NORDIC®
SEMICONDUCTOR

Navigating the design complexities of low power LTE-M and NB-IoT networks

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Today's hosts

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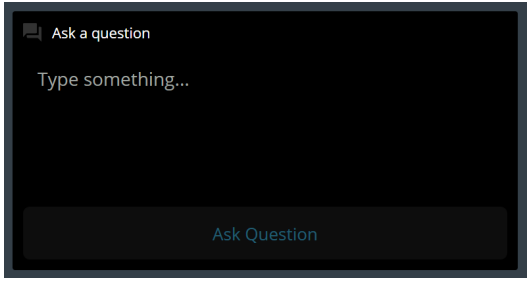
NORDIC SEMICONDUCTOR

Practicalities

- Duration: 50-60 mins
- Questions are encouraged!
- Please type questions in the top of the right sidebar
  - All questions are anonymous
  - Try to keep them relevant to the topic
- We will answer questions towards the end
- The chat is not anonymous, and should **not** be used for questions
- If you have more questions:
  - Go to DevZone for Nordic related questions
  - Email connect@arkessa.com for Arkessa related questions
- A recording of the webinar will be available together with the presentation at webinars.nordicsemi.com



{ DevZone

Agenda

- Cellular IoT Intro
- Highly Integrated Solution
- SIM to eSIM
- Roaming and coverage
- Security
- SIM lifecycle – from purchase, to end of line test, to activation, production etc
- Low power cellular IoT
- Cloud connectivity
- Putting it all together
- Q&A

Cellular IoT Intro

Cellular IoT ... Lots of difference applications


ASSET TRACKING

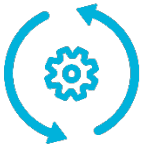

WEARABLES


PRODUCT SERVICE


ELECTRICY/GAS/ WATER METERING


SMARTHOME


ENVIRONMENTAL MONITORING

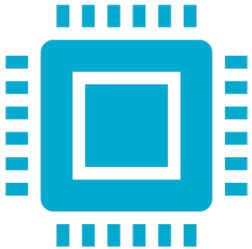

PREDICTIVE MAINTENANCE


HEALTHCARE


SMART CITY INFRASTUCTURE

Cellular IoT …. But lots of different bits and pieces

Device



Connectivity

Cloud

Edge device + Connectivity + Cloud = cellular IoT

All this requires seamless operation and exchange of more and more information

how to make that happen ?

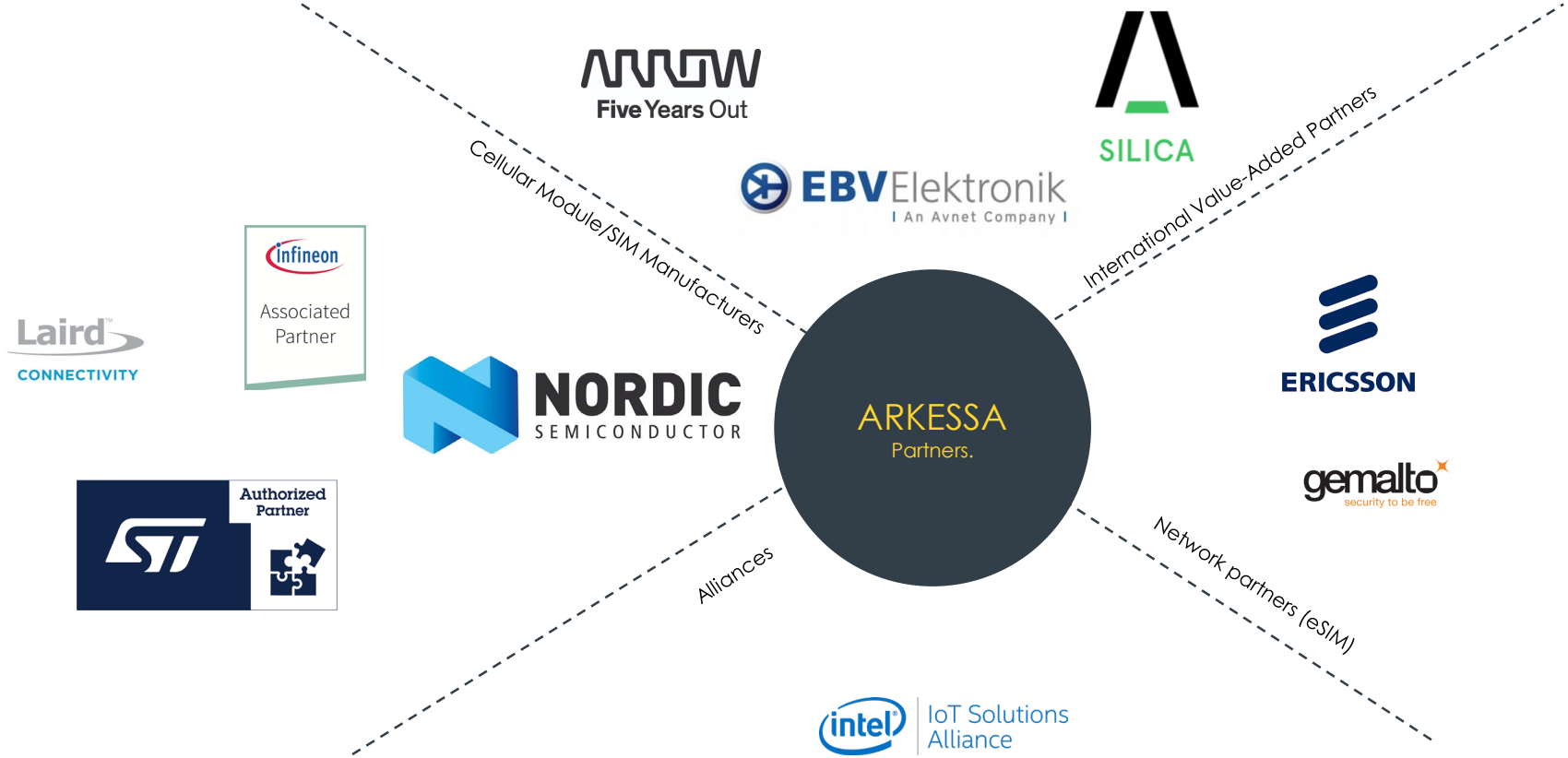
Nordic Semiconductor

Key Facts:

- Founded in 1983, HQ in Norway
- ~1000 employees
- R&D in Norway, Finland and Poland
- Publicly Listed OBX: NOD
- Market Cap 3800 MUSD (Q1 2021)
- Key parters: TSMC, QORVO, AMKOR, ASE

- Fabless Semiconductor Company
- Market Leader in Bluetooth Low Energy
  - >40% market share
  - > 350M ICs shipped per year
  - 1000s of customers in volume production
  - 95,000 development kits shipped in 2020
- Short-range Ultra low power wireless SoCs
  - *Bluetooth®* Low Energy/ Zigbee / Thread / ANT
- Cellular IoT: LTE-M, NB-IoT Chipset & SiP
  - *LTE design team in Finland (150+ engineers)*

Arkessa is part of the Wireless Logic Group

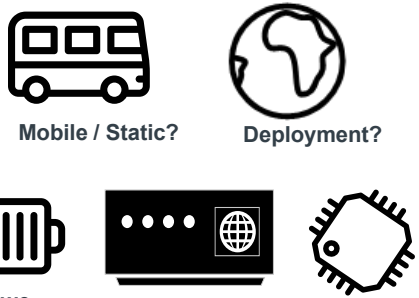


More than a SIM card

Security?

Latency?

Analytics & Management ?



Mobile / Static?

Deployment?

Powe r?

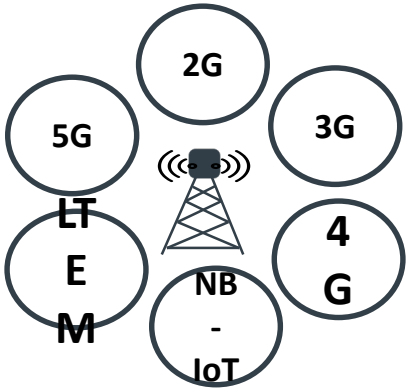
Module?

Environment?

Data?

SIM

eSIM



Bearer

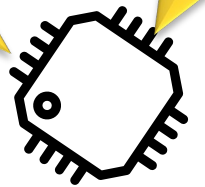
Private / Public?

Access?

It all starts with your application

SIM format – plastic vs MFF2 chip
PSM/eDRX support?
Freq bands?
LTEM roaming support?

What enabling technologies should I consider? E.g. LPWA, eSIM, 5G?



Where does the SIM need to connect and when?

Is there a need for manufacture / to perform end of line testing?

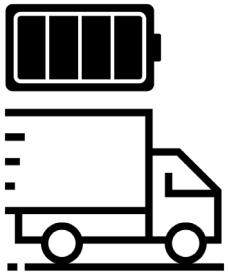
Where is the data being sent?

Security - How will you access edge device? FOTA?

What is the application and business model?

Battery powered?

SIM current?



How much data per month will the application use?

Highly Integrated Solution

nRF9160 – Voids Cellular Modules

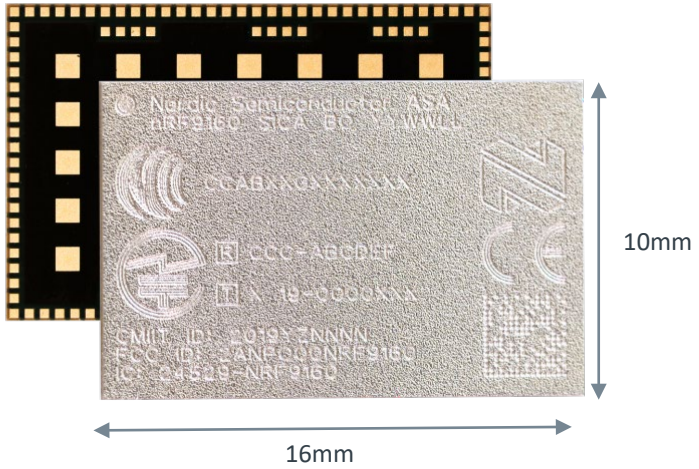
- Based on **Nordic Dual Core SoC**:
- **Arm® Cortex® M33 MCU** for the application
- Multiband **LTE-M/NB-IoT** modem with GPS

- **Small** form factor - includes PMIC, RF FEM, passives and crystals

- **Ultra Low Power** – Avg. 18µA @ 81.92s eDRX
  - Power saving mode (PSM) floor current: 2.7 µA

