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# Requirements and Use Cases

## Feature/Functions

* LTE CAT M1 integrated.
* 6-axis IMU
* Comprehensive data collection and analysis including location data and driving behavior data.
* On-demand tracking
* Realtime tracking including vehicle speed
* Mileage statistic and Engine hours
* Driving behavior monitoring, including speeding, hard acceleration, hard deceleration, excessive engine idle time etc.
* Data reporting according to time interval, distance and heading change
* Ignition on/off detection
* Base station ID report (when no GPS signal)
* Internal battery for unplug notification
* Vehicle battery monitor
* Alarms and events

◇ \_Engine on/off

◇ \_High engine coolant temperature

◇ \_Speeding

◇ \_Hard acceleration

◇ \_Hard brake

◇ \_Sharp turn

◇ \_Quick lane change

◇ \_Crash

◇ \_Low battery voltage

◇ \_Excessive engine idle time

◇ \_Towed

◇ \_Vibration

◇ \_Plug indication

◇ \_Unplug notification

◇ \_Fatigue driving

◇ \_MIL on/off

* SMS alarm to user phone
* Connect backend server via domain or IP address

## Additional References

The following documents contain additional requirements which clarify, enhance, or further describe the high-level requirements referenced in the Uses Cases, but are not themselves directly referenced here.

These Devices are reliable low-cost GSM based systems and leverages Spartan’s M2M and antenna expertise to develop cost efficient products that meet the customer requirements and expectations.

## Device Normal / General Operation

The track device’s normal operation begins after installation at a qualified service center. Once installed in a vehicle the device is ready for operation as defined below:

* Will send location and event reports using the A communication protocol. The A protocol is defined in the A interface document.
* Will communicate with the backend server via an IP message (UDP/TCP) or an SMS text message. These messages will only be accepted from approved addresses/phone numbers loaded into configuration file.
* The device will expect an acknowledgement for every message transmitted. If the acknowledgement is not received by the device then device will resend the same message after a predefined timeout period until it successfully received an acknowledgement for the transmitted message.
* Device will store reports/events internally in absence of cell coverage. Once cell coverage is available again, the device will send the saved reports/Events. (Number of reports are defined in the product requirements)
* Device will accept user provided configurable parameter values which lie within the range specified and will reject the ones out of the range. Device will not perform any verification of text-based parameters.
* Device will provide preset values for user configurable parameters wherever possible and reasonable. For example, the presets for ‘stationary time’ (time vehicle is static prior to a park message being sent) could be 30 minutes, 60 minutes and 120 minutes.
* The device will acknowledge every remote command received from user.
* The device will respond to a request for location with a location report.
* The device will allow the server to update/change configurations.
* Device will send when main power disconnected
* The device will send a daily Heartbeat location report. The heartbeat frequency will base on configuration, by default once every 25 hours (but configurable) and will include latitude, longitude, date, time and device ID, the heartbeat frequency will be configurable among a choice of presets.
* The device will send a Parking alert event when the vehicle has been stationary for more than one hour which will include the device location. The parking alert shall be able to toggle between on and off, and the “stationary time” prior to alert shall be configurable among a choice of presets.

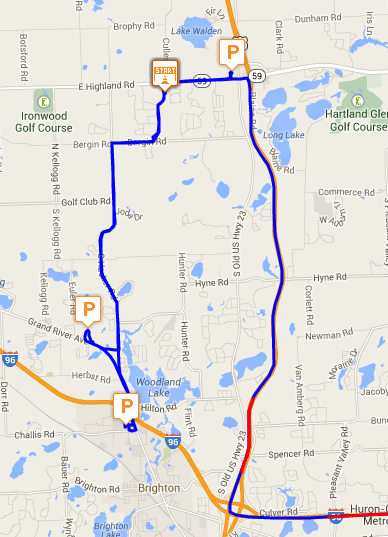


Figure 3: Parking events

* The device will support Circular and Polygon Geofences.
  + The server administrator will be able to add/modify/delete any Geofence
  + The device will check for Geofence events every 1 minute. The device will send a Geofence alert every time the vehicle crosses a fence in either direction.

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| --- | --- |
| Figure 4: Circular Geo Fence | Figure 5: Polygon Fence |

* When the Ignition is Off:
  + Device will behave the same way as when Ignition is On.

## Over the Air updates (OTA):

* OTA will work with Ignition on and Off.
* Over-the-Air update of the Firmware will replace the current image with the new image and declare the newly loaded image as the current image once the update succeeds.
* The device will be able to store two main images (current and new) simultaneously.
* If an error occurs either during the image download or it is determined that the newly loaded image is corrupt, then the device will go back to the older image it was running prior to update and declare that again as the current image.
* The OTA process will utilize all of the device’s microprocessor resources and during the process all other capabilities will be suspended.
* The OTA process will utilize the Flash memory and will overwrite any stored messages if downloaded image required more memory than the available free memory.
* Upon conclusion or early termination of the download, device will report the resulting status.

