Cellocator™ CelloTrack T Family Overview

Cellocator Division
Pointer Telocation Ltd.

Proprietary and Confidential

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POINTER

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1 Introduction

1.1 About this Document

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

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
3Y	Three Years
8M	Eight Months
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		
2		

1.4 Revision History

Version	Date	Description
1.0	December 29, 2013	Initial release
1.1	April 20, 2014	Add CelloTrack Operational Modes and CelloTrack Power Features chapters
1.2	July 7, 2014	Change LEDs names in The CelloTrack Interface section
1.3	December 9, 2014	CelloTrack XT battery supports at least 4.25 Ah. System led blinking on deactivation till all queued messages are sent (FW41u).

Version	Date	Description
		Add NBO number **CE 1177,1909.**
1.4	May 23, 2016	• GPS receiver replaced with Telit Jupiter SC872-A GNSS receiver as described in PCN 0124 - New GNSS Receiver for CelloTrack T - Oct 2015. • CelloTrack XT utilizes 5.3 Ah battery • CelloTrack XT battery operation range has been increase to -20 to 60 °C • Added 3G EU variant • Updated accessories • Updated features list • Remove CelloTrack T improvements • Updated Specifications • Added GNSS notes

2 The CelloTrack T Family

2.1 CelloTrack T Family Overview

Cellocator's CelloTrack T product family, designed for advanced asset tracking and asset management applications, provides enhanced functionality, ease of installation and support for a wide range of applications.

The capabilities provided by the CelloTrack family 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 transportation equipment such as trailers, containers, train wagons or any kind of valuable mobile asset such as electricity generators, heavy machinery, chemical toilets and waste containers.

The CelloTrack family is based on Cello Technology and supports similar tracking, communication, GNSS location-based features and maintenance capabilities as per those available in the Cello family.

Other CelloTrack T features include:

- Stand-alone tracking device. Can be installed and operated for long time periods without a power supply.
- Houses all components in the same enclosure, including battery, GNSS positioning engine, Cellular modem and antennas.
- Highly rugged durable IP67 weatherproof casing for outdoor long-life service.
- Long operation time (up to 3 years) via a variety (13/2/5.3 Ah) of rechargeable Lithium Polymer battery capacities.
- Scalable Cellular communication technology – available in 2G and 3G variants.
- MediaTek MT3333 positioning engine for reduced acquisition time and better accuracy.
- Accurate periodic peeking and/or scheduled glancing timing.
- Two fully configurable general purpose I/O ports: Digital, Analog or Pulse Counter inputs or Open Collector outputs.
- A 3D accelerometer that detects crash (accident), movement and vibrations of assets and enables different transmission rates for a moving asset and a standing asset.
- A programmable (on/off/test/panic) push button.
- Two monitoring LEDs for GSM and GNSS status indication.
- A charging and communication connector.
- Easy mounting using double-sided adhesive / screws / or magnetic cradle.
- Dual tampering detection: Cradle from surface or Unit from cradle.
- Minimal maintenance.
- ISO16750 compliance (Shock, temperature, humidity, UV, chemical, salt, and so on)
- Supports up to 9000 time-stamped events.
- Adaptive logging and reporting frequency (Idle, movement, speed, network, Time of day, battery status).
- Advanced carrier selection algorithm.
- Built-in Geo-fence capabilities.

2.2 CelloTrack T Family Variants

The CelloTrack T variants can be divided into 3 categories:

- Unit type:
  - CelloTrack
  - CelloTrack Power
  - CelloTrack Lighter Kit
- Battery type
  - 3Y (13 Ah)
  - 8M (2Ah)
  - XT (5.3 Ah)
- Cellular network type
  - 2G
  - 3G NA
  - 3G EU

The CelloTrack T variants are summarized in the following table.

CelloTrack 2G Family / CelloTrack 3G (NA, EU) Family			
	3Y	**8M**	**XT**
CelloTrack	CelloTrack 3Y	CelloTrack 8M	CelloTrack XT
CelloTrack Power	CelloTrack Power 3Y	CelloTrack Power 8M	CelloTrack Power XT
CelloTrack Lighter	CelloTrack Lighter 3Y	CelloTrack Lighter 8M	NA

2.3 The CelloTrack

The regular CelloTrack unit is designed for unpowered assets. It is ideal for trailers, containers, trains and other high value mobile assets.

The unit includes a 6-pin connector for battery charging, programming, and two general purpose I/Os which can function as dry contact inputs, threshold based input, analog input, frequency counter or open collector output (relay driver). The connector is covered by a rubber cover for dust and water protection (IP67).

The unit is charged via a dedicated charger from a standard electric wall outlet (110 / 230 V).

2.4 The CelloTrack Power

The CelloTrack Power unit is designed specifically for assets which have an occasional power connection, such as trailers. The unit charges its battery when the power is connected and uses its battery and the advanced power management algorithm to maintain tracking when the power is disconnected.

The unit includes a pigtail harness for battery charging, programming and two general purpose I/Os which can function as dry contact inputs, threshold based input, analog input, frequency counter or open collector output (relay driver). The unit is charged via the asset (trailer) power supply (12 / 24 V).

