Agenda

- Introduction
- Nordic Semiconductor OY and cellular IoT development
- Tour of Facilities
- Cellular made easy – cellular for everything else
- Cellular IoT primer
- Nordic cellular IoT offering
- Demos
- Certifications
- Customer Sampling
Unique position in fast growing IoT markets

- Proprietary 2.4GHz RF
  - 300 million units
  - #1 position

- Bluetooth® Low Energy
  - Including multi-protocol 2.4GHz/802.15.4
  - 1 billion units
  - #1 position

- Low power cellular IoT
  - (LTE-M and NB-IoT)
  - 100 million units
  - Market entry H2 2018

Source: Nordic management and industry reports
### Full year 2017 operating model

<table>
<thead>
<tr>
<th>Category</th>
<th>2017</th>
<th>2016</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue growth</strong></td>
<td>+19%</td>
<td>+2%</td>
<td>(+17pp) Bluetooth +40% and Proprietary -6%</td>
</tr>
<tr>
<td>y-o-y</td>
<td>(MUSD 236)</td>
<td>(MUSD 198)</td>
<td></td>
</tr>
<tr>
<td><strong>Gross margin</strong></td>
<td>47.2%</td>
<td>47.0%</td>
<td>(+0.2pp) Gross margin recovery from 46.2% in Q3 2016, closing in on 50% target</td>
</tr>
<tr>
<td><strong>R&amp;D short-range</strong></td>
<td>15%</td>
<td>15%</td>
<td>(+0.2pp) Investment for continued growth and expansion in short-range IoT</td>
</tr>
<tr>
<td><strong>R&amp;D cellular IoT</strong></td>
<td>8%</td>
<td>8%</td>
<td>(+0.0pp) Investment for accelerated revenue growth and improved profitability on a mid term basis</td>
</tr>
<tr>
<td><strong>SG&amp;A</strong></td>
<td>14%</td>
<td>13%</td>
<td>(+1pp) Organizational scaling to manage and fuel growth</td>
</tr>
<tr>
<td><strong>EBITDA margin</strong></td>
<td>10%</td>
<td>11%</td>
<td>(-1pp) Continued impact from cellular IoT investment</td>
</tr>
</tbody>
</table>
Cellular IoT Investments

- Invested more than MUSD 62 in cash cost since project start
- From 2018 project is in commercialization phase reducing the net reported opex
- Investments continue to grow, but reiterate target to be profitable based on annual cost in 2020
Proud and excited with our achievement

Time to market

Less than 3 years from start to sampling customers

Solution

Built the most advanced cellular IoT product
Highly successful short-range business

- Short-range EBITDA in the period MUSD 160 - funding entire LTE investment
- In the period, average adjusted EBITDA margin of 21%
- Synergies between short-range and LTE to drive operational leverage
Business aspiration for cellular IoT

Short-term (~2018)
- Secure design wins
- Production ready and certified solution
- Help and drive customer production ramp

Mid-term (~2020)
- Surpass break even on a running basis; cellular IoT gross profits > cellular Opex on a running 12-months basis

Long-term (~2022 →)
- Significant contribution to Nordic total revenue and profitability
Nordic Semiconductor OY and cellular IoT development
Svein-Egil Nielsen & Juha Heikkilä
Fall of 2014 large technology layoffs in Finland
Travelled to Oulu to investigate and recruit opportunities
Ended up building a large R&D organization in Finland

Three Offices:
- Oulu
- Turku
- Espoo

Employees in Finland

- 2015 start: 65
- 2015: 114
- 2016: 132
- 2017: 154
Highly skilled organization

R&D Finland rapidly built up: Optimized for cellular low power and low cost IoT solutions development

Investments in addition to personnel:

- Design and Verification Flow (HW + SW)
- Pre-silicon Verification Platforms
- Extensive Analog and RF test laboratory
- Extensive cellular Protocol SW test laboratory
- Certification Testers
- Production Testers
Relevant experience

Radio Systems personnel with Nokia-Renesas-Broadcom, Ericsson background
- Design experience from very first cellular systems up to high category LTE modems

Power management, RF and Digital IC and SOC design personnel with Nokia-Renesas-Broadcom and Nokia-ST Ericsson-Ericsson background
- Multi-billion IC/SOC volume experience

Firmware and protocol SW personnel with Nokia-Renesas-Broadcom and Nokia-ST-Ericsson-Ericsson background
- Multi-billion cellular product volume experience
Finland provides excellent opportunities for technology R&D

Finland’s existing world class cellular engineering competences

- Background from Nokia, Ericsson, Renesas, Broadcom chipset development
- Strong cellular chipset development ecosystem in Oulu (MediaTek, Altair, Nokia)

Education: University of Oulu, Aalto University, Tampere University of Technology

Strong government funding programs for 5G and IoT ecosystem boosts in Oulu. Even 6G program initiated recently.