## GPS scenarios:

* When the Ignition is On, Device will receive a GPS signal at least once every 15 seconds for internal use.
* Device will provide basic sanity checks on new GPS location.
* If GPS location is suspect:
  + Device will save last good location
  + Device will provide location aging
* Drift Control: When the vehicle is parked the device will define its location based upon the last “dynamic” GPS fix recorded prior to stopping the vehicle. A dynamic GPS fix is one which is calculated while the vehicle is moving and is more representative than a static GPS fix.

## Watch mode: (configurable)

* Device will provide initial vehicle location within 30 second.
* Device will provide updates on location every 60 minutes (user configurable among presets) if ignition is on until feature is disabled.
  + Note: location updates will not occur if ignition is off unless the vehicle begins to move.
  + Note: in the case device absence of cell coverage. Once cell coverage, device will send special notification (Ack)

## Repo mode/theft mode:

* Device will provide initial vehicle location within 20 seconds.
* Device will provide updates on location every 3-5 minutes (user configurable among presets) if ignition is on until feature is disabled.
  + Note: location updates will not occur if ignition is off unless the vehicle begins to move.
  + Note: in the case device absence of cell coverage. Once cell coverage, device will send special notification (Ack)

## Late Payment / Audible warning:

* After device receives command to trigger late payment warning:
  + Device will trigger notification by setting off an external buzzer when Ignition is turned on next time.
  + Signal will be periodic:
    - On for 1 second
    - Off for 1 second
    - Repeat 30 times
  + Device will notify the user that the late payment warning was delivered after triggering the buzzer notification.

## Device Engine Starter Disable / Enable Vehicle



Figure 6: Enabling and Disabling Vehicle

The device will support disabling of the vehicle engine starter for recovery purposes and also provide the capability to over-ride the disabled starter. The device will respond to a request to disable the vehicle by sending an acknowledgment to the request and sending the GPS position at the time the request is received.

* Following that, device will check if the conditions for disabling the starter are met which are as follows:
  + Ignition is OFF.
  + Vehicle is stationary.
  + Cell Coverage is present.
  + GPS fix is valid.
* When the above conditions are met, send a report with GPS location and disable the engine starter.
* The disabled starter can also be re-enabled as explained below.

## Manual Starter Override

The device will support a manual override of the starter-disable feature by performing a pre-defined number of ignition cycles (Ignition On->Ignition Off ->Ignition On). Manual override will have following features:

* MSO feature will be enabled whenever the vehicle is in starter-disabled state.
* There will be a manual override counter to track and determine the number of times this feature gets used.
  + The counter will decrement with each MSO usage.
  + When the counter reaches 0, manual override will be disabled.
* In order to initiate an ignition On/Off cycle, the ignition needs to be off for 15 seconds.
* Manual override require the following key sequence to re-enable the starter:
  + When the counter is 2: 5 Ignition cycles within 5 seconds.
  + When the counter is 1: 7 Ignition cycles.
* The manual override counter can also be reset using configuration parameter.
* “Emergency enable” command will override MSO feature.

## Device Theft/Tow Away detection and Reporting

The device will detect and report if the vehicle is being towed as defined below:

* Vehicle motion is detected via accelerometer.
* Vehicle theft/towing detection will be enabled when the ignition is turned OFF.
* Towing event is generated if there is a change in position that is more than a predefined limit during ignition OFF.

## External Sensor Support:

* External sensors connected on analog inputs will be monitored periodically. It will have the option to be reported periodically. An event will be generated whenever a change in the read value is detected to be beyond the configured percentage of the previously reported value.
* A user will be able to remotely control digital outputs.

## Data flow mirroring:

* The Device will have the ability to mirror the data flow to a second back-up server. The data on primary and back-up server should be mirror of one another.

## Accelerometer: “six degrees of motion detection”

* The accelerometer will be able to detect motion during Ignition on and off states.
* Able to wake up device from sleep modes to full power “need to be able to tune this feature sensitivity”.
* Device will be able to provide raw accelerometer samples at regular intervals.
* Ability to adjust/tune accelerometer sensitivity so that driver behavior parameters can be set to capture “hard breaking, acceleration, hard turns, impacts, etc.”
* Always store last 30 seconds of accelerometer data so historical data can be retrieved by system should there be an incident where the vehicles last 30 seconds become material in a safety matter.

## Device Installation:

* Device will have one LED to indicate Cell signal and one LED to indicate GPS signal. The LEDs shall blink while searching and remain solid when the signal confirmed.
* Ability to toggle LED’s on or off to save power but not affect device state or preperformance.

Appendix A: Glossary

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|  |  | Description |
| ADC | : | Analogue to Digital Converter |
| GPIO | : | General Purpose Input Output |
| HTTP | : | Hypertext Transport Protocol |
| I/O (IO) | : | Input/output |
| I/P | : | Input |
| O/P | : | Output |
| SPI | : | Serial Peripheral Interface |
| TBD | : | To Be Decided |
| TCP/IP | : | Transmission Control Protocol / Internet Protocol |
| UART | : | Universal Asynchronous Receiver / Transmitter |
| UDP | : | User Datagram Protocol |
| USB | : | Universal Serial Bus |