



Introduction to Nordic Thingy:91

Prototyping Platform for cellular IoT applications

Webinar

Nordic Semiconductor

August 2019

Duration: approx 45 mins

Today's hosts

John Leonard



Senior Product
Marketing Manager

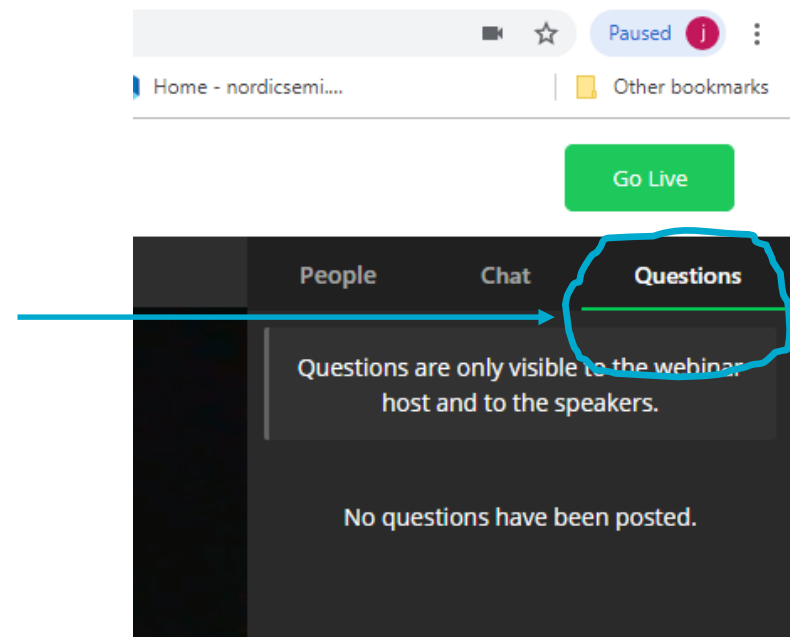
Bjørn Kvaale



Applications
Engineer

This webinar

- Duration: 45 mins
- Questions can be asked by typing in the questions field. We can't take questions verbally
- We will take the questions at the end of the webinar.



Content

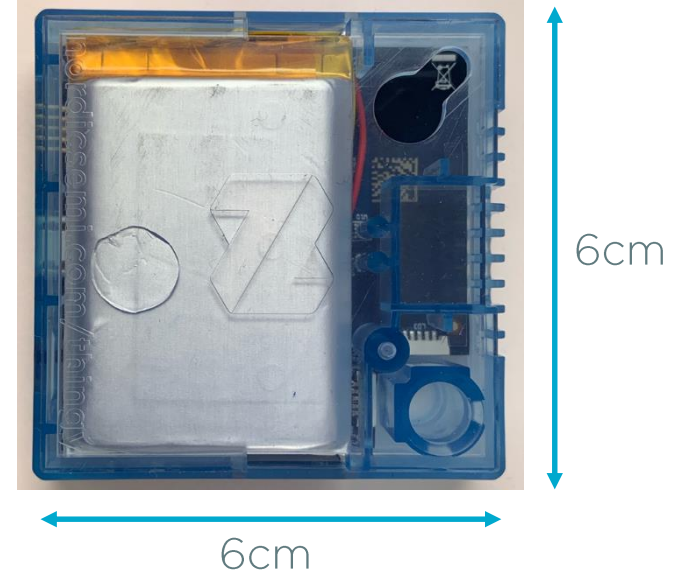
- What is Nordic Thingy:91?
- Prototyping and PoCs
- The Nordic Thingy:91 kit
- nRF9160 SiP – LTE-M/NB-IoT + GPS
- Sensors and features
- Cellular IoT
- Nordic cloT prototyping platform
- nRF52840 & BLE
- nRF Connect SDK
- Asset-tracker example
- Summary
- Demo
- Q&A

What is Nordic Thingy:91?

- An 'out-of-the-box' rapid prototyping kit for IoT
- Supports LTE-M/NB-IoT and GPS
- Ships with a eSIM
- Supports Bluetooth Low Energy
- Lots of other sensors etc.
- Comes with a sophisticated application ready to go
- Dev tools and SDK



Nordic Thingy:91 – Flexible, rugged, compact



Why we made it? -IoT projects are big

- IoT systems are complex and straddle multiple domains
- Only the largest companies have expertise across all domains
- Many IoT companies are young and have limited resources available
- Need to demonstrate viability at an early stage