Source: www.investinfinland.fi
Significant scale and resource sharing across Nordic Semiconductor organization

Scaling on existing infrastructure
- Technology Platforms
- Design and QA processes
- CAD tools
- Datacenter

Cross functional teams
- Development teams involved from across organization and territories
  - Scale on specialized skills
  - Ensure design reuse
  - Common processes and systems

Common technology and supply partners
- Existing suppliers such as: TSMC, ASE, AMKOR
- Technology partners, ARM
World class laboratory setup

- Pre-silicon modelling environments (IC emulation and FPGA) in place
- RF and Power measurement capability with high level of automatization
- Automated protocol testing capability
- RF Shielded champers
- Infrastructur vendor basestations
- Certification testing
That’s not all….we must lead on connectivity

Must have excellent radio performance and solid interoperability with carriers worldwide

- Develop and own the connectivity technology as a key differentiator for success; RF, Baseband, Protocol stacks
- Have global Multi-Band support
- Invest in interoperability through robust design, close collaboration with infra-vendors and carriers throughout development of the product
- Dedicated team for interoperability and certifications with carriers.

=> Achieve best in class Radio performance and interoperability similar to our position in Bluetooth
The development target was to make a product to disrupt the cellular IOT space

Achieve best in class power consumption for a cellular device targeted at IOT application

- Leverages Nordic Semiconductor’s knowhow in low power from Bluetooth and proprietary 2.4GHz devices
- Build product from ground up with focus on low power – fresh new design – highly flexible software based architecture
- Use integrate memories and low-leakage process features

Make a developer friendly product that can enable everyone to make an cellular IOT product

- Leading edge application processor design with ARM M33, Trustzone and Cryptocell
- SDKs and toolchains shared with Bluetooth products
- Firmware upgrade capability on both application and modem
- Cloud enabled through nRFCloud
- Technical support through Nordic 24/7 support @DevZone

Ultra compact and small size

- Integrate and use advanced packaging techniques to reduce solution size
Using cross functional teams to develop

Common development with Bluetooth products

- Power and Clock Team
- Chip Physical Design
- Analog Periphery
- SoC Prod Test
- SDK and Application FW Team
- Cloud
- Test team (IOT, IODT, Oper, field)
- Verification team (GFC, FCC, CE)
- Digital Base Band Team
- RF Analog Team
- LTE Algorithm team
- Modem Firmware Team
- Module Production & test

Cellular specific development
Tour of Facilities
Cellular made easy –
Cellular for everything else

Thomas Embla Bonnerud
Our unique approach to low power cellular IoT

By leveraging synergies with our existing and fast growing low power short-range IoT business;

- Deliver a highly integrated solution for connectivity and application
- Provide a superior ease of use and developer experience
- Apply a broad market engagement model
Complementary connectivity technologies

Low power short-range IoT
(Bluetooth, Thread, Zigbee, 802.15.4 and Proprietary RF)

(+) Local area connectivity; smart phones etc.
(+) Lowest power and smallest size
(+) Lowest cost and no subscription

Low power cellular IoT
(LTE-M and NB-IoT)

(+) Public network
(+) Coverage and roaming
(+) Quality of service, reliability and security

Solving different requirements and needs for connectivity
Similar markets – overlap and synergistic

Emerging and fast growing
Broad and diversified customer base
Across a broad range of applications
Consumer and non-consumer

Market overlap and synergies
In terms of customer base and applications
Combining and mixing short-range and cellular
Cellular enabling new type of products and services
Different connectivity – similar application

Low power short-range connectivity

Different connectivity for different needs
Cloud connectivity via short-range or directly with cellular
Short range connectivity for home network

Low power short-range + cellular connectivity

Similar application level requirements
Embedded processing, memory, interfaces and security
Application layer software and development tools

