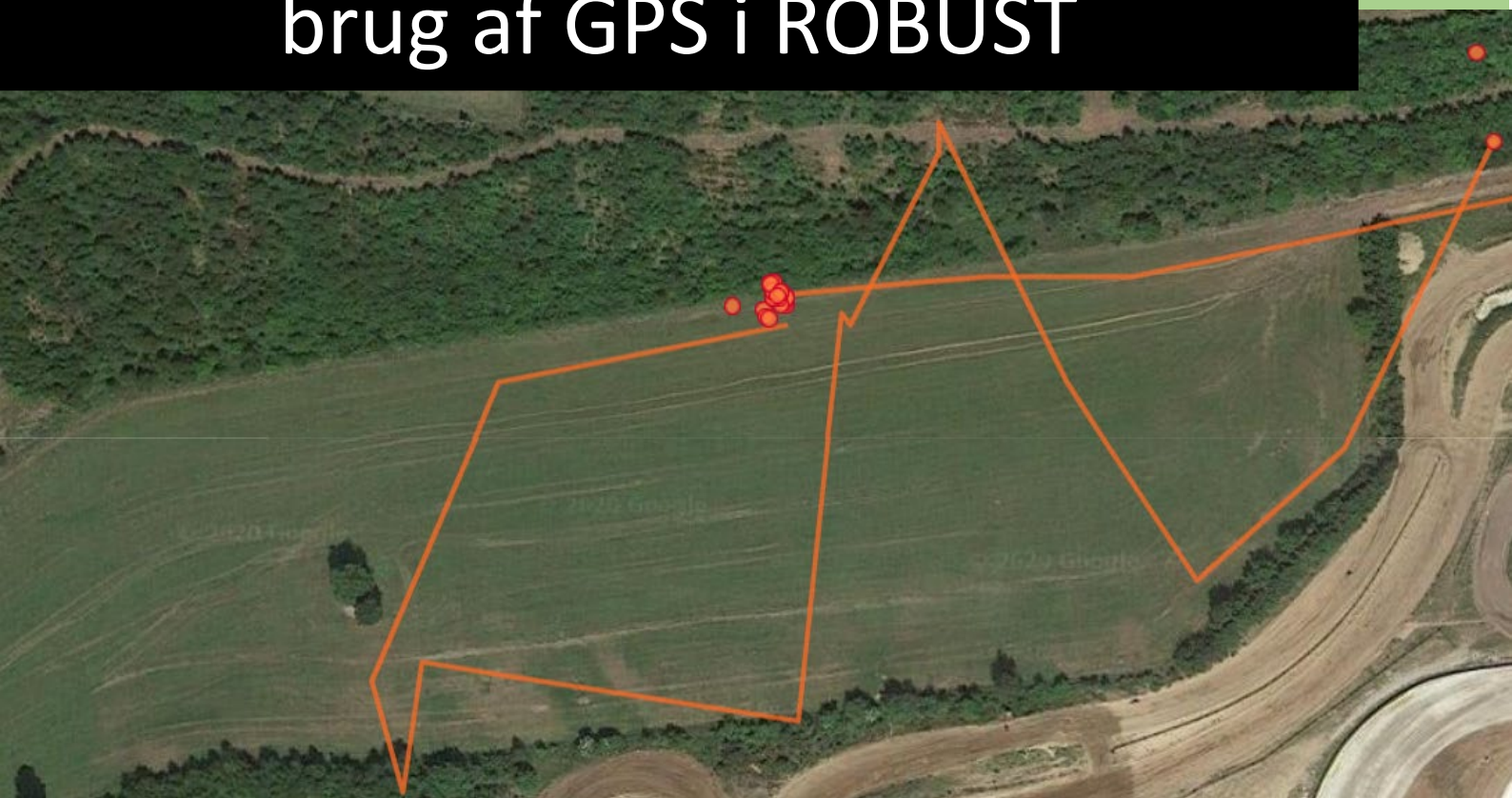


# Teknisk manual: Erfaringer med brug af GPS i ROBUST



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Manualen er udarbejdet som en del af projektet ROBUST "Skovlandbrug – et bæredygtigt landbrugssystem for planteavl og mælkeproduktion", som er støttet af Fonden for Økologisk Landbrug og Grønt Udviklings- og Demonstrations Program, GUDP under Fødevareministeriet.