Sensors-Embedded-Connectivity-Cloud-Analytics-Insights

Prototyping and PoCs

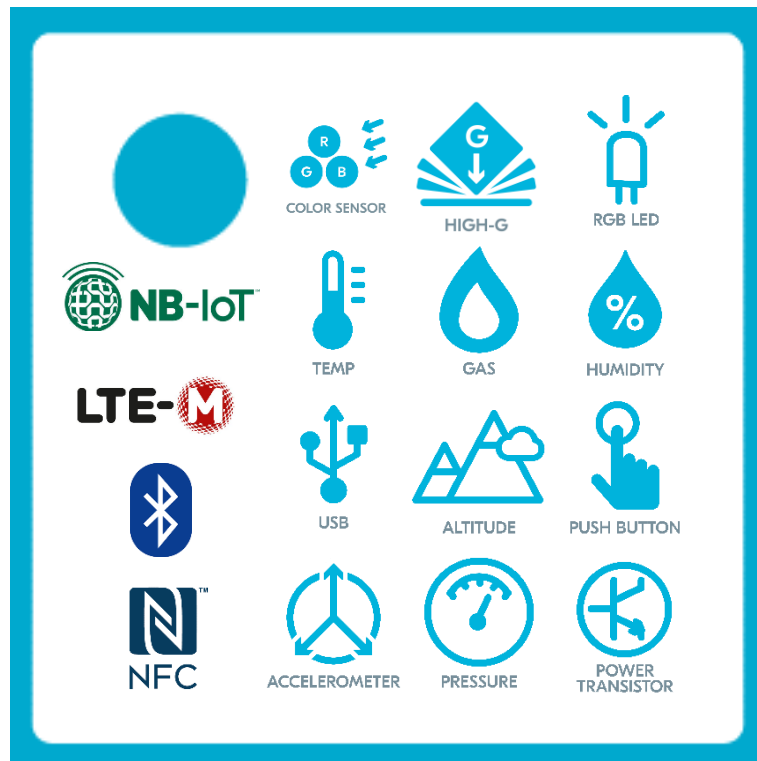
- Embedded is getting more and more complex
- Even simple connected products have significant complexity
- PoCs need to be built so they can be adapted to final product
- Nordic offers PoC that works immediately and can be tailored later
- Nordic Thingy:91 covers sensors to connectivity



Sensors-Embedded-Connectivity

Nordic Thingy:91

- cloT: LTE-M and NB-IoT
- Short range: Bluetooth Low Energy
- Positioning: GPS
- Touch-to-pair: NFC
- eSIM: iBasis global roaming
- Sensors: various
- Power: LiPo battery
- Upgrades: FOTA
- Programming: External DK



What can you measure?

Parameters	
Impact	Absolute position (GPS)
Temperature	Relative position
Movement	Altitude
Vibration	Button press
Humidity	Pressure
Light level	Gas
Light color	

Comms and actions

Comms	Actions
LTE-M	RGB LED
NB-IoT	Buzzer
Bluetooth LE	4 x MosFET ouputs
Bluetooth mesh	
Zigbee	
Thread	
NFC	

Sensors partners

- Bosch Sensortec BME680
 - Barometric pressure and altitude
 - Temperature
 - Relative humidity
 - Volatile organic compounds (VOCs)



- Analog Devices
 - ADXL362 Low power accelerometer
 - ADXL372 $\pm 200g$ accelerometer



- ROHM BH1749 Light/Color Sensor



Main features



Environmental Unit
Measures pressure, humidity, temperature and gas



Pressure
Measures barometric pressure and altitude



Relative Humidity
Measures relative humidity with a fast response time



Temperature
Measures ambient temperature

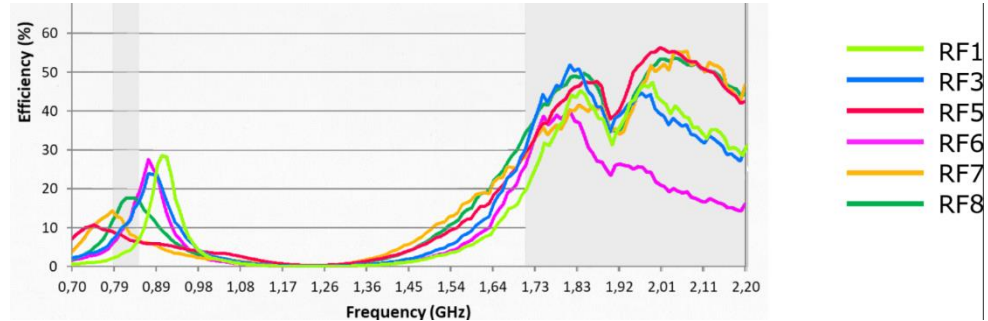
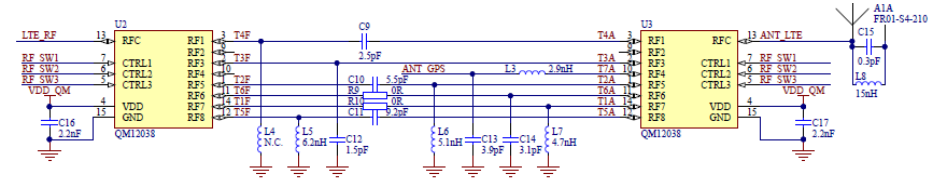


