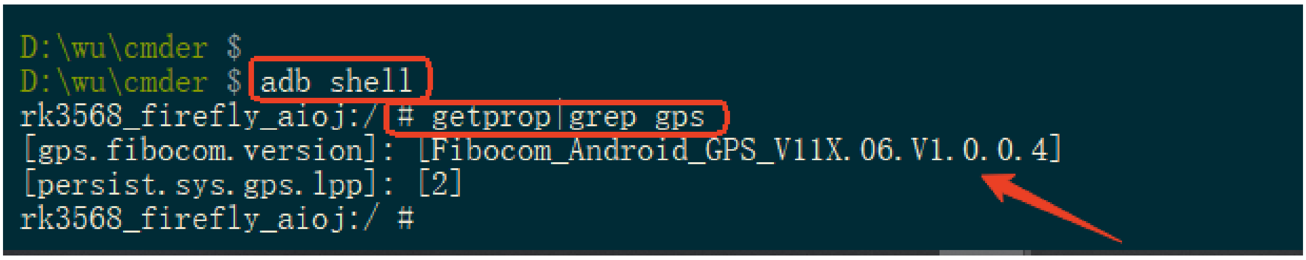


Figure 9. GPS version

If the version number does not appear, it means that the GPS library is running abnormally. Follow the FAQs chapter to troubleshoot the issue. If the issue persists, capture GPS log and contact Fibocom technical support.

3.4 Capture GPS Log

Use the following command to capture GPS log:

```
adb logcat -b all > GPS.txt
```

3.5 Verify Positioning Function

3.5.1 Preconditions

- A module that supports the GPS function
- An Android device
- A laptop
- A SIM card (required for AGPS testing)
- A 4G antenna (required for AGPS testing)

- A GPS antenna
- Two USB cables
- Follow sections 3.1 Import the gps_cfg.inf Configuration File and 3.2 Import the gps.default.so Library File to import the configuration file and GPI library file to the Android device.
- Connect the laptop and Android device via USB.
- Connect the Android device and module via USB.
- Connect the module to the GPS antenna and ensure that the antenna can be placed outdoors or outside the window.
- Prepare the app software for viewing GPS positioning information (see Section 3.5.2 for usage instructions).
- Prepare the Android screen mirroring device and connect it to the Android device.
- Open the app software and wait for about 1 minute to check whether the positioning is successful.

3.5.2 GPS Positioning

Fibocom provides an app software (GPSTest_PLUS.apk) to verify whether GPS reception is normal. After related files are imported, you can use this software to verify whether GPS reception is normal.

Note: To obtain GPSTest_PLUS.apk, contact Fibocom technical support.

GPSTest_PLUS.apk

1. Install the GPS Test Plus.

Run the following command in adb to install the GPS Test Plus:

```
adb install GPSTest_PLUS.apk
```

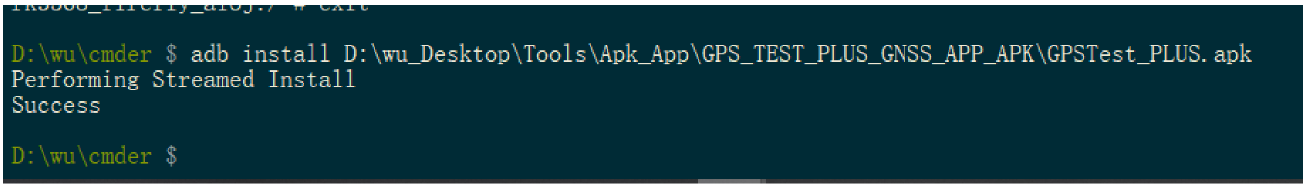


Figure 10. GPS Test Plus installation

2. Use the APK.

After the above operation is complete, open the Android screen mirroring tool and click the **GPS Test Plus** icon on the following page.

