Cat Tracker

nRF9160 Tracker v0.1.2

Preliminary Description

2020-06-18

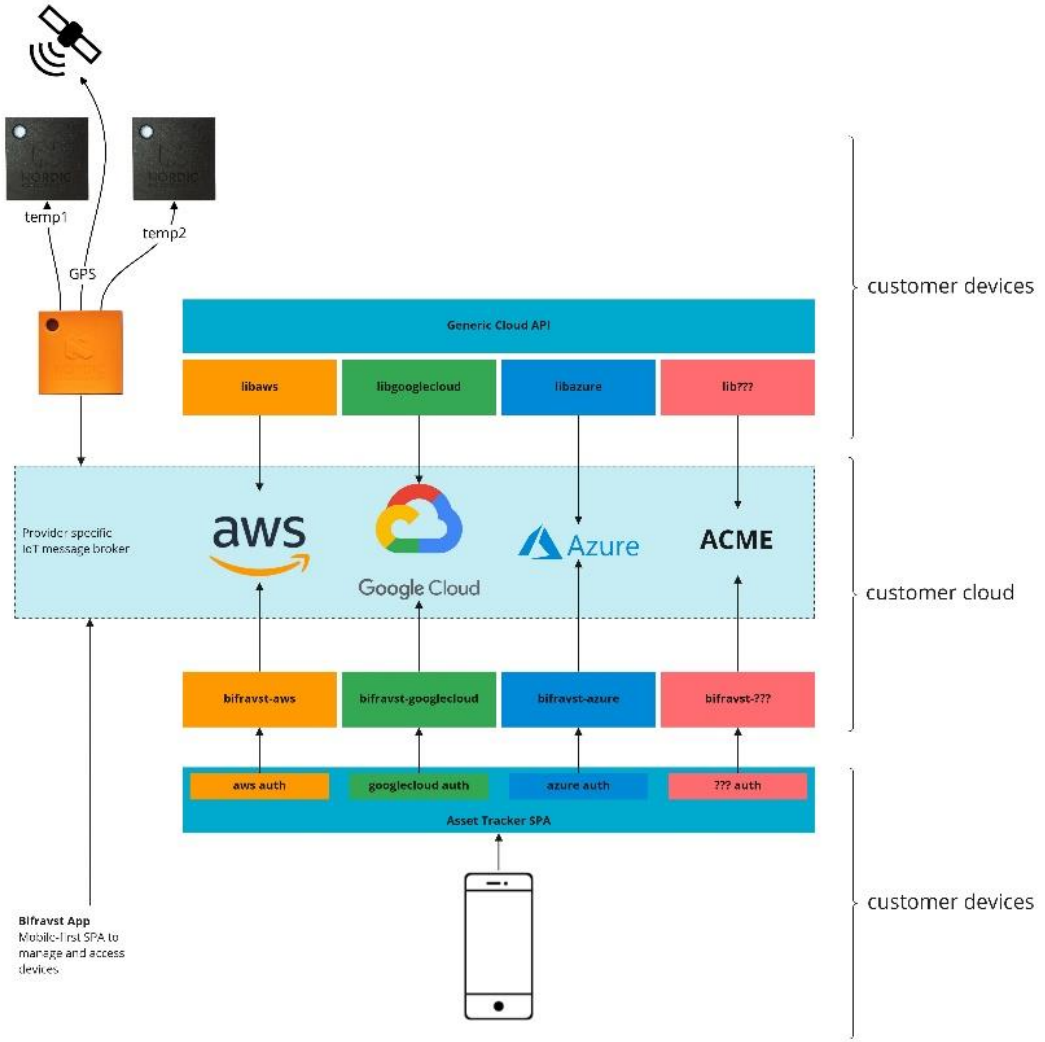
“Bifravst” – Full Stack IoT Solution

Bifravst aims to provide a concrete end-to-end sample for an IoT product in the asset tracker space, a *Cat Tracker*. Bifravst is not a framework, but a real application.

Developers are enabled to set up a real world IoT solution using their cloud provider and start adapting the sample firmware and software for their use case within minutes.

The firmware samples should highlight power saving features of the nRF9160 because this is critical for developing very small formfactor devices.

Layer Model of Bifravst



nRF9160 Tracker

FW

The firmware is developed on the Thingy:91, using its built in LTE-M and GPS antenna. The firmware is assumed to be identical on the tracker prototype itself.