Different connectivity but similar application
Alignment integrated solution
Between a low power short-range and cellular IoT solution
Highly integrated solution

Cutting edge cellular connectivity
Developed by Nordic`s cellular team in Finland
Low power contribution from Norway

Common application platform
Across Nordic`s short-range and cellular products
Developed in Norway

Significant synergies
Application a big part of an integrated solutions
Common platform for software and development tools
Ease of use and developer experience

The two pillars Nordics ease of use
Complete solution – hardware and software
Great development tools

Leveraging a common platform
Application software framework and development tools
Developed in Norway and Poland

Mix and match for customers
Consistent and common experience across product lines
Lower barriers of entry for existing short-range customers
Broad market engagement model

Instrumental part of leadership in short-range
Sales, marketing and support organization
Developer community and distribution network

Leverage our organization for cellular IoT
Unique market reach in terms of cellular IoT
Drive innovation and adoption of cellular IoT

Leverage existing customer relationships
Customers expanding their offering with low power cellular IoT
Combining or mixing with short-range
Highly synergistic combination for Nordic

Low power short-range and cellular IoT

Accelerate growth
Scale for our investments
Improve profitability
Strengthen competitiveness
Cellular IoT to fuel our 5th growth cycle

Revenue 2000 - 2017 (MUSD)

1st
Technologies: Proprietary RF Transceivers
Markets: Game controllers

2nd
Technologies: Proprietary RF SoCs
Markets: PC Peripherals

3rd
Technologies: Bluetooth
Markets: Wearables

4th
Technologies: Bluetooth
Markets: Consumer Non-consumer Diversification

5th
Technologies:
- Low power short range IoT - Bluetooth, Thread, Zigbee, 15.4, and Proprietary RF
- Low power cellular IoT - LTE-M, NB-IoT
SoCs and SIPs
Markets:
- Consumer
- Non-consumer
- Diversification

2018 →
Cellular IoT Technical Primer
Peder Rand
Removing the $1000 IoT gateway
LPWAN technology landscape

Not low power

Cellular 2G

Cellular LTE Cat 1+, 3G

Low power

Sub 1GHz ISM band LPWANs

Low Power Cellular IoT

Maximum throughput

< 1 bps

100’ kbps

> 1 Mbps
LTE-M/NB-IoT vs. ISM-band LPWAN

Cellular IoT (cIoT) in Licensed band gives predictable Quality of Service (QoS)
- No interference
- Advanced protocol

Security is built into LTE
Connect directly to your cloud service

No very limiting regulatory restrictions on output power or duty cycle
New low power LTE technologies

<table>
<thead>
<tr>
<th>Feature</th>
<th>LTE-M (eMTC, LTE Cat-M1)</th>
<th>NB-IoT (LTE Cat-NB1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Also known as</td>
<td>“eMTC”, “LTE Cat-M1”</td>
<td>“LTE Cat-NB1”</td>
</tr>
<tr>
<td>Max throughput</td>
<td>- 375kbps</td>
<td>- 30/60kbps</td>
</tr>
<tr>
<td>Range</td>
<td>Up to 4X</td>
<td>Up to 7X</td>
</tr>
<tr>
<td>Mobility</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Roaming</td>
<td>Yes</td>
<td>Not yet</td>
</tr>
<tr>
<td>Deployment density</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Module size</td>
<td>Suitable for wearables</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>Up to 15 years of battery lifetime</td>
<td></td>
</tr>
</tbody>
</table>
LTE bandwidth

How is the LTE BW achieved in your phone?

- Dynamic modulation QPSK, 16QAM, 64QAM
  - Changes depending on distance to base station
  - Can be different for uplink (UL) and downlink (DL)
- OFDM - Multiple carriers, up to 1200... 15 KHz apart...
- MIMO – multiple TX and RX antennas
- Full duplex in FDD (TX and RX at the same time)

How is LTE-M and NB simplified?

- Lower bandwidth
  - no MIMO
  - no 64 QAM
  - Few OFDM sub. carriers 6-72
  - Use half duplex communication
Managing range

- QPSK, high Pout, Range Ext. mode B
- QPSK, high Pout, Range Ext. mode A
- QPSK, High Pout
- 16QAM, Low Pout

eNB decides output power, modulation and range extension mode for a connection.

