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## APPLICABILITY TABLE

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1. INTRODUCTION

1.1. Scope
This document provides guidelines for using the Assisted GPS (A-GPS) functionality provided by Telit’s ME910 family of modules. This document also includes information on the Secure User Plane Location (SUPL) standard created by the OMA standardization body.

1.2. Audience
This document is intended for Telit customers, who need to develop applications that use the Location Service (LCS).

1.3. Contact Information, Support
For general contact, technical support services, technical questions and report of documentation errors contact Telit Technical Support at:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
- TS-SRD@telit.com
- TS-ONEEDGE@telit.com

Alternatively, use:
https://www.telit.com/contact-us

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:
https://www.telit.com

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates the user feedback on our information.
1.4. Symbol Conventions

**Danger:** This information MUST be followed or catastrophic equipment failure or personal injury may occur.

**Warning:** Alerts the user on important steps about the module integration.

**Note/Tip:** Provides advice and suggestions that may be useful when integrating the module.

**Electro-static Discharge:** Notifies the user to take proper grounding precautions before handling the product.

*Table 1: Symbol Conventions*

All dates are in ISO 8601 format, that is YYYY-MM-DD.

1.5. Related Documents

- [1] ME910C1 Quick Start Guide, 80529NT11661A
2. BACKGROUND INFORMATION

2.1. GPS - Global Positioning System

The GPS system is based on a constellation of 24 satellites that are evenly spread across six circular orbital planes with a height of around 20200 km. Orbits in this height are referred to as medium earth orbit (MEO).

Each satellite has an atomic clock and follows a known orbit: GPS receivers use the time information regularly transmitted by the satellites and the time elapsed for receiving this signal from each satellite to compute their positions.

Note: The detailed description of the GPS system is beyond the scope of this document.

Figure 1: ECEF Coordinate System
As shown in the above figure, Telit GPS receivers defaults to the geodetic reference (datum) WGS-84, an ECEF (Earth Centered, Earth Fixed) coordinate system that consists in an ellipsoid approximating the total mass of the Earth.

WGS-84 provides a worldwide common grid system that can be translated into local coordinate systems or map datums. Many different reference ellipsoids are used around the world: a specific reference is chosen to minimize the local differences between the geoid and the ellipsoid separation or other mapping distortions. Local map datums are the best fit to the local shape of the earth and are not universally applicable.

2.2. GNSS - Global Navigation Satellite System

In addition to the GPS constellation, other satellite navigation systems are currently in operation or under development. The working principles of these systems are similar to those of the GPS systems described in the previous section.

When the system has global coverage, it is referred to as Global Navigation Satellite System (GNSS).

Galileo (European Union), BeiDou (China), GPS (USA), and GLONASS (Russia) are the GNSSs currently in operation, although Galileo and Beidou are not yet fully operational. Furthermore, additional regional navigation and augmentation systems are under development (QZSS, NAVIC, and so on).

2.3. Time to First Fix (TTFF)

One of the parameters characterizing the performance of a GNSS receiver is the Time to First Fix (TTFF). TTFF indicates the time required for a GNSS device to get and process adequate satellite signals and data to provide accurate positional information (a “fix”).

To provide an accurate position, GNSS receivers use the following data sets:

- Satellite signals
- Timing information (for example, GPS time)
- Almanac data
- Ephemeris data

When a GNSS device is switched off for an extended time, the acquired information can expire and, when it is switched on again, it will take longer to re-acquire these data sets, resulting in a longer “Time to First Fix”. One way to speed up the TTFF is to use the Assisted-GPS (A-GPS) Positioning Technique.
A-GPS is based on the use of a data connection (for example, a cellular network) to provide predicted satellite information from an A-GPS server to the GNSS receiver. With the help of this data, the receiver is usually able to achieve a positional fix faster than using live data only. Although the term “A-GPS” is commonly used, the server-based data can also refer to other constellations (for example, GLONASS predictions).

A “cold” start is when the GNSS receiver must receive all data before starting navigation, which can take several minutes.

A “warm” start is when the GNSS has most of the data it needs in memory and will start quickly, within a minute or less.

A “hot” start is when the receiver has all the data from the satellites (time, almanac, ephemeris) and only needs to calculate the positional solution. The fix is usually acquired in few seconds.

In other words, using A-GPS allows the device to start in a condition similar to “warm” and “hot”, thus shortening the TTFF.
3. GNSS SOLUTION

3.1. Standalone GNSS

Standalone (or autonomous) GNSS mode is a feature that allows the GNSS receiver installed on the cellular module to perform First Fixing without the use of network data. The GNSS receiver estimates position directly from satellites (GPS, GLONASS, and so on) in line of sight.

To set up the GNSS receiver in standalone mode, follow the steps outlined below. Although modern cellular modules integrate a GNSS receiver rather than a GPS receiver, the AT commands still refer to GPS for legacy reasons.