I projektet ROBUST er der i 2021 og 2022 brugt GPS'er til observation af køers brug af skovarealer og læbælter. Sommerbjerg ved Mads Helms og Ellinglund ved Gert Lassen har medvirket i undersøgelsen. På Ellinglund havde køerne adgang til forskellige mindre skovarealer og på Sommerbjerg havde køerne adgang til et læbælte.

### GPS'er og montering

38 GPS'er af mærket Lightbug Pro blev indkøbt til projektet. Planen var at fordele dem hos de to medvirkende besætninger, men en hurtig erfaring omkring batteriforbrug gjorde det nødvendigt at lade GPS'erne op flere gange i løbet af græsningssæsonen. Derfor blev 8-10 GPS'er afleveret til besætningerne af gangen. GPS'erne blev lagt i en dertil indkøbt taske, som blev monteret på en halsrem på koen. Taskene var dog ikke holdbare, og 5 GPS'er blev tabt og ikke fundet igen i løbet af de første par uger. Efterfølgende blev taskerne med GPS'erne tapet fast på køernes halsremme, så de ikke faldt af.

### GPS-indstillinger

I 2021 blev GPS'erne indstillet til en opdateringsfrekvens på 15 min, dvs. hvert 15 min blev der sendt et signal om GPS'ens placering. Dette skulle ifølge producenten give en nøjagtig position minimum for hver halve time.

I 2022 blev der forsøgt med andre indstillinger, bl.a. for at se om vi kunne få endnu mere præcise data. Det gjorde at batteriet meget hurtigt blev drænet, og efter første runde i 2022 blev indstillingerne ændret tilbage til det oprindelige igen, i et forsøg på at spare mere batteri, så GPS'erne kunne blive på køerne i længere tid.

Indstillingerne er lavet på Lightbug.cloud og kan ses i bilag 1.

### Beskrivelse af data fra GPS'erne

Data fra GPS'erne er hentet fra Lightbug.cloud og er derefter 'kørt' igennem et specialudviklet program der kan vise koens lokation (definerede områder; mark, skygge, skov/læbælte) samt dato og tidspunkt for den pågældende lokation. Endvidere vises koens tid brugt i de definerede områder som varighed i minutter. GPS'ernes nøjagtighed i meter varierer meget, og den faktiske nøjagtighed er angivet i det downloadede data. I dataanalysen er data sorteret, så der kun indgår data med en nøjagtighed på max 5 meter. Det gør dog stadig at resultaterne er noget usikre, specielt for data, der viser tiden brugt i læbæltet hos Mads og i skyggeområder hos både Gert og Mads, da det er meget smalle områder.

GPS'ernes præcision bliver usikker når batteriet begynder at løbe tør. Ved en batteristatus på omkring 3,20 V stopper GPS'en med at lagre data. GPS'erne er afhængige af adgang til netværk for at sende signaler og data. Især i skov, men også på en mark kan signalet til netværket være begrænset, og data har derved en vis usikkerhed.

I projektet har der, i de læbælter og skovarealer køerne har haft adgang til, været opsat vildtkamera for at observere køernes adfærd. Dette giver samtidig en registrering af hvornår køerne har været i de pågældende områder, og kan understøtte data fra GPS'erne.