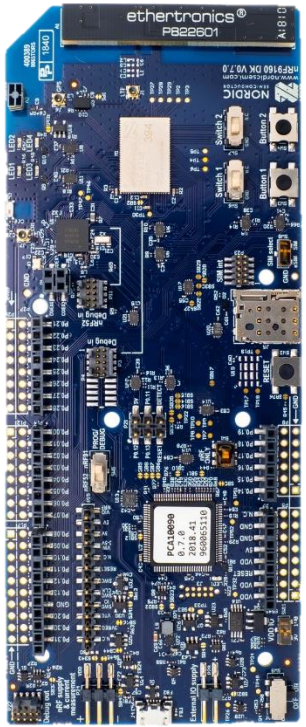
HW

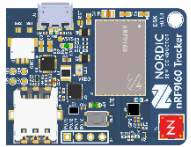
A prototype in a small size is engineered to run the firmware. It is heavily influenced by the Thingy:91, however it is drastically smaller and cheaper.

App

The web application is user account based and connects with a physical Thingy:91. The app displays different “cats”, and plots their position on a map. Additional information (LTE status, sensor data, battery) is also available.

Development Goal





Advantages With nRF9160 in a Tracker

nRF9160 is a small SiP with most required components embedded, which makes it possible to realize more compact designs.

nRF9160 has modern cellular technology; NB-IoT and LTE-M is more in thread with IoT than GSM due to modulation, data rate and power usage to name a few.

nRF9160 has an embedded GPS radio, which makes asset tracking an ideal use case.