Gas
Measures Volatile Organic Compounds (VOC)

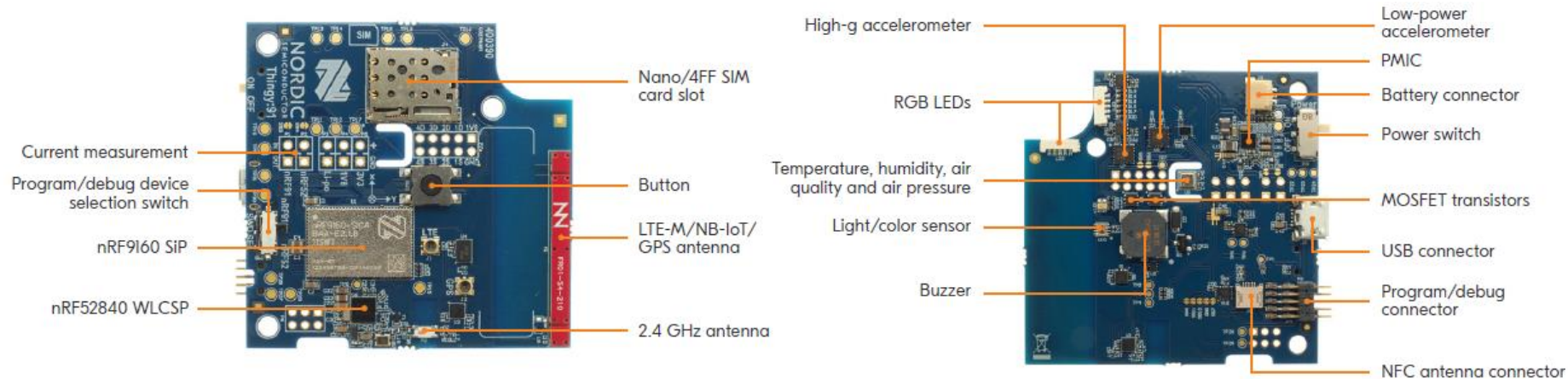
Active antenna performance

- Active tuning of the antenna.
- Small ground plane means small bandwidth on the antenna.
- Using MAGPIO, RF switches and different matching networks to move the peak performance of the antenna to the currently used frequency.
- Application note with Fractus Antennas.

