

# Skywire<sup>®</sup> LTE CAT3 GPS and Assisted GPS (A-GPS) Application Note

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# 1. Introduction

This document covers setting up GPS and Assisted GPS (A-GPS) on the Skywire® LTE CAT3 modem. The reader should be comfortable interfacing with a modem over a serial connection. This guide uses the Skywire Development Kit (NL-SWDK) as the platform for communicating with the modem.

## 1.1. Overview

A-GPS uses the cellular data network to download satellite data required to calculate the modem's position. Normally this data is received directly from the satellites, but this process can take several minutes if the GPS receiver has been powered off for a long period of time or if it has been moved a significant distance while it was powered off. Using the cellular network to receive approximate location data significantly reduces the time to first fix (TTFF) for the modem.

## 1.2. Notation

Throughout this document, commands for the modem will be in **bold** on their own line, as shown below:

**AT**

**OK**

The first line is the command to be issued (**AT**), and the remaining lines are the response sent back by the modem (**OK**). The response from the modem may be longer than one line.

## 1.3. Orderable Parts

Part Number	Description	Manufacturer
NL-SWDK	Skywire Development Kit	NimbeLink
NL-SW-LTE-TSVG	LTE Skywire Modem (LE910)	NimbeLink
MA.301.A.AB.001	Cellular and GPS Antenna	Taoglas

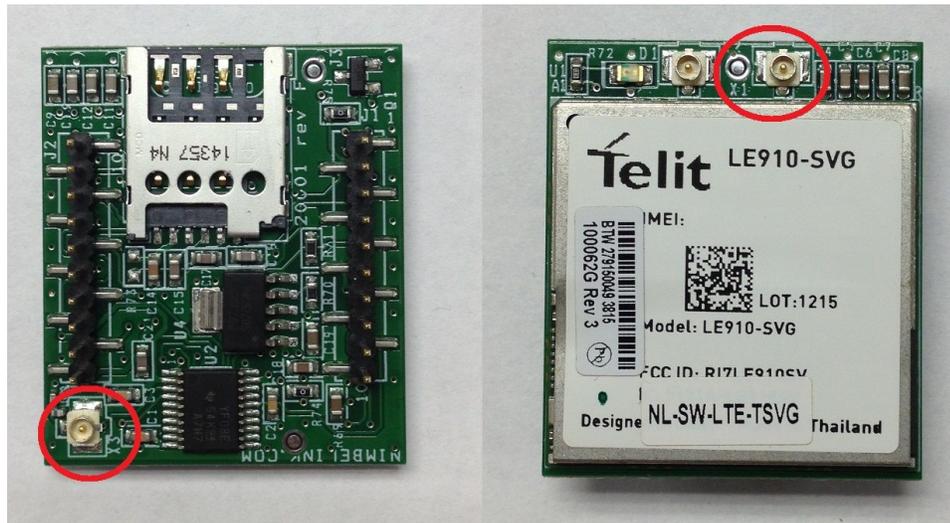
## 1.4. Additional Resources

- [Nimbelink's 4G LTE Cat 3 Skywire™ Product Page](#)
- [Nimbelink's Skywire™ Development Kit Product Page](#)
- [Nimbelink's Skywire™ Development Kit Documentation](#)
- [Telit's LE910 AT Command Set](#)
- NMEA [Message Format](#)

## 2. Hardware Setup

Before sending commands to the modem, make sure the following hardware connections are setup properly. This guide uses the Skywire Development Kit, but this is not required to receive GPS data. Steps 2-5 are specific to the Skywire Development Kit and will be different depending on your hardware setup:

- 2.1. Connect a cellular antenna to U.FL connector X1, and connect a GPS antenna to U.FL connector X3 on the Skywire. The diversity antenna X2 can be left unconnected.



Left: GPS U.FL connector (X3); Right: primary cellular U.FL connector (X1)

- 2.2. Connect power to the Skywire Development Kit
- 2.3. Connect USB connector J14 to your PC. J14 is used to send AT commands to the modem.
- 2.4. Power on the modem by pressing the "ON BTN" for 3+ seconds, Then wait at least 15 seconds before trying to communicate with the modem.
- 2.5. Optional: Connect USB connector J5 to your PC to receive GPS data on a separate communication line (see Section 3, "Option 2").

### 3. Offline GPS Setup

The following sequence of commands is used to set up the GPS receiver to receive location fix data without assistance from a network connection using the NL-SW-LTE-TSVG modem based on the Telit LE910-SVG module.

