COMPETENCE & RELIABILITY

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U-BLOX IOT MODULES

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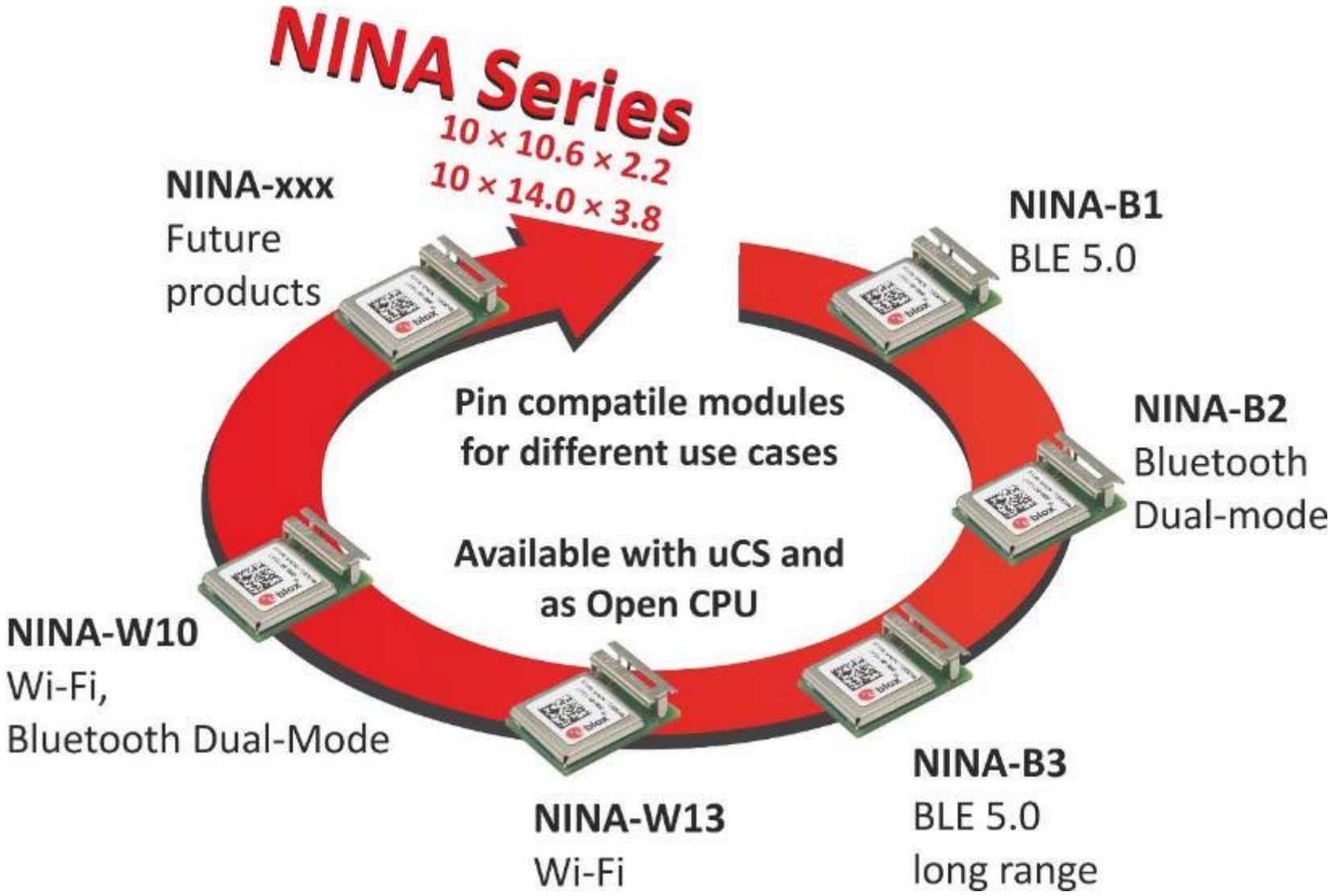
NINA Bluetooth low energy modules

Mariusz Ciesielski, Microdis
April 2018

NINA Series


NINA Series
10 x 10.6 x 2.2
10 x 14.0 x 3.8
NINA-xxx
Future
products
NINA-B1
BLE 5.0
Pin compatile modules
for different use cases
Available with uCS and
as Open CPU
NINA-B2
Bluetooth
Dual-mode
NINA-W10
Wi-Fi,
Bluetooth Dual-Mode
NINA-W13
Wi-Fi
NINA-B3
BLE 5.0
long range