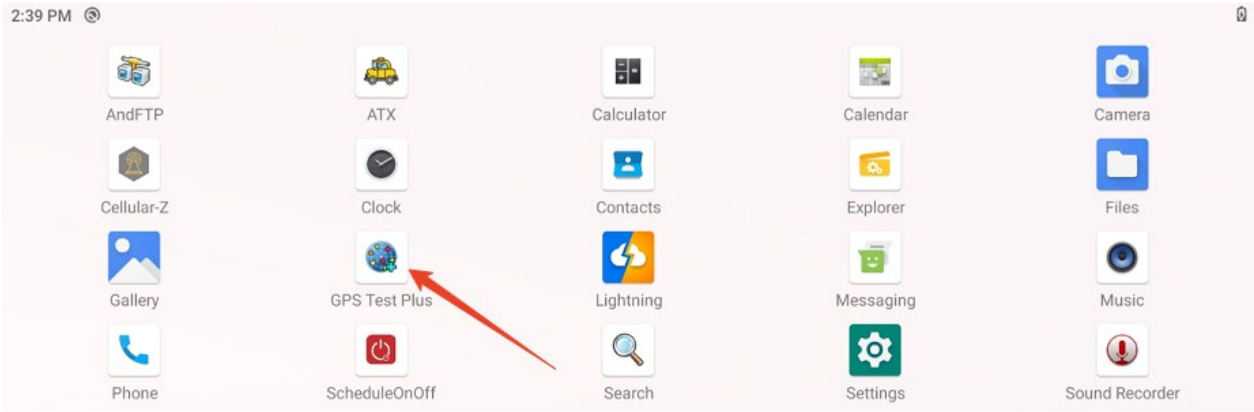


Figure 11. APK icon

After successful positioning, the software interface is as follows.

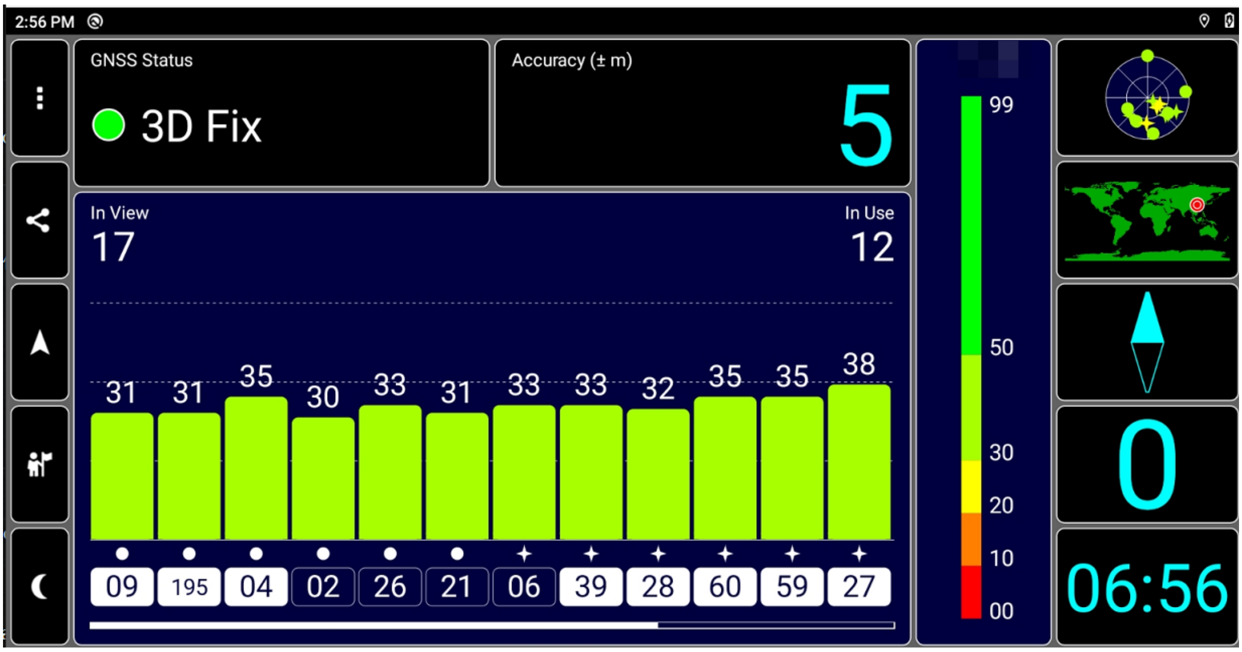


Figure 12. Positioning success interface

4 NMEA Data Description

4.1 NMEA1803 Data Format

After the above adaptation steps are completed, open the GPS software and enter the **gps_fbc.+Received:** regular expression in the GPS log to search for the NMEA data from the module (as shown below).

