CelloTrack Solar / LV500 Overview

Cellocator by PowerFleet®

Proprietary and Confidential

Version 1.1

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The FCC Wants You to Know

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

a) Reorient or relocate the receiving antenna.

b) Increase the separation between the equipment and receiver.

c) Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.

d) Consult the dealer or an experienced radio/TV technician

This device complies with FCC Rules Part 15:

Operation is subject to two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference that may be received or that may cause undesired operation.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to two conditions:
(1) This device may not cause harmful interference, and (2) this device must accept any interference that may be received or that may cause undesired operation.

Le present appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisee aux deux conditions suivantes :(1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioelectrique subi, meme si le brouillage est susceptible d'en compromettre le fonctionnement.

Warning

Modifications not expressly approved by the manufacturer could void the user authority to operate the equipment under FCC Rules.

A distance of at least 20 cm. between the equipment and all persons should be maintained during the operation of the equipment.
Une distance d'au moins 20 cm. entre l'équipement et toutes les personnes devraient être maintenues pendant le fonctionnement de l'équipement

Table of Contents

1 Introduction

1.1 About this Document

This document provides a brief overview of the CelloTrack Solar / LV500 and its accessories. It includes descriptions of the CelloTrack variants, CelloTrack special features and modes of operation, battery life tables and technical specifications.

This document describes the high-level system features and capabilities of the CelloTrack Solar. For further details about MultiSense devices, the other main component of the CelloTrack Solar solution, refer to the *MultiSense Product Overview*.

NOTE: The LV500 is a brand product identical to the CelloTrack Solar. Thus, referring to or mentioning the CelloTrack Solar, includes also the LV500 as well, unless specifically explained.

1.2 Abbreviations

Abbreviation	Description
FB	Front Button
GSM	Global System for Mobile communications
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
OTA	Over the Air
SMS	Short Message Service (GSM)
IP	International Protection Rating
AH	Amper Hour
3D	3 Dimensions
LED	Light Emitted Diode
APS	Automatic Power Save (modem feature)
GPIO	General Purpose Input / Output

1.3 References

#	Reference	Description
1	CelloTrack Solar Brochure	
2	Cellocator Wireless Communication Protocol	
3	Cellocator Cello Programming Manual	
4	Cellocator Serial Communication Protocol	

1.4 Revision History

Version	Date	Description
1.0	September 10, 2019	Initial release
1.1	August 10, 2019	Adding the LV500 Brand: Note in section 1.1 Section 1.5

1.5 LV500 versus CelloTrack Solar

The LV500 is a brand product identical to the CelloTrack Solar. Thus, referring to or mentioning the CelloTrack Solar, includes also the LV500 as well, unless specifically explained.

2 The CelloTrack Solar Overview

2.1 Overview

Cellocator's CelloTrack Solar is designed for advanced asset tracking and asset management applications, and provides enhanced functionality, ease of installation and support for a wide range of applications: target applications include inventory management throughout short/mid-term Track & Trace, shipment and distribution management, security (anti-theft), protection (anti-vandal, break-in detection) and more.

The capabilities provided by the CelloTrack Solar can greatly reduce an enterprise's financial losses incurred as a result of the often-difficult task of successfully tracking and remotely managing the location, usage profile and security aspects of unpowered but mobile transportation equipment. This equipment includes trailers, containers, train wagons or any kind of valuable mobile asset such as electricity generators, heavy machinery, chemical toilets and waste containers.

The CelloTrack LTE unit can interface via a short-range RF link to multiple MultiSense devices, which acts as a Wireless Sensors Network (WSN). Read more about MultiSense devices in the *MultiSense and MultiSense-TH* section.

The unit also provides a durable and long-life solution that supports up to 10 years of continuous operation (single GNSS readings and Cellular transmissions per day).

The unit supports the required 4G network standards for NA and supports all the major service providers and their affiliates, such as AT&T, T-Mobile, Telus and Rogers. It supports also the EU networks.

Based on Cello and CelloTrack technologies, the CelloTrack Solar supports similar tracking, communication, GNSS location-based features and maintenance capabilities as per those available in the Cello and CelloTrack families.

2.2 Highlights

CelloTrack Solar main features include:

- Stand-alone tracking device; it can be installed and operated for long periods without a power supply.
- Houses all components in the same enclosure, including primary battery, solar based power system, GNSS positioning engine, cellular modem and antennas.
- Highly rugged durable enclosure, fit to container ribs and ceiling, and comply with IP67 and IP69k weatherproof casing for outdoor long-life service.
- Long operation time (up to 10 years @ 1 transmission / day) via 34 Ah primary battery and solar based power system.
- Purpose-built for minimum idle current consumption during hibernation.
- Supports NA and EU 4G LTE networks with user equipment category CAT 1.
- Scalable cellular communication technology; it can support any cellular network supported by the chosen modem family.
- SiRFstarV™ based GPS and GLONSS positioning engine for reduced acquisition time and better accuracy.
- Supports a Wireless Sensor Network and up to 16 MultiSense devices.
- A 3D accelerometer that detects crashes (accidents), movement and vibrations of assets and enables different transmission policy for a moving asset and a standing asset.

- A programmable (on/off/test/panic) magnetic button.
- Two monitoring LEDs for communication and system status indication.
- an internal USB connector for programming and maintenance (RMA and debugging)
- Easy (single step) mounting using four screws.
- Magnetic tampering detection
- Operating temperature range: -30°C to 75°C.
- Environment requirements (shock, temperature, humidity, UV, chemical, salt, etc.) compliance.
- Supports up to 9000 time-stamped events.
- Supports a variety of reporting transmission profiles to meet required transmissions and power budget.
- Supports OTA FW upgrade (FOTA).
- Designed for operation with minimal maintenance.

3 The CelloTrack Solar Description

3.1 CelloTrack Solar Interfaces

3.1.1 *CelloTrack Solar Connector*

The CelloTrack utilized internal USB connector for maintenance, code upgrade and configuration update.

3.1.2 *CelloTrack Magnetic Button and LEDs*

- The Magnetic Button allows activation/de-activation and battery status check.
- The SYS LED is a dual color (Green and Red) LED, which indicates unit activation/de-activation, panic, and battery status.
- The COMM LED is a dual color (Green and Red) LED, which indicates the unit's cellular communication and position status.