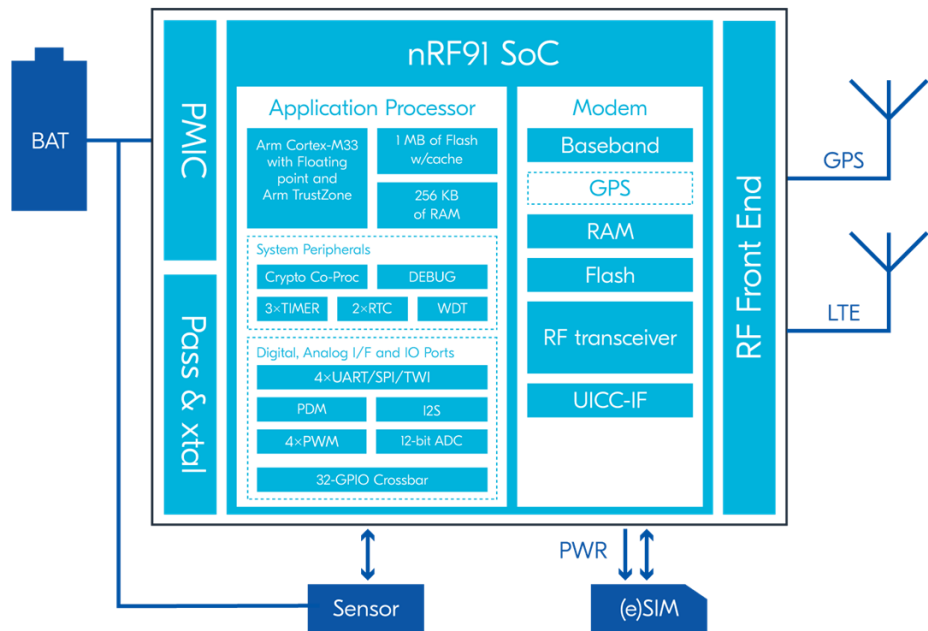
FRACTUS ANTENNAS



Thingy:91 Hardware



nRF9160 SiP for cIoT



Radio/Modem

- LTE-M and NB-IoT
- +23dBm output power
- GPS

Application processor

- Arm Cortex-M33 @ 64MHz
- 1MB flash + 256kB RAM
- Arm TrustZone

Integrated

- PMIC
- RFFE
- Extensive peripheral set

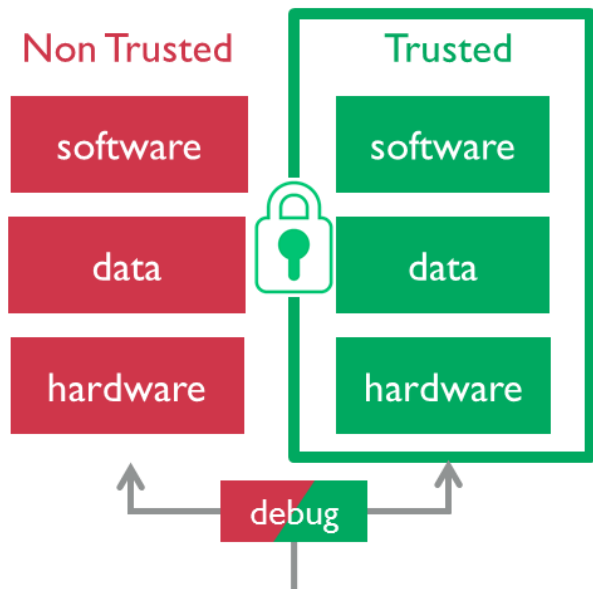
Low power LTE-M/NB-IoT modem + GPS

Multi-Protocol low power LTE	3GPP LTE release 13 Cat-M1 and Cat-NB1 compliant 3GPP LTE release 14 Cat-NB1 and Cat-NB2 compliant 729 – 2200 MHz band range
LTE bands	1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 66
Performance	-108 dBm RX Sensitivity (LTE-M) -114dBm NB-IoT Up to +23 dBm TX output Power 375kbps – LTE-M, 60kbps – NB-IoT
Energy Efficiency	eDRX, PSM
Features	GPS On-chip Balun, Single ended 50Ω

Arm Cortex-M33 application processor

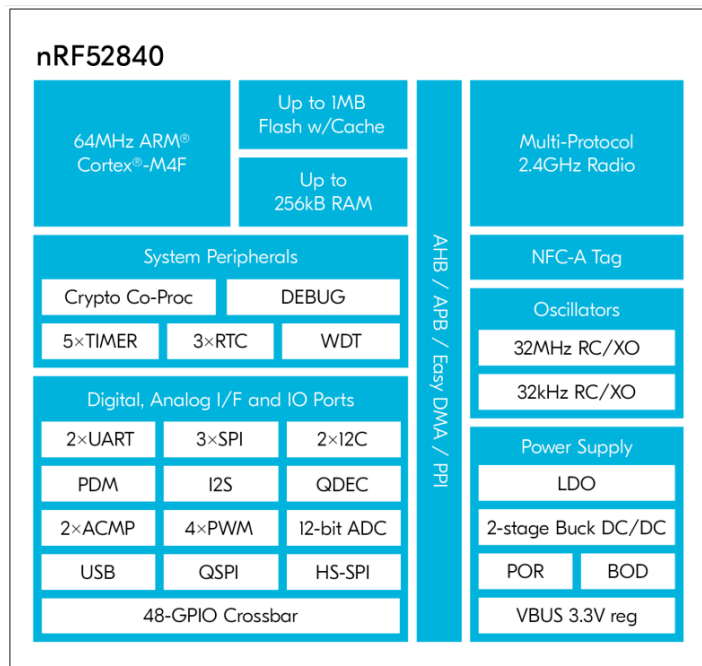
Processor Core	ARM® Cortex®-M33 at 64MHz
DSP & FPU	As per Cortex-M4F
Trusted execution	Arm TrustZone
Performance	234 EEMBC CoreMark® - 3.65 Coremarks/MHz

nRF9160 – Arm TrustZone



- nRF9160 is a security-hardened device – in hardware
- Arm TrustZone
- Arm CryptoCell
- Parts of the device no outsiders can get access to
 - Memory
 - Key storage
 - Critical functions