During a connection (RRC connected mode) decisions are made based on measurement reports from user equipment (UE).

In Idle and PSM mode UE attempts connection to strongest eNB (RSSI).
Cellular IoT deployments

Source: GSMA.com June 2018
Hardware Application Circuit
Data exchange

Your Application Here!

MQTT/Coap/HTTP

API

TLS/DTLS

TCP/UDP

IPv4 | IPv6
L3
L2
L1

PHY
Application Level Protocols

**MQTT**
- ASCII-based machine-to-machine (M2M)/"Internet of Things" connectivity protocol
- Publish/Subscribe model
- TCP and TLS

**CoAP**
- Constrained Application Protocol
- REST model – GET, PUT, POST and DELETE
- 4-byte binary header
- UDP and DTLS
Getting Connected

Getting your device on the network
Getting connected

HSS
Home Subscriber Server

MME
Mobility management entity

Cloud

Attach request

Authentication

scheduler

Serving gateway

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Data to the cloud
Security

SIM Card Authentication and Encryption

Cellular Core

Network

Cloud Authentication and Encryption

Cloud
Data to the cloud (indirectly)
Flexibility and upgrades

10 years battery life is the goal, but...

- When will you find a bug?
- When will you find a security vulnerability?
- When would you like to upgrade performance or features?
- How long will your FW stay fresh and competitive?
- Update algorithms
Embedded Development
Challenges of IoT Embedded Development

#1 The target device does not have a screen or keyboard

#2 Restricted data and program memory

#3 Limited energy source
Embedded Development

```c
int main(void)
{
    // Initialize bsd library
    bsd_init();
}
```
Edge Computing

#1 Radio transfers cost energy and subscription fee

#2 Send information - not data

#3 When something interesting happens - then send data
The cost of sending data

- Processing data: ~3 mA
- Sending data: ~150 mA

3 ms
What is a SIM card

- A secure microcontroller with hardware encryption/decryption capabilities
- It securely stores the subscriber identity and its associated keys who are used to:
  - Identify and authenticate subscribers on cellular networks
  - Generate the encryption key for the connection.
Motivation for having SIM cards

Functional features

- Subscriber identity – allocate cost of use to the right subscriber
- Encryption key exchange between base station and user device
- Separation between user-configurable modem software and the operator controlled SIM
- Method for distributing identity, key pairs to manufactured products

Non-functional features

- Physical manifestation of carrier relationship with the customer – the carrier supplies the SIM card
M2M eUICC

- Often referred to as eSIM
- Can be implemented in pluggable or solderable hardware
- Implements interoperable GSMA specification for remote profile switching and loading
- Has one bootstrap profile that allows initial connection
- Connects to a server (SM-SR) through which the owner of the device can remotely choose which profile to use, update or delete profiles

- Gives device owners security in case of changes in the operator’s situation and negotiating power as they have a real option to switch
Expanding the cellular IoT

- Edge nodes on coin-cell batteries
- Use ultra-low power protocols like
  - Bluetooth Low Energy
  - ZigBee
  - Thread
- Gateway on larger lithium cells
- Central/coordinator for local network
- Use LTE-M for cloud-connectivity
Summary

1. Cellular IoT will give ubiquitous and low power cloud access to things

2. LTE-M for mobile devices with medium data requirements
   NB-IoT for stationary devices with low data requirements

3. Send Information, not data – except when something interesting happens

SnowBot is connected to the cloud [https://lefthandrobotics.com/product/](https://lefthandrobotics.com/product/)
Nordic cellular IoT Offering

Peder Rand
The nRF91 Advantage in cIoT

Low Power
- Build everything from scratch for low power
- Integrate memories and use low-leakage process features

Ease of Use
- Enable self-service for thousands of customers and hundreds of applications

Integration
- Integrate and use advanced packaging techniques to reduce solution size
Simplified customer engagement model

Traditional model

Chipset supplier → Module supplier → Customer

- Module supplier does value add integration and solutions
- Module supplier often handle sales, marketing and support

Nordic model

Nordic → Customer

- Nordic is one-stop shop for Cellular IoT
- Building on Nordic’s proven broad market engagement model
Low power cellular connectivity made easy

Complete modem in a package
Multimode LTE-M / NB-IoT

All the benefits of a traditional module
Ease of integration and use
Teleregulatory, standard and carrier certifications