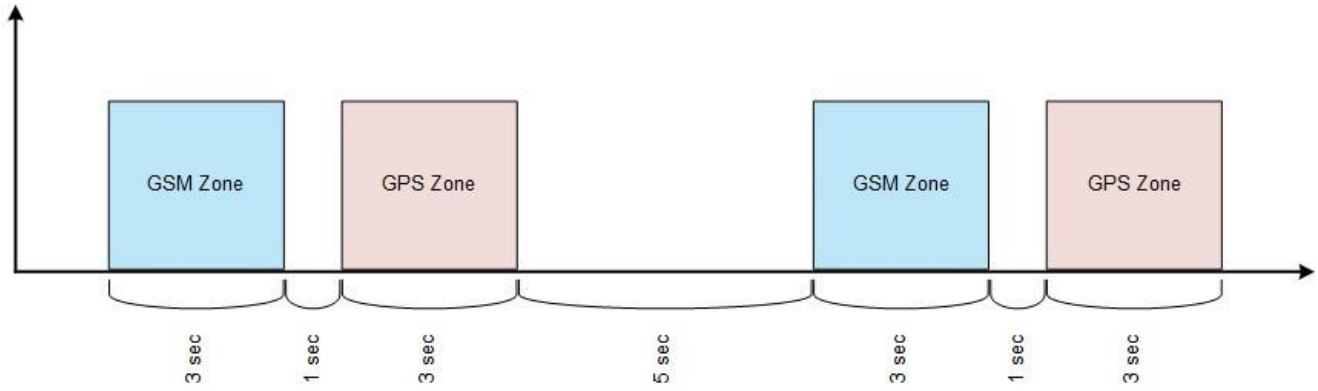
The Magnetic Button and SYS LED behavior are explained in the User Features section below.

3.1.3 *COMM Led Overview*

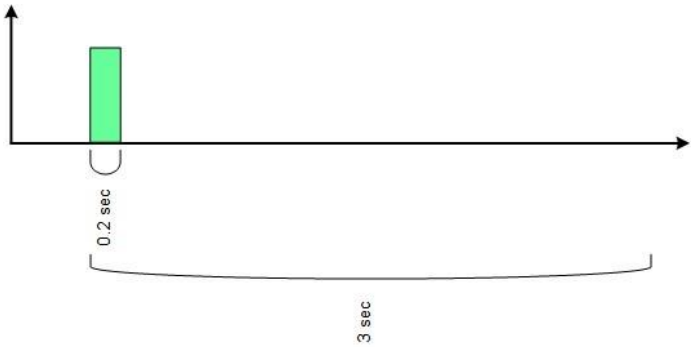
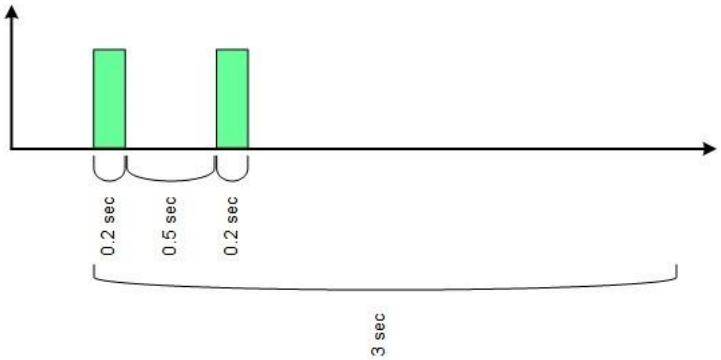
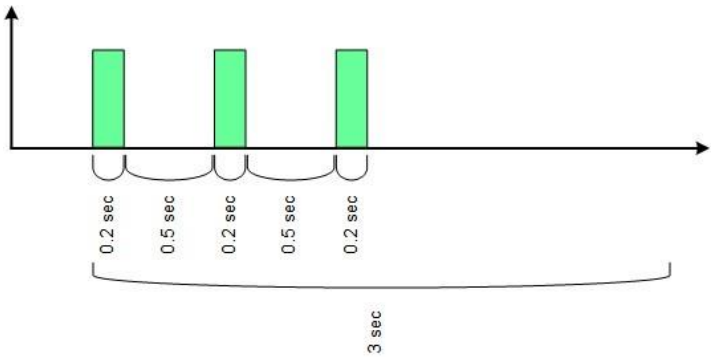
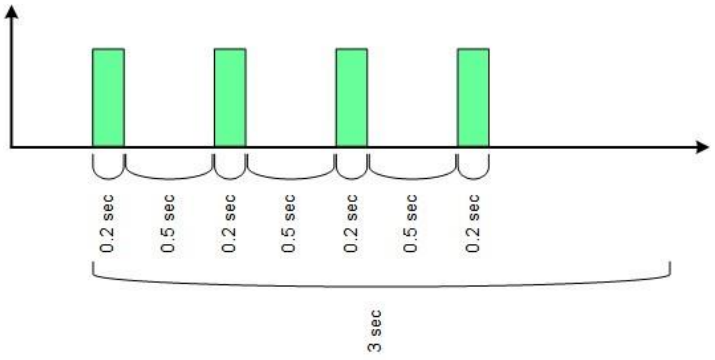
The COMM LED is used to indicate unit cellular communication and position with a green light.

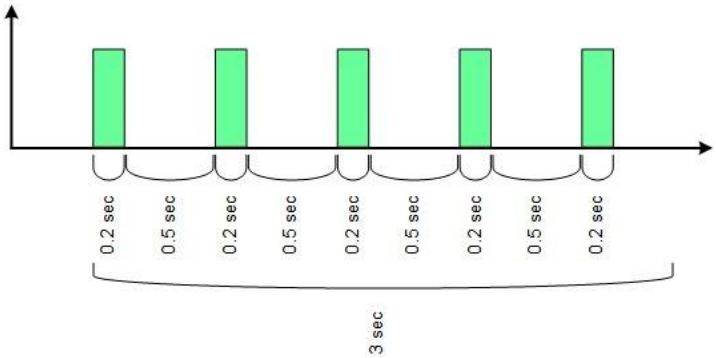
The blinking pattern is constructed from cycles of 2 blinking zones each, which will be repeated by the unit continually. The first zone represents the functionality of cellular communication (GSM), the second zone – the GNSS status.

Each zone lasts 3 seconds with 1 second of LED off interval between them. 5 seconds LED off interval separates between each cycle.

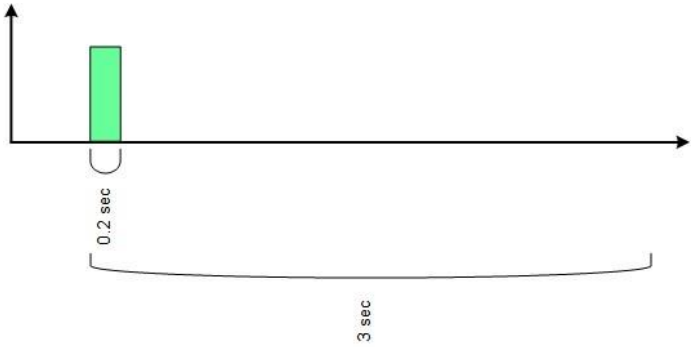
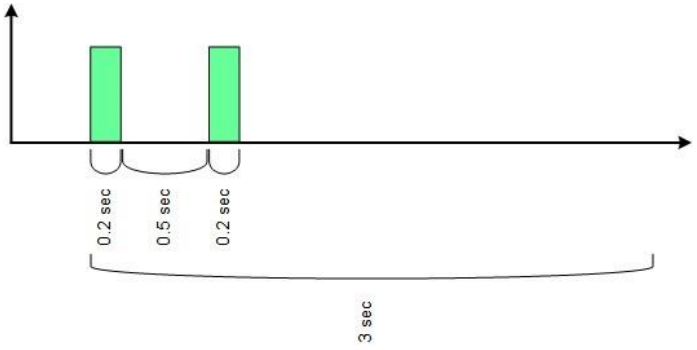
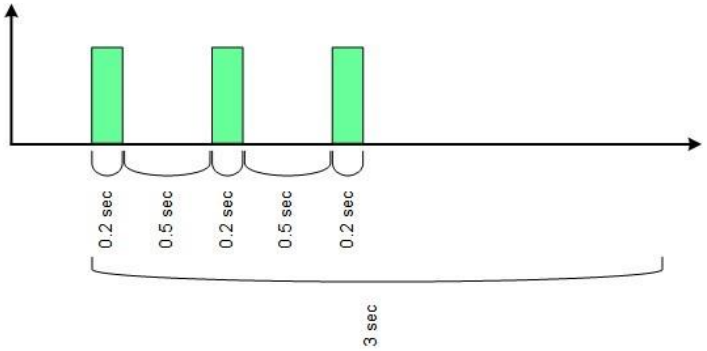