2.5 The CelloTrack Lighter

The CelloTrack Lighter unit is designed especially for applications where power is connected only on "ignition on" and minimum installation and maintenance is required.

The CelloTrack Lighter is shipped as a kit comprised of the CelloTrack Power and the Lighter Harness. The Lighter Harness is terminated with a connector which fits a vehicle's standard cigarette lighter socket.

This setup allows the unit to be installed in the driver's cabin with a fast and simple connection to the vehicle power. The unit charges its battery when the power is connected and uses its battery and the advanced power management algorithms to maintain tracking when vehicle power is disconnected.

2.6 The CelloTrack 3Y

The CelloTrack 3Y variants provide a durable and long life solution that support 29 months of continuous operation for 3G variants and 28 months for 2G variants with single GPS reading and Cellular transmissions per day.

The CelloTrack 3Y supports the same set of capabilities - including the same Firmware and Programming Library (PL) - as the CelloTrack 8M and CelloTrack XT variants. The

CelloTrack 3Y variants are visually different from the other CelloTrack variants with the use of a silver label.

2.7 The CelloTrack 8M

The CelloTrack 8M variants provide a cost effective solution that supports eight months of single GPS readings and Cellular transmissions per day utilizing a 2AH rechargeable battery. The CelloTrack 8M is an ideal solution for trailers tracking applications in which the battery is being recharged during the time the trailer is hooked to the Track and up to 8M of remote monitoring is guaranteed while the trailer parks in the operation hub.

The CelloTrack 8M supports the same set of capabilities - including the same Firmware and Programming Library (PL) - as the CelloTrack 3Y and CelloTrack XT variants. The CelloTrack 8M variants are visually different from the other CelloTrack variants with the use of a white label.

2.8 The CelloTrack XT

The CelloTrack XT variants provide an asset tracking solution for environments that require a wider operational temperature range (-30°C to +70°C) and a wide charging temperature range (-20°C to +60°C). The CelloTrack XT variants support up to 15 months of single GPS readings and GPRS transmissions per day, utilizing a 5.3 Ah rechargeable Li-Poly battery.

The CelloTrack XT family supports the same set of capabilities - including the same Firmware and almost the same Programming Library (PL) - as the CelloTrack 3Y and 8M variants. The CelloTrack XT variants are visually different from the other CelloTrack variants with the use of a yellow label.

NOTES:

- The SIM card must also support the declared temperature range to provide overall unit support.
- The parameter "Enable Extended Charging Temperature Range" in the PL should be set to 1 in CelloTrack XT.
- Programming an extended temperature for standard CelloTrack or CelloTrack 8M units may decrease the battery life due to it not being charged within the recommended temperature range.

2.9 CelloTrack 3G NA Family

The CelloTrack 3G NA (North America) Family provides solutions for the asset monitoring market in North America.

The CelloTrack 3G NA family supports the required network standards: HSPA 5.76[UL]/7.2[DL] Mbps, 800/850, AWS 1700, 1900 and GSM/GPRS/EDGS, 850, 900, 1800, 1900 (Quad band).

The CelloTrack 3G NA family supports all the big service providers and their affiliates, such as AT&T, T-Mobile, Telus and Rogers. It also supports the following certifications / homologations: FCC, CE Safety, PTCRB, AT&T, IC and Rogers.

2.10 CelloTrack 3G EU Family

The CelloTrack 3G EU Family provides solutions for the asset monitoring market in whole world except North America.

The CelloTrack 3G EU family supports the required network standards: HSPA 5.76[UL]/7.2[DL] Mbps, 900, 2100 and GSM/GPRS/EDGS, 850, 900, 1800, 1900 (Quad band).

2.11 CelloTrack Accessories

The CelloTrack accessories are described in the following table:

Part	Description	
CelloTrack Cradle PN: 805-60803	A cradle designed to be mounted on the surface of a container, wagon or track, and which holds the CelloTrack unit.	
CelloTrack Magnetic Cradle PN: 815-60803	Allows CelloTrack Family units to be fixed on steel (iron) surfaces by means of very strong permanent magnets.	
Lighter Harness PN: 711-00316	The Lighter Harness, together with the CelloTrack Power, make up the CelloTrack Lighter kit.	
Communication Harness PN: 711-00251	Allows configuration and FW upgrades. Please read the warning below.	
CelloTrack Charger – EU PN: 711-00168	CelloTrack external charger to be used in Europe.	
CelloTrack Charger – US PN: 711-00170	CelloTrack external charger to be used in the USA.	
CelloTrack Charger – UK PN: 711-00171	CelloTrack external charger to be used in the UK.	

Part	Description	
CelloTrack 3y Battery PN: 711-20069	Additional 3Y (3 Years) battery.	
CelloTrack XT Battery PN: 711-20071	Additional XT (Extreme Temperature) battery.	
CelloTrack Power 3G NA Evaluation Kit PN: K080-001	Evaluation kit for the CelloTrack Power 3G NA.	
CelloTrack 3G NA Evaluation Kit PN: K080-002	Evaluation kit for the CelloTrack 3G NA.	
CelloTrack Power 3G EU Evaluation Kit PN: K080-011	Evaluation kit for the CelloTrack Power 3G EU.	
CelloTrack 3G EU Evaluation Kit PN: K080-012	Evaluation kit for the CelloTrack 3G EU.	
CelloTrack Evaluation KIT PN: K080-003	Evaluation kit for the CelloTrack 2G.	
CelloTrack Power Evaluation KIT PN: K080-004	Evaluation kit for the CelloTrack Power 2G.	