Global operation with one variant
Multiband support for world wide coverage
System level solution for IoT security

Secure connectivity
Cellular network, end-to-end internet protocol security
Modem is a separate secure island

Secure application
Arm® TrustZone® for ARMv8 and CryptoCell® technology
Root of trust and trusted execution environment

Secure over-the-air updates
Modem and application firmware updates
Embedded flash
Advanced System-in-Package assembly

Qorvo × Nordic Semiconductor
Strategic partnership for SiP development and manufacturing

Built-in global RF Front-End and shield
Qorvo custom RF Front-End and MicroShield™ technology

Ultra-compact form factor
10 x 16 x 1 mm
New industry benchmark on solution size

Up to 3x smaller footprint

Up to 2x thinner

Up 5x less volume
Built-in Assisted GPS for positioning

Support for cellular based positioning
Modem support for Enhanced Cell ID and OTDOA

Built-in GPS receiver
Optimized for asset tracking

Assisted GPS for fast-time-to-fix
Combines cellular and GPS position data
Power Consumption

~ 15 uA
Connected with 10 minutes downlink latency (eDRX)
More than 15 years battery life

~ 0.5 mA
Sending tracking information every 20s (DRX)
More than 6 months battery life

~ 150 mA
Downloading new firmware @ 360 kbps (RRC Connected)
A 512 KB image updated in 30 s

LTE-M, 23 dBm, 3.7 V, 2700 mAh
Highly integrated single chip SoC
The nRF91 SoC

Designed for low power
Uses integrated memories and low-leakage process features extensively
Common power management and clock system for modem and application

Tight integration
Efficient, on-chip data and control transfer between application and modem

Multiple Secure Islands
Modular approach to security
Modem Architecture

Low power architecture
Hybrid modem and general purpose stack processing for low power

No memory loading
Modem runs from embedded flash/RAM for fast startup times and flexibility

Flexible transceiver
Wide range of bands supported for world-wide operation
Application Processor for Edge Computing

Evolved
Cutting-edge M-class, low power application processor with trusted execution support

Powerful Peripherals
Draws from the nRF52 pool of low-power peripherals
Interface to any sensor or external system

Edge Computing
Processing and memory resources for low-power edge computing – send information, not data
Our Software

Full application development SDK

nRF Connect for Cloud application works out-of-the-box

Comprehensive sample applications
Integrating the nRF91 SiP

- 10 mm x 16 mm LGA, 0.5 mm pitch
- Simple 4-layer PCB
- 32 GPIO + coexistence interface + trace/debug
- Single-ended 50Ω RF
- Integrated crystals and passives
- Single 3.1 V – 5.5 V supply
- Industrial -40°C to +85°C temperature range
Mix and match with Bluetooth

- Chipset approach
- Automatic coexistence interface
- Software drivers and sample application in the SDK
Easy to use development kit

- ARM debug and trace on-board
- Wide band antenna for world-wide operation
- Supports Arduino Uno Shields
- Bluetooth on-board
Unique value proposal with nRF91 SiP

Size and power consumption
- Industries smallest and lowest power solution
- A “no compromise” attitude to performance

Value add integration and features
- Application processor and Assisted GPS
- Global operation and advanced system level security

Solution completeness and ease-of-use
- Software and development tools; including cloud
- Nordic support and developer community
Demo time
Demos

- Demoing nRF91 production silicon
- Using internal development boards for demo
- Showing
  - CAT-M1 data transfer live network
  - NB-IOT data transfer live network
  - GPS
Certifications
Svein-Egil Nielsen
Nordic’s nRF91 needs a number of certifications

Requirements and processes

- Overview of what certifications are needed for nRF91
- How we develop the product to ensure certifications success
- Certification process
- Progress

Certification is a permission to sell a product, it is not a guarantee of a great product.
nRF9160 Certification Overview

Type approval and country specific certifications (Regional regulatory)

- Main regulatory certifications: CE (Europe), FCC/ISED (USA and Canada)
- In addition, there are some country specific regional certifications e.g. TELEC (Japan) ACMA (Australian), KCC RRA (South Korea), IMDA (Singapore), SRRC RTA and CCC (China), ...
- Regional regulatory certification is required for all products in the market