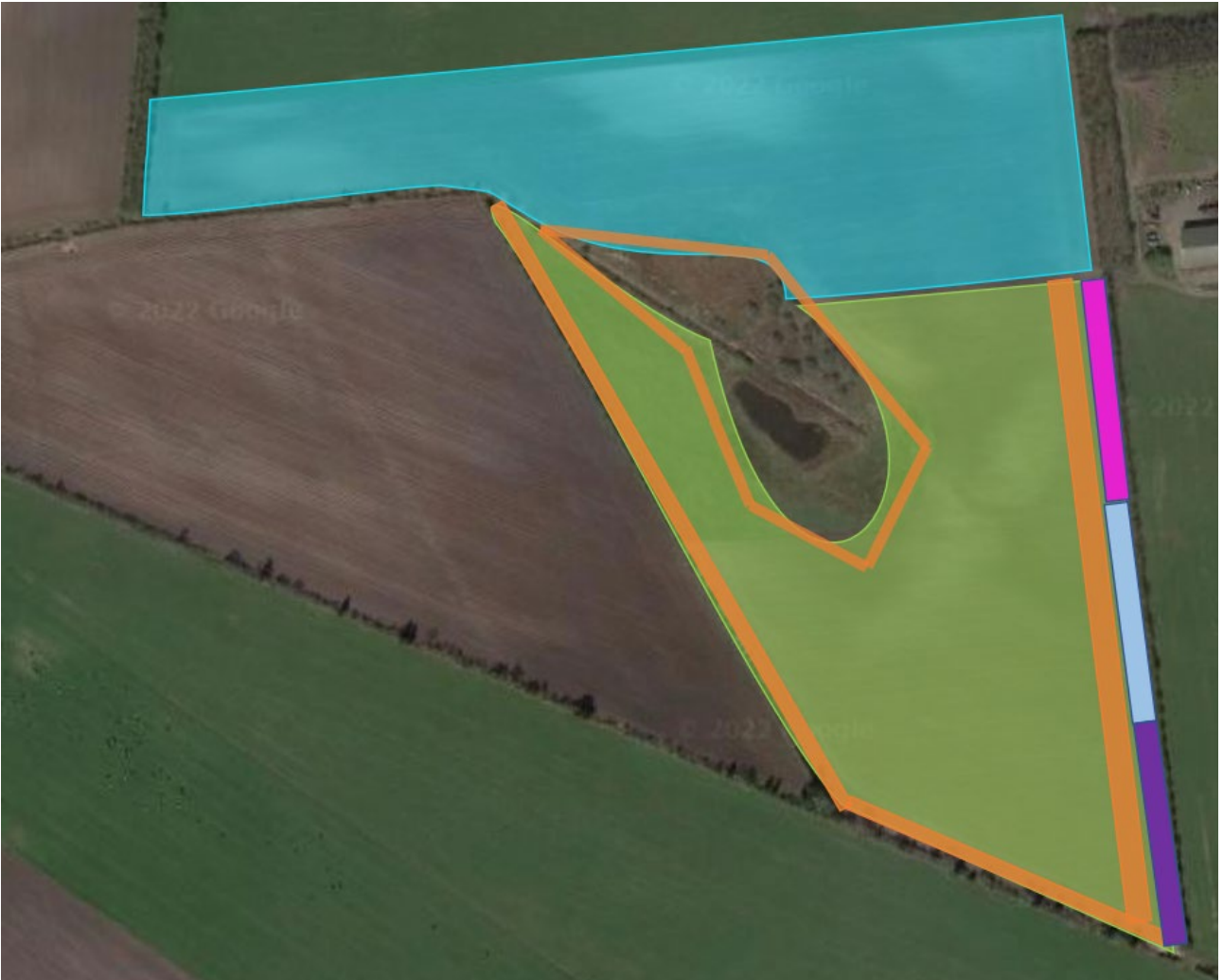
### GPS-data Mads

#### Skov- og markstykker

Hos Mads har GPS'erne været monteret på malkekøer der har haft adgang til et læbælte og dermed ikke et egentligt skovstykke. Køerne flyttes rundt på forskellige marker, og er således kun få dage på hver mark, før de flyttes videre til en anden. For at kunne få så mange detaljer om køernes brug af de tilgængelige arealer som muligt, er området ved databehandlingen inddelt i mindre definerede områder.

Læbæltet er opdelt i 3 stykker samt et samlet stykke (mørklilla, lyslilla og pink område). Den samlede mark

er opdelt i to områder (lysegrønt og turkist område). Endvidere er der defineret skyggeområder (orange områder), der ligger langs læbælterne der omkranser marken samt er område i midten af marken med buske og træer. Skyggeområder er medtaget for at se om køerne bruger skyggen fremfor skoven.



Billede 1: Områder Mads, mark 1 og 2, læbælte 1-3 samt skyggeområder.



## GPS-data Gert

### Skov- og markstykker

Hos Gert har GPS'erne været monteret på ammetanter, der sammen med en stor flok kalve har haft adgang til den samme mark i hele perioden, med skiftende adgang til fem forskellige skovstykker.

Der har således været adgang til skovstykke 1-3 (rødt område) på forskellige tidspunkter, men data er samlet for de tre skovstykker, da det ikke har været muligt at opdele data for hvert enkelt skovstykke. Det samme gælder for skovstykke 4-5 (gult område). Marken er ved dataopgørelsen opdelt i tre stykker samt et samlet stykke (klar blå, lyseblå og lys turkis). Områderne med skygge ligger langs med træerne der omgiver markerne, eller ligger midt på, eller på tværs af marken (pink områder).



Billede 2: Områder Gert, mark 1 og 2, skovstykker 1-3 og 4-5 samt skyggeområder.