WARNING: The Communication Harness used for the CelloTrack T family (PN 711-00251) is different from the one used for the legacy CelloTrack (PN 711-00278). Using the wrong Communication Harness can damage the electrical circuit of the CelloTrack T, and require repair at the Cellocator premises (RMA). Therefore only the correct Communication Harness, easily differentiated by its red label, should be used.

2.12 The CelloTrack Cradle

The CelloTrack Cradle is designed to be mounted on the surface of a mobile asset and to firmly hold the CelloTrack unit. The cradle supports mounting on a surface by double-sided adhesive tape or by using screws. The cradle also supports a setup with four POT magnets, allowing instant attachment to metal (iron) surfaces.

The unit can be easily placed into the cradle using the cradle side snaps. The cradle also supports securing the CelloTrack in the cradle by using four cable ties.

Detection of removal of the cradle from the mounting surface (cradle tamper detection) is also supported.

2.13 The CelloTrack Magnetic Cradle

The CelloTrack Magnetic Cradle is a standard CelloTrack cradle with four powerful POT magnets. This configuration allows instant attachment to a vehicle or an asset with a metal surface, on a per-trip basis, in order to provide covert CelloTrack installation. It is especially useful for monitoring rented trucks or containers for a specific trip or time period.

The POT magnet technology annuls the influence of the magnetic field on the CelloTrack GSM modem, GNSS antenna, and the electronic circuit, while providing a concentrated magnetic force to attach the cradle to the asset's surface.

The CelloTrack Magnetic Cradle is designed to contend with rapid acceleration or braking, and serious vibration caused by journeys over rough roads, and it can even remain effective where layers of dirt separate between the magnets and the vehicle surface or in cases where the vehicle's body material is not 100% iron. Each of the magnets supports up to 16 Kg, i.e, 64 Kg per cradle, while the CelloTrack weight is approximately only 0.55 Kg.

The CelloTrack Magnetic Cradle has been successfully tested while driving in difficult conditions on rough roads.

2.14 CelloTrack T Family 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
- Jamming detection
- Road curve smoothing
- Cell-ID report
- 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

The CelloTrack Power support also the following features:

- External Power monitoring
- Temp dependent Backup Battery charging

NOTES:

- Jamming detection is not supported in due to modem limitations.
- The Automatic Power Save (APS) modem feature is not supported in CelloTrack 2G variants.
- Cell-ID feature is only operable if 2G communication is used and when the APS power mode is disabled.
- For proper warm start operation, the GNSS module should be configured to be turned on for at least 2 hours per day.
- Warm start is operative only in the temperature range of -20°C to +60°C. Thus, outside of this range, cold start will be operated.

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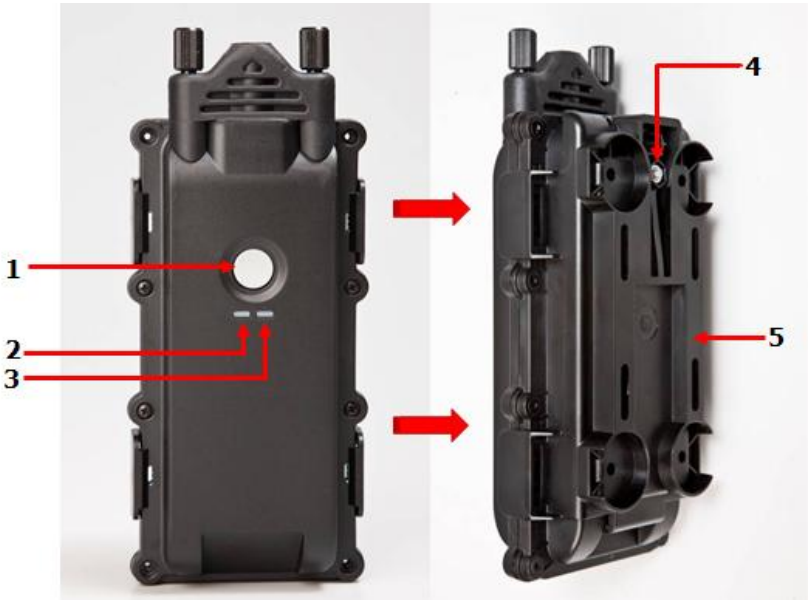
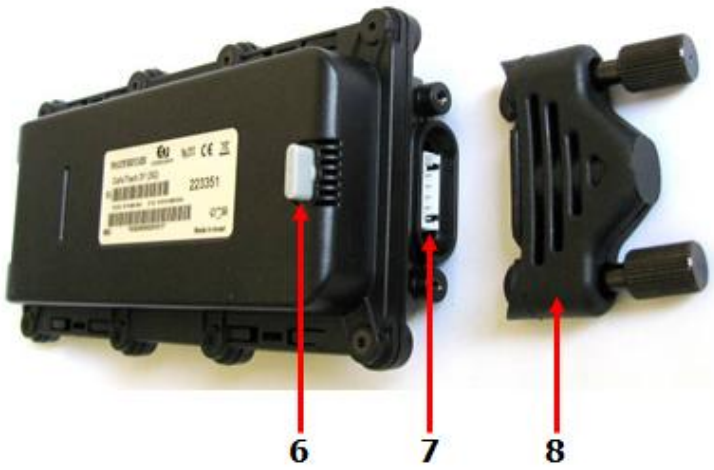
3 CelloTrack Interfaces