NINA module advantages

Ready to go - focus on product development

- No R&D capacity required for connectivity – No need for RF knowledge
- Point-to-point and multi-point connectivity
- Global certification – Full market access

Time to market

- Time to market reduced by 3 to 6 months – no lengthy, expensive, and risky certification process
- A number of software options available – depending on targeted usage

Excellent radio performance

- Optimized antenna performance /range for maximum link budget – best module on the market

Product size

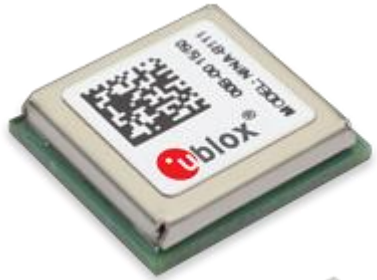
- Small compact solution with or without integrated antenna

Cost effective

- Single component replaces many, at better total cost of ownership
- 100% yield

Less risk

- Fully tested with guaranteed performance and quality
- Simpler supply chain



NINA Product characteristics added value

u-blox connectivity SW

- Pre-flashed application software
- AT command control
- Limited software development on customer side

Series of pin compatible modules

- NINA-B11 – Bluetooth low energy
- NINA-B31 – Long range BLE 5.0
- NINA-W13 – Wi-Fi
- NINA-W10 – Open CPU for Wi-Fi and Bluetooth dual mode
- NINA-B2 – Dual mode Bluetooth
- Wi-Fi and Bluetooth (coming soon)

Smallest size

- 10×10.6 mm with antenna pin
- 10×14 mm with internal antenna
- Integrated flash memory and crystal

Superior security functionality

- Secure Boot
- Bluetooth privacy
- Secure simple pairing

NINA-B1

- The most advanced Bluetooth® low energy module

Bluetooth low energy 5

- Bluetooth 5 qualified
- High data rate
- LE secure connections

Antenna flexibility

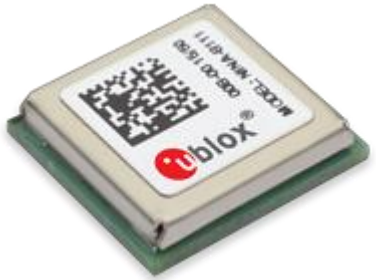
- Superior antenna onboard
- External antenna option
- 350 m range

u-blox connectivity software

- Serial Port Service, 780 kbps
- GATT server and client
- Concurrent central and peripheral
- NFC for easy pairing

Open CPU for customer application

- Powerful Arm® Cortex®-M4 with FPU
- Multiple software options for embedded customer application
- Bluetooth mesh, Apple HomeKit, AirFue and more



Lowest power consumption

- State-of-the art power consumption
- Low power crystal onboard
- 0.3 µA sleep, 2 µA standby

Industrial applications

- Pin compatible with other NINA modules
- Global certification
- Industrial temperature range

ANNA-B112

The smallest industrial Bluetooth 5 module

Bluetooth® low energy 5.0

- Bluetooth 5 qualified
- Bluetooth secure connections
- Increased data rate

Antenna flexibility

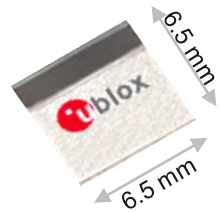
- Integrated antenna
- 160 m range
- External antenna option

u-blox connectivity software

- Serial Port Service, 780 kbps
- GATT server and client
- Simultaneous central and peripheral
- NFC for easy pairing

Open CPU for customer application

- Powerful Arm® Cortex®-M4 with FPU
- Multiple software options for embedded customer application
- Bluetooth mesh, Apple HomeKit, AirFuel and so on.



Small and low power

- 6.5 x 6.5 x 1.2 mm
- State-of-the art power consumption
- 0.3 µA sleep
- 2 µA standby with external crystal