Billede 3: Områder Gert, mark 3 og skygge. Markestykke 3 ligger i forlængelse af mark 2, adskilt af en række træer på tværs.

## Bilag 1: Indstillinger GPS'er

Hjemmeside: [LightBug - IoT & Tracking Portal](#)

Indstillinger laves for alle GPS på en gang. Der vælges Advanced.

### Indstillinger i 2021

Easy Setup | **Mode**

---

**Device Mode** Motion Tracking ▼

This mode enables motion detection on your device. It works great if you want to receive an alert when the tracker moves or if you need to see exactly where it has been but it does drain the battery faster

Easy Setup | **Update Frequency**

---

Select the desired update rate for when the device is moving

**Update Rate** 15 minutes ▼

---

When stationary, the device will automatically enter power-saving mode. In this mode, it will send periodic "beacon" updates to confirm it is still operational and download settings, if they have changed.

**Beacon Rate** 1 day ▼

Advanced | Motion Detection

Choose whether the device should increase its reporting frequency when moving

**Enable Motion Detection**



Set the motion sensitivity required to wake the device. 1 = most sensitive, 10 = least sensitive

**Sensitivity**

5

Set the motion sensitivity required to keep the device awake once it is moving. 1 = most sensitive, 10 = least sensitive. This value should be lower or the same as wake sensitivity above.

**Sensitivity after first move**

2

Select how long the device should wait before entering power saving mode after motion stops. Shorter timeout will capture more stops (for example when a vehicle stops at traffic lights). Longer timeout may increase battery life.

**Stop Timeout (seconds)**

120

**Detect Shocks rather than falls**



Advanced | Update Rate

**Interval (seconds)**

900

**Beacon interval (seconds)**

86400

Advanced | **GPS**

Select how many GPS points to send per *interval*. This setting only applies when the device is awake

**Packing** 5

GPS points will be recorded once every 180s and transmitted in batches to the server every *interval* (900s)

Select the maximum amount of time the GPS will search for a fix before giving up. Recommended range is 60-200s.

**GPS Timeout (seconds)** 180

Choose how long the GPS should remain on for once a fix has been acquired. Longer times *may* increase accuracy but will drain more power.

**GPS stabilise time (seconds)** 10

Choose if the the GPS should be left on when device is moving. This increases accuracy but significantly reduces battery life

**Lock GPS on**

Advanced | **Home**

If your device is often at home, disabling motion detection when in range of your home Wi-Fi network can help increase battery life.

**Please note:** there may be a delay between your device leaving home and motion detection being re-enabled. Do not use this setting if you need fast alerts.

**Ignore motion when near home Wi-Fi**

**Network Name:** MyHomeWiFi

Minimum time between Wi-Fi scans. To conserve battery, the device will limit the number of searches it makes when motion is detected. Higher intervals give better battery life, lower intervals reduce the time to first alert when the device leaves home.

**Position Check Interval (seconds)** 120



Advanced | Power Saving

Abandon Transmissions that are taking too much power to preserve battery

**Enable power budget**



**Budget (mAh)**

10

Collect data in wake mode and limit transmission so that data is only uploaded every *beacon interval* (1d)

**Transmit only on beacon**



**Disable Wi-Fi**



**Disable Bluetooth**



**Disable GPS**



Advanced | Network

Leave cellular modem on and connected when the device is awake. Can improve performance in low signal areas.

**Modem on when awake**



Leave cellular modem on and connected when the device is in power-saving mode. Reduces time to first alert when device moves.

**Modem on in sleep**



Delay transmission on first wake. Useful to avoid approximate locations when the device first wakes up (waiting gives GPS chance to lock in). Value is multiplied by 30s on the device side. Value of 2 = 60s = 1 minute

**Network wake delay (x30 seconds)**

0

Force 2G mode and disable 4G network search. Reduces search time in countries with no 4G LTE-M / CAT-M1 coverage (e.g. the UK) but may prevent roaming when abroad.

**Lock 2G mode**



Advanced | Mode Control

Only record points at the start and end of each trip to save power.

**Start Stop Only**



Lock wake mode when the button is pressed. Designed for SOS type usage

**Lock wake on Button**






Disable power-saving mode. Stay awake even when device is stationary.