3.1 The CelloTrack Interface





1 – FB (Front Button)
2 – GSM LED
3 – SYS LED
4 – Cradle Tamper Switch
5 – Cradle
6 – Unit Tamper Switch
7 – Connector
8 – Connector Cover

3.2 The CelloTrack Power Interface

1. **CelloTrack Power harness (pigtail)**
2. **FB (Front Button)**
3. **GSM LED**
4. **SYS LED**

3.3 Overview of the CelloTrack LEDs

The CelloTrack LEDs have been designed to provide a simple visual interface for the unit states. The following table describes each unit state and the appropriate LED indications.

SYS LED	GSM LED	Front Button	Tamper Switch	CelloTrack Unit State
Blinking	OFF	Pressed	Not pressed	Not activated
Illuminated	OFF	Pressed	Pressed (in cradle)	Activation process
OFF	Illuminated	Not relevant	Not relevant	GSM not registered
OFF	Blinking	Not relevant	Not relevant	GSM registered
OFF	OFF	Not relevant	Not relevant	Deactivated, Modem off
Blinks once	Not relevant	Not relevant	Not relevant	GNSS status: fixed to not fixed or not fixed to fixed
Blinks, then Illuminates and then turns off	Not relevant	Pressed	Not pressed (out of cradle)	Deactivation process

3.4 CelloTrack Connector

The CelloTrack 6-pin connector is protected by a plastic cover, providing IP67 compliancy. The following illustration shows the CelloTrack unit with the rubber cover removed.

The connector pin out is as follows:

Pin 1 – VCC

Pin 2 – Ground (GND)

Pin 3 – General Purpose I/O 1 (GP1)

Pin 4 – General Purpose I/O 2 (GP2)

Pin 5 – RS232 TXD

Pin 6 – RS232 RXD

NOTE: Removing the connector cover revokes the unit's IP67 compliancy. It is the customer's responsibility to provide proper sealing if the connector cover is removed.

3.5 CelloTrack Power Harness

The CelloTrack Power utilizes a 45 cm pigtail harness which ends with several free wires and a connector for the programming cable, as described in the following table.

Pin No.	Color	Function	Free Wire	Programming Connector Pin No.
1.	red	VCC (9-32v)	+	
2.	black	Ground (GND)	+	1
3.	orange	General Purpose I/O (GP)	+	
4.	brown	General Purpose I/O (GP)	+	
5.	green	RS232 TXD		2
6.	yellow	RS232 RXD		3

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**
- **Tracking** (fully operational)

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

There is an additional **Radio-Off** state, but this is not strictly an operational state; the unit enters this state when the battery voltage is too low to maintain correct operation.

NOTE: For detailed configuration information, refer to the *Pointer Programming Manual*.

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 CelloTrack Power unit awakens once every half minute and checks whether the following conditions for battery charging have been met:

- The power input (vehicle battery) is within range.
- The vehicle temperature (dictated by the environment temperature) is within the battery charging temperature range.

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.
GPS battery charging peek	For CelloTrack Power only, the unit samples the power input conditions and enables/blocks battery charging.
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 on page 27.
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 *Not Live Tracking* section on page 24

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 on page 23) 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 and its charging state.

This combination is known as *adaptive glancing frequency*.

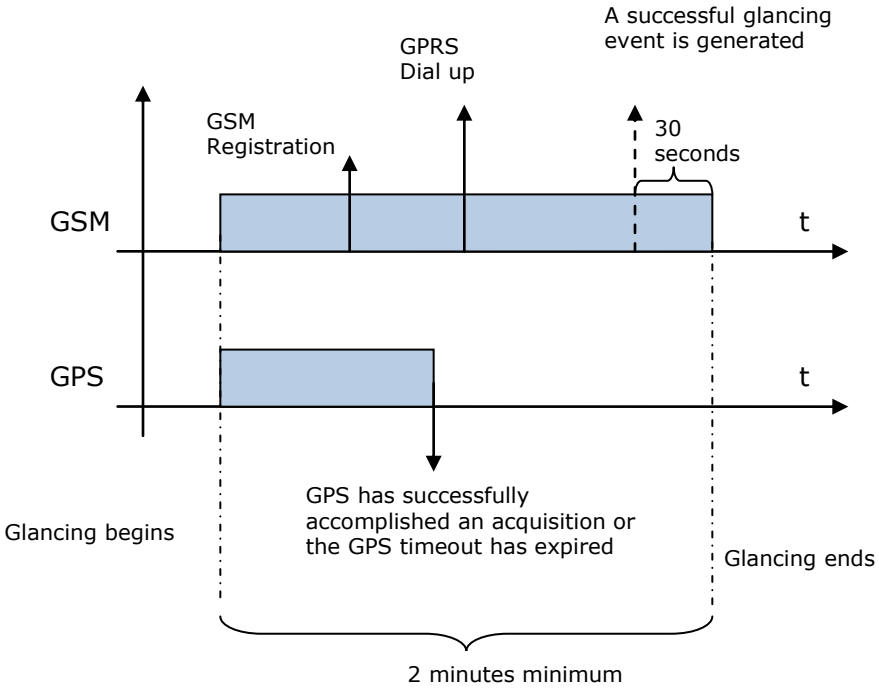
The GPS module remains active until a successful GNSS acquisition occurs or until the dedicated GNSS timeout expires.