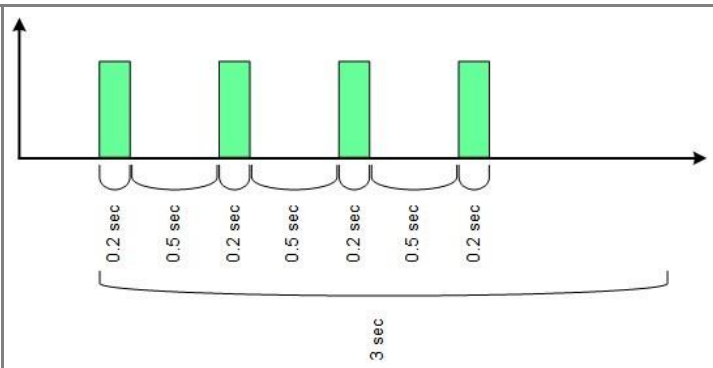
3.1.4 *Cellular Network Monitoring Zone*

Status	Blinking pattern
GSM Off	Off
Not registered to GSM/No SIM	
Registered in Home GSM network (not attached to GPRS)	
Registered in Roaming GSM network (not attached to GPRS)	
Attached to GPRS/home	

Status	Blinking pattern
Attached to GPRS/roaming	

3.1.5 *GNSS Monitoring Zone*

Status	Blinking pattern
GNSS Off	Off
GNSS is unplugged/faulty	
GNSS communicating, but not navigating	
GNSS is in navigation mode	

GNSS is in GYRO mode (only for compatible models)	

Note: To save energy, the COMM LED performs only 10 indications cycles (total time 120 seconds) upon unit activation and/or upon unit reset, and is then shut off.

3.2 User Features

3.2.1 *Activation*

When the unit is not active, upon pressing the front button for 5 seconds (long press), the unit is activated. The SYS LED lights for 5 seconds in Green, to indicate that the unit is active. The COMM LED performs 10 GSM/GPS indication cycles, and then is shut off.

Note that after battery replacement, the unit is automatically activated, i.e. with no need of activation by button as described above. After automatic activation, the SYS LED behaves as described above.

NOTE: Consecutive presses are ignored, if started before the SYS LED indication of the previous press/sequence ended.

3.2.2 *De-Activation*

When the unit is active, upon pressing the front button for 5 seconds (long press), the unit is de-activated. The SYS LED shall light for 5 seconds in Red, to indicate that the unit is not active. For enabled logged or distress events, the de-activation is postponed until the events are transmitted (or until Modem Max On Time expiration). In the postponed time, the SYS LED blinks (200msec on every 1 second) in Red.

NOTE: Consecutive presses are ignored, if started before the SYS LED indication of the previous press/sequence ended.

3.2.3 *Panic/Distress*

When the unit is active, upon pressing the front button for a period of between 0 and 5 seconds (short press), a panic/distress press is recognized. The SYS LED then reflects the battery SOH (State of Health):

- If the SOH is above the preprogrammed minimum - the SYS LED lights for 2 seconds in Green.
- If the SOH is below (or equal to) the preprogrammed minimum - the SYS LED lights for 2 seconds in Red.

NOTE: Consecutive presses are ignored, if started before the SYS LED indication of the previous press/sequence ended.

3.2.4 *Battery Status Manual Check*

A maintenance operator can manually check the battery status.

When the unit is active, the maintenance operator can perform a panic/distress event by pressing the front button for a period of between 0 and 5 seconds (short press). The SYS LED then reflects the battery SOH (State of Health):

- If the SOH is above the preprogrammed minimum - the SYS LED lights for 2 seconds in Green.
- If the SOH is below (or equal to) the preprogrammed minimum - the SYS LED lights for 2 seconds in Red.

3.3 BLE Functionality

The method of communication between the CelloTrack and MultiSense devices is *BLE* (Bluetooth Low Energy) *2.4 GHz short range low energy wireless communication*. This method of communication is intended to provide considerably reduced power consumption, footprint and cost, with these three parameters the most important values within the IoT world.

NOTE: BT SIG certification is currently in the product evolution process.

Using *BLE*, the CelloTrack can communicate with up to 16 MultiSense devices in a *Master* and *Slave* type setup. However, in order to function correctly as a WSN, the CelloTrack unit and MultiSense devices must be paired, as described on page 16.

Using CelloTrack and paired MultiSense devices as a local WSN enables you to leverage an environment, within which you can sense where different measurements are expected such as inside cooled cargo boxes, or in a long trailer where the environmental conditions inside the trailer may be different from those closer to the door.

Another form of communication between the CelloTrack and MultiSense devices is via *transparent* (guest) mode. In this mode, no pairing process is required and thus the CelloTrack unit does not manage or save MultiSense device data or thresholds. As a result, in transparent mode the CelloTrack unit can be used as a gateway to unlimited MultiSense devices.

In situations where only MultiSense MAC addresses are required, Tag mode (similar to iBeacon mode) can be activated.

For further information about the configurable BLE parameters, refer to the *Programming Manual*.

3.4 MultiSense and MultiSense-TH

The MultiSense is a remote peripheral sensor, communicating and configured by the CelloTrack unit via a short-range RF link.

There are 2 models of MultiSense: regular devices that can measure temperature called "MultiSense", and "MultiSense-TH" devices which have a combined temperature and humidity sensor.

The MultiSense device has the following sensors:

- Temperature sensor
- Humidity sensor (only in the MultiSense-TH model)
- Hall effect magnetic sensor
- Ambient Light Sensor (ALS)
- Accelerometer sensor

The CelloTrack unit supports up to 16 fully programmable MultiSense devices.

If "Guest mode" is enabled (via the *Guest and Tag MultiSense reporting* parameter), the unit will also connect with MultiSense units not in its list, read their sensors and pass the data (in raw format) to the server. Only listed MultiSense units also get configuration blocks and their readings are fully processed by the CelloTrack unit.

If "Tag mode" is enabled, the CelloTrack unit will only report on existence (reception of advertisements) of unpaired MultiSense units, not reading their sensors.

MultiSense devices can be paired with the unit by entering the MultiSense MAC address, which is written on the MultiSense, in the MultiSense Editor window accessed via the Cellocator Programmer.

3.5 CelloTrack Feature List

The following list details the features and capabilities of the CelloTrack family. These features are actually a combination of the Fleet management capabilities derived from Cellocator's Cello product line and specific asset management capabilities designed solely for the CelloTrack family.