nRF52840 multiprotocol SoC



On the Nordic Thingy:91

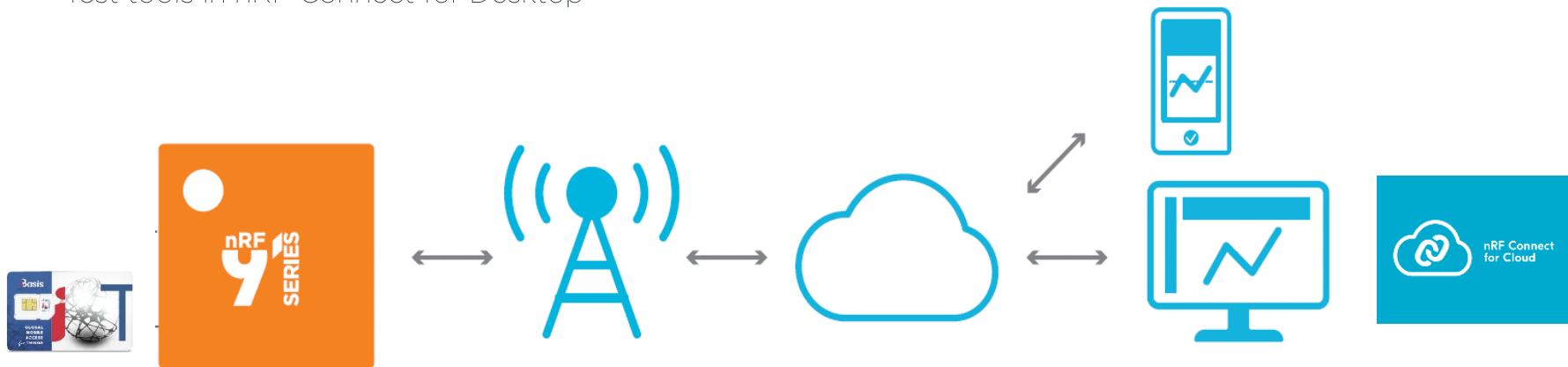
- Comms support from nRF9160 to USB
- Standard nRF52840 compatible with SoftDevices and SDKs

Key features

- Bluetooth 5/802.15.4 radio
- Arm Cortex-M4F
- 1MB flash + 256kB RAM
- NFC
- Extensive peripheral set

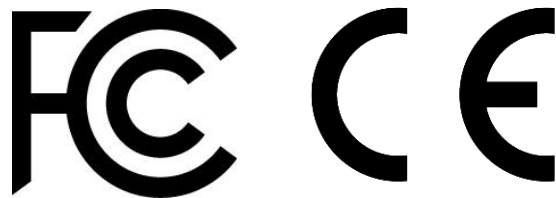
The prototyping platform

- Supplied with roaming eSIM from iBasis
- 10MB pre-loaded data plan
- Provision to network using nRF Connect for Cloud
- FOTA is driven from the nRF Connect for Cloud
- Monitor parameters in nRF Connect for Cloud
- Test tools in nRF Connect for Desktop



Certifications and usage

- Thingy:91 is CE and FCC certified
- LTE bands: B2, B3, B4, B8, B12, B13, B20, B28
- nRF9160 certified:
 - CE
 - FCC
 - GCF
 - PTCRB
 - Japan, Taiwan, ISED, ACMA, RCM, IMDA
 - Arm PSA
 - Network operators: Verizon



Asset tracking with cellular IoT



Containers



Equipment/plant



Livestock



Valuables



People



Parcels

Cellular IoT

Long range connectivity - options

Low Power Wide Area Networks (LPWAN)

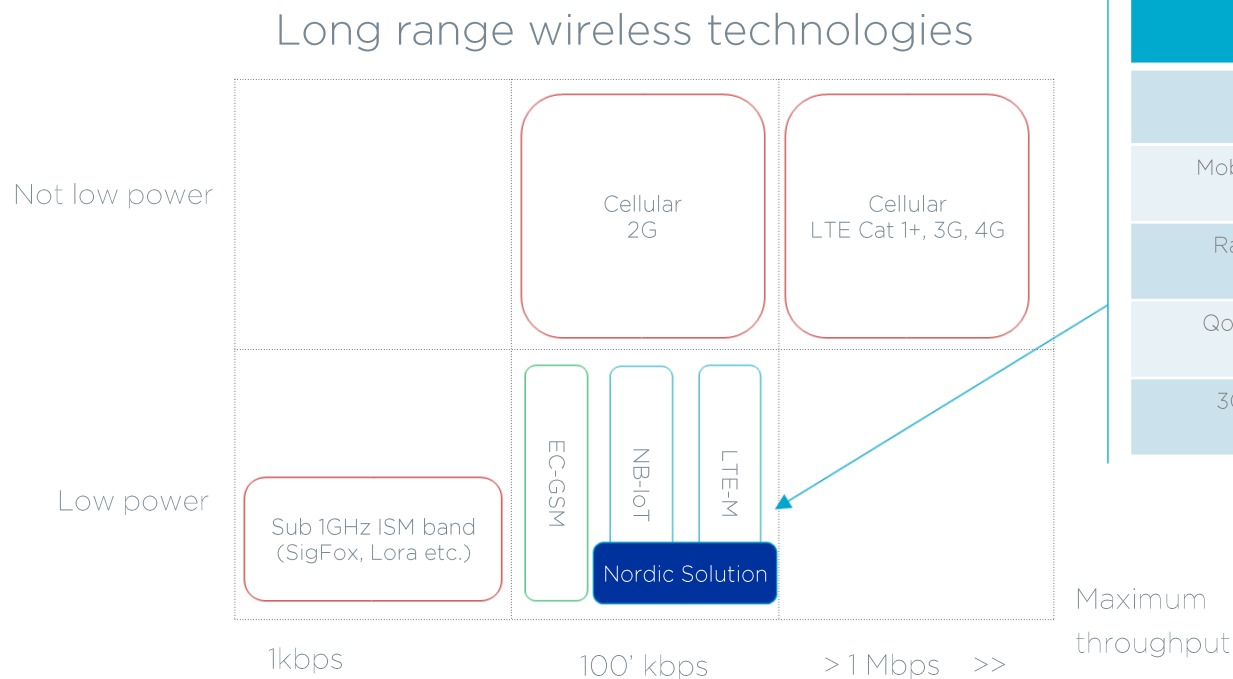
Some LPWAN considerations:

- Mobility and roaming
- Range/Link budget
- Security
- Data throughput
- QoS/reliability
- Coverage/Density
- Standardized/Non-standardized
- Carrier network support

Some IC considerations:

- Choice of SoCs/ICs with support
- Advanced technology devices
- Security features
- Single device application solutions
- Global operation

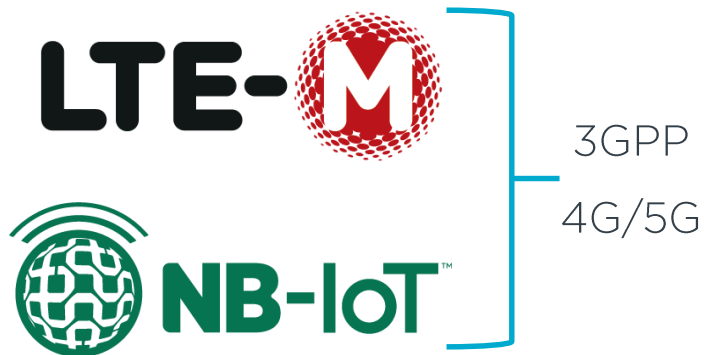
LPWAN Technology landscape and strategy



LTE-M	NB-IoT
384kbps	30-60kbps
Mobility & roaming	-
Range x4 of 4G	Range x7 of 4G
QoS, TLS security	QoS, TLS security
3GPP standard	3GPP standard

Long range connectivity options - LPWAN

Standards-based/Licensed

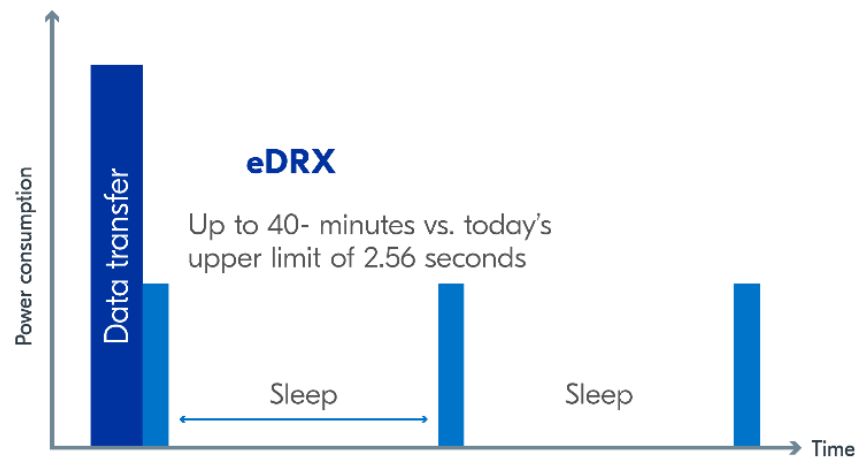
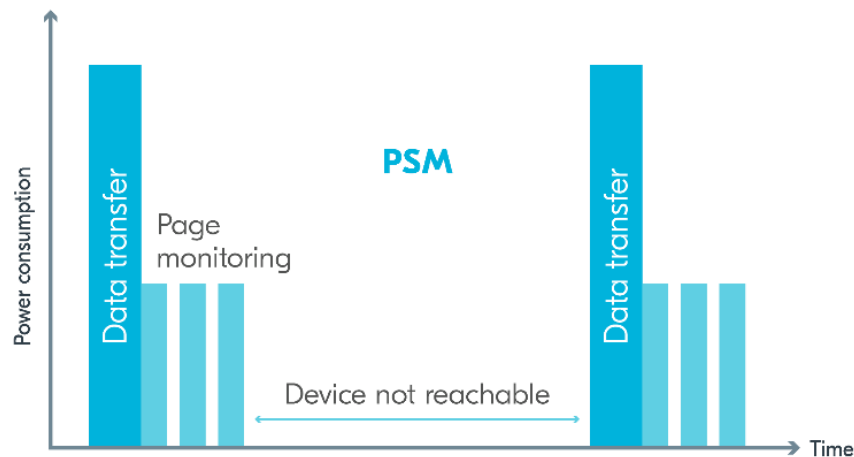