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.

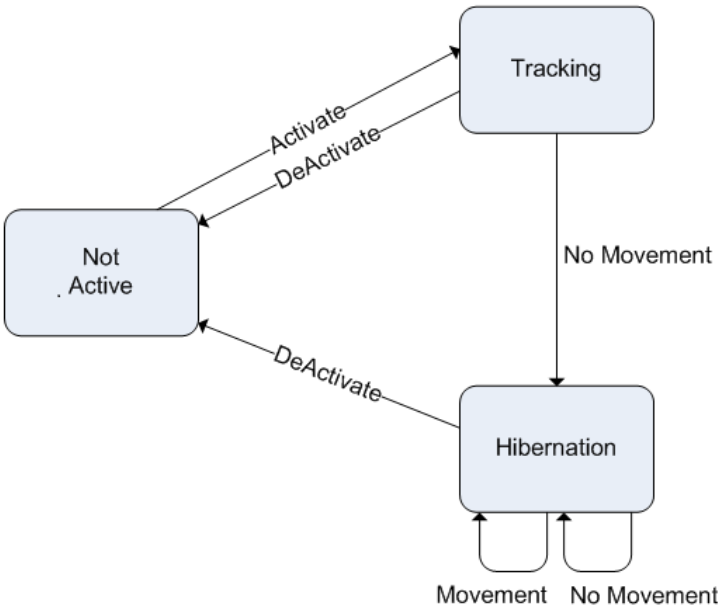
NOTE: *Specific Time Glancing* can only be enabled if the GNSS has acquired a valid fix (location and time) at least once in the past.

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*

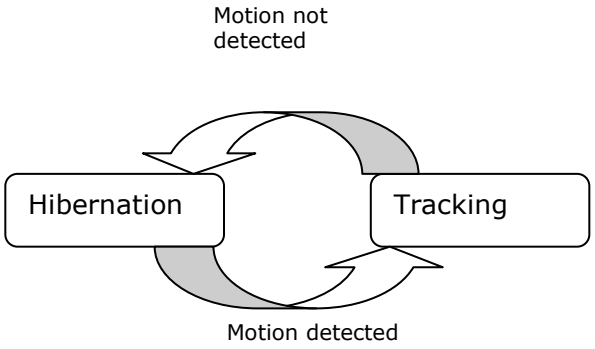
In *Not Live Tracking* the unit does not enter the *Tracking* state; however, it sends start and stop messages when motion is detected or ends.

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:

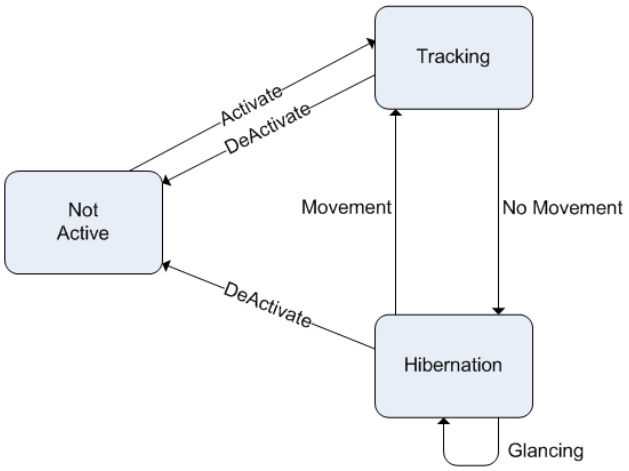
- Powers up its GNSS module.
- Powers up its GSM module.
- Sends regular location updates to the server.
- Provides full CelloTrack functionality, including: periodical and distance events, geo-fence related events, speed related events, and maintenance events.
- Activates its interfaces (input, outputs,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