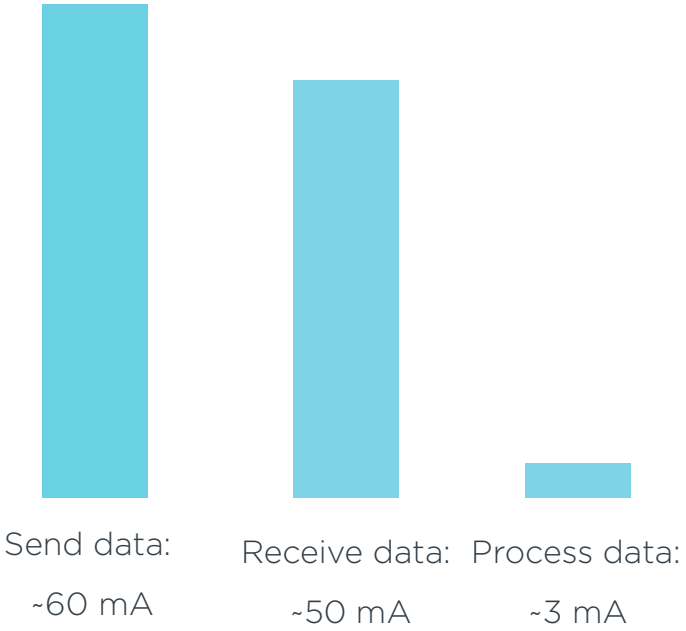
- Multiband support for global coverage

- **Pre-certified** for world-wide operation



nRF9160 SiP

Utilize nRF9160 for Edge Computing

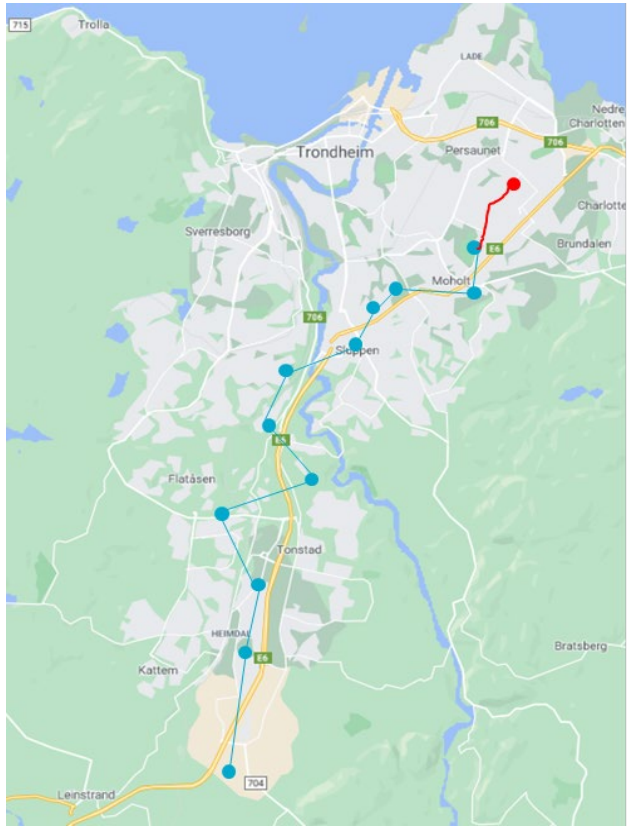


- Send information – not data
  - Data: Accelerometer data, continues 3x16-bit values every 100ms
  - Information: The thing fell over sideways hard and is now laying flat
    – 1 byte of information at the event
- When something interesting happens
  - Send data anyway

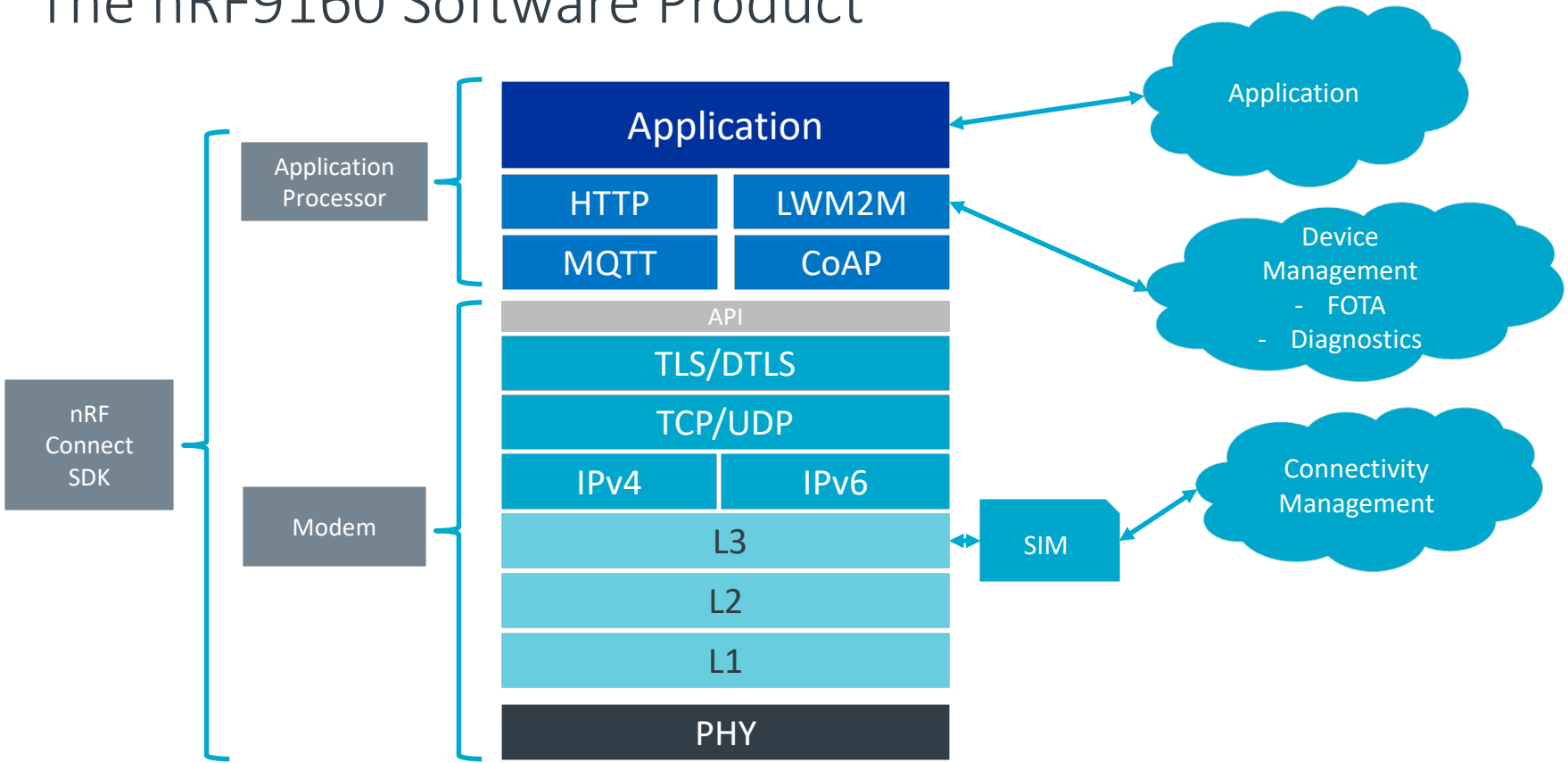
nRF9160 combines GPS and Cellular Location

- Cellular Positioning – Fast and Ultra Low Power
  - Save power when accuracy is not needed
  - Works indoor
  - Single- and multi-cell measurement support