- Geo-Fences *(100)*
- Way Points
- Roaming List *(100)*

- Usage counters (PTO)
- Server authentication
- Automatic SIM PIN lock
- DNS support
- Virtual odometer
- Road curve smoothing
- Offline Tracking
- Wake up event
- Movement detection
- Crash detection
- Time based events (adaptive to movement status)
- Specific time (in day) reporting
- Distance based events
- Velocity Adaptive message rate
- Home/Roam adaptive message rate
- Distress reporting mode (higher priority)
- Over speeding alerts
- Go/Halt reports
- Internal excessive temp
- A/D threshold events
- Frequency threshold events
- GNSS status events
- Watchdog
- Battery level reporting
- Network dependent traffic Opt
- Cellocator+ (Maintenance) server support
- OTA/Serial Firmware upgrade
- OTA/Serial configuration update
- Nested Output activation
- Gradual Output activation
- Programmed Output activation

NOTE: Cell-ID and jamming detection are not supported due to modem limitations.

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4 CelloTrack Operational States

The CelloTrack unit operates in one of the following three operational states:

- Not Activated State (for storage and battery conservation)
- Hibernation State
- Tracking State (fully operational)

Each operational state is comprised of a number of operational modes.

There is an additional BOD/EOD Tracking Mode that the CelloTrack unit can be programmed to support.

4.1 Not Activated State

The *Not Activated* operational state enables storage of a fully assembled unit (including battery connection and SIM card insertion) but prevents unnecessary battery drainage and self-discharging. This state is designed for maximum battery conservation and can prove especially useful, for example, when transporting multiple pre-installed units to an installation plant.

When the CelloTrack unit is in the *Not Activated* state, it remains in sleep mode most of the time. Once per second, however, it exits sleep mode, checks for an activation attempt by checking whether the front button and/or temper switch is depressed, and returns to sleep (assuming the main button is not depressed).

In this state, the unit does not respond to input triggers, nor does it perform or react to Motion Detection, and the unit's GNSS and GSM modules remain unpowered.

Entering this state: Upon Deactivation Procedure

Leaving this state: Upon Activation Procedure

4.2 Hibernation State

When the CelloTrack unit is in the *Hibernation* state, it remains in sleep mode most of the time and awakens once per second to check for inputs, button state changes, and motion. Typically, the *Hibernation* state is used for asset or cargo tracking, when maximum battery life is the primary consideration and infrequent updates are sufficient.

In addition to checking inputs, button state changes, and motion once per second, the CelloTrack unit awakens periodically, powers up all its modules, communicates with the server, and transmits a unit location update. This is known as *glancing* (see the following section).

The *Hibernation* state employs a number of modes and functionalities, as shown in the following table.

Mode	Description
Sleep	For battery conservation.
Sensor checking	Once per second.
Glancing	Occurs periodically or at a specific time of day; refer to the following Glancing section.
Offline tracking data upload session	If offline tracking is enabled, the unit transmits all messages collected during the trip at the end of the trip (and after a preprogrammed time has elapsed). Refer to the Offline Tracking section.

Mode	Description
Maintenance server sessions	The unit periodically connects to a maintenance server for firmware and configuration upgrades. Typically this is done once per day.
Not live tracking	The unit never enters the *Tracking* state, but does, however, send start and stop messages when movement is detected or ends. Refer to the Live Tracking section.

During *Hibernation*, GPRS messages are not received by the unit and not stored in the cellular network – thus they are lost. However, SMS messages that are sent by the system are received by the unit during glancing.

4.2.1 *Glancing*

The periodical wake up and location update process is known as *glancing.* During *glancing*, the unit is fully operational, the GSM and GNSS modules are powered up (when the GNSS is powered the navigation SYS LED blinks every 2 seconds), and the RS232 port is operational.

By default, *glancing* occurs according to a configurable time period. Alternatively, you can configure *glancing* to occur at a specified time of the day (see the Specific Time Glancing section) or enable both modes. If both modes are enabled they are maintained in parallel and independently.

The *glancing* frequency depends on the following two periods (for more information, refer to the *CelloTrack Programming Manual*):

- The glancing duration (programmable).
- The sleep period between location updates – this is dependent on whether the unit is in motion.

This combination is known as *adaptive glancing frequency*.

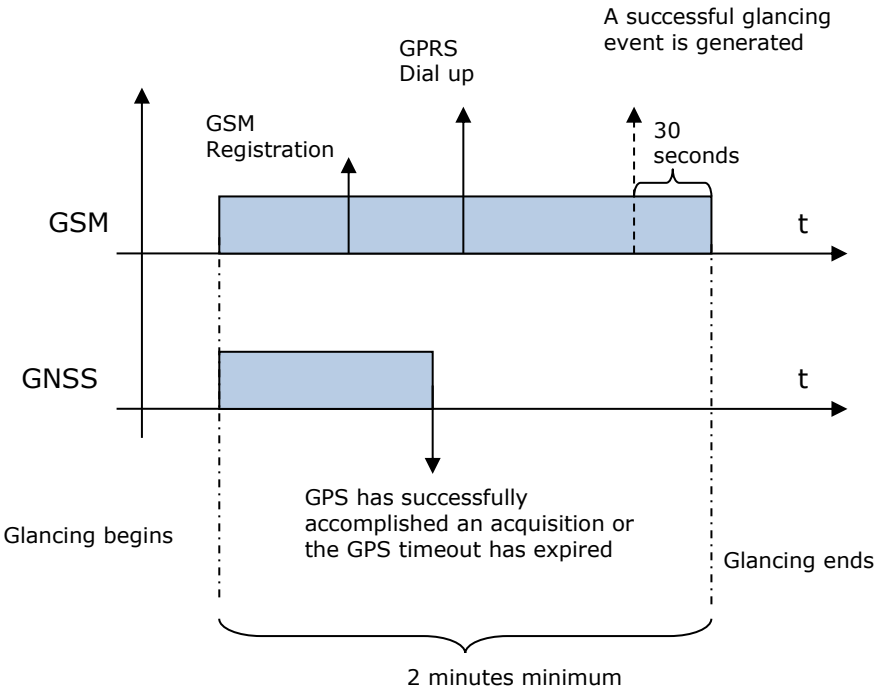
The GNSS module remains active until a successful GNSS acquisition occurs or until the dedicated GNSS timeout expires.

The GSM module is activated for a pre-programmed time. When this ends, the next *glancing* cycle begins. Thus it is the GSM duration which actually defines the duration of the *glancing* cycle.

Typically, the GSM duration must be no shorter than two minutes in order to accomplish GSM registration, GPRS dial up, and reception of SMS commands sent from the back end application during *Hibernation*.

30 seconds before the end of *glancing*, the unit sends an update message and the GNSS data. If GNSS acquisition fails during the current *glancing* session, the last known GNSS data is sent. This message can either be sent as a regular event and/or configured as a distress session.

The following figure shows the stages of *glancing*.



The current consumption in *glancing* depends on the distance to the GSM communication base and communication network conditions.