1. To start from a known GNSS setting, switch on/off the module and restore the default GNSS parameters.
   
   AT$GPSRST
   OK

2. Delete the GPS information stored in NVM. It is the history buffer interfacing the GPS receiver to the module.
   
   AT$GPSNVRAM=15,0
   OK

   **Note:** This step is optional and should be performed only if the buffer needs to be cleaned.

3. Verify that no GNSS information is available after history buffer cleaning.
   
   AT$GPSACP
   $GPSACP
   OK

4. Start the GNSS receiver in standalone mode.
   
   AT$GPSP=1
   OK

5. To enable unsolicited messages of GNSS data in NMEA format, refer to [2]. In this example, only RMC sentence is enabled:
   
   AT$GPSNMUN=3,0,0,0,0,1,0
OK

This command enables the GNSS data stream format and reserves the AT interface port for the NMEA stream only.

After a time interval based on the environmental characteristic of the location where the GNSS receiver operates (outside, inside, city, and so on), the continuous streaming of RMC sentences becomes populated.

6. To stop the NMEA stream enter the following escape sequence:

+++

Figure 2: Escape Sequence for Stopping NMEA Stream

7. To enable additional NMEA sentences containing information on other constellations (for example, GLONASS or GALILEO), refer to the following commands described in [2]:

AT$GPSGLO
AT$GPSNMUN
AT$GPSNMUNEX

8. Poll the current location.

AT$GPSACP

$GPSACP:152324.000,4542.8396N,01344.2874E,3.00,310.0,3,000.00,0.00,0.00,200412,05

OK

3.2. A-GPS - Secure User Plane Location (SUPL)

As mentioned in previous sections, Assisted GPS mode is a feature that allows the GNSS receiver to perform its First Fix faster using assistance data, which is usually provided over the cellular network.
The LE910Cx/ME910C1/ML856C1/NE910C1 series supports the following type of A-GPS:

- Secure User Plane Location (SUPL) was proposed by OMA

3.2.1. MS-Based mode

In MS-Based mode, the module requires assistance data to the SLP Server. The A-GPS receiver, installed on the module, receives the signals from the visible satellites and calculates its position using data from the SLP Server.

For the MS-Based mode, an example is provided below. It should be noted that in this configuration an example of SUPL Server is provided; however, it is responsibility of the user to select the appropriate server fitting their needs.

Following are some of the assumptions:

- Module is powered off;
- GNSS antenna is connected and placed in sight of satellites (must be able to receive GNSS signal);
- Cellular antenna is connected;
- SIM card is inserted; and
- APN is already set.

1. To begin, turn on the cellular module.

2. Delete the GNSS information stored in NVM, if required. It is the history buffer between the GNSS device and the module.

   AT$GPSR=0
   AT$GPSNVRAM=15,0

   **Note:** This step is optional and should be performed only if the buffer needs to be cleaned.

3. Verify that no GNSS information is available after history buffer cleaning (command response should be empty and have no location information).

   AT$GPSACP
   $GPSACP

4. Set the SUPL version support to 2.0.

   AT$SUPLV=2
5. Set the location’s Quality of Service (QoS). AT$GPSSAV command can be used to save GPS parameters into NVM.
   
   AT$GPSQOS=50,50,150,0

6. Set the selected SLP address and Port number.
   
   AT$LCSLP=<slp_address_type>,<slp_address>,<port number>
   
   For example:
   
   AT$LCSLP=1,"ExampleSUPLwebsite.com",7276

7. Enable SUPL TLS.
   
   AT$LCSTER=1,,0 // non-secure mode
   AT$LCSTER=1,,1 // secure mode

8. Lock <cid> for SUPL use.
   
   AT$LCSLK=1,<cid>
   
   For example:
   
   AT$LCSLK=1,1

9. Activate the PDP context.
   
   AT#SGACT=1,1 //returns a list of IP addresses for the specified context

10. Start the SET Initiated Session using the MS-Based mode:
    
    AT$GPSSLSR=1,1,,1
    OK

11. Poll the acquired position using the AT$GPSACP command until location information is returned.
    
    AT$GPSACP
    $GPSACP:152324.000,4542.8396N,01344.2874E,3.00,310.0,3,000.00,0.00,0.00,200412,05
    OK
    It must be returned within few seconds (less than ten seconds)
- Full Test Sequence Non-Secure Mode:

```
1 $GPSR=0
2 OK
3 $GPSVREM=15,0
4 OK
5 $SUPLV=2
6 OK
7 $GPSQOS=50,50,150,0
8 OK
9 $LCSSLP=1,"upl.google.com",7276
10 OK
11 $LCSTER=1,,0
12 OK
13 $LCSSLK=1,1
14 OK
15 $GACT=1,1
16 $GACT: 10.88.11.226
17 OK
18 $GPSLSR=1,1,,1
19 OK
20 $GPSACP
21 $GPSACP: ,,1,,
22 OK
23 $GPSACP
24 $GPSACP: ,,1,,
25 OK
26 $GPSACP
27 $GPSACP: ,,1,,
28 OK
29 $GPSACP
30 $GPSACP: ,,1,,
31 OK
32 $GPSACP
33 $GPSACP: ,,1,,
34 OK
35 $GPSACP
36 OK
37 $GPSACP
38 $GPSACP
39 $GPSACP: 091381.0000,3913.6931N,00908.1553E,1.6,18.2,3,0.0,0.0,0.0,221119.08
```