**Lock wake**





## Indstillinger i foråret 2022


 **Settings for 38 devices** 





 **Configuration**


 Notifications

 Tags

 Data Plan

 Sharing

 Schedule

 **Warning:** You are editing settings for 38 devices

Setup | **Type**

---

**Configuration Mode** Advanced ▾

**Warning!** Some of these settings can significantly alter device behaviour. We don't recommend using advanced mode unless you've spoken to our support team first.

Advanced | Motion Detection

Choose whether the device should increase its reporting frequency when moving

**Enable Motion Detection**



Set the motion sensitivity required to wake the device. 1 = most sensitive, 10 = least sensitive

**Sensitivity**

6

Set the motion sensitivity required to keep the device awake once it is moving. 1 = most sensitive, 10 = least sensitive. This value should be lower or the same as wake sensitivity above.

**Sensitivity after first move**

2

Select how long the device should wait before entering power saving mode after motion stops. Shorter timeout will capture more stops (for example when a vehicle stops at traffic lights). Longer timeout may increase battery life.

**Stop Timeout (seconds)**

180

**Detect Shocks rather than falls**



Stop Timeout er forudindstillet til 120 sekunder og er i vores indstillinger ændret til 180 sek.

Advanced | Update Rate

**Interval (seconds)**

3600

**Beacon interval (seconds)**

86400

Advanced | GPS

---

Select how many GPS points to send per *interval*. This setting only applies when the device is awake

**Packing** 1

---

Select the maximum amount of time the GPS will search for a fix before giving up. Recommended range is 60-200s.

**GPS Timeout (seconds)** 120

---

Choose how long the GPS should remain on for once a fix has been acquired. Longer times *may* increase accuracy but will drain more power.

**GPS stabilise time (seconds)** 10

---

Choose if the the GPS should be left on when device is moving. This increases accuracy but significantly reduces battery life

**Lock GPS on**

Advanced | Home

---

If your device is often at home, disabling motion detection when in range of your home Wi-Fi network can help increase battery life.

**Please note:** there may be a delay between your device leaving home and motion detection being re-enabled. Do not use this setting if you need fast alerts.

**Ignore motion when near home Wi-Fi**

**Network Name:** MyHomeWiFi

---

Minimum time between Wi-Fi scans. To conserve battery, the device will limit the number of searches it makes when motion is detected. Higher intervals give better battery life, lower intervals reduce the time to first alert when the device leaves home.

**Position Check Interval (seconds)** 120

Advanced | Power Saving

Abandon Transmissions that are taking too much power to preserve battery

**Enable power budget**



**Budget (mAh)**

15 ▾

Collect data in wake mode and limit transmission so that data is only uploaded every *beacon interval* (1d)

**Transmit only on beacon**



**Disable Wi-Fi**



**Disable Bluetooth**



**Disable GPS**



Advanced | Network

Leave cellular modem on and connected when the device is awake. Can improve performance in low signal areas.

**Modem on when awake**



Leave cellular modem on and connected when the device is in power-saving mode. Reduces time to first alert when device moves.

**Modem on in sleep**



Delay transmission on first wake. Useful to avoid approximate locations when the device first wakes up (waiting gives GPS chance to lock in). Value is multiplied by 30s on the device side. Value of 2 = 60s = 1 minute

**Network wake delay (x30 seconds)**

0

Force 2G mode and disable 4G network search. Reduces search time in countries with no 4G LTE-M / CAT-M1 coverage (e.g. the UK) but may prevent roaming when abroad.

**Lock 2G mode**





Advanced | Mode Control

---

Only record points at the start and end of each trip to save power.

**Start Stop Only**



Lock wake mode when the button is pressed. Designed for SOS type usage

**Lock wake on Button**



Disable power-saving mode. Stay awake even when device is stationary.

**Lock wake**



Indstillinger på hjemmesiden: [LightBug \(thelightbug.com\)](http://thelightbug.com)

Indstillinger laves for hver enkelt GPS

**Device Name**

---

8002929

**Wake / Sleep options**

---



increase interval when moving



disable motion detection when at home

### When moving, Update location every

---

24 hrs   0 min

in wake mode, i.e. when moving

### When stationary, Update location every

---

24 hrs   0 min

in sleep mode, i.e. if not moving

### Breadcrumbs

---

Record  5  locations between transmissions to create a trail of points

Allows you to save battery by recording often but transmitting less regularly

**Example:** Interval is set to 20 minutes and breadcrumbs is set to 20. The app will only update every 20 minutes, but the spacing between points will be just 1 minute.

### Movement Settings

---

Movement Threshold (5/5) - higher values mean the device needs to move more before waking up.