If there is a GSM registration fault, the modem is switched off before the programmed time in order to conserve power. The *glancing* event messages that were not transmitted are stored in the unit's message queue for the next *glancing* session (if storing to memory is enabled).

4.2.2 *Specific Time Glancing*

Glancing can be configured to occur at a specific time of the day to enable the reception of status updates from all the units of the fleet concurrently. To prevent communication server overload due to multiple simultaneous transmissions, a randomization algorithm is implemented: when the appointed time arrives, each unit calculates a random time offset and transmits its update. The result is that all the transmissions are grouped around the specified time, some before, some after.

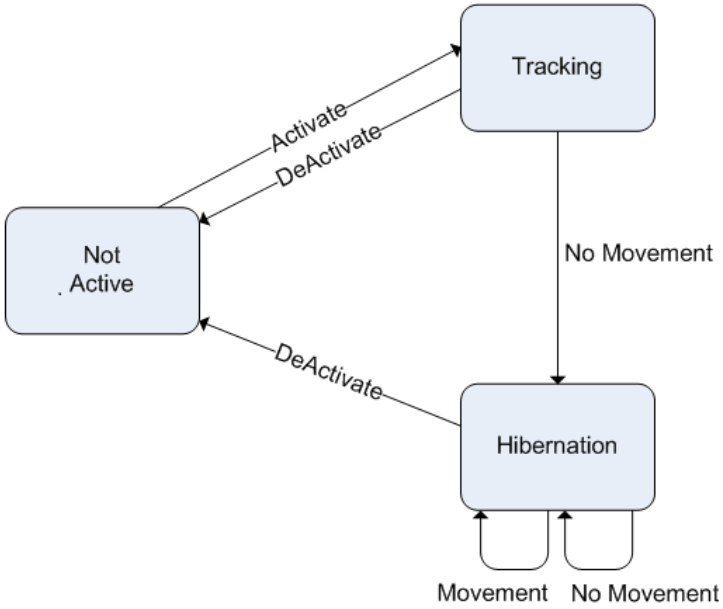
NOTE: *Specific Time Glancing* can only be enabled if the GNSS has acquired a valid fix (location and time) at least once in the past.

If the unit is not in the *Hibernation* state when the specified time occurs (for example, it is in the *Tracking* state), the *glancing* message is still transmitted.

4.2.3 *Not Live Tracking*

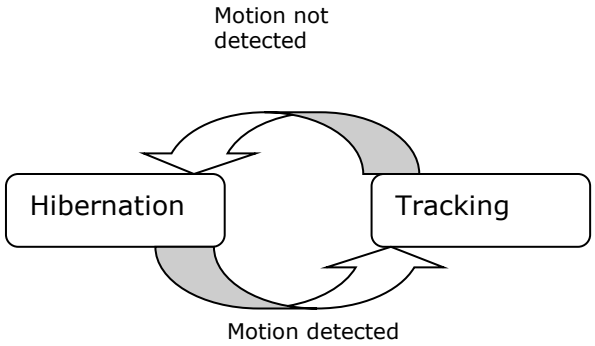
In *Not Live Tracking* the unit does not enter the *Tracking* state; however, it sends start and stop messages when motion is detected or ends.

If both *Not Live Tracking* and *Motion Detection* are enabled, and the unit is in the *Hibernation* state, then when motion is detected the unit immediately opens a distress session, sends a "start motion" message, and returns to *Hibernation*. When no further motion is detected, the unit opens a distress session, sends a "stop motion" message, and returns to *Hibernation*. This is known as *start-stop reporting* during *Hibernation*.



4.3 Tracking State

By default, the unit is configured to enter the *Tracking* state when motion is detected and to exit *Tracking* when motion ends. This is done to conserve battery power.



In the *Tracking* state the unit does the following:

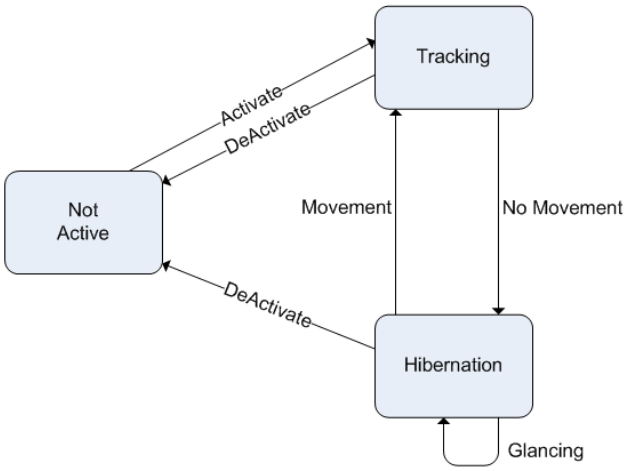
- Powers up its GNSS module.
- Powers up its GSM module.
- Sends regular location updates to the server.
- Provides full CelloTrack functionality, including: periodical and distance events, geo-fence related events, speed related events, and maintenance events.
- Activates its interfaces.

In the *Tracking* state, the unit provides the best tracking and communication features, generates time/location updates (known as time events), and behaves as a standard fleet management oriented unit. This is the most energy-intensive state.

You can configure the unit to work in one of the following tracking modes, and which are described in the following sections:

- **Live Tracking**
- **Tracking with GNSS Peeking**
- **Offline Tracking**
- **Improved (Take Location) Tracking Mode**
- **BOD/EOD Tracking Mode**

4.3.1 *Live Tracking*



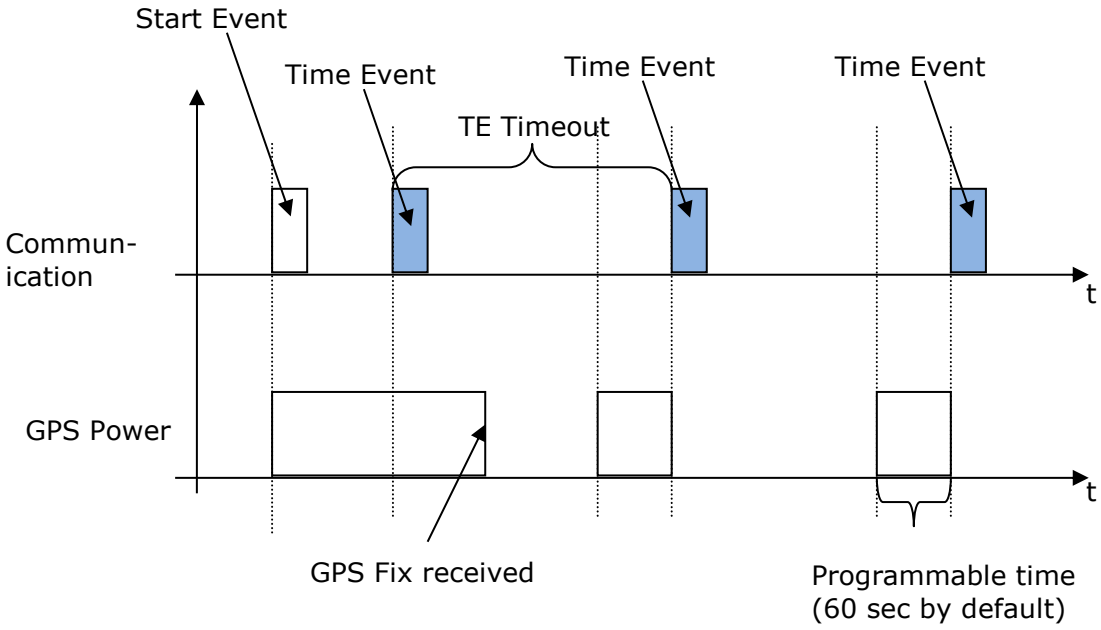
The unit is fully active and sends periodic updates to the server. This is not the default tracking mode.