- Integrated GPS – Great for accurate tracking
  - Down to 3m accuracy
  - Assisted GPS supported
  - Continues, interval and single-show mode

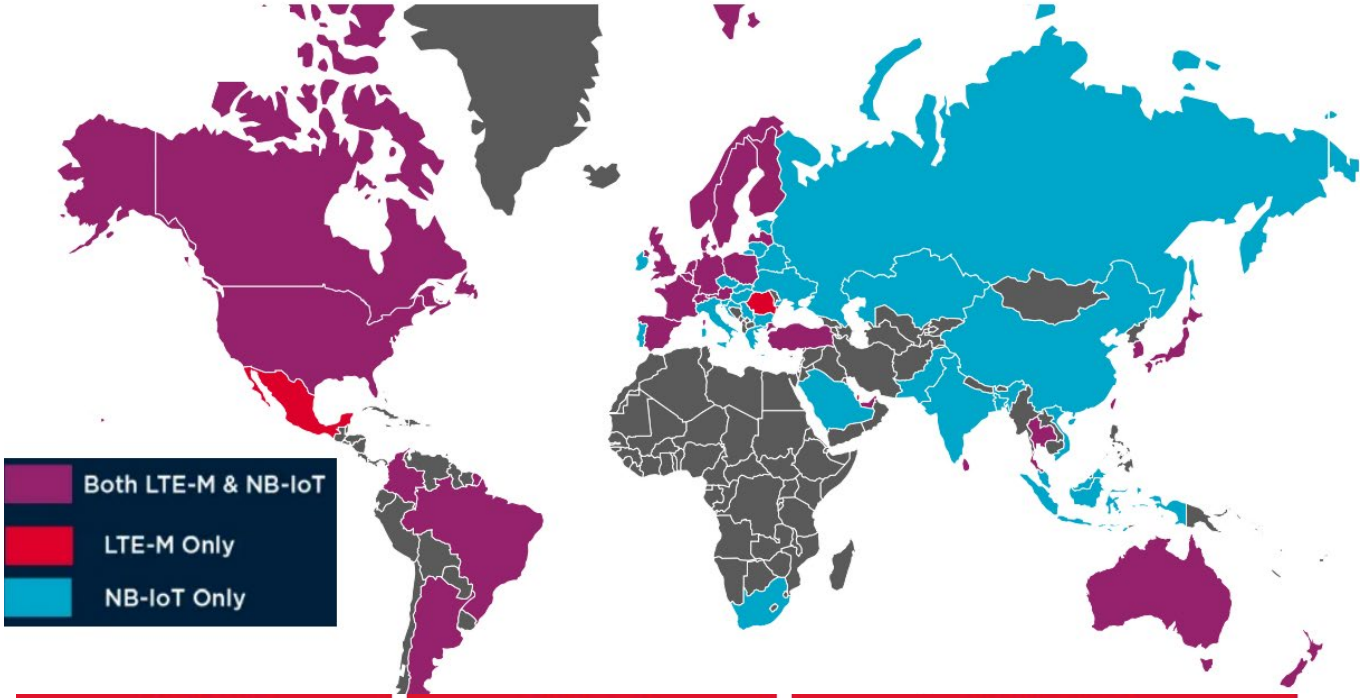


The nRF9160 Software Product



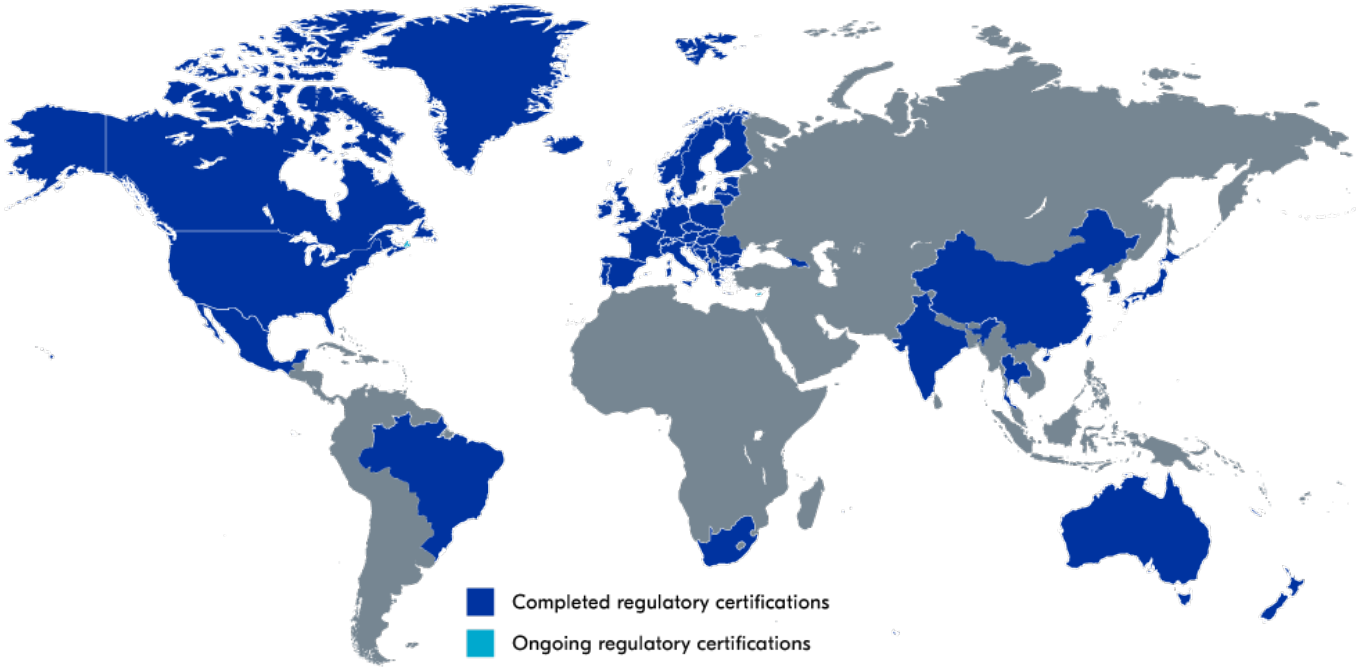
Roaming and Coverage

Low Power Wide Area Network Coverage



Number of LTE-M Networks	Number of NB-IoT Networks	Total Number of Mobile IoT Networks
51	102	153

nRF9160 Regulatory Certification Status



Does your Arkessa SIM have coverage?

