

OPTION

Spot-On parking sensor



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2.Revision history

Version	Description	Editor	Date
1.0	First release	J. Mariën	2023-01-31
1.1	General overview	J. Mariën	2023-05-23
1.2	Correction to section 5.1	J. Mariën	2024-03-05
1.3	Updated the general overview section	J. Mariën	2024-04-22
1.4	Removed curser from image in section 3	J.Mariën	2024-05-02

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3. General overview

The battery-powered LoRaWAN parked car detector uses the combination of a magnetometer and radar sensor to determine a parked car and signals this via LoRaWAN. The SPS200 is a v1.0.3 LoRaWAN class A sensor.

The detection mechanism in the SpotON Parking Sensor uses a calibrated magnetometer to detect car movements and a pulse coherent radar (PCR) to determine whether a car is present. A battery-operated device must prevent costly power-consuming events by reducing them to the minimum, increasing delays and waiting for stable conditions to filter out disturbances and determine clear state changes.

While car movements are detected by magnetic variation, car presence detection can be limited to PCR-only mode or PCR and magneto combined (default). PCR and magnetic detection mode is useful for environmental conditions that disrupt the PCR measurement, for example, when there is snow or water on the sensor.

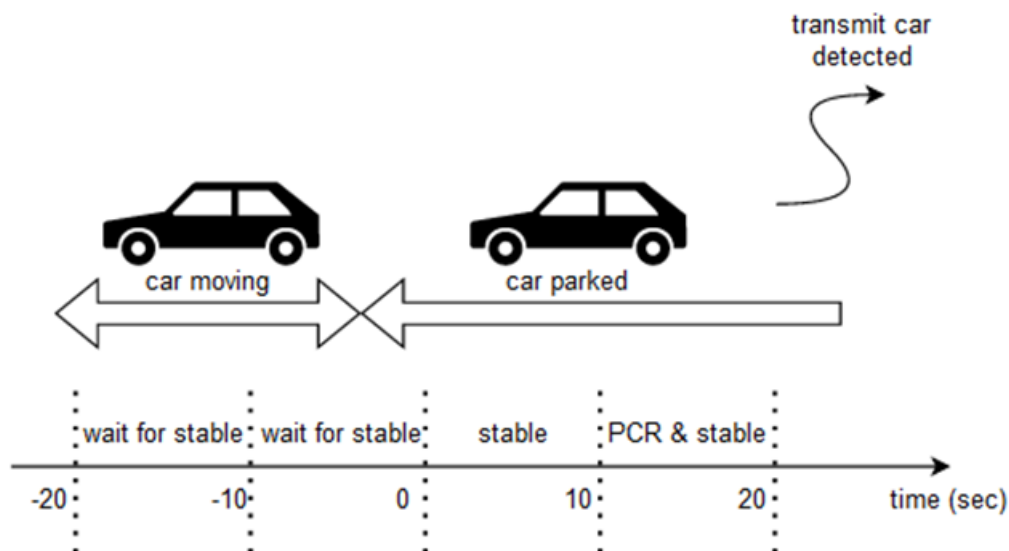
Detecting the presence of a car requires that the automatic magnetic calibration is completed.

We define two intervals

- the measurement time is 1 second, and
- the detection window of 10 seconds.

After the car is parked it takes about 20 seconds before the message is transmitted.

If the car moves/leaves again within this timeframe, the detection system is restarted. Only when a stable condition is reached of two consecutive windows with no activity, only then a decision is reached and a state determined.



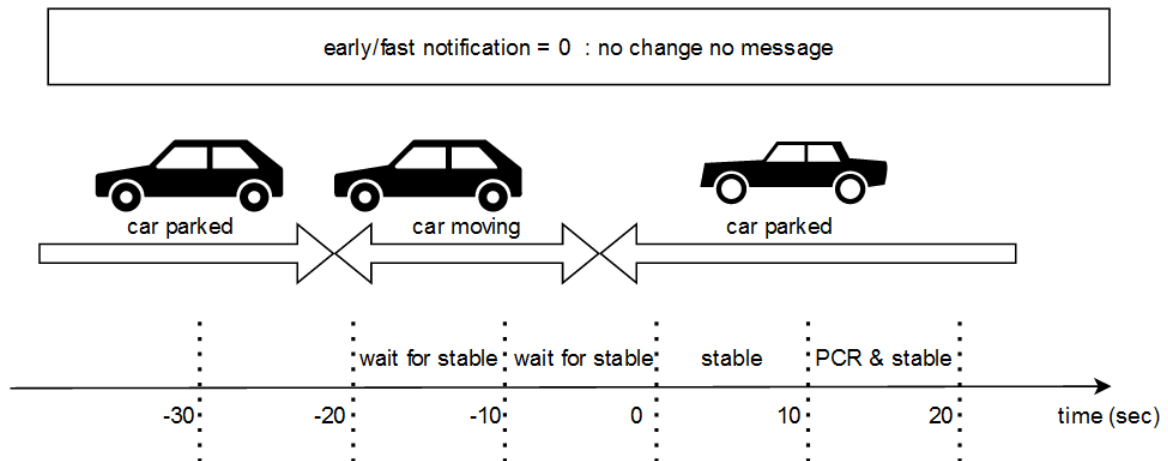
The SPS200 is self-calibrating and needs no further calibration actions after installation.

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3.1. Special detection scenarios

A normal scenario where a car is leaving, and a parking scenario is covered by the regular use case, but we do foresee one parameter for a scenario where we could retain more power depending on the specific use case.