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**

4.3.1 *Live Tracking*



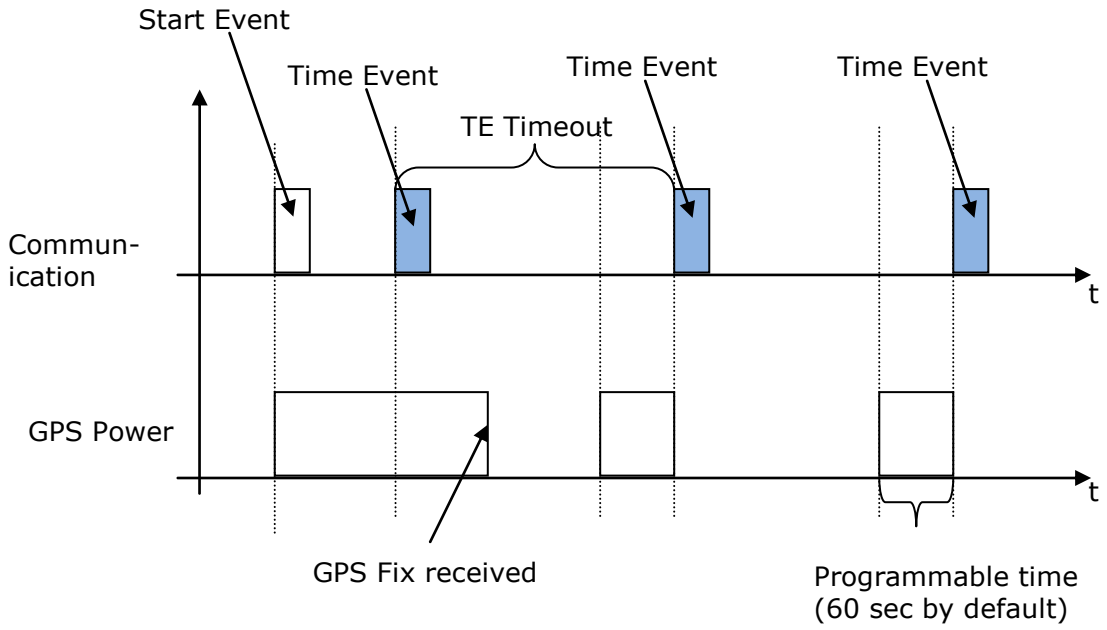
The unit is fully active and sends periodic updates to the server. This is not the default tracking mode.

4.3.2 *Tracking with GNSS Peeking*

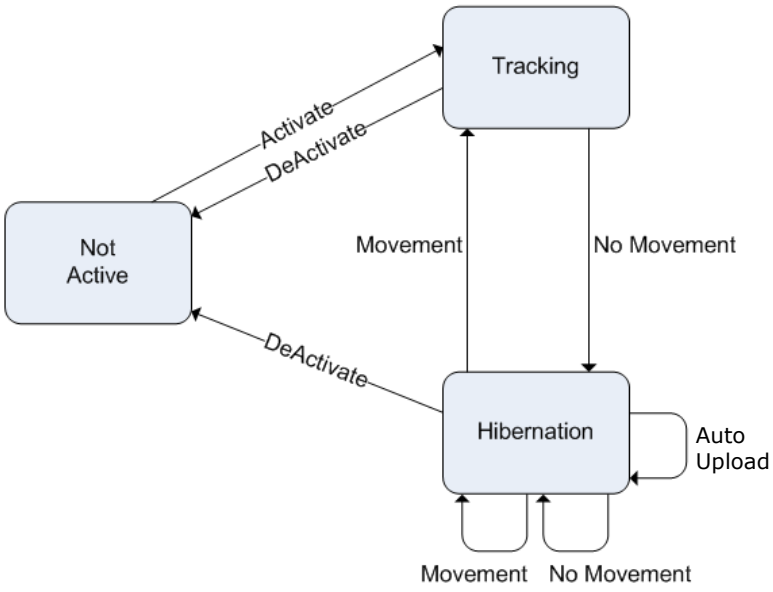
This tracking mode is similar to live tracking but uses less battery power: the GNSS module operates in peeks just before each time event (instead of permanent activation) and only if:

- 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.

4.4 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.

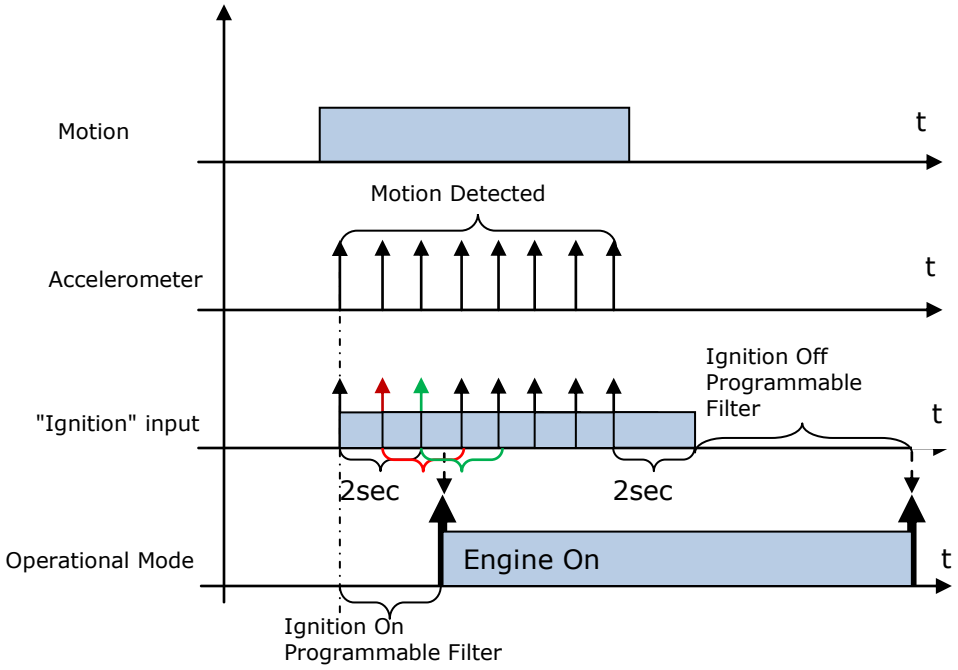
The unit exits *Radio-Off* mode and resumes tracking when the battery voltage exceeds 3.5 volts for 30 consecutive seconds.