- Download latest coverage map www.nordicsemi.com/arkessa
- NB-IoT single SKU 30 countries
- LTEM single SKU 15 countries
- Updated monthly showing :
  - Band Frequencies
  - Power Savings Support (PSM or eDRX)
  - Coverage Enhancement Mode
  - Country coverage
  - All bearer types available

SIM to eSIM

Global Enterprise Connect

Global Reprogrammable SIM/eSIM (GSMA compliant eUICC)

Multi-Operator on a Single Mobile Core Network

Connectivity Management (Monitor and Control)

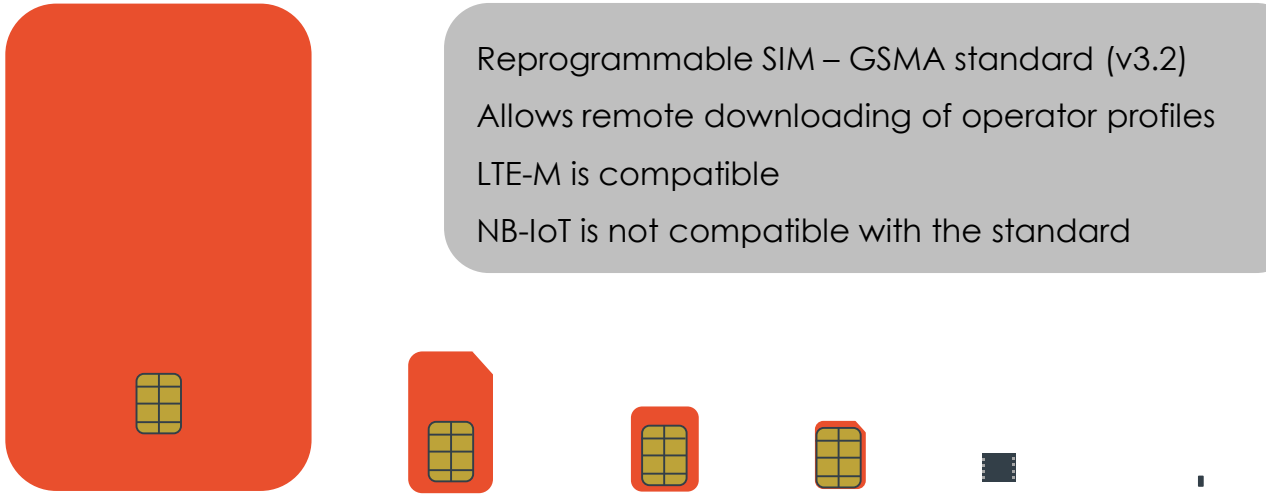
Subscription Management (SM-SR & SM-DP)

Deploy anywhere

Manufacture anywhere

Global Enterprise Connect – Simplified, Scalable, Secure

ESIM and LPWA



Reprogrammable SIM – GSMA standard (v3.2)

Allows remote downloading of operator profiles

LTE-M is compatible

NB-IoT is not compatible with the standard

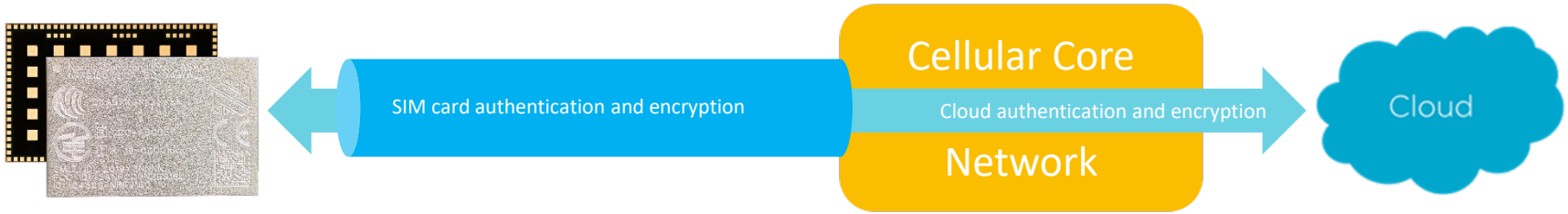
ID Card Size	**Mini-SIM**	**Micro-SIM**	**Nano-SIM**	**Embedded SIM**	**eSIM**
1FF	2FF	3FF	4FF	MFF2	WLCSP
86x54mm	25x15mm	15x12mm	12x9mm	6x5mm	2x1mm