Proprietary/Unlicensed



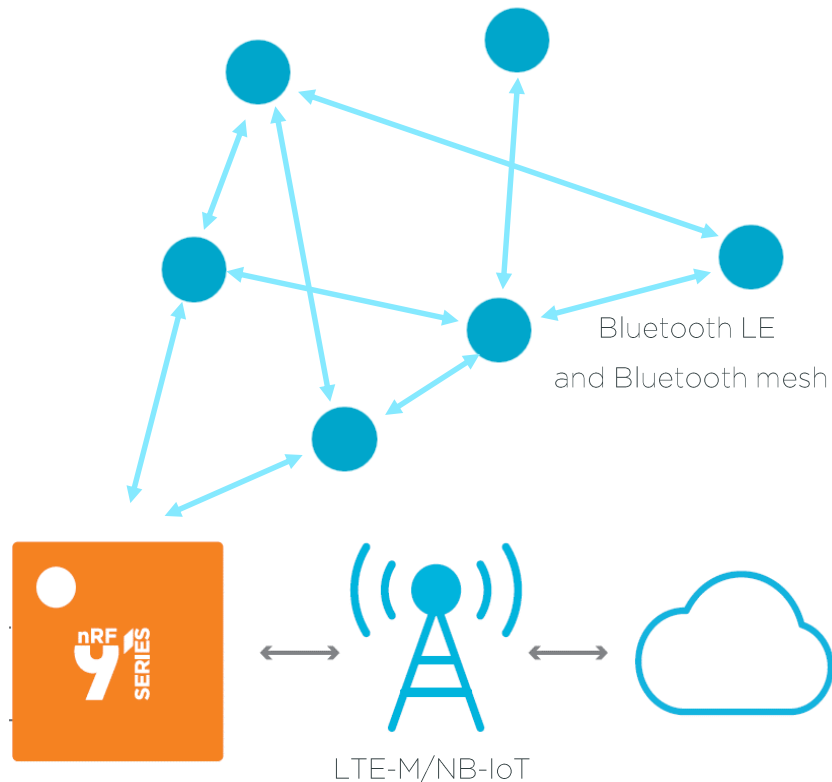


LTE energy saving modes



IoT + Bluetooth LE/Bluetooth mesh

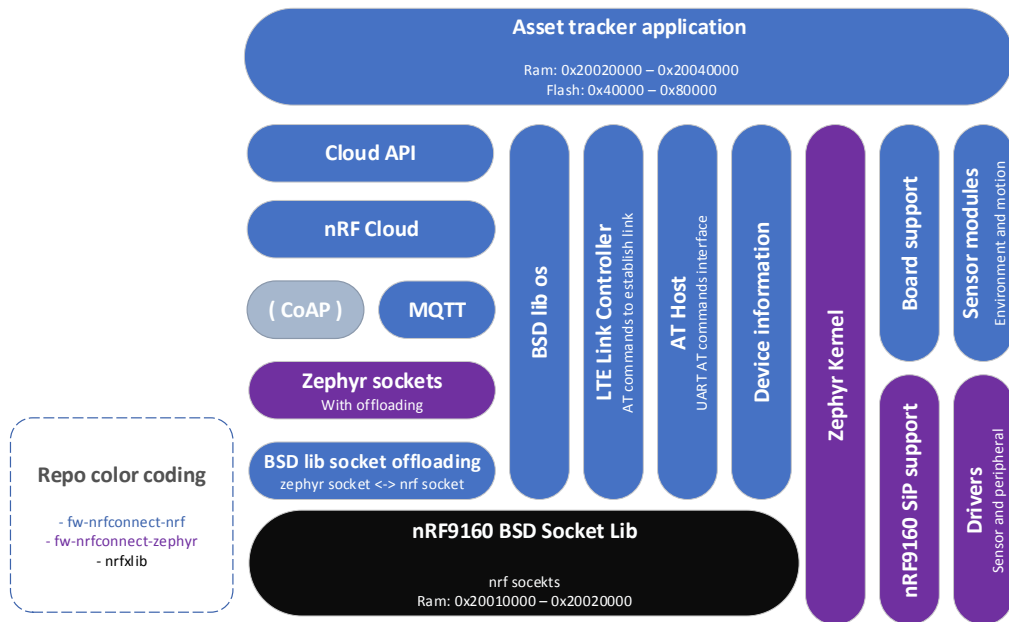
- Nordic Thingy:91 has nRF9160 and nRF52840
- IoT and Bluetooth LE/mesh are naturally complimentary
- Not supported 'out-of-the-box' as yet



Developing & nRF Connect SDK

Developing and firmware

- Thingy:91 SW is in nRF Connect SDK.
- Uses Zephyr RTOS.
- Sensor drivers ported to Zephyr.
- Available on Nordic Semi GitHub.
- Segger Embedded Studio IDE
- Use nRF9160 DK for program/debug.