4.3.2 *Tracking with GNSS Peeking*

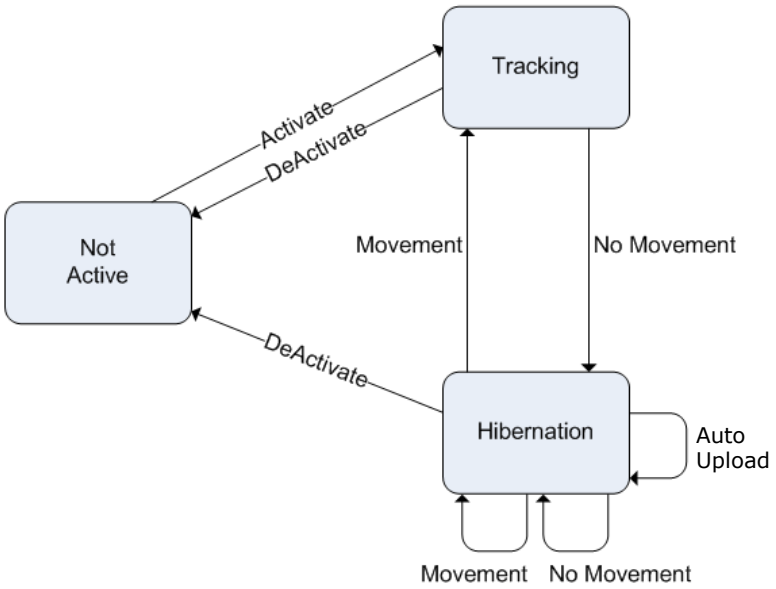
This tracking mode is similar to live tracking but uses less battery power: the GNSS module operates in peeks just before each time event (instead of permanent activation) and only if:

- Time events are enabled and the time event interval is longer than 90 seconds.
- One valid GNSS fix has already been set.

The GNSS module is switched off immediately after the time event message is generated.



4.3.3 *Offline Tracking*



In this tracking mode the unit collects all updates during a trip and sends them all together at the end of the trip (the GNSS remains active). When motion is detected and offline tracking has been enabled, the unit powers up its modem and sends a *start motion* update. The unit then powers down its modem (the modem is a major current consumer) and generates and saves status updates until the end of motion is detected (end of trip). It then powers up its modem again and sends all the interim messages to the server in a single transmission.

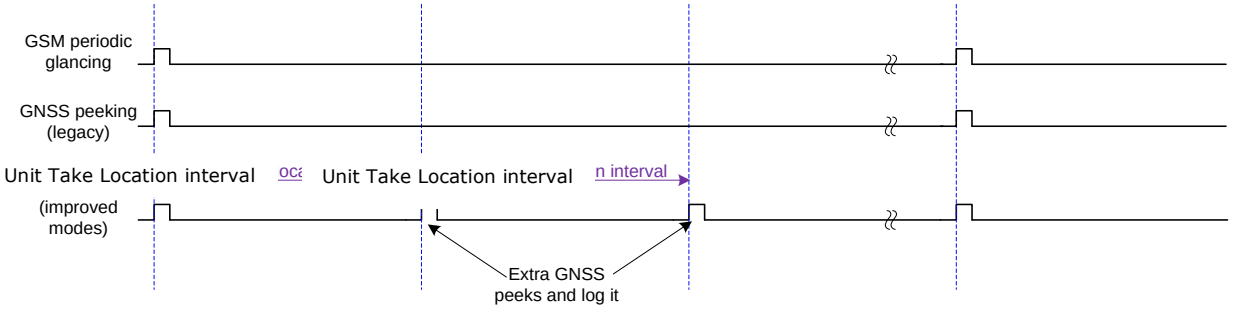
This transmission session is known as *Offline tracking data upload* session which is one of the *Hibernation* state modes as explained in the Hibernation State section.

4.3.4 *Improved (Take Location) Tracking Mode*

This mode is based on the not-live-tracking mode and allows the unit to add and log extra locations between transmissions. Since the entire system is hibernating most of the time, the battery life is prolonged.

In this mode, the unit behaves as follows:

- Checks power lines, button state changes, motion and MultiSenses (if programmed to) once per second and logs them efficiently. Looks for distress (critical) events (such as tamper, sensor reading crossed some predefined critical threshold) to report them immediately.
- Takes GNSS locations extra configurable times a day and logs them internally as Type-0 and/or Type-11 with the same message but encapsulated.
- GNSS and cellular modems are also activated upon distress event occurrences to immediately report the position of the event. A transmission is sent even if the GNSS has not got a fix after the timeout. If no fix is reached the Cell-ID transmission logic is used.
- The GNSS module is shut down, disregarding any applicative constraints to preserve energy.
- Turns on the cellular modem, at configurable times, and transmits the logged messages, including the logged positions, measurements and events, to the server.
- For all cellular transmissions, the entire log memory is transferred/uploaded, and then cleared upon an ACK from the server.
- At all other times, the unit is sleeping (hibernating).



4.3.5 *BOD/EOD Tracking Mode*

The CelloTrack unit can be programmed to support the **BOD (Beginning of Day)/EOD (End of Day) Tracking** mode.

This mode enables reporting on the leaving of the pick-up location (BOD) and arriving to the destination location (EOD), supporting a minimal number of transmissions.

To support this mode, the unit maintains the BOD (BOD was recognized) /EOD (EOD was recognized) states; the last EOD location is also kept.

The unit uses the accelerometer for movement detection. The unit can be programmed to communicate periodically with the MultiSense devices and log the sensor states.

The reporting policy of the BOD/EOD Tracking Mode is as follows:

- Upon movement detection (short time) – start event is logged.

- If the movement continues for more than the programmed time and the distance from the latest known EOD location is larger than the programmed value – the BOD is detected. The unit transmits a BOD message as well as all logged messages.
- During the trips, short stops generate stop and start events which are logged.
- When movement is stopped for more than the programmed time - EOD is detected. The unit transmits an EOD message as well as all logged messages and keeps the EOD (destination) location for the next BOD detection.
- The unit can be programmed to take locations and log the messages periodically according to a programmable time on each trip (BOD state).

The unit also supports the entering and exiting Theft Mode (Periodic Glancing), which can be activated by OTA command.

On Periodic Glancing the unit performs full glancing (GPS, Modem) according to the period defined in the OTA command.

4.4 Radio-Off

The unit enters *Radio-Off* mode when the CelloTrack battery voltage falls below 3.4 volts for 30 consecutive seconds. When this happens, the unit initiates the following:

- A Radio-Off event is generated and logged.
- All log history is saved to nonvolatile memory.
- The cellular modem and GNSS are turned off.