Industrial applications

- Range of certifications
- Industrial temperature range -40 °C to +85 °C

NINA-B1 Specification overview

Feature	u-blox connectivity software	OpenCPU
Bluetooth version	v5.0	
MCU	Arm Cortex-M4 at 64 MHz, DSP, Floating point unit, RTC (CoreMark 215)	
Memory	512 kB Flash, 64 kB RAM	
32 kHz LPO crystal	Yes	
Max TX output ower RX Sensitivity	External antenna: +7 dBm including antenna gain Onboard antenna: +6 dBm including antenna gain External antenna: -98 dBm including antenna gain Onboard antenna: -97 dBm including antenna gain	
NFC	NFC tag including Out-of-Band pairing	
Host interfaces	UART, GPIO	UART, SPI, I^2C, I^2S, GPIO, ADC, PWM
Power supply	VCC & VIO 1.7 to 3.6 VDC	
Power consumption	Tx at 0 dBm: 5.3 mA Rx: 5.4 mA Advertising (1 per second) at 4 dBm: 26 µA (average) Standby (wakeup on BLE, NFC, RTC, GPIO): 2.2 µA Sleep (no clocks running, no RAM retention): 300 nA	
Operating temperature	-40 to +85 °C	
Dimensions	10.0 x 10.6 x 2.2 mm (NINA-B111) 10.0 x 14.0 x 3.8 mm (NINA-B112)	
Packaging	Tape & Reel	

NINA-B3 Specification overview

Bluetooth version	5.0
Additional wireless standards	NFC-A tag, 802.15.4 (NINA-B30, only)
MCU	Cortex-M4 at 64 MHz, DSP, Floating point unit, RTC
Memory	1 MB Flash, 256 kB RAM
32 kHz LPO crystal	Yes
Max TX output ower **RX Sensitivity**	+8 dBm -95 dBm (1 Mbps modulation) -103 dBm (125 kbps modulation)
NFC	NFC tag support for Out-of-Band pairing
Interfaces, u-blox connectivity software (NINA-B31x)	UART, SPI, GPIO (28)
Interfaces, HW support (NINA-B30x)	UART, USB, SPI, I^2C, I^2S, QDEC, PDM, PWM, ADC, GPIO (38)
Power supply	VCC & VIO 1.7 to 3.6 VDC
Power consumption	Active TX/RX: 6.6 mA (0 dBm) Stand-by: 1.3 uA Sleep: 400 nA (no clocks running, no RAM retension)
Operating temperature	-40 °C to +85 °C
Dimensions	10.0 × 11.6 × 2.2 mm (NINA-B301, NINA-B311) 10.0 × 15.0 × 3.8 mm (NINA-B302, NINA-B312)
Packaging	Tape & Reel

Planned feature set

NINA-W131/NINA-W132

Key features

Wi-Fi features

- Supports 802.11b/g/n
- 802.11n rates up to 72 Mbps
- 19 dBm radiated output power

Security features

- Secure boot
- 802.11i security – WPA/WPA2
- Enterprise Security – EAP/TLS, LEAP, PEAP

Radio features

- Internal antenna or antenna pin

Planned feature set

u-blox connectivity software & Open CPU

NINA-B Software capabilities and environments

Source	Pre-flashed	Nordic SDK	mbed.org SDK	Wirepas SDK
Easy config via AT commands	●			
Customer developed application		●	●	●
UART, GPIO	●	●	●	●
SPI, I²C, ADC, PWM		●	●	●
Serial Data over Bluetooth LE	●	●	●	●
# of simultaneous connections	8	20	20	100k+
GATT server and client	●	●	●	
NFC pairing	●	●	●	
Beacon	●	●	●	●
Firmware upgrade over air		●		●
Operation without host		●	●	●
LE secure connections		●		
Bluetooth 5	●	●		
Large scale mesh				●
Bluetooth mesh		●		
IPv6		△		

△ Upcoming feature

NINA-B with u-blox connectivity software

Out-of-the-box Bluetooth low energy connectivity

- NINA-B1 pre-flashed, fully tested and verified by u-blox
- Fastest time to market for a wide range of IoT applications
- Easy configuration and control via AT commands

- Examples of supported applications and use cases

  Two Bluetooth devices communicate over SPS (Serial Port Service)
    - Up to 780 kbps throughput

  Bluetooth hub connecting to several sensors (using GATT)