Hardware Requirements

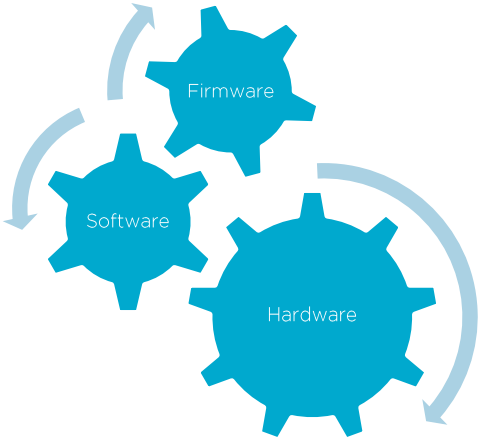
1 Small Size

2 Low Power

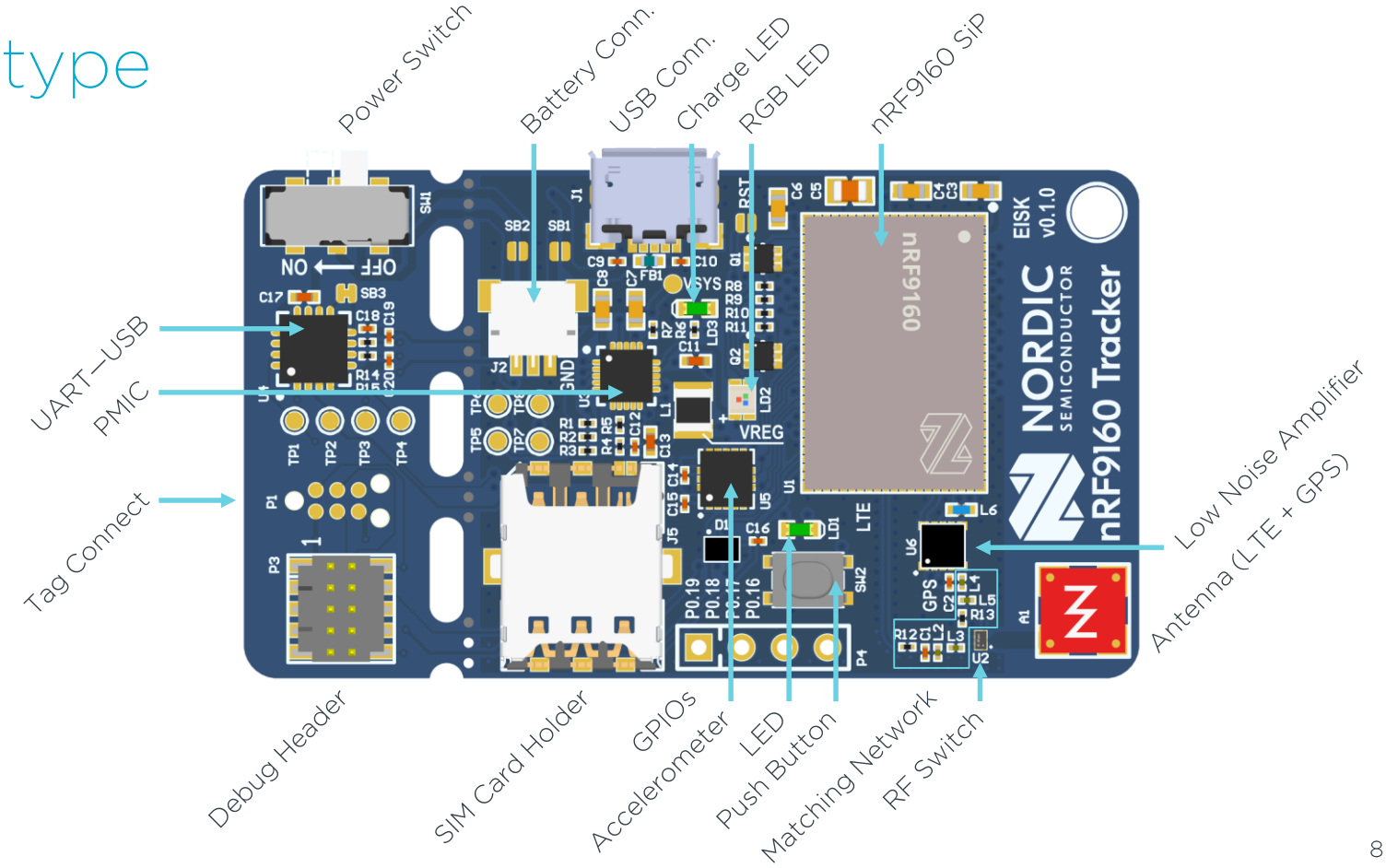
3 Cheap Design

4 Connectivity and Sensors

5 Great Signal Reception

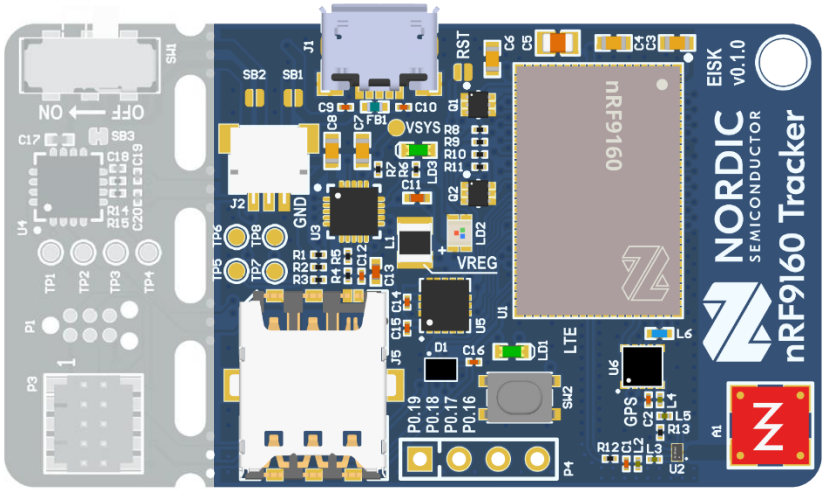


Prototype



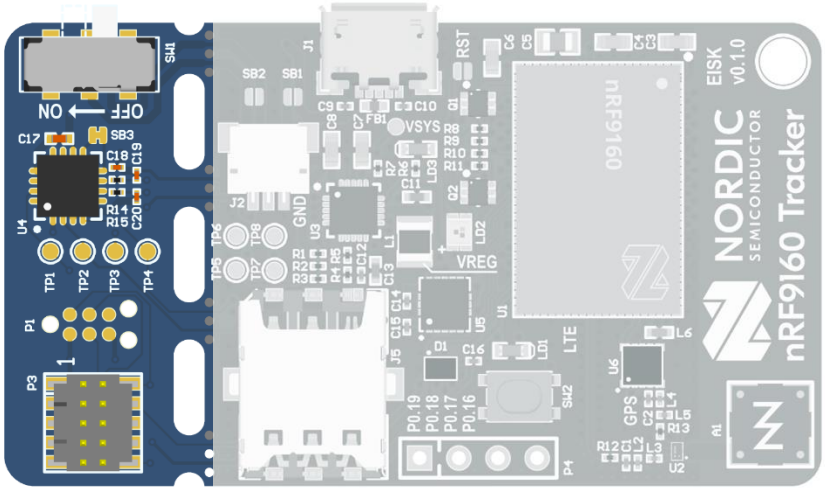
Prototype: Main Components

- nRF9160 SICA SiP
- NN CUBE mXTEND™
- Analog Devices PMIC
- SIM card interface
- Low Power Accelerometer
- Pushbutton
- RGB-LED and green LED
- 4 GPIOs (both analog and digital)