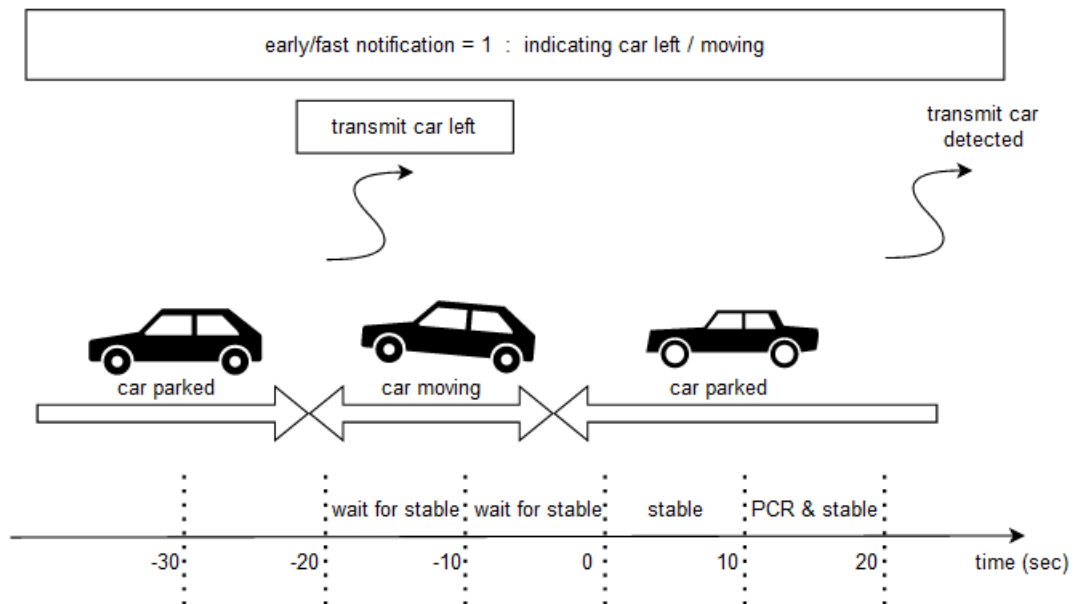
3.1.1. Scenario for park guidance and maximum battery lifetime



For guiding cars to a free parking space, it is of no use to transmit that the spot was free for a couple of seconds. Battery power can be retained by not sending a message. In the above scenario, a "quick" car change may not lead to signalling indications.

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3.1.2. Scenario for indicating all movements and more battery consumption



It is not possible to detect that the car has only moved and that the same car is in the same spot. In case of a bumper-to-bumper move where there is only a couple of seconds delay between an empty parking space and a newly parked car, we have the possibility to send a 'car left' message from the moment the car starts moving. It is not distinguishable if after this car had moved the same car is parked or another car is present.

4.Deployment

With every sensor, or batch of sensors, a csv file will be provided with the keys needed to communicate with the device. If you did not receive such a file, please contact your Option point of contact.

Each device has a unique and fixed DevEUI and a fixed crypto-random AppKey. All devices have the same JoinEUI. The IEEE_OPTION_OUI is used as a prefix for the DevEUI and JoinEUI. During production the sensor generates the DevEUI and AppKey. These keys are not readable from any debug port.

For the activation of the devices and configuration of the LoRaWAN region, please refer to our Spot-On NFC guide.

5.How to decode uplink data

5.1.LORAWAN_APP_INFO

General info that is sent every heartbeat interval (= 1 hour).

- port: 1
- Data:
 - uint8_t sensor type
For the SPS200 this will always be the value "4".
 - uint8_t hardware revision
 - uint32_t app version
 - uint8_t lora class
For the SPS200 this will always be the value 0 = class A sensor.
 - uint8_t reset reason
 - 0 = RESET_CAUSE_UNKNOWN
 - 1 = RESET_CAUSE_LOW_POWER_RESET
 - 2 = RESET_CAUSE_WINDOW_WATCHDOG_RESET
 - 3 = RESET_CAUSE_INDEPENDENT_WATCHDOG_RESET
 - 4 = RESET_CAUSE_SOFTWARE_RESET
 - 5 = RESET_CAUSE_EXTERNAL_RESET_PIN_RESET

5.2.LORAWAN_APP_CAR

One or more car detect events.

- port: 2
- confirmed: yes
- Data:

An array of one or more car detect events is sent.

The time indicates the time of the event in epoch format.

The car bit indicates whether a car is detected or not.

The counter is a 7-bit counter incremented every time a car event is created.

The queue is cleared once the lora uplink message is confirmed.

- uint32_t time
The time indicates the time of the event in epoch format.
- uint8_t car detected + counter
The car bit, bit 0, indicates whether a car is detected or not.
The counter, the remaining 7 bits, is a counter that is incremented by 1 every time a car event is created.

5.3.LORAWAN_APP_PWR

Once the power is disabled (by an nfc command), this message is sent.

- port: 4
- confirmed: no
- Data:
 - uint8_t state
The state value is 0 for inactive or 1 for active.

6.How to encode downlink data

6.1.LORAWAN_APP_RX_CMD

Receive a command to perform a specific operation.

- port: 1
- Data:
 - uint8_t command
 - LORA_CMD_RESET = 1: reboot the sensor
 - LORA_CMD_INFO = 2: request a lora info uplink
 - LORA_CMD_SLEEP = 4: configure the sleep until duration. This command contains an extra int32_t Unix timestamp to disable the car detection until this time. If the LORA_CMD_SLEEP is set to 0 or is not defined, then the car detection is enabled (again).