GFC certification (Global Certification Forum)/PTCRB

- GCF/PTCRB Certification demonstrates that devices conform international standards for mobile technologies, 3GPP, and interoperate with networks worldwide
- GCF/PTCRB Certification is required for all devices incorporating mobile connectivity

Carrier approvals

- Certain operators require their own approvals for products to operate in their network to ensure product will meet their specific requirements
- In many regions and with many carriers no carrier specific certification is required
Certification and interoperability drives development from the start (I)

EX: RF design

- From the start of design, design targets (parameter limits) are driven by the need for great interoperability and to pass certification
- We typically have much stricter requirements than certification and specification limits
- Limits are set by teams that have significant cellular experience
Certification and interoperability drives development from the start (II)

EX: Software design

- We continuously test software toward specification and certification requirements to ensure maturity and prevent regression.
- Software builds are also continuously tested with infra-vendor equipment and in live networks (field trials).

*nPass rate affected by inability to test all test cases with existing equipment*
Current certification process with final silicon

- Global certification
- Regulatory certification
- Carrier certification

Certified DevKit
- Certified Module
- Certified Chipset
Certification progress and targets

Collaboration with main infrastructure vendors
- Interoperability testing (lab and field testing) have been ongoing both in inhouse basestations and in infrastructure vendors labs

Regulatory certifications (e.g. CE, FCC)
- Pre-certification tests passed for selected bands
- Actual certification projects starting with final silicon

Global certification (GCF)
- Significant number of GCF test cases have been run on approve test equipment
- Full set of GCF test cases can now be run on newly installed equipment

Carrier certification
- Pre-certification testing passed for initial sampling in selected carrier labs
- Field testing ongoing in several territories
- Carrier certification projects ongoing

Target to have GCF/CE/FCC in place during 2018
Customer Sampling

Peder Rand
Cellular IoT Applications

- Asset tracking
- Healthcare
- Wearables
- Metering

Diverse Markets & Application

- Location
- Condition
- Sub-units

The patient should not be the network operator

- Leverage existing infrastructure
- Great coverage and scalability

- Garbage Bins
- Street lights
- Sharebikes
- Smart Parking

- Un-teather from the phone
- Sports/fitness and security
- Leverage existing infrastructure
- Great coverage and scalability
The power of early sampling
Case Study – Asset Tracking
The Challenges

- Will it know where it is?
  - Efficient GPS antenna solution
  - Indoor positioning?
- Will it be able to communicate with my cloud service?
  - Cellular subscription coverage for the relevant area
  - Range, range, range
- Will the battery life be sufficient?
  - Match maintenance cycles?
The Challenges

- Should it be capable of tracking smaller items around it?
  - Use BLE or other simple protocols

- Will it be cheap enough to manufacture and use?
  - COB, cellular subscription, cloud solution

- Will it be manageable?
  - Firmware upgrades, comissioning, decomissioning
The Evaluation of LTE-M and NB-IoT

- Can our challenges most efficiently be solved with LTE-M or NB-IoT for long-range communication?
- How do the different suppliers stack up against each other?
  - Power Consumption
  - Application development support
  - Size
  - Production capacity and quality
  - Solution cost
The HW product

- Development kit – reference design
The SW product

Asset Tracking
- Coap
- LWM2M

API
- DTLS
- UDP
- IPv4
- IPv6
- L3
- L2
- L1
- PHY

Asset monitoring
Device Management
Connectivity Management

SIM
Support and Community

Chip, firmware, SDK, module all developed and supported by Nordic!

Nordic DevZone
Engineer-to-Engineer
& Technical Support

Nordic self-service software on Nordic web and GitHub
Production

- Qorvo and Nordic already manufacture high-volume, quality products in billions
- A world-wide distribution network for fulfilment
- Quality systems in place to quickly resolve challenges
Customer Sampling

Status and plans
First NB-IoT customers sampled

Working on EU Networks

Addressing primarily static installations

Combines with LTE-M for efficient Firmware Over The Air (FOTA)
nRF91 lead customer sampling program

Target to sample more than 100 by end of Q3
Sampled total of 75 customers
Diversified set of customers
Demand for first production quantities end-2018

First design win secured
European customers in asset tracking - FAST
Switched from a competing solution

Start of general availability Q4 2018
Priority is to secure design wins with lead customers
Secure volume ramp

Diversified set of customers
Mix of BIG and FAST
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