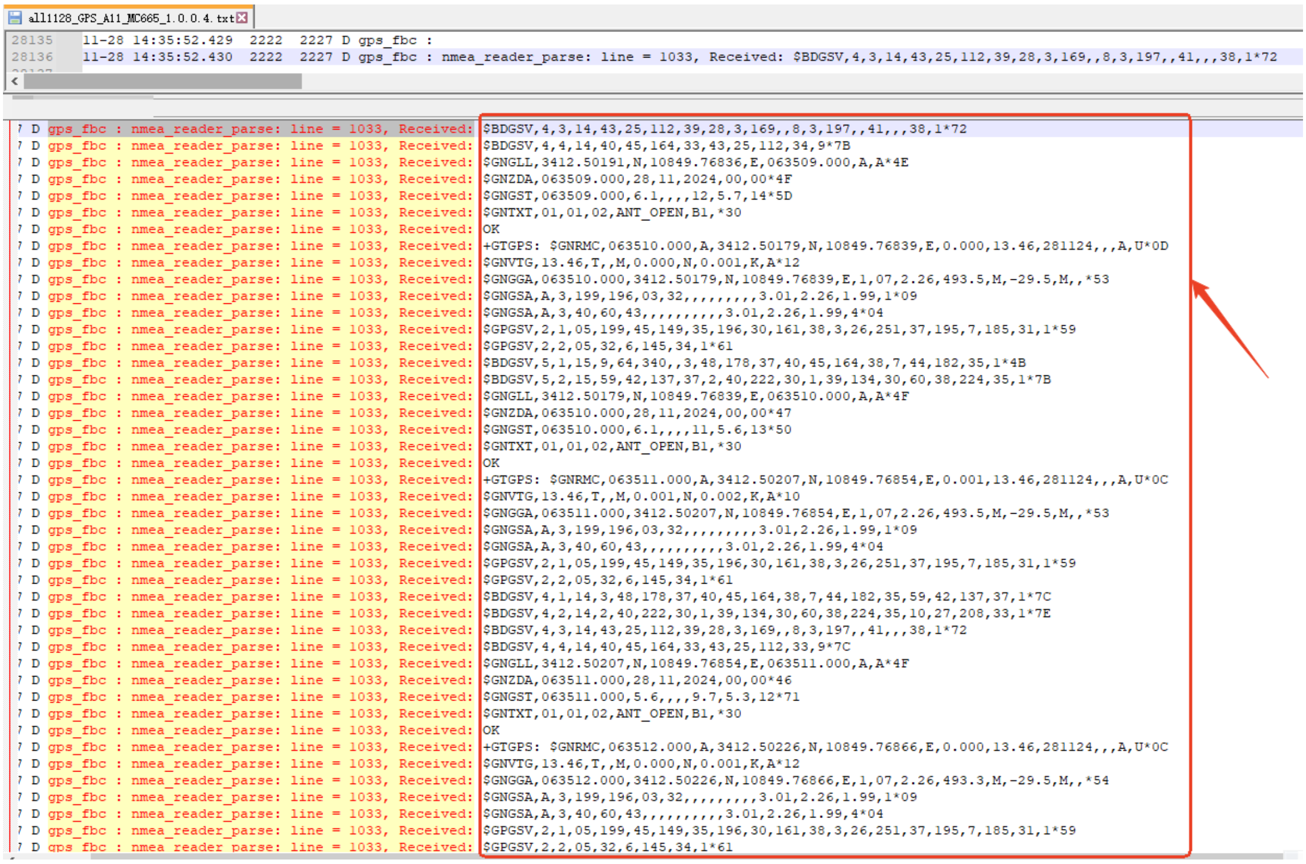


Figure 13. NMEA data example

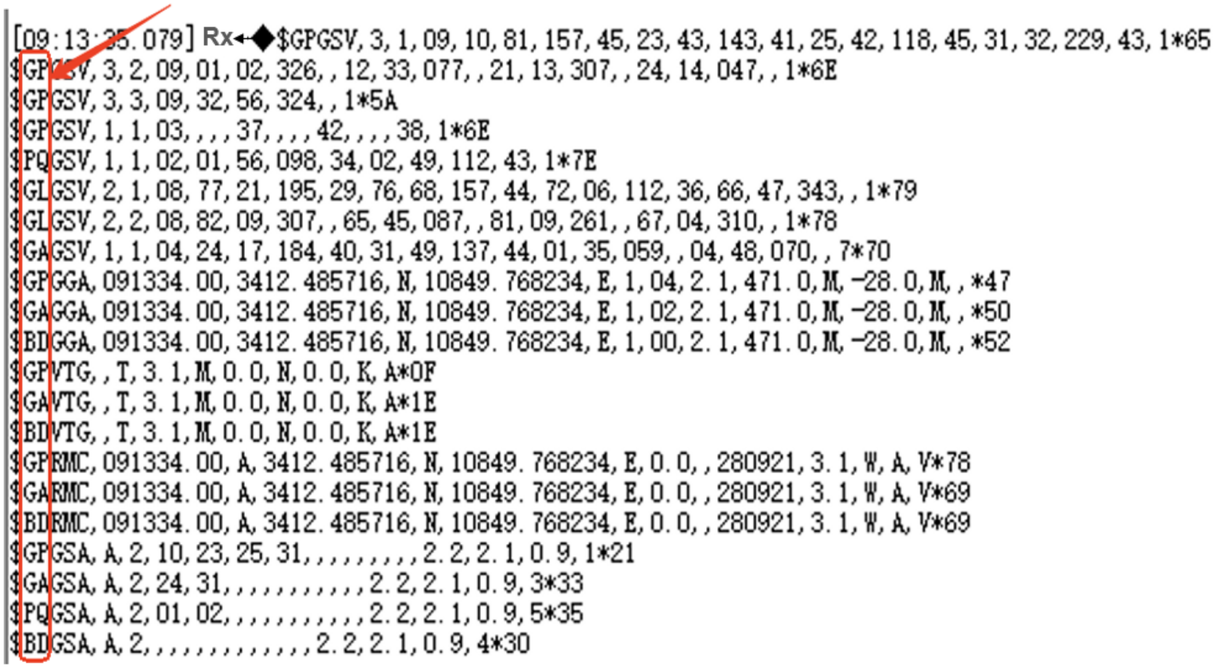
Each row on the right side of the above picture represents a row of NMEA data. The data format is basically the same, as described in the following table.