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*.

4.6 CelloTrack Activation and Deactivation

4.6.1 *Activation*

When the CelloTrack unit is in the *Not Activated* state, it awakens once per second to check whether an activation attempt is in progress. Activation requires both the tamper switch and front button to be depressed continually for three seconds. If these are not depressed, the unit returns to sleep mode.

By default, the system requires both the tamper switch and front button to be depressed for activation. It is possible to configure the unit to ignore the tamper switch and relate only to the front button.

Activation - The front button and tamper switch are depressed continually (the cradle causes the tamper switch to remain depressed) for three seconds.

Indication of successful activation – The SYS LED glows while the front button is depressed. After three seconds the LED switches off and the front button can be released.

If you depressed the front button but the tamper switch is not depressed (the unit is out of its cradle), the SYS LED blinks to confirm the unit remains in the *Not Activated* state.

4.6.2 *Deactivation*

When the CelloTrack unit has been activated (for example, it is in the *Hibernation* state), it checks whether a deactivation attempt is in progress. Deactivation can be triggered manually by pressing the front button or by received OTA command. When deactivation is triggered the unit enters deactivation process and starts to send all the queued messages. The deactivation process lasts till all messages are sent but not more than 90 seconds. When deactivation process is terminated the unit shuts down.

Manually Deactivation - The front button is pressed continuously for three seconds. The unit must be removed from its cradle and the tamper switch should not be depressed.

Indication of a Deactivation process: The SYS LED blinks (0.2 seconds on / off) through the deactivation process period, which is generally very short (one blink) but may last up to 90 seconds.

Indication of a successful Deactivation - The SYS LED glows for short time and switches off. The GSM LED switches off. The unit enters the *Not Activated* state.

NOTE: Pressing the front button for three seconds while the unit is in its cradle and activated (the cradle causes the tamper switch to remain depressed), will trigger a panic event.

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5 CelloTrack Power Features

CelloTrack Power includes a built-in CCCV battery charger (not included in the standard CelloTrack unit).

The charger charges the unit's back-up battery whenever an external energy source is available and the temperature is within the charging range.

The CelloTrack Power unit also does the following:

- Indicates the charger status in its update messages.
- Continually reports the unit's temperature.
- Enables increased time and distance event frequency while powered by an external power source.

5.1 Battery Charging

The CelloTrack Power activates the charger when all the following conditions are met:

- The temperature is between 5°C and 45°C (note that during charging, the unit generates heat that might increase the temperature by 5-6°C).
- An external power source is detected.
- The unit is running in the *Tracking* state (this is the default setting; it is also possible to enable charging in the *Hibernation* state).

The unit terminates charging when any of the following conditions are met:

- The temperature is out of the permitted range.
- The external power source is disconnected.
- The unit enters the *Hibernation* state (if charging in *Hibernation* is disabled).

6 CelloTrack T Specifications

Communication	
Cellular communication	**3G NA:** HSPA 5.76[UL]/7.2[DL] Mbps; 850, 1900, AWS **3G EU**: HSPA 5.7[UL]/7.2[DL] Mbps, 900, 2100 **2G:** GSM/GPRS, 850, 900, 1800, 1900 (Quad band)
SIM	Internal, replaceable, 1.8/3V Remote PIN code management
Antenna	Internal, multi band GSM antenna
GNSS	
Technology	Internal module, MediaTek MT3333 chipset.
Sensitivity (tracking)	-165dBm
Acquisition (normal)	Cold <35Sec, Warm<35Sec, Hot<1Sec
Inputs & Outputs	
I/O	Two configurable ports supporting true GPIO (General Purpose Input Output). Each I/O port supports: ✓ Discrete Dry Input ✓ Discrete Wet Input ✓ Analog 0-2.5V Input ✓ Analog 0-30V Input ✓ Frequency Counter Input ✓ Output **Discrete Dry** – Ground sensing. Configurable ground threshold. **Discrete wet** – Logic 1 and 0 Configurable thresholds. **Analog inputs with variable resolution** - 8bit - 0-2.5V: 20mV resolution, accuracy ±30mV; 8bit - 0-30V: 100mV resolution, accuracy ±100mV 12bit - 0-2.5V: 3mV resolution, worst case accuracy <10mV; max 20mV. 12bit : 0-30V: 8mV resolution, worst case accuracy <40mV **Frequency counters –** Up to 5kHz input signal; Signal level (3V < Vin ≤ 30V); Accuracy ±2% **Output** - Open collector