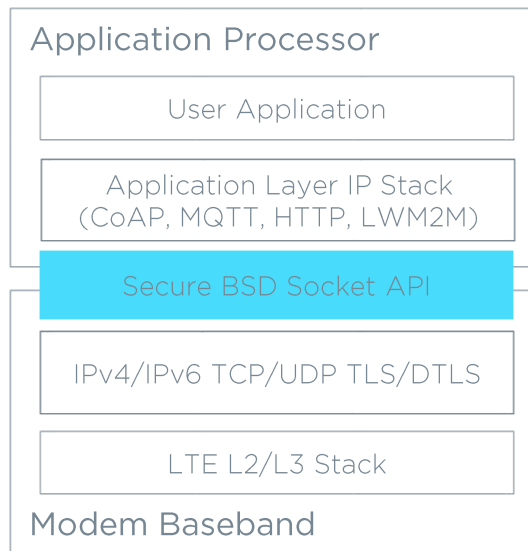


Why the Zephyr RTOS?

- Zephyr designed & built for low power wireless
- Zephyr is independent
 - Linux Foundation Project
 - Contributions made by over 300 industry embedded experts
- Zephyr is scalable
 - Very small configurations for memory constrained devices (< 8 kB)
 - Powerful, feature-rich, configurations for large memory, high-processing power devices
- Zephyr includes popular IP standards
 - Nordic can focus on other important features



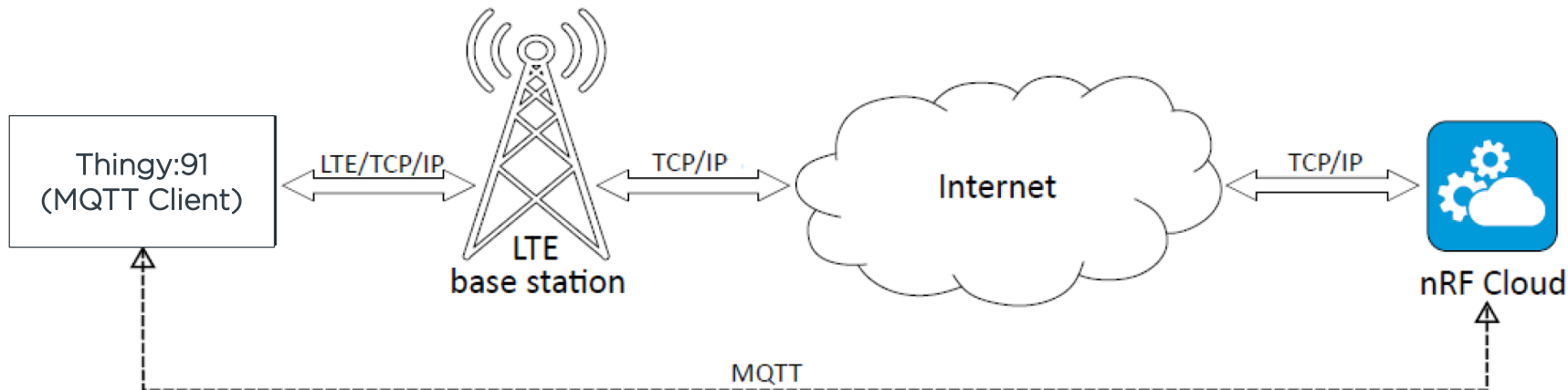
Software architecture



- Complete and easy to use solution
- Connectivity and application software
- Support for OTA Modem and Application updates
- Reference design with multiple sensors
- Support for “thin modem” operation

Nordic Thingy:91: Asset Tracker

- Sends simulated GPS coordinates & real accelerometer, temperature, humidity & air pressure data to nRF Connect for Cloud
- Source code for connecting to server



Getting started

- Goto: www.nrfcloud.com
- Add new LTE Device
- Activate SIM Card
- Associate Thingy:91 using PIN DUA (Device-User-Association).
 - Input IMEI and PIN from label on PCB.
- Demo - Showing data in graphs.
- REST API, MQTT API, webhooks, IFTTT, Slack
- Can take a few minutes on first start-up to be visible on network

Sign in to nrfcloud.com

1 Add new LTE Device

2 Activate SIM Card
Input SIM ICCID, PUK and personal information:

3 Insert SIM Card and power on Thingy:91

Then wait for light blue blinking or 'Waiting for DUA with PIN' on the console output.
Note: Pi0t series might need a manual restart the very first time it connects.

4 Associate the Nordic Thingy:91 to your user account
Wait for green blinking. Then your Thingy:91 is associated and connected!

Add LTE Device
To connect your device, enter the IMEI and PIN

IMEI:
ex. 123456789012345

PIN:
ex. 123456

Add Device

Here we could default without a PIN?

Nordic Thingy:91 – available now



<http://www.nordicsemi.com/About-us/FindDistributor>

Asset-tracker demo

Q&A