Table 2. Protocol format

$	<Address>	Check Sum	End
The starting character of each statement.	It is divided into two parts: Transmitter identification (such as GP, BD…) Statement type (such as RMC, GGA…)	XOR operation is performed on data between "$" and "*" (excluding these two characters) according to bytes and expressed in hexadecimal.	<CR><LF> Each statement ends with "\r\n".

4.2 Identifier Difference Between NMEA1803 Protocol 3.01 and 4.1

Different GNSS systems (such as GPS, Beidou, and Galileo) have different identifiers, which are located at the beginning of each NMEA data, as shown in the following figure.



```
[09:13:35.079] Rx←◆$GPGSV,3,1,09,10,81,157,45,23,43,143,41,25,42,118,45,31,32,229,43,1*65
$GPGSV,3,2,09,01,02,326,,12,33,077,,21,13,307,,24,14,047,,1*6E
$GPGSV,3,3,09,32,56,324,,1*5A
$GPGSV,1,1,03,,,,37,,,,42,,,,38,1*6E
$PQGSV,1,1,02,01,56,098,34,02,49,112,43,1*7E
$GLGSV,2,1,08,77,21,195,29,76,68,157,44,72,06,112,36,66,47,343,,1*79
$GLGSV,2,2,08,82,09,307,,65,45,087,,81,09,261,,67,04,310,,1*78
$GAGSV,1,1,04,24,17,184,40,31,49,137,44,01,35,059,,04,48,070,,7*70
$GPGGA,091334.00,3412.485716,N,10849.768234,E,1,04,2.1,471.0,M,-28.0,M,,*47
$GAGGA,091334.00,3412.485716,N,10849.768234,E,1,02,2.1,471.0,M,-28.0,M,,*50
$BDGGA,091334.00,3412.485716,N,10849.768234,E,1,00,2.1,471.0,M,-28.0,M,,*52
$GPVTG,,T,3.1,M,0.0,N,0.0,K,A*0F
$GAVTG,,T,3.1,M,0.0,N,0.0,K,A*1E
$BDVTG,,T,3.1,M,0.0,N,0.0,K,A*1E
$GPRMC,091334.00,A,3412.485716,N,10849.768234,E,0.0,,280921,3.1,W,A,V*78
$GARMC,091334.00,A,3412.485716,N,10849.768234,E,0.0,,280921,3.1,W,A,V*69
$BDRMC,091334.00,A,3412.485716,N,10849.768234,E,0.0,,280921,3.1,W,A,V*69
$GPGSA,A,2,10,23,25,31,,,,,,,,,2.2,2.1,0.9,1*21
$GAGSA,A,2,24,31,,,,,,,,,,,2.2,2.1,0.9,3*33
$PQGSA,A,2,01,02,,,,,,,,,,,2.2,2.1,0.9,5*35
$BDGSA,A,2,,,,,,,,,,,,,2.2,2.1,0.9,4*30
```

Figure 14. Identifiers of different systems

The following table lists the identifiers of each GNSS system in different NMEA versions.