- 3.1. Send a start location services request for autonomous GPS data:

```
AT$GPSSLR=2,3,,,,,1
```

```
OK
```

- 3.2. Enable unsolicited GPS data from the modem:

```
AT$GPSNMUN=3,1,0,0,0,0,0
```

```
CONNECT
```

The modem should immediately begin sending empty **\$GPGGA** messages until it gets a GPS fix, which can take several minutes:

```
$GPGGA,,,,,0,,,M,,M,,*66
```

```
$GPGGA,,,,,0,,,M,,M,,*66
```

... (may take several minutes) ...

```
$GPGGA,191237.000,4700.8722,N,09327.7253,W,1,05,2.25,254.0,M,,M,,0000*6E
```

```
$GPGGA,191238.000,4700.8755,N,09327.7240,W,1,05,2.25,252.0,M,,M,,0000*65
```

If the modem does not start sending data after several minutes, move your GPS antenna so that it has a clear line of sight to the sky and verify that it is connected properly to the modem.

Once a location fix has been achieved, you can issue **+++** to the modem to stop the unsolicited messages:

```
+++
```

```
OK
```

- 3.3. An alternative to the unsolicited messages is to issue the Get Acquired Position command (**\$GPSACP**). Every time this command is issued, the GPS receiver responds with the current location information:

```
AT$GPSACP
```

```
$GPSACP: 173716.000,4503.2552N,09326.8309W,500.0,-2909.1,2,259.2,4.0,2.1,180316,03
```

```
OK
```

## 4. Assisted GPS (A-GPS) Setup

The following sequence of commands is used to set up and enable A-GPS on the NL-SW-LTE-TSVG modem based on the Telit LE910-SVG module. AGPS can only be used when the modems GPS location services are disabled:

- 4.1. Confirm that the modem has been connected to properly by sending the AT command, and receive the response:

```
AT  
OK
```

- 4.2. Verify the modem operator:

```
AT+COPS?  
+COPS: 0,0,"Verizon Wireless",7  
OK
```

- 4.3. Verify that the PDP contexts are properly configured. In this example, we will be using context 3:

```
AT+CGDCONT?  
+CGDCONT: 1,"IPV4V6","vzwims",,,,,0,0  
+CGDCONT: 2,"IPV4V6","vzwadmin",,,,,0,0  
+CGDCONT: 3,"IPV4V6","vzwinternet",,,,,0,0  
+CGDCONT: 4,"IPV4V6","vzwapp",,,,,0,0  
+CGDCONT: 5,"IPV4V6",,,,,,0,0  
OK
```

If context 3 is not configured properly, it can be set using the following command:

```
AT+CGDCONT=3,"IPV4V6","vzwinternet",,,,,0,0  
OK
```

- 4.4. Configure the modem to use User Plane Secure Transport (SUPL):

```
AT$SUPLSEC=1  
OK
```

4.5. Set the SUPL version to version 2.0:

**AT\$SUPLV=2**

**OK**

4.6. Enable A-GPS in the modem:

**AT\$AGPSEN=1**

**OK**

4.7. Set the GPS Quality of Service parameters. In order, they are <horiz\_accuracy (in meters)>, <vertical\_accuracy (in meters)>, <response\_time (in seconds)>, <age\_of\_location\_info (in seconds)>:

**AT\$GPSQOS=50,50,150,0**

**OK**

4.8. Set the SUPL Location Platform (SLP) address of the server that will provide the A-GPS data.

**AT\$SLP=1,"supl.nokia.com:7275"**

**OK**

The <"supl.nokia.com:7275"> is the server address field should be replaced by the user's SUPL server address and the SUPL servers port number. Many different providers offer SUPL servers for public use over port 7275. Common SUPL servers include:

- "supl.nokia.com"
- "supl.google.com"

4.9. Lock the specified context (context 3 in this case) for LoCation Services (LCS) use only:

**AT\$LCCLK=1,3**

**OK**

4.10. Activate the specific context (context 3) and get an IP address:

**AT#SGACT=3,1**

**#SGACT: 100.124.52.183,38.0.16.4.176.19.248.166.0.0.0.93.117.172.69.1**

**OK**

- 4.11. Start GPS location service request. Sending this command sets \$GPSP=1 which enables the GPS module, preventing further \$GPSSLR commands until \$GPSP is set to 0 (the GPS module is turned off). The parameters in this example are <transport\_protocol (1=SUPL)>, <pos\_mode (0=Pure MS Assisted)>, , , , , <gps\_reporting\_period (in seconds)>

**AT\$GPSSLR=1,0,,,,,2**

**OK**

At this point, there are two options for receiving the A-GPS data. The first option is to receive the data over the UART COM port being used to send commands to the modem (J14 on the Skywire Development Kit). This prevents any subsequent commands from being sent until the data is finished being read. The second option enables unsolicited GPS data on a separate COM port (J5 on the Skywire Development Kit).