<table>
<tr><th colspan="2">Interfaces</th></tr>
<tr><td>COM port</td><td>Cellocator Serial Protocol
Debug, Configuration, FW upgrade
RS232, CMOS levels</td></tr>
<tr><td>3D Accelerometer</td><td>Movement detection</td></tr>
<tr><td>MMI</td><td>2 LED status indication
Activation / Distress button
Tamper switch</td></tr>
<tr><td>Connectors</td><td><table><tr><td>CelloTrack</td><td>CelloTrack Power</td></tr><tr><td>6 pin Molex, Automotive</td><td>Pigtail</td></tr></table></td></tr>
<tr><th colspan="2">Power</th></tr>
<tr><td>Input voltage:</td><td><table><tr><td>CelloTrack</td><td>CelloTrack Power</td></tr><tr><td>4.2V 1A CCCV Charger</td><td>9-32V DC</td></tr></table></td></tr>
<tr><td>Internal Battery</td><td>CelloTrack 3Y family: Li-Polymer, 3.7V, 13Ah, rechargeable
CelloTrack 8M family: Li-Polymer, 3.7V, 2Ah, rechargeable
CelloTrack XT family: Li-Polymer, 3.7V, 5.3Ah, rechargeable</td></tr>
<tr><th colspan="2">Environment</th></tr>
<tr><td>Temp, operating</td><td>CelloTrack and CelloTrack 8M:
Discharging: -20^{0}C – 60^{0}C. Charging: 0-45^{0}C.
CelloTrack XT:
Discharging: -30^{0}C – 70^{0}C. Charging: -20^{0}C – 60^{0}C</td></tr>
<tr><td>Temp, storage</td><td>CelloTrack and CelloTrack 8M: -20^{0}C – 35^{0}C
CelloTrack XT: -20^{0}C – 60^{0}C</td></tr>
<tr><td>Ingress Protection</td><td>IP67</td></tr>
<tr><td>Vibration, Impact, Humidity, chemical</td><td>ISO 16750</td></tr>
<tr><td>Mounting</td><td>Magnetic or screw mounted cradle
Tampering detection</td></tr>
<tr><th colspan="2">Certifications</th></tr>
<tr><td>CE</td><td>CE EMC & R&TTE according to 89/336/EEC or 1999/5/EC
CE Safety EN60950-1:2001+A11:2004
NBO number: CE 1177,1909</td></tr>
</table>

FCC	Part 15 Subpart B, part 22/24 compliant
IC	ICES-003, Issue 5:2012 Class B. CAN/CSA-CEI/IEC CISPR 22:10
PTCRB	TRP, TIS, Spurious and harmonics emission
AT&T	Yes
Dimensions & Weight	
Dimensions	~155mm x 81mm x 45mm
Weight	CelloTrack 3Y ~ 490gr CelloTrack Power 3Y ~ 530gr CelloTrack 8M ~ 280gr CelloTrack Power 8M ~ 320gr CelloTrack XT ~ 330gr CelloTrack Power XT ~ 370gr

7 CelloTrack T Battery Life

The life expectancy of the CelloTrack T battery types is described in the following sections.

7.1 Battery Life Calculation Assumptions

The calculations are based on the following assumptions and setup:

- Battery self-discharge rate: 3% of available capacity per month @ 25°C.
- Battery is fully charged optimally before first use.
- Operation mode: periodic peeking. Number of messages per day as specified in the table.
- Up to 2.5 minutes total on-time on peeking.
- Up to 1.3 minutes GNSS on-time on peeking.
- Values may vary according to operational conditions.

7.2 CelloTrack 3G Battery Life

7.2.1 *CelloTrack 3y - 13 AH Battery Life*

TX / 24Hrs	Life time [months]
96	1
48	2
24	5
12	8
8	11
6	14
4	17
2	23
1	29

7.2.2 *CelloTrack 8M - 2 AH Battery Life*

TX / 24Hrs	Life time [months]
96	5 Days
48	10 Days
24	20 Days
12	40 Days
8	2 Months
6	3 Months
4	4 Months
2	6 Months

1	8 Months

7.2.3 *CelloTrack XT –5.3 AH Battery Life*

TX / 24Hrs	Life time
96	15 Days
48	1 Months
24	2 Months
12	3 Months
8	4 Months
6	5 Months
4	7 Months
2	11 Months
1	15 Months

7.3 CelloTrack 2G Battery Life

7.3.1 *CelloTrack 3y - 13 AH Battery Life*

TX / 24Hrs	Life time [months]
96	1
48	2
24	4
12	8
8	11
6	13
4	16
2	22
1	28

7.3.2 *CelloTrack 8M - 2 AH Battery Life*

TX / 24Hrs	Life time [months]
96	5 Days
48	10 Days
24	20 Days
12	40 Days
8	50 Days
6	2 Months
4	3 Months
2	5 Months

1	8 Months

7.3.3 *CelloTrack XT - 5.3 AH Battery Life*

TX / 24Hrs	Life time
96	10 Days
48	20 Days
24	50 Days
12	3 Months
8	4 Months
6	5 Months
4	7 Months
2	10 Months
1	14 Months