Table 3. Identifiers of different NMEA versions

GNSS System	GNSS System Transmitter Identifier (NMEA3.01)	GNSS System Transmitter Identifier (V4.1)
Galileo	GA	GA
BeiDou	BD	GB
GPS	GP	GP
QZSS	GP	GQ
NAVIC	IR	GI
GLONASS	GL	GL
Combination of Multiple Satellite Systems	GN	GN

Fibocom's **PQ** symbol stands for **QZSS**.

4.3 NMEA Output Protocol Analysis

Different NMEA data have different meanings. Following is a detailed explanation of five common NMEA data. The following sections use United States' Global Positioning System (GPS) as an example.

4.3.1 $GPGSV

Description: visible satellite information

Example: $GPGSV,3,1,10,20,78,331,45,01,59,235,47,22,41,069,,13,32,252,45*70

Table 4. $GPGSV field definition

Field	Description
Field 0	$GPGSV, statement ID, indicating that the statement is GPS Satellites in View (GSV) visible satellite information
Field 1	Total number of GSV statements (1–3)
Field 2	The number of the GSV in this sentence (1–3)
Field 3	Total number of currently visible satellites (00–12) (insufficient leading digits are padded with 0)
Field 4	PRN code (pseudo-random noise code) (01–32) (insufficient leading digits are padded with 0)
Field 5	Satellite elevation angle (00–90 degrees) (insufficient leading digits are padded with 0)
Field 6	Satellite azimuth (00–359 degrees) (insufficient leading digits are padded with 0)
Field 7	Signal-to-noise ratio (00–99 dbHz)
Field 8	PRN code (pseudo-random noise code) (01–32) (insufficient leading digits are padded with 0)
Field 9	Satellite elevation angle (00–90 degrees) (insufficient leading digits are padded with 0)
Field 10	Satellite azimuth (00–359 degrees) (insufficient leading digits are padded with 0)
Field 11	Signal-to-noise ratio (00–99 dbHz)
Field 12	PRN code (pseudo-random noise code) (01–32) (insufficient leading digits are padded with 0)
Field 13	Satellite elevation angle (00–90 degrees) (insufficient leading digits are padded with 0)
Field 14	Satellite azimuth (00–359 degrees) (insufficient leading digits are padded with 0)
Field 15	Signal-to-noise ratio (00–99 dbHz)

Field	Description
Field 16	PRN code (pseudo-random noise code) (01–32) (insufficient leading digits are padded with 0)
Field 17	Satellite elevation angle (00–90 degrees) (insufficient leading digits are padded with 0)
Field 18	Satellite azimuth (00–359 degrees) (insufficient leading digits are padded with 0)
Field 19	Signal-to-noise ratio (00–99 dbHz)
Field 20	Checksum (the value after XOR operation on the numbers between $ and *)

4.3.2 $GPGGA

Description: Positioning information

Example: $GPGGA,092204.999,4250.5589,S,14718.5084,E,1,04,24.4,19.7,M,,,,0000*1F

Table 5. $GPGGA field definition

Field	Description
Field 0	$GPGGA, statement ID, indicating that the statement is Global Positioning System Fix Data (GGA) GPS positioning information
Field 1	UTC time, in **hhmmss.sss** format
Field 2	Latitude, in **ddmm.mmmm** format (insufficient leading digits are padded with 0)
Field 3	Latitude N (north latitude) or S (south latitude)
Field 4	Longitude, in **dddmm.mmmm** format (insufficient leading digits are padded with 0)
Field 5	Longitude E (east longitude) or W (west longitude)
Field 6	GPS status, 0 = unavailable (FIX NOT valid), 1 = Single point positioning (GPS FIX), 2 = Differential positioning (DGPS), 3 = Invalid PPS, 4 = Real-time differential positioning (RTK FIX), 5 = RTK FLOAT, 6 = Estimating
Field 7	The number of satellites in use (00-12) (insufficient leading digits are padded with 0)
Field 8	HDOP, level precision factor (0.5–99.9)
Field 9	Altitude (–9999.9 to 99999.9)
Field 10	Unit: M (meter)
Field 11	Height of earth ellipsoid relative to geoid WGS84 level division
Field 12	WGS84 level division, unit: M (meter)
Field 13	Differential time (seconds counted since the time the differential signal was received. It is left empty if it is not differential positioning.)
Field 14	Differential station ID, ranging from 0000 to 1023 (If the number of leading bits is insufficient, 0 is padded. If differential positioning is not used, this field is empty.)
Field 15	Checksum (the value after XOR operation on the numbers between $ and *)