eSIM – Over The Air Reprogramming

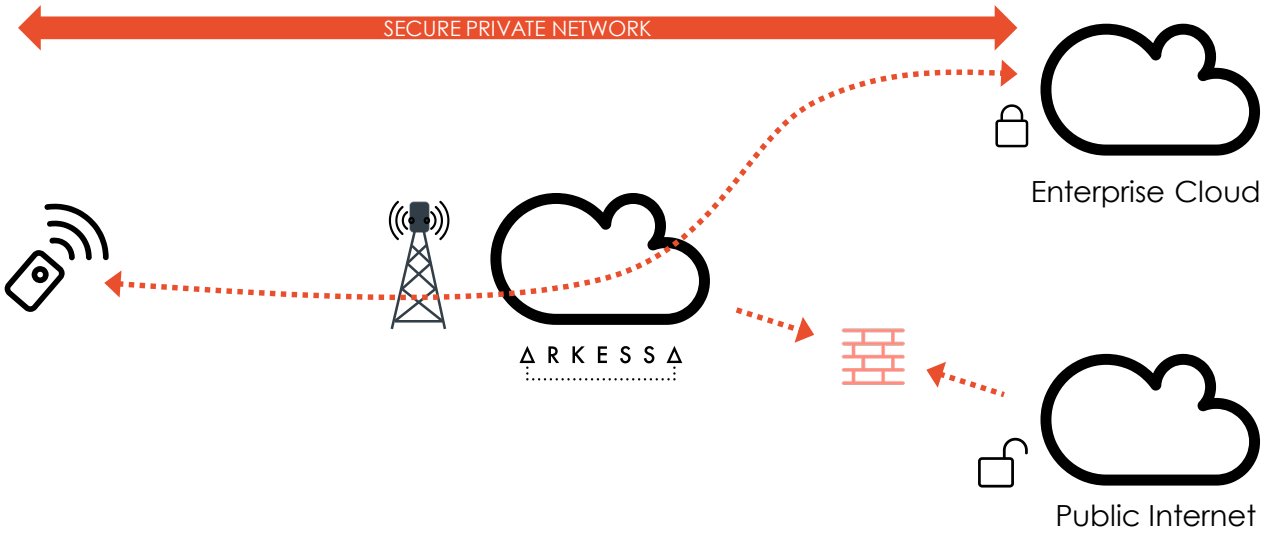
Security

Cellular IoT offer a Holistic security solution

- LTE modem provides
  - SIM card authentication and encryption
  - Cloud authentication and encryption with TLS/DTLS
- The nRF9160 Application processor provides
  - Root of Trust and Trusted Execution with TrustZone
  - Application layer security with ARM CryptoCell and Key Management Unit
- Secure FOTA to update modem and application firmware



Security



- The Arkessa Core Network creates a SECURE PRIVATE NETWORK between device and cloud.
- Redundancy in the Arkessa Core Network ensures HIGH-AVAILABILITY.
- Public Internet access is RESTRICTED unless required by the application.

SIM Lifecycle

Taking care of the SIM lifecycle

From SIM purchase to end user – how long?

Is there a need for manufacture end of line testing?

Where in the world?

- Test mode
- Inactive SIM's
- API's
- eSIM

What is the application and business model?

B to B to C?

Will you resell your product as a service?

Low Power Cellular IoT

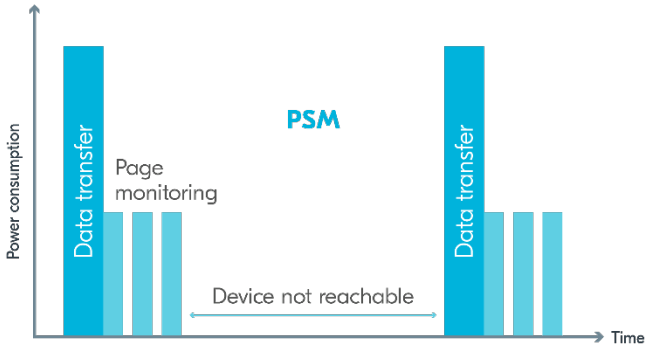
PSM and eDRX summary

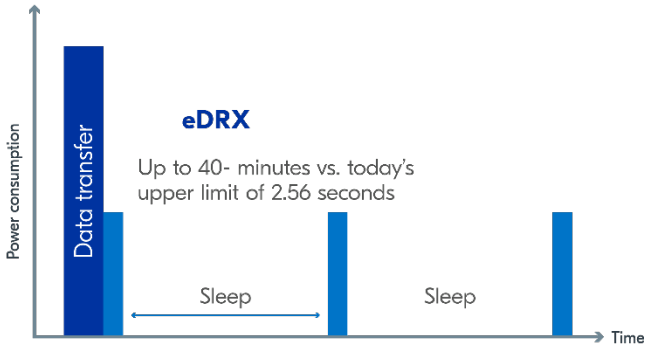
- Power Saving Mode

- Suitable for more than 10 min latency
- Can sleep up to 413 days
- nRF9160 PSM floor current is <3 uA

- Extended Discontinuous Receive

- Suitable for less than 10 min latency
- LTE-M interval 5.12s to 2621.44s (44 min)
- NB-IoT interval 20.48s to 10485s (175 min)
- nRF9160 LTE-M eDRX floor current is <5 uA





PSM and eDRX

PSM offer the best power saving & this is available on most LPWA networks

eDRX still not widely available

It is ultimately up to the network to reject the request, enable one feature or both. The availability of PSM and eDRX vary across different networks with different timers also being implemented

Choice of hardware SIM :

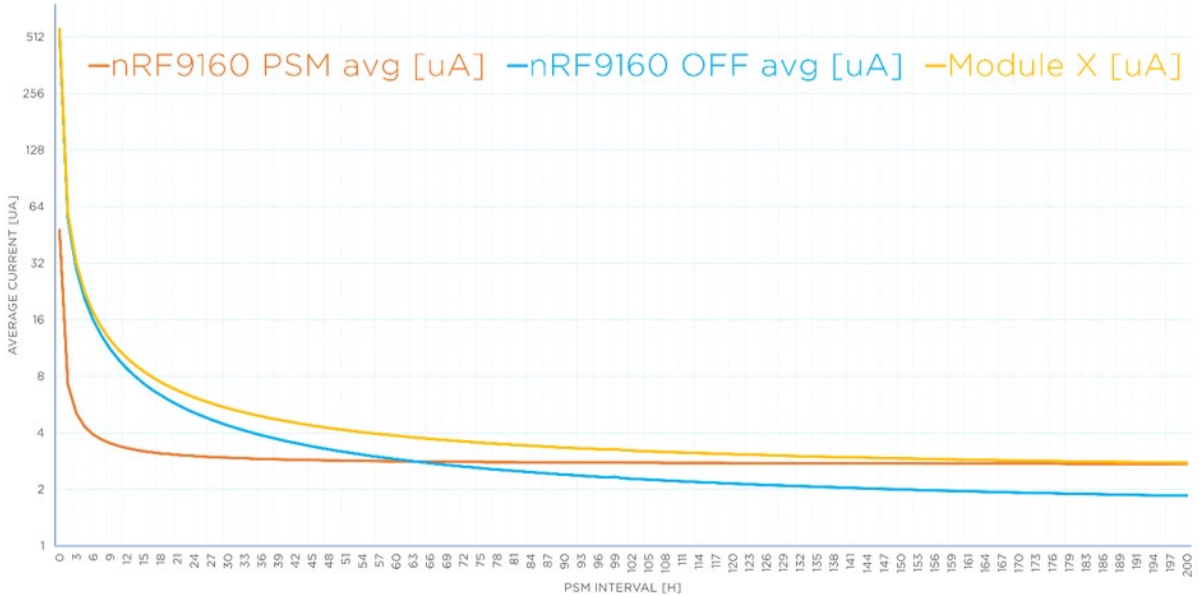
ETSI TS 102 221 standard states the maximum current consumption of a SIM is between 30 – 60mA depending on the supply voltage. However this can vary a lot.