Wait at least  180s  after movement stops before sending a location and returning to sleep mode

If you are mainly interested in where device has stopped (and not how it got there), you can set a short timeout with a longer transmit interval.

## GPS Settings

Wait up to  for a GPS fix before giving up. WiFi / Cell positioning will be used if this happens. Giving the GPS more time to get a fix is useful if using Pro4G indoors but will drain the battery faster. If Pro4G is inside a metal box (like a truck), leaving the GPS on longer will not help and simply drain the battery.

Let the GPS run for  to stabilize.  
Higher values may increase accuracy

## Misc. Behavior Settings

Leave the GSM on when awake

Leave the GSM on when asleep

Leave the GPS on when awake

Disable WiFi accuracy assist

## Indstillinger i efteråret 2022

The screenshot shows a settings application interface. At the top, there is a header with a settings icon and the text "Settings for 38 devices" next to a search icon. Below the header is a dropdown menu with a downward arrow. On the left side, there is a navigation menu with the following items: "Configuration" (highlighted with an orange bar), "Notifications", "Tags", "Data Plan", "Sharing", and "Schedule". The main content area on the right features a yellow warning banner that reads "Warning: You are editing settings for 38 devices". Below the banner, there is a "Setup | Type" section. Under "Setup", the "Configuration Mode" is set to "Advanced" with a dropdown arrow. A warning box below this states: "Warning! Some of these settings can significantly alter device behaviour. We don't recommend using advanced mode unless you've spoken to our support team first."

Advanced | Motion Detection

---

Choose whether the device should increase its reporting frequency when moving

**Enable Motion Detection**



Set the motion sensitivity required to wake the device. 1 = most sensitive, 10 = least sensitive

**Sensitivity**

5

Set the motion sensitivity required to keep the device awake once it is moving. 1 = most sensitive, 10 = least sensitive. This value should be lower or the same as wake sensitivity above.

**Sensitivity after first move**

2

Select how long the device should wait before entering power saving mode after motion stops. Shorter timeout will capture more stops (for example when a vehicle stops at traffic lights). Longer timeout may increase battery life.

**Stop Timeout (seconds)**

180

**Detect Shocks rather than falls**



Advanced | Update Rate

---

**Interval (seconds)**

900

**Beacon interval (seconds)**

86400

Advanced | GPS

Select how many GPS points to send per *interval*. This setting only applies when the device is awake

**Packing** 5

GPS points will be recorded once every 180s and transmitted in batches to the server every *interval* (900s)

Select the maximum amount of time the GPS will search for a fix before giving up. Recommended range is 60-200s.

**GPS Timeout (seconds)** 90

Choose how long the GPS should remain on for once a fix has been acquired. Longer times *may* increase accuracy but will drain more power.

**GPS stabilise time (seconds)** 10

Choose if the the GPS should be left on when device is moving. This increases accuracy but significantly reduces battery life

**Lock GPS on**

Advanced | Home

If your device is often at home, disabling motion detection when in range of your home Wi-Fi network can help increase battery life.

**Please note:** there may be a delay between your device leaving home and motion detection being re-enabled. Do not use this setting if you need fast alerts.

**Ignore motion when near home Wi-Fi**



Advanced | Power Saving

Abandon Transmissions that are taking too much power to preserve battery

**Enable power budget**



**Budget (mAh)**

10

Collect data in wake mode and limit transmission so that data is only uploaded every *beacon interval* (1d)

**Transmit only on beacon**



**Disable Wi-Fi**



**Disable Bluetooth**



**Disable GPS**



Advanced | Network

Leave cellular modem on and connected when the device is awake. Can improve performance in low signal areas.

**Modem on when awake**



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**Modem on in sleep**



Delay transmission on first wake. Useful to avoid approximate locations when the device first wakes up (waiting gives GPS chance to lock in). Value is multiplied by 30s on the device side. Value of 2 = 60s = 1 minute

**Network wake delay (x30 seconds)**

0

Force 2G mode and disable 4G network search. Reduces search time in countries with no 4G LTE-M / CAT-M1 coverage (e.g. the UK) but may prevent roaming when abroad.

**Lock 2G mode**



Advanced | Mode Control

---

Only record points at the start and end of each trip to save power.

**Start Stop Only**



Lock wake mode when the button is pressed. Designed for SOS type usage

**Lock wake on Button**



Disable power-saving mode. Stay awake even when device is stationary.

**Lock wake**