4.3.3 $GPVTG

Description: Ground speed information

Example: $GPVTG,89.68,T,,M,0.00,N,0.0,K*5F

Table 6. $GPVTG field definition

Field	Description
Field 0	$GPVTG, statement ID, indicating that the statement is Track Made Good and Ground Speed (VTG) ground speed information
Field 1	Movement angle, 000–359, (insufficient leading digits are padded with 0)
Field 2	T = True North Reference System
Field 3	Movement angle, 000–359, (insufficient leading digits are padded with 0)
Field 4	M = Magnetic North Reference System
Field 5	Horizontal movement speed (0.00) (insufficient leading digits are padded with 0)
Field 6	N = knots
Field 7	Horizontal movement speed (0.00) (insufficient leading digits are padded with 0)
Field 8	K = km/h
Field 9	Checksum (the value after XOR operation on the numbers between $ and *)

4.3.4 $GPRMC

Description: Recommended data format of positioning information

Example: $GPRMC,024813.640,A,3158.4608,N,11848.3737,E,10.05,324.27,150706,,,A*50

Table 7. $GPRMC field definition

Field	Description
Field 0	$GPRMC, statement ID, indicating that the statement is Recommended Minimum Specific GPS /TRANSIT Data (RMC) positioning information.
Field 1	UTC time, in **hhmmss.sss** format
Field 2	Status, A = positioned, V = not positioned.
Field 3	Latitude, in **ddmm.mmmm** format (insufficient leading digits are padded with 0)
Field 4	Latitude N (north latitude) or S (south latitude)
Field 5	Longitude, in **dddmm.mmmm** format (insufficient leading digits are padded with 0)
Field 6	Longitude E (east longitude) or W (west longitude)
Field 7	Speed, knots
Field 8	Azimuth, degree

Field	Description
Field 9	UTC date, in DDMMYY format
Field 10	Magnetic declination, (000-180) degrees (insufficient leading digits are padded with 0)
Field 11	Magnetic declination direction, E = East, W = West
Field 12	Mode, A = automatic, D = differential, E = estimation, N = invalid data (3.0 protocol content)
Field 13	Checksum (the value after XOR operation on the numbers between $ and *)

4.3.5 $GPGSA

Description: Current satellite information

Example: $GPGSA,A,3,01,20,19,13,,,,,,,,,40.4,24.4,32.2*0A

Table 8. GPGSA field definition

Field	Description
Field 0	$GPGSA, statement ID, indicating that the statement is GPS DOP and Active Satellites (GSA) information
Field 1	Positioning mode (2D/3D), A = automatic selection, M = manual selection
Field 2	Positioning type, 1 = not positioning, 2 = 2D positioning, 3 = 3D positioning
Field 3	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 1 (If the number of leading bits is insufficient, 0 is padded.)
Field 4	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 2 (If the number of leading bits is insufficient, 0 is padded.)
Field 5	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 3 (If the number of leading bits is insufficient, 0 is padded.)
Field 6	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 4 (If the number of leading bits is insufficient, 0 is padded.)
Field 7	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 5 (If the number of leading bits is insufficient, 0 is padded.)
Field 8	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 6 (If the number of leading bits is insufficient, 0 is padded.)
Field 9	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 7 (If the number of leading bits is insufficient, 0 is padded.)
Field 10	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 8 (If the number of leading bits is insufficient, 0 is padded.)
Field 11	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 9 (If the number of leading bits is insufficient, 0 is padded.)
Field 12	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 10 (If

Field	Description
	the number of leading bits is insufficient, 0 is padded.)
Field 13	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 11 (If the number of leading bits is insufficient, 0 is padded.)
Field 14	PRN code (pseudo-random noise code), satellite PRN code (00) used by channel 12 (If the number of leading bits is insufficient, 0 is padded.)
Field 15	PDOP integrated position precision accuracy factor (0.5–99.9)
Field 16	HDOP, level precision factor (0.5–99.9)
Field 17	VDOP vertical precision factor (0.5–99.9)
Field 18	Checksum (the value after XOR operation on the numbers between $ and *)