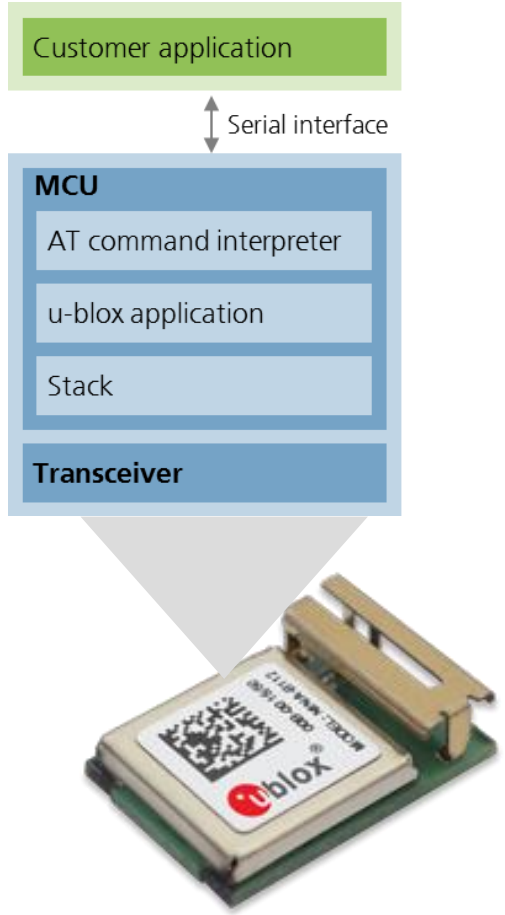
  Connecting a sensor to a Bluetooth hub (using GATT or SPS)

  Up to 7 sensors connecting to a Bluetooth hub (using EDM)

  Bluetooth beacons

  NFC pairing

  GPIO control



NINA-B1 u-blox connectivity software roadmap

	v2	v3	v4
Availability	Available	Available	Available
IOT Networking	Serial Port Service GATT client & server Central role (SPS+GATT) Multipoint - Extended Data Mode - GATT Beacon	Higher throughput: - Packet length extension	Bluetooth 5 Higher throughput: - 2 Mbps link GPIO control
Ease of commissioning	AT command interface Configuration over the air	NFC tag for pairing NFC tag for small data	
Trustful IoT	Secure simple pairing		
Ordering code	NINA-B111-01B NINA-B112-01B	NINA-B111-02B NINA-B112-02B	NINA-B111-03B NINA-B112-03B

Every software release also includes the functionality from previous versions.

NINA-B2 u-blox connectivity software roadmap

	v1
Availability	ES Q2 2018 IP Q2 2018
IOT Networking	Bluetooth: - Serial Port Profile (SPP) Bluetooth Low Energy: - GATT client and server - Serial Port Service (SPS) - Beacons Extended Data Mode (EDM)
Ease of commissioning	AT command interface
Trustful IoT	Secure boot Secure simple pairing
Ordering code	NINA-B221-00B NINA-B222-00B

Note: Every software release also includes the functionality from previous versions.

NINA-B31 u-blox connectivity software roadmap

	v1
Availability	ES Q2 2018 IP Q3 2018
IOT Networking	Bluetooth 5 - 2 Mbps link speed - Long range Serial Port Service GATT Peripheral and central roles Extended Data Mode Beacon
Ease of commissioning	AT command interface Configuration over the air NFC tag
Trustful IoT	Secure boot Secure simple pairing
Ordering code	NINA-B311-00B NINA-B312-00B

Every software release also includes the functionality from previous versions.

Secure Boot

- Fundamental for security in IoT systems

Secure Boot

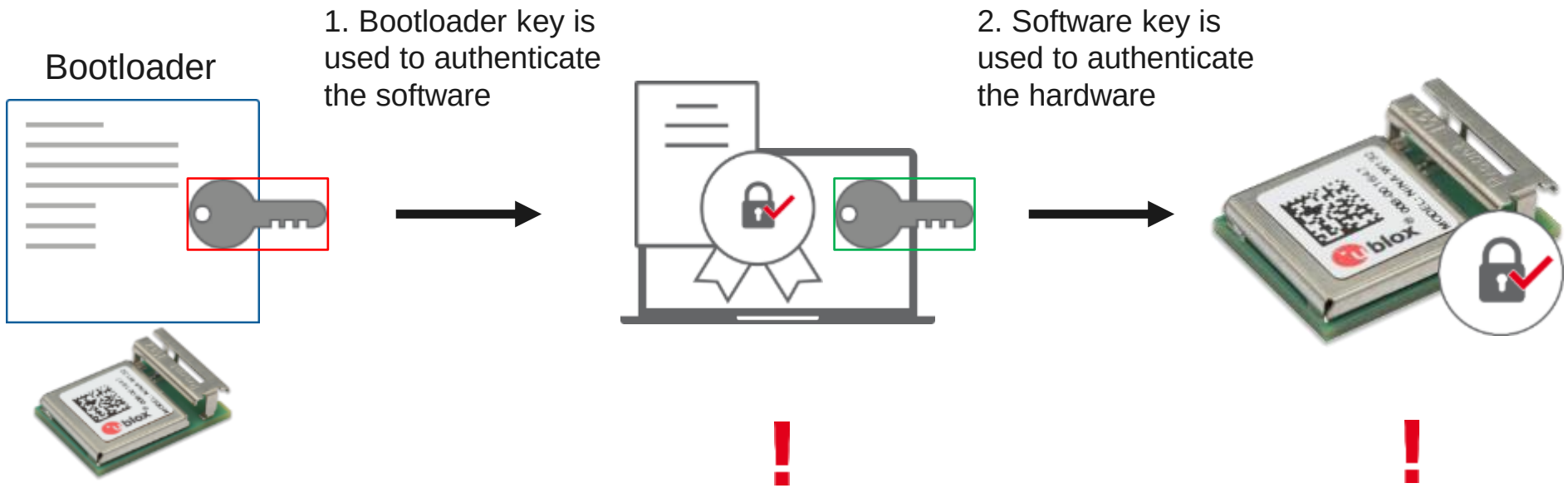
For a secure IoT system, it is fundamental that the **software** running on each node is **authenticated**