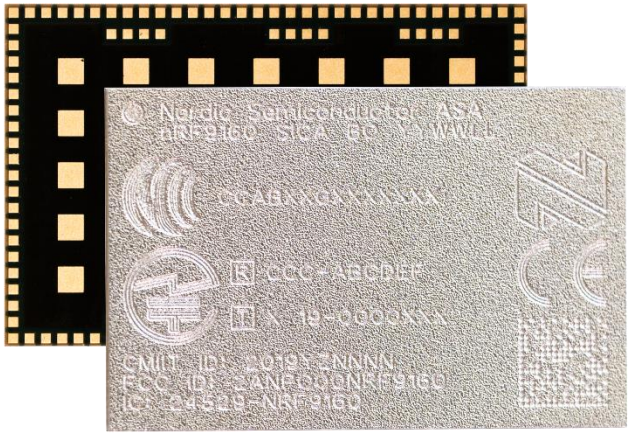
Prototype: Break-off Components

- Power Switch
- FTDI UART—USB
- Tag Connect
- Programming Header



MCU: nRF9160 SiP

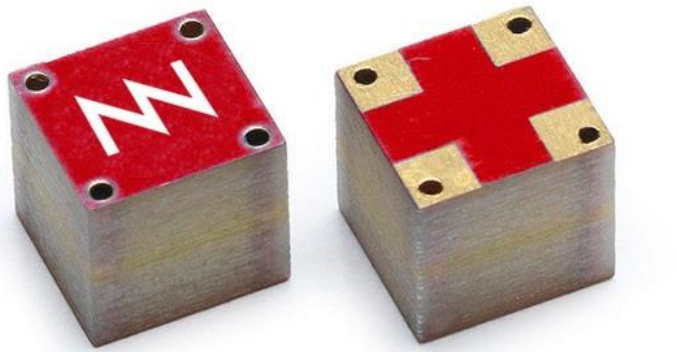
- ARM® Cortex®-M33
- 1 MB flash
- 256 kB low leakage RAM
- ARM® Trustzone® & Cryptocell 310
- 32 GPIOs
- Single supply voltage: 3.0–5.5 V
- All necessary clock sources integrated
- 4x: SPI, TWI (e.g. I²C), UART



(10 × 16 x 1.04) mm LGA package

Antenna: NN CUBE mXTEND™

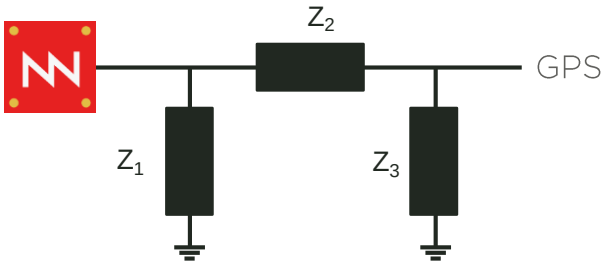
- Fractus AnteNNas®
- Virtual Antenna™
- Small footprint
- “Wideband”
- Used as LTE and GPS antenna!



https://www.fractusantennas.com/chip-antenna/

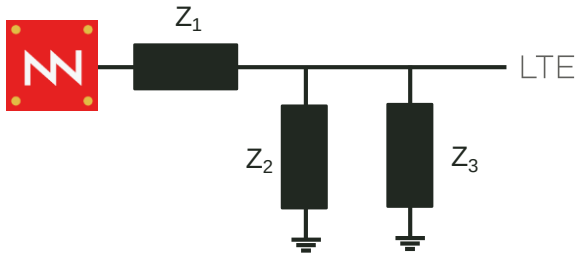
Matching Networks

GPS Matching Topology



Component	Value	Part Number
Z1	11 nH	LQW03AW12NJ00
Z2	2.8 nH	LQW03AW2N8C00
Z3		

LTE Matching Topology



Component	Value	Part Number
Z1	8.7 nH	LQW03AW8N7J00
Z2	2.0 nH	LQW03AW2N0C00
Z3	3.0 pF	GJM0335C1E3R0WB01

NB! These values correspond to the matching network implemented on the preliminary electromagnetic simulated analysis and should be optimized considering the complete device in a real scenario.