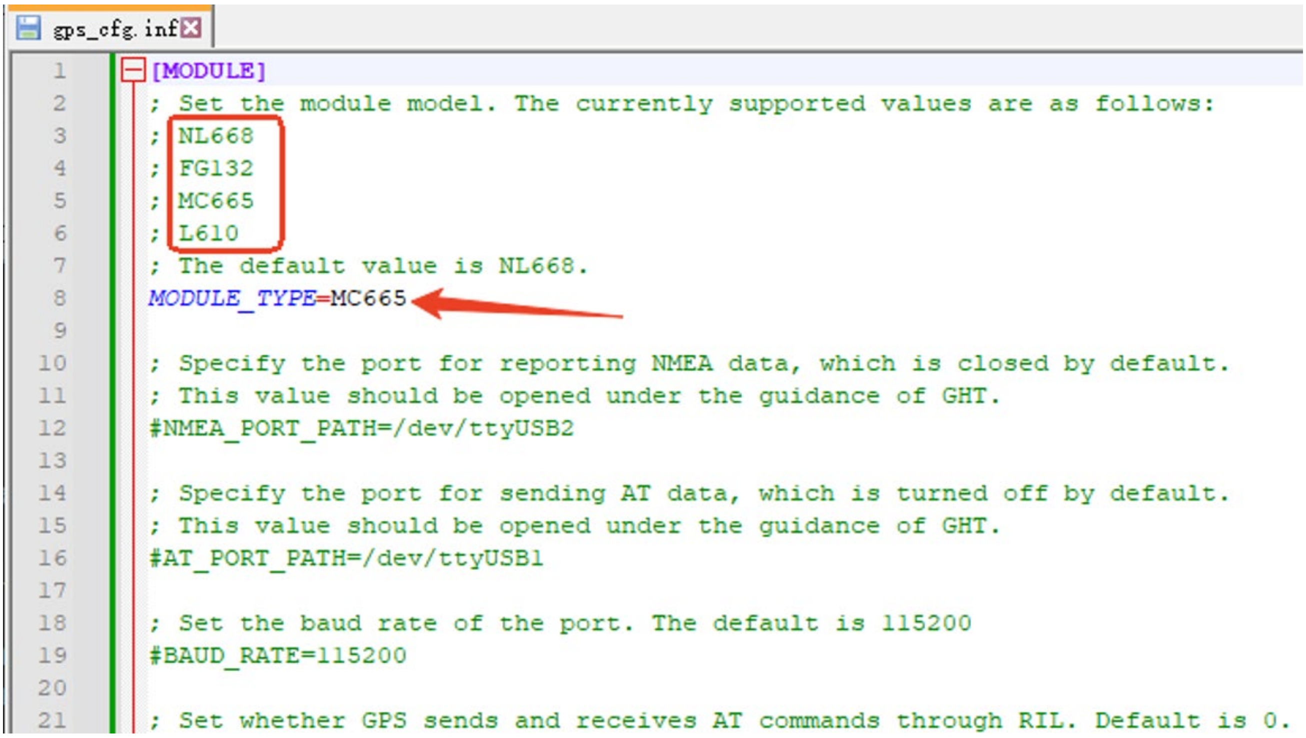
5 FAQs

5.1 File Importing Failed

Check whether ADB is installed successfully and whether the file path is correct.

5.2 Abnormal GPS Communication After File Importing

Check whether the **MODULE_TYPE** in the **gps_cfg.inf** file is correct: The correct value must be one of the comments marked in the red rectangle and the same as the actual module model used.



```
gps_cfg.inf
[MODULE]
; Set the module model. The currently supported values are as follows:
; NL668
; FG132
; MC665
; L610
; The default value is NL668.
MODULE_TYPE=MC665

; Specify the port for reporting NMEA data, which is closed by default.
; This value should be opened under the guidance of GHT.
#NMEA_PORT_PATH=/dev/ttyUSB2

; Specify the port for sending AT data, which is turned off by default.
; This value should be opened under the guidance of GHT.
#AT_PORT_PATH=/dev/ttyUSB1

; Set the baud rate of the port. The default is 115200
#BAUD_RATE=115200

; Set whether GPS sends and receives AT commands through RIL. Default is 0.
```

Figure 15. Example of correct MODULE_TYPE

5.3 Failed to Find Satellite After Software Is Opened

The possible causes are as follows:

- Generally, satellites cannot be found indoors. You need to search for satellites in the open air. You can also try to search for satellites by the window when performing debugging.
- Check whether the GPS antenna is properly connected.

5.4 How to Enter Developer Mode

1. Open the Android screen mirroring device.
2. Choose **setting** -> **system** -> **About table**.

3. Keep clicking **Build number** under **About table** until the "You are now a developer" message pops up.
4. Choose **system** -> **Developer option** -> **Root access**, and select **Apps and ADB**.