Parameter	Unit	SIM		
		Arkessa ACLP	Arkessa GEC	SIM x
Clock stop current	uA	66.8	36.8	63
Network attch	uC	1 526.00	10 465.00	3 310.00
SIM Shutdown	uC	124	947	128
PSM event (TAU), SIM in off mode	uC	793	4 802.00	2 378.00
PSM event (TAU), SIM in clock stop mode	uC	150	553	414

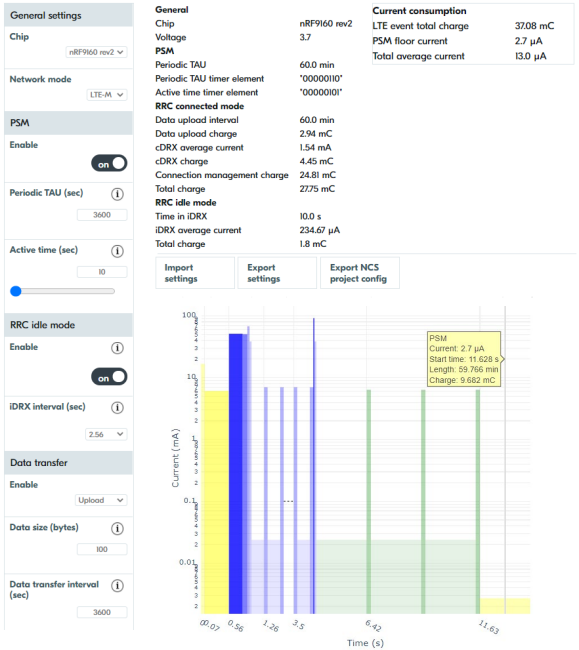
nRF9160: optimized in every scenario, not just PSM floor

- A snippets of parameters that matter – it is not only about a PSM floor

RCC connected mode, cDRX intervals, cDRX inactivity timer, RRC inactivity timer, RCC idle mode, T3324 timer, iDRX intervals, iDRX PDCCH, PTW, Default paging cycle, PSM, T3412 timer, SIM current, Band, Signal Conditions (TX Output Power), CE levels, Repetitions, QPSK, BPSK, Data size and intervals, protocols,



Online Power Profiler for cellular IoT



Made to also fit cellular "dummies"

- Extensive User Guide available

No expensive LTE call box needed anymore

- Control and set network parameters

Re-configure, test and learn quickly

- See what parameters affects power consumption and how

Export settings to nRF Connect SDK project

- Unified solution with the Power Profiler Kit 2

Power Profiler Kit II

First-of-its-kind tool for cellular developers

Perfect to track and measure power consumption

- Simple, accurate and powerful

Easy to estimate battery life

- Auto-calculates energy consumption

Spot and debug unwanted current drains

- Continuously during engineering cycle
- Compare with the Online Power Profiler

- Simple and cost-efficient ($89 retail price)

Cloud Connectivity

nRF9160: Flexible and advanced protocols

Support for all major protocols

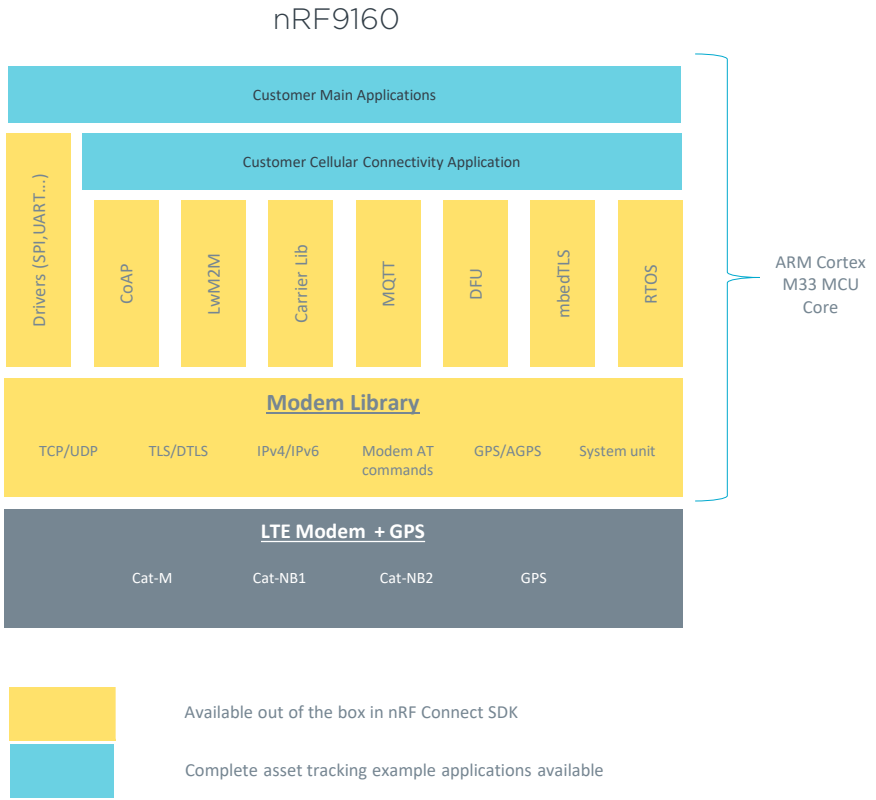
- e.g. MQTT, CoAP, LWM2M, HTTP(S), etc

Native in nRF Connect SDK

- All open source and free of charge
- Flexible sockets: connect to multiple Clouds and services
- Robust and flexible FOTA
- RTOS for a modular approach
- Full application and cloud examples