The unit does not send messages until power is resumed.

These actions ensure the integrity of the logged history and facilitate a smooth restart when power is reapplied.

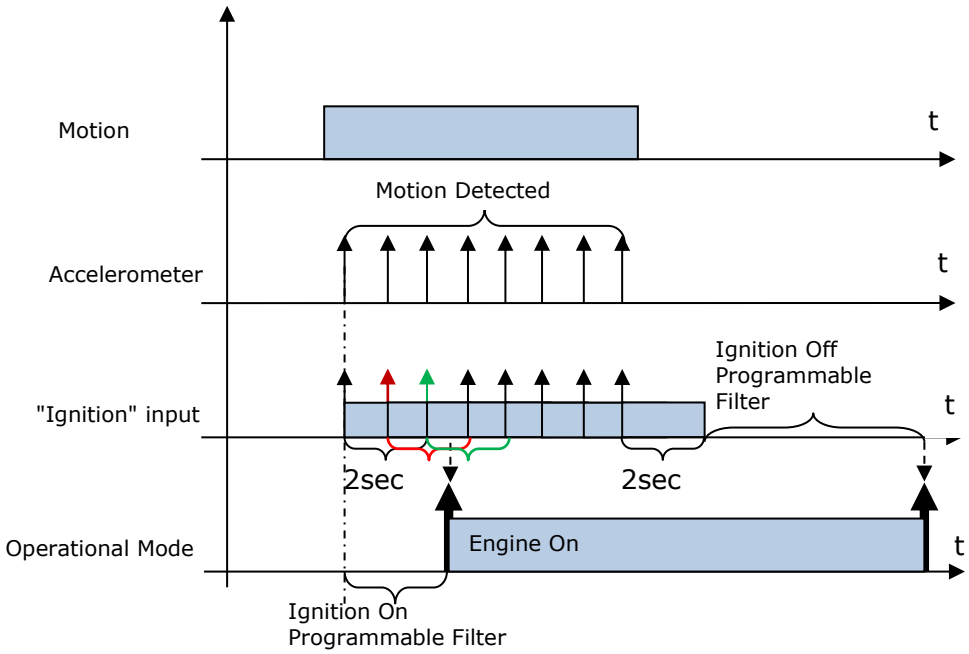
The unit exits *Radio-Off* mode and resumes tracking when the battery voltage exceeds 3.5 volts for 30 consecutive seconds.

4.5 Motion Detection

In CelloTrack units, *Motion Detection* is used to detect the unit movement; the ignition signal is not required for asset tracking. Motion is detected via the unit's built-in accelerometer, which only operates when *Motion Detection* is enabled.

Two seconds of continuous accelerometer motion is recognized by the unit as valid motion detection. When motion is detected continuously for a preprogrammed duration (typically two seconds from the initial valid motion detection), the unit reports a *start* event, which indicates engine-on/movement.

Two seconds of continuous lack of accelerometer motion is recognized by the unit as a valid lack of motion detection. When lack of motion is detected continuously for a preprogrammed duration (typically 40 seconds from the initial valid lack of motion detection), the unit reports a *stop* event, which indicates end of movement.



NOTE: *Motion Detection* is operable when the unit is in any state other than *Not Activated*.

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5 CelloTrack solar Specifications

Communication	
Cellular communication	LTE Cat 1 NA with 3G Fallback **LTE NA:** Bands 2, 4, 5, 12 (700, 850, 1700/2100 (AWS), 1900 MHz)**,** data rates: 10.2[DL] / 5.2[UL] Mbps **3G NA:** UMTS Bands 5, 4, 2 (850, 1700/2100 (AWS**),** 1900); HSPA 5.76[UL]/7.2[DL] Mbps LTE Cat 1 EU with 3G and 2G Fallback **LTE EU:** Bands 1, 3, 8, 20. 28 (700, 800, 900, 1800, 2100 MHz)**,** data rates: 10.2[DL] / 5.2[UL] Mbps **3G EU:** UMTS Bands 1, 8 (900, 2100 MHz); HSPA 5.76[UL]/7.2[DL] Mbps **2G EU:** GSM 900, 1800 MHz; GPRS: 24[UL]/48[DL] Kbps Packet Data**:** TCP/IP, UDP/IP SMS**:** PDU mode
SIM	Internal, Micro sim replaceable, 1.8/3V Optional SIM on chip Remote PIN code management
Antenna	Internal, multi band antenna
GNSS	
Technology	Internal module, SiRFstarV™ based GPS and GLONSS supported.
Sensitivity (tracking)	-165dBm
Acquisition (normal)	Cold <27 Sec, Warm<10 Sec, Hot<1 Sec
Antenna	Internal, on board patch antenna
Interfaces	
COM port	Internal USB 2.0 interface over standard micro-USB connector Cellocator Serial Protocol Debug, Configuration, FW upgrade
3D Accelerometer	3D, ±8g range, 12 Bit representation, 4mg resolution Movement detection

MMI	2 dual colored (red, green) LED status indication Reed relay and magnet based Activation Reed relay and magnet based tamper detection
Wireless	2.4 GHz Proprietary wireless interface for MultiSense integration. Transmission power – 6.5 dBm Line of site – 100 m minimum
Connectors	Internal micro-USB connector
Power	
Internal Battery	lithium-thionyl chloride (SOCl2), 3.6V, 34 Ah, primary (non-rechargeable)
Supercaps	200F, 5.4V
Solar Panel	Monocrystalline, two panel of 110x80 mm max 2.4 W @STC
Average Current Consumption	On taking location and transmission session: 50mA Hibernation: < 230µA Shipment (Off): < 230 µA
Environment	
Temp, operating	-30^{0}C – +75^{0}C.
Temp, storage	0^{0}C – 30^{0}C (battery limitation)
Humidity	95% non-condensing
Ingress Protection	IP69k, IP67
Environmental Requirements: • temperature • Vibration • Humidity • Mechanical shock • Salt fog • Altitude • Contaminates • Sunlight	Based on: AAR S5703 Railroad Electronics environmental Requirements MIL-STD-810E
Mounting	Screws
Regulatory compliance / certification	
CE	CE Safety EN60950-1:2001+A11:2004
FCC	Part 15 Subpart B, part 22/24/27

IC	ICES-003, Issue 5:2012 Class B. CAN/CSA-CEI/IEC CISPR 22:10
PTCRB	LTE and 3G; TRP, TIS, Spurious and harmonics emission
AT&T	Yes
Environment	Based on: AAR S5703 Railroad Electronics Environmental Requirements MIL-STD-810E
UL	Compliant
RoHS	RoHS 3 Directive 2015/863Compliant
conflict minerals	Conflict Mineral directives
Reliability	
Annual Failure Rate (AFR)	≤ 0.5%.
Highly Accelerated Life Test (HALT)	Qualmark HALT Testing Guidelines, document 933-0336, Rev. 04. No failures observed exceed spec by 12%.
reliability assessments	conducted
Dimensions & Weight	
Enclosure material	PolyCarbonate Lexan 9330, White
Solar panel window material	PolyCarbonate transparent
Dimensions	~43mm x 110mm x 490mm
Weight	~ 1150gr

6 CelloTrack Release Package

The release package of the CelloTrack LTE includes, in addition to the components mentioned in the *The CelloTrack Solar Variants* section, a number of software tools and documents, as described in the following sections.