5.5 How to Customize Configuration File Name

You can modify the name of the configuration file as follows:

1. Run **adb root** and **adb remount** to obtain permissions.
2. Then, run **adb pull /system/build.prop to** pull the **build.prop** file to your local PC.

```
D:\adb_tool\adb_1.0.39>adb root

D:\adb_tool\adb_1.0.39>adb remount
remount succeeded

D:\adb_tool\adb_1.0.39>adb pull /system/build.prop
/system/build.prop: 1 file pulled. 0.4 MB/s (1991 bytes in 0.005s)
```

Figure 16. Pull build.prop file

3. Add **gps.cfg.file=<customized configuration file name>** to the end of the **build.prop** file and save the file.

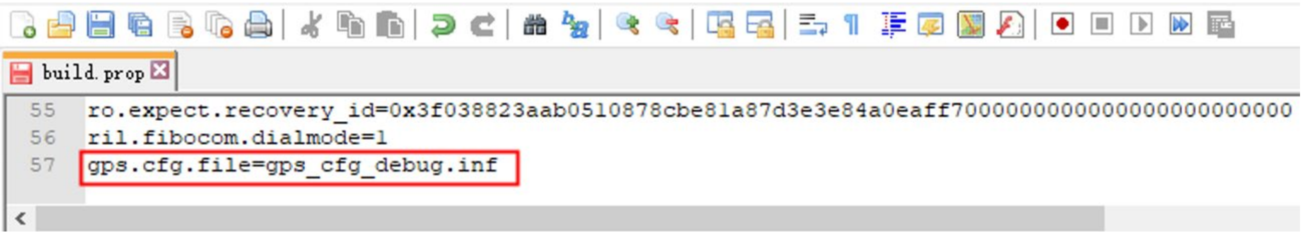


Figure 17. Modify name of configuration file

4. Use the **adb push** command to push the modified file back to its original location.

```
D:\adb_tool\adb_1.0.39>adb push D:\adb_tool\adb_1.0.39\build.prop /system/
D:\adb_tool\adb_1.0.39\build.prop: 1 file pushed. 0.1 MB/s (2021 bytes in 0.016s)
```

Figure 18. Push build.prop file

5. Run **adb reboot** to restart the device for the configuration to take effect. Remember to modify the name of the configuration file at the same time.

5.6 How to Turn On AGPS

Assisted GPS (AGPS) refers to the network-assisted GPS positioning system. It can use information from mobile phone base stations and work with traditional GPS satellites to accelerate positioning.

The AGPS function is turned off by default. To turn on AGPS, do as follows:

1. Run the following commands to pull the **/system/build.prop** file to your local PC.

```
adb root
```

```
adb remount
adb pull /system/build.prop <local_path>
```

2. Add **agps.mode=1** to the end of the build.prop file and save the file.

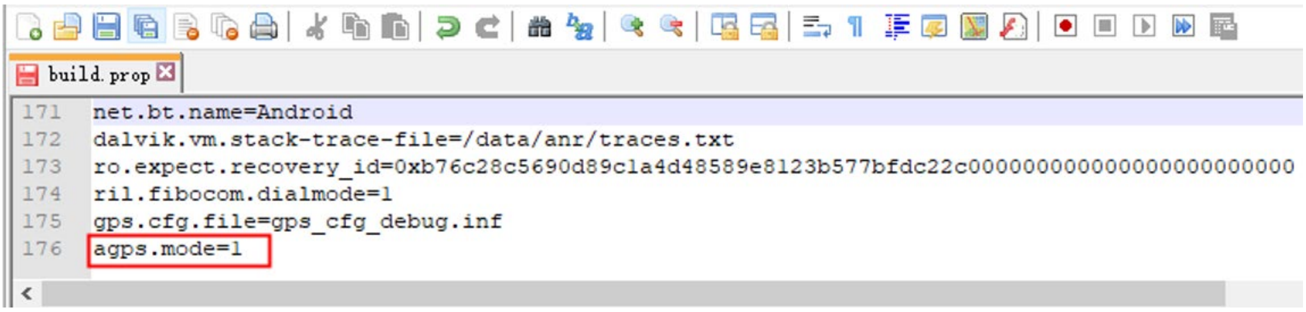


Figure 19. Example of agps.mode

3. Then use the following command to push the updated **build.prop** file to the **/system/** directory:

```
adb push <locat_path_to_build.prop> /system/build.prop
```

4. Run **adb reboot** to restart the device for the configuration to take effect.

6 Acronyms and Abbreviation

Table 9. Acronyms and abbreviation

Term	Full Name
GPS	Global Positioning System
AGPS	Assisted Global Positioning System
GNSS	Global Navigation Satellite System
NMEA	National Marine Electronics Association
Galileo	Galileo satellite navigation system
BeiDou	Beidou Navigation Satellite System
QZSS	Quasi-Zenith Satellite System
NAVIC	Indian Regional Navigation Satellite System (IRNSS)
GLONASS	Global Navigation Satellite System