- 4.12. Option 1:

Enable unsolicited NMEA GPS data in the format of <NMEA SENTENCE><CR>. In this example, Global Position System Fix Data messages are enabled (which include latitude and longitude readings). Setting the first parameter to "3" allows the modem to send the GPS data over the main UART serial communication port, preventing further commands from being sent:

**AT\$GPSNMUN=3,1,0,0,0,0,0**

**CONNECT**

- 4.13. To return to command mode, send the escape sequence "+++" (the escape sequence will not be echoed to the terminal):

**+++**

**OK**

- 4.14. Option 2:

Enable unsolicited NMEA GPS data in the format of <NMEA SENTENCE><CR>. In this example, Global Position System Fix Data messages are enabled (which include latitude and longitude readings). Setting the first parameter to "2" configures the GPS to send its data over a dedicated COM port which is one of the COM ports instantiated by the USB sub-system:

**AT\$GPSNMUN=2,1,0,0,0,0,0**

**OK**

4.15. Response:

The modem should respond unsolicited with the following messages (repeated every 2 seconds). If "Option 2" is being used, open a separate terminal for the "Telit Serial NMEA Interface" COM port to see the GPS data:

**\$GPGGA,220703.0,4701.387238,N,09327.689237,W,1,00,0.1,300.0,M,-33.0,M,,\*6E**

**\$GPGGA,220705.0,4701.387238,N,09327.689237,W,1,00,0.1,300.0,M,-33.0,M,,\*68**

**\$GPGGA,220707.0,4701.387238,N,09327.689237,W,1,00,0.1,300.0,M,-33.0,M,,\*6A**

**\$GPGGA,220709.0,4701.387238,N,09327.689237,W,1,00,0.1,300.0,M,-33.0,M,,\*64**

**\$GPGGA,220711.0,4701.387238,N,09327.689237,W,1,00,0.1,300.0,M,-33.0,M,,\*6D**

**\$GPGGA,220713.0,4701.387238,N,09327.689237,W,1,00,0.1,300.0,M,-33.0,M,,\*6F**

## 5. Troubleshooting

If you are unable to receive GPS data after following the steps above, try the following steps and commands to verify the modem is properly configured:

- 5.1. Verify that the modem is connected to the network:

**AT+CGREG?**

**+CGREG: 0,1**

A response of "0,1" or "0,5" indicates the modem is connected to the cellular network.

- 5.2. Check the signal quality being received by the modem's antenna:

**AT+CSQ**

**+CSQ: xx,yy**

The values of "xx" and "yy" are as follows:

Values of xx	Relative Signal Strength
0 - 9	Marginal: -113 dBm to -95 dBm
10 - 14	OK: -93 dBm to -85 dBm
15 - 19	Good: -83 dBm to -75 dBm
20 - 30	Excellent: -73 dBm to -53 dBm
31+	Excellent: -51 dBm or greater
99	Not known or detectable

Values of yy	Bit Error Rate
0	Less than 0.2%
1	0.2% to 0.4%
2	0.4% to 0.8%
3	0.8% to 1.6%
4	1.6% to 3.2%
5	3.2% to 6.4%

6	6.4% to 12.8%
7	More than 12.8%
99	Not known or detectable

- 5.3. Check the firmware version on the modem:

**AT+CGMR**

**##.##.###**

This guide uses firmware version 17.01.571, but other versions may work as well. Contact [product.support@nimbelink.com](mailto:product.support@nimbelink.com) to get the latest firmware if you think your firmware may be out of date.

- 5.4. Verify that the modem has an IP address for the PDP context (context 3 in this example):

**AT+CGPADDR=3**

**+CGPADDR: 3,<IPV4\_address>,<IPV6\_address>**

- 5.5. Verify that the GPS module has been turned on by the start GPS service request. After sending the **AT\$GPSSLR** command, send the following command:

**AT\$GPSP?**

**\$GPSP: 1**

**OK**

A response of **\$GPSP: 0** indicates that the GPS module was either not turned on or was shut off after an error was encountered. One common error is **SUPL ERROR,15** which indicates an "error in fix", meaning the GPS is unable to get data on its location. In this case, reposition your GPS antenna and repeat the A-GPS setup.

# 6. Appendix

## 6.1. AT Commands and Acronyms

+COPS:	Operator Selection
+CGDCONT:	Define PDP Context
\$SUPLSEC:	Set the User Plane Secure Transport
\$SUPLV:	Set the version of supported SUPL
\$AGPSSEN:	Assisted GPS enable
\$GPSQOS:	GPS Quality of Service
\$SLP:	Update SLP server address
\$LCSLK:	Lock context for LCS use
#SGACT:	Socket Context Activation
\$GPSNMUN:	Unsolicited NMEA Data Configuration
\$GPSSLSR:	GPS Start Location Service Request
GPGGA:	Global Positioning System Fix Data
GPGLL:	Geographical Position - Latitude/Longitude
GPGSA:	GPS DOP and Active Satellites
NMEA:	National Marine Electronics Association