With u-blox' **Secure Boot**, the module boots up only in the presence of original certified software

If anyone tries to run the module with a counterfeit software, it **will not boot**

Secure Boot

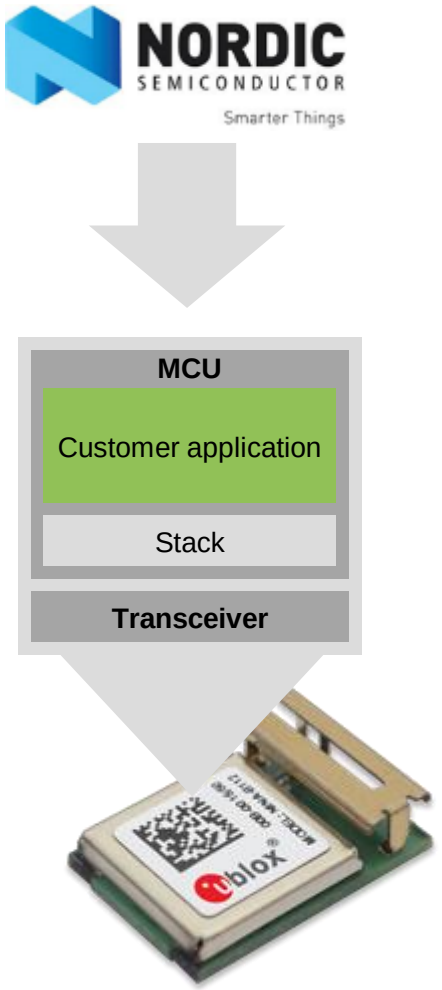
- How does it work?