6.1 Evaluation Suite

The Evaluation Suite is the application which contains all the software components necessary for the evaluation of any Cellocator unit. The software components required for evaluating the CelloTrack LTE are described below.

6.1.1 *Communication Center*

The Communication Center also supports the KML generator. The **Keyhole Markup Language (KML)** is an XML notation for expressing geographic annotations and visualizations within Internet-based, two-dimensional maps and three-dimensional Earth browsers, such as **Google Earth, Google Maps**, and **Google Maps for Mobile**.

For more details about the new Communication Center capabilities and usage during the integration process, refer to the *Cellocator Evaluation Suite Manual*.

6.1.2 *Cellocator Programmer*

The concept of operation and parameters flow between the four entities of HW, Programmer screen, storage and CelloTrack LTE Editor is shown below:

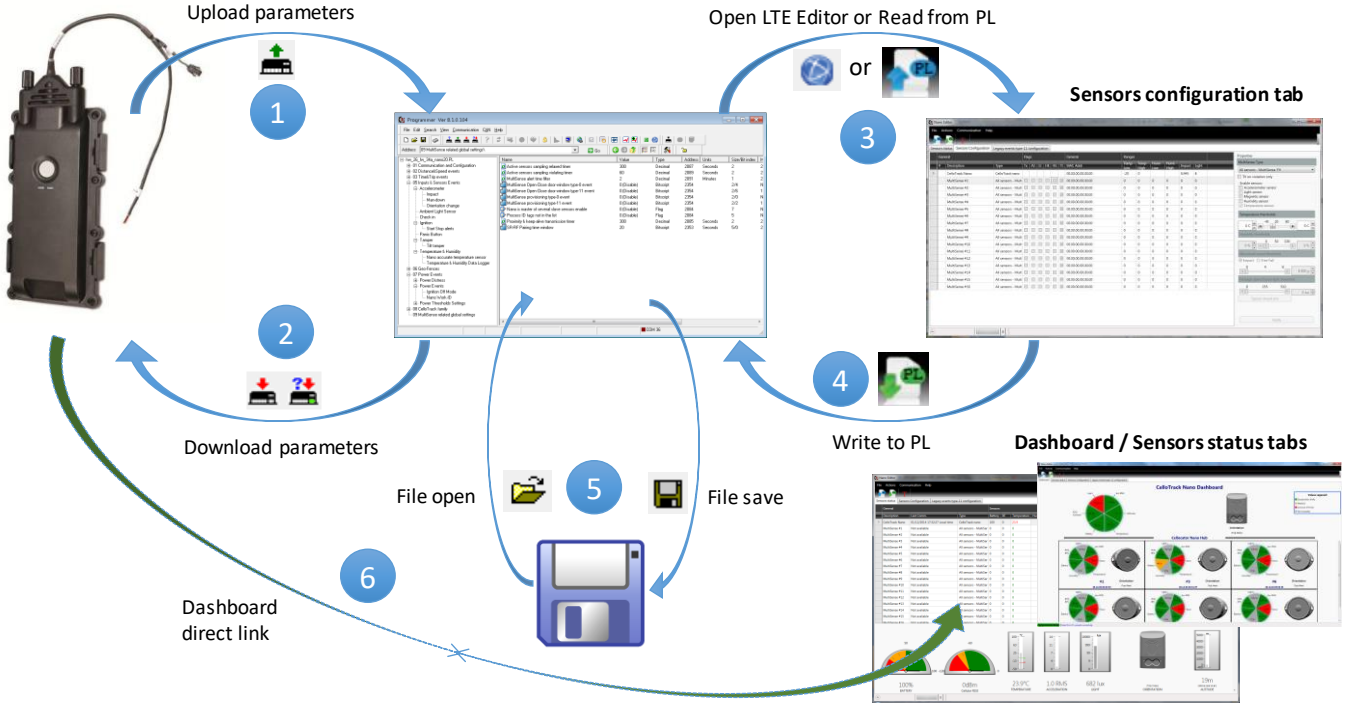

Figure 1: Operation Flow

The Cellocator Programmer supports the CelloTrack LTE Editor which can read, edit and write PL parameters for CelloTrack LTE and MultiSense devices.

The CelloTrack LTE Editor has four main tabs:

- **Dashboard:** This tab provides you with a real-time overview of the entire system when the CelloTrack LTE is connected to the Cellocator Programmer.
- **Sensors Status:** This tab is a dashboard where all relevant CelloTrack and Multisense data is presented. When selecting one of the listed devices, its data is shown graphically in the lower part of the window, providing a visual overview of the selected device.
- **Sensors Configuration:** This tab provides the ability to activate sensors (i.e. accelerometer, light, magnetic, humidity, temperature, proximity) and sensor thresholds per device (CelloTrack, MultiSense) which can be downloaded as a PL afterwards via the standard PL OTA/Serial procedure.
- **Legacy events type-11 configuration:** This tab contains all type-0 fields related to the CelloTrack that can be transmitted over Type 11 protocol. The user can set each one of the fields, which can be sent as a PL afterwards via the standard PL OTA/Serial procedure.

6.2 Integration Package (Cellocator GW)

The Cellocator Gateway is a set of software components offered to Cellocator customers wishing to integrate the Cellocator OTA protocol into their production environment.

Customers using the Cellocator Gateway benefit from a quicker and easier integration process, and are also entitled to software upgrades, technical support and more.

Cellocator Gateway is built utilizing the latest MS-based technologies, and provides high availability and load balancing options, as well as enabling clients the opportunity to integrate and start working with Cellocator units without investing a large amount of time and resources.

The new version of Cellocator GW includes all new fields related to the CelloTrack solution.

6.3 Cellocator Wireless Communication Protocol

This document explains the unit's wireless communication protocols and concept. It describes every byte of the incoming/outgoing packets, which can be sent or received by the unit over-the-air.

6.4 Cellocator Integration Package Manual

This document provides a complete product description of the Integration Package solution and other integration related information, for the purposes of integrating the Cellocator OTA protocol within a new client's production environment.

6.5 Evaluation Suite Manual

The Cellocator Evaluation Suite Manual is a comprehensive guide that provides information required to run an initial appraisal and testing process of Cellocator units.

The Cellocator Evaluation Suite contains a complete set of components that simplify bench testing of the system and serve as a demonstration platform for people wishing to understand the operational aspects of the system. The Suite is also intended to facilitate the development of interfaces to the Cellocator system by integrators or service providers.

6.6 Cellocator Programmer Manual

This document describes the features supported by the Cellocator unit and provides details about the configuration parameters.

6.7 Integration Manual

This document provides the software integrator with information and hints on how to integrate an application with the CelloTrack.

6.8 Training Presentation

This documentation provides preliminary Integration Manual information through the beta phase.

6.9 Battery power calculator

This excel based calculator provides the CelloTrack Solar life time based on the specific required operation method.