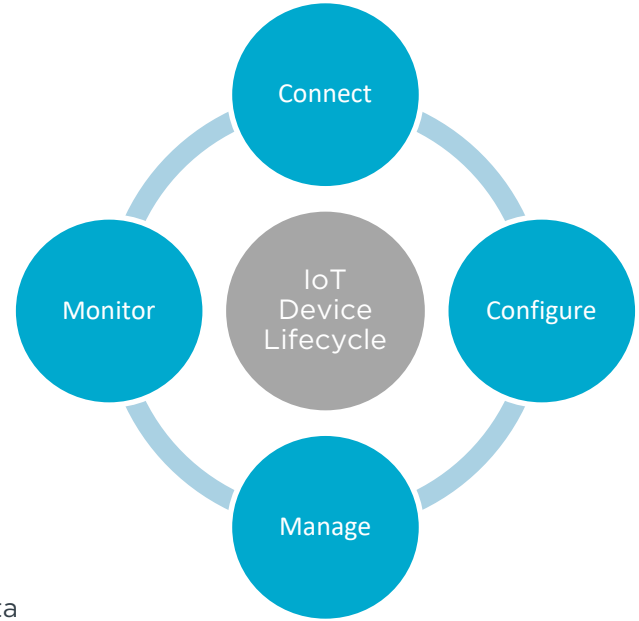
Connectivity protocols seamlessly integrated with modem

- Nordic owns of the entire solution – simple support
- Focus on on your own application



nRF Cloud

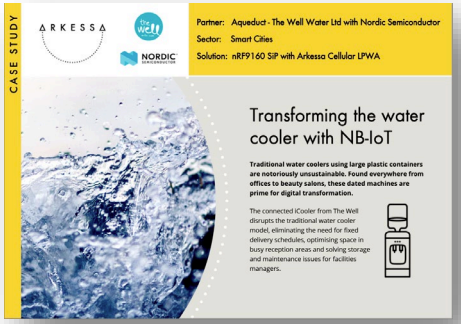
- **Device management Services**
  - nRF9160 DK, Thingy:91 & Custom nRF9160 HW
  - FOTA updates, Monitoring, Multi-users, SIM management
- **Location Services**
  - Cell ID/single cell and Assisted GPS
- **Platform Services**
  - Device API, Security, User data
- Samples in nRF Connect SDK
  - Asset tracker – displays device location on map and sensor data
  - Azure, AWS and other cloud libraries available and coming



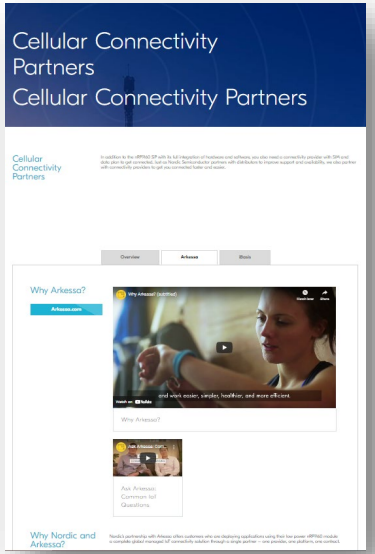
Next steps

Marketing

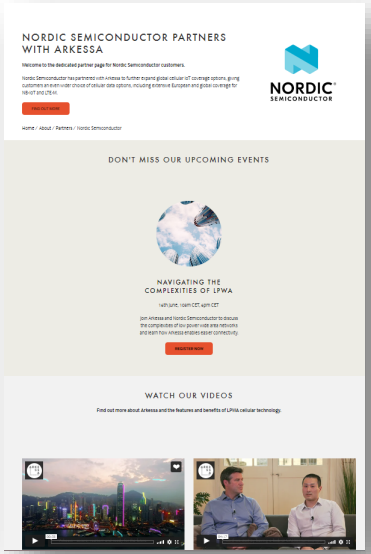
Wireless Quarter magazine



Well Water case study



Arkessa on Nordic Semiconductor website



Nordic Semiconductor on Arkessa website

LPWA Trial Packs

NB-IoT and LTE-M	
No. of SIMs	5
SIM Format	2FF, 3FF, 4FF or MFF2 (one format per pack)
Data Allowance	25MB/SIM/month (NB-IoT) or 50MB/SIM/month (LTEM)
Trial Period	3 months
EmPort	Access to SIM management platform


Mini-SIM - 2FF

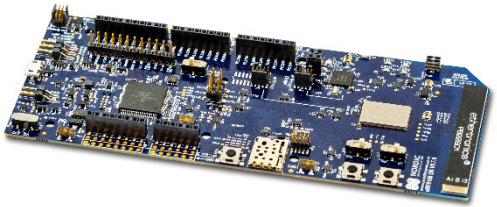

Micro-SIM - 3FF


Nano-SIM - 4FF


eSIM – MFF2

nRF9160 – complete low power cellular IoT solution

Evaluation Kits



Thingy:91 – battery powered, small and mobile

nRF9160 DK – include debugger and expansion headers

nRF52840 board controller with Bluetooth LE

LTE, GPS, and 2.4 GHz antennas

nRF Connect SDK

Open source, hosted on GitHub

Nordic owned and maintained

Middleware, protocol stacks and drives

20+ samples and application examples

Development Tools

nRF Connect for Desktop

nRF Cloud

Programmer, cellular monitor and link tools

Online Power Profiler and Power Profiler Kit II

Nordic Semi and Arkessa: Major takeaways

#1	Low power cellular design is more than the modem and a SIM card, Arkessa and Nordic exists to that make cellular IoT simple, scalable and secure
#2	LTE-M1 and NB-IoT network availability and roaming agreements accelerates, nRF9160 is globally certified and with Arkessa connectivity it enables global deployment of devices
#3	The nRF9160 is bulit from scratch for low power in all modes – Arkessa ensures you have access to access to PSM or eDRX sleep

Nest step: request your SIM trial pack – www.arkessa.com/nordicsemi and get connected

Q&A

Register for upcoming Nordic Tech Webinars

www.nordicsemi.com/webinars