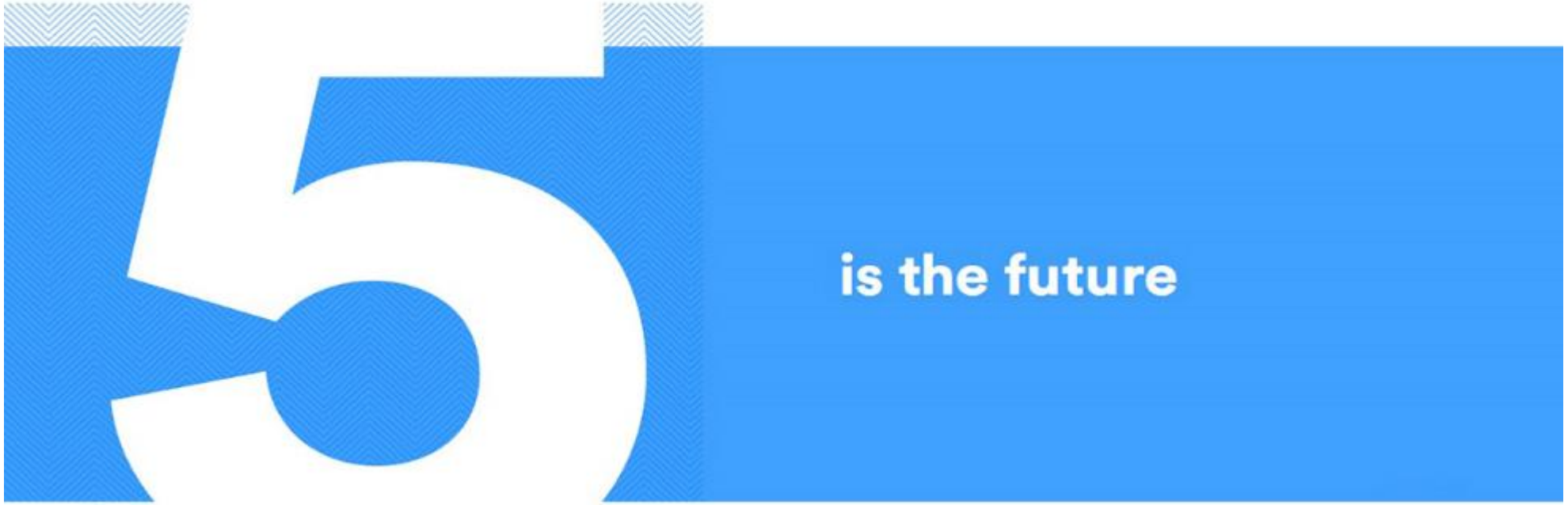
NINA-B Open CPU with Nordic SDK

For full flexibility and access to all hardware capabilities

- SDK for customer developed application in NINA-B
- Supports features such as:
  - Bluetooth 5 high speed
  - Bluetooth Mesh
  - Apple HomeKit, AirFuel
  - Advertising extensions (upcoming)
  - IPv6 with cloud connectivity (upcoming)
- Allows for advanced optimization and tuning
- Reuse between Nordic chipset generations
- Wide range of examples code available



Bluetooth®



Bluetooth 5 feature overview

2x speed

2x link speed

4x range

4x range with lower data rates

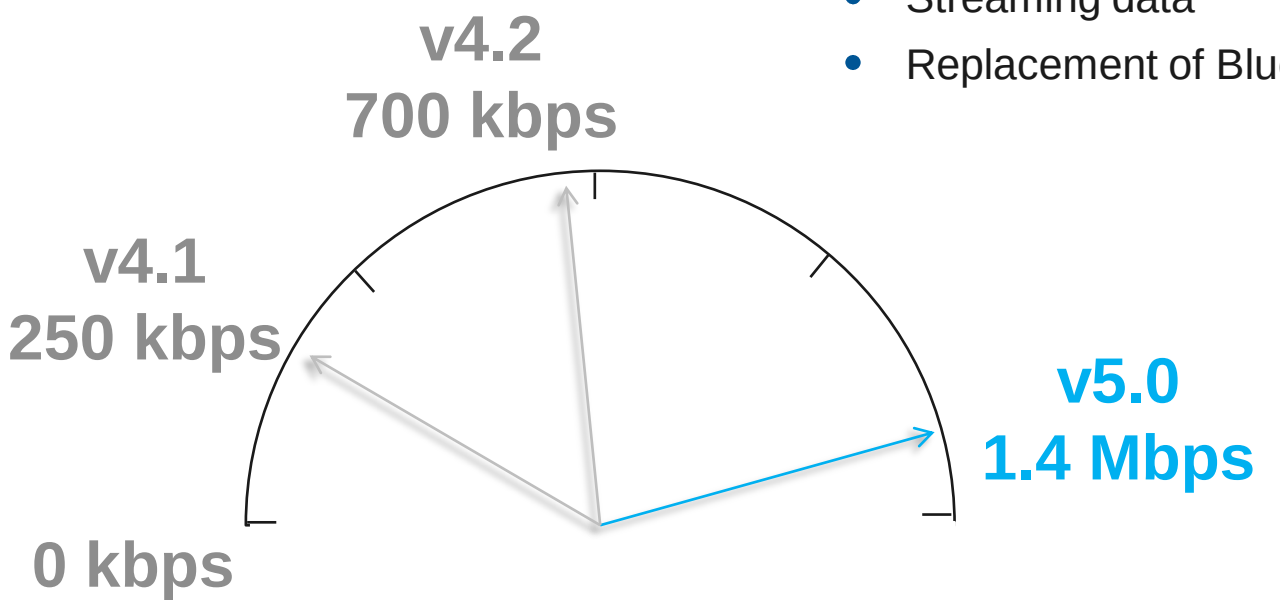
8x data

8x broadcast message capacity

Bluetooth 5 – higher data rate