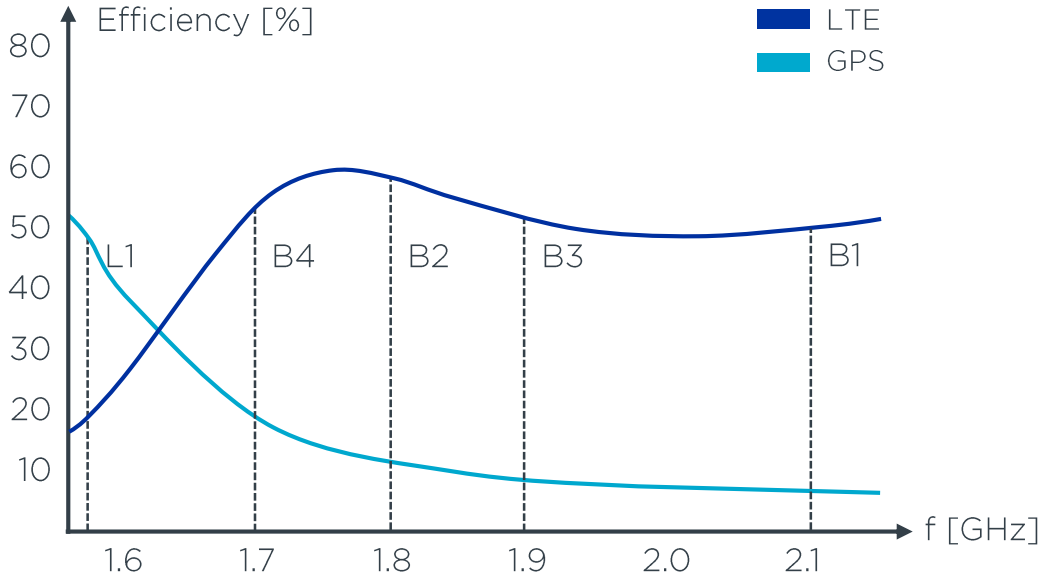
Antenna Efficiency

Radio	Band	f [MHz]	Eff. [%]
GPS	L1	1575	52.1
LTE	B4	1710	55.4
	B1	2155	51.5
	B1–B4	1710–2155	52.4*

* Average efficiency over bandwidth

Band	ITU Region	Continent#
B3, B4	1	America
B1, B2	2, 3	Europe, Asia

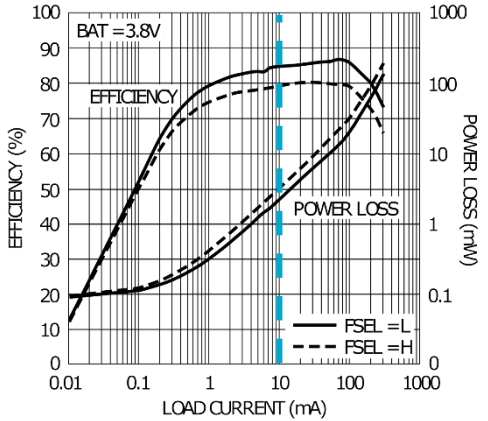
Approximated, see Wiki page for more details



NB! These values correspond to the matching network implemented on the preliminary electromagnetic simulated analysis and should be optimized considering the complete device in a real scenario.

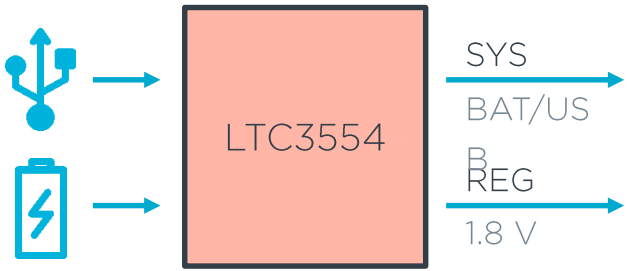
PMIC: Analog Devices LTC3554

- DC/DC converter
- Stable regulated voltage of 1.8 V
  - Voltage for all active components on PCB (except nRF9160)
- Battery charging via USB bus
- Very low quiescent current
- Auto-on if USB is connected
- Sleep-wake: Push-button interrupt



Voltage Supplies

	USB	BAT	REG	SYS
Portable		X	Yes	BAT
Charge	X	X	Yes	USB
Stationary	X		Yes	USB
INT	n/a	X	No	BAT



- Regulated 1.8 V is always on until INT
- Battery charges through USB
- Only nRF9160and LEDs supplied by VSYS
- NB! VSYS is unregulated

Accelerometer: Analog Devices ADXL362

- Ultra low power
  - 0.1 mA @ 1.8 V (approx.)
  - 4 nA standby current
- ±2 g, ±4 g or ±8 g
- On-chip temperature sensor
- SPI digital interface
- Movement detection for dynamic power usage

Connectivity

GPIOs

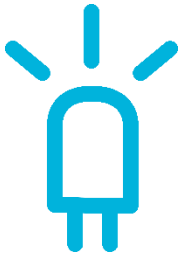
4 GPIOs for development

Digital and analog

1.8 V GPIO voltage

0.254 mm pitch

LEDs



GPIO controlled LEDs

1 RGB LED

1 Green LED

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