Figure 3: Full Test Sequence Non-Secure Mode
- **Full Test Sequence Secure Mode:**

Figure 4: Full Test Sequence Secure Mode

```plaintext
1 AT$GFSR=0
2 OK
3 AT$GFSVSTM=15,0
4 OK
5 AT$SUPLV=2
6 OK
7 AT$GFSQOS=50,50,150,0
8 OK
9 AT$LCSLP="supl.google.com",7275
10 OK
11 AT$LCSTER=1,,1
12 OK
13 AT$LCSLS=1,1
14 OK
15 AT$SGACT=1,1
16 SGACT: 10.08.11.226
17 OK
18 AT$GFSLSR=1,1,,1
19 OK
20 AT$GFSACP
21 $GFSACP: ,,1,,1,,
22 OK
23 AT$GFSACP
24 $GFSACP: ,,1,,1,,
25 OK
26 AT$GFSACP
27 $GFSACP: ,,1,,1,,
28 OK
29 AT$GFSACP
30 $GFSACP: ,,1,,1,,
31 OK
32 AT$GFSACP
33 $GFSACP: ,,1,,1,,
34 OK
35 AT$GFSACP
36 $GFSACP: 091751.008,3913.6942N,00904.1525E,1.4,18.2,3,0.0,0.0,0.0,0.0,221119,08
37 OK
38 AT$GFSACP
39 $GFSACP: 091751.008,3913.6942N,00904.1525E,1.4,18.2,3,0.0,0.0,0.0,0.0,221119,08
```
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4.3. Safety Recommendations

Make sure the use of this product is allowed in your country and in the environment required. The use of this product may be dangerous and has to be avoided in areas where:

- it can interfere with other electronic devices, particularly in environments such as hospitals, airports, aircrafts, etc.
- there is a risk of explosion such as gasoline stations, oil refineries, etc. It is the responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conformed to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible for the functioning of the final product. Therefore, the external components of the module, as well as any project or installation issue, have to be handled with care. Any interference may cause the risk of disturbing the GSM network or external devices or having an impact on the security system. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed carefully in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The equipment is intended to be installed in a restricted area location.

The equipment must be supplied by an external specific limited power source in compliance with the standard EN 62368-1:2014.

The European Community provides some Directives for the electronic equipment introduced on the market. All of the relevant information is available on the European Community website:

https://ec.europa.eu/growth/sectors/electrical-engineering_en
## 5. GLOSSARY

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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<td>3GPP</td>
<td>Third Generation Partnership Project</td>
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<tr>
<td>A-GPS</td>
<td>Assisted-Global Positioning System</td>
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<tr>
<td>C-Plane</td>
<td>Network Control Plane Network</td>
</tr>
<tr>
<td>DTE</td>
<td>Data Terminal Equipment</td>
</tr>
<tr>
<td>ECEF</td>
<td>Earth-Centered Earth-Fixed</td>
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<tr>
<td>GMLC</td>
<td>Gateway Mobile Location Center</td>
</tr>
<tr>
<td>GNSS</td>
<td>Global Navigation Satellite System</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>LCS</td>
<td>LoCation Service</td>
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<td>Mobile Originated-Location Request</td>
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<td>Mobile Station</td>
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<td>MT-LR</td>
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<td>NMEA</td>
<td>National Marine Electronics Association</td>
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<td>NVM</td>
<td>Non-Volatile Memory</td>
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<td>OMA</td>
<td>Open Mobile Alliance</td>
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<td>PDP</td>
<td>Packet Data Protocol</td>
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<td>SET</td>
<td>SUPL Enable Terminal</td>
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<td>S-GNSS</td>
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<td>SUPL Location Platform</td>
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<td>Serving Mobile Location Center</td>
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<td>Short Message Service</td>
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<td>SSL</td>
<td>Secure Socket Layer</td>
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<td>SUPL</td>
<td>Secure User Plane Location</td>
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<td>TTFF</td>
<td>Time to First Fix</td>
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<td>UART</td>
<td>Universal Asynchronous Receiver Transmitter</td>
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<td>URC</td>
<td>Unsolicited Result Code</td>
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<td>WCDMA</td>
<td>Wideband Code Division Multiple Access</td>
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## 6. DOCUMENT HISTORY

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From Mod.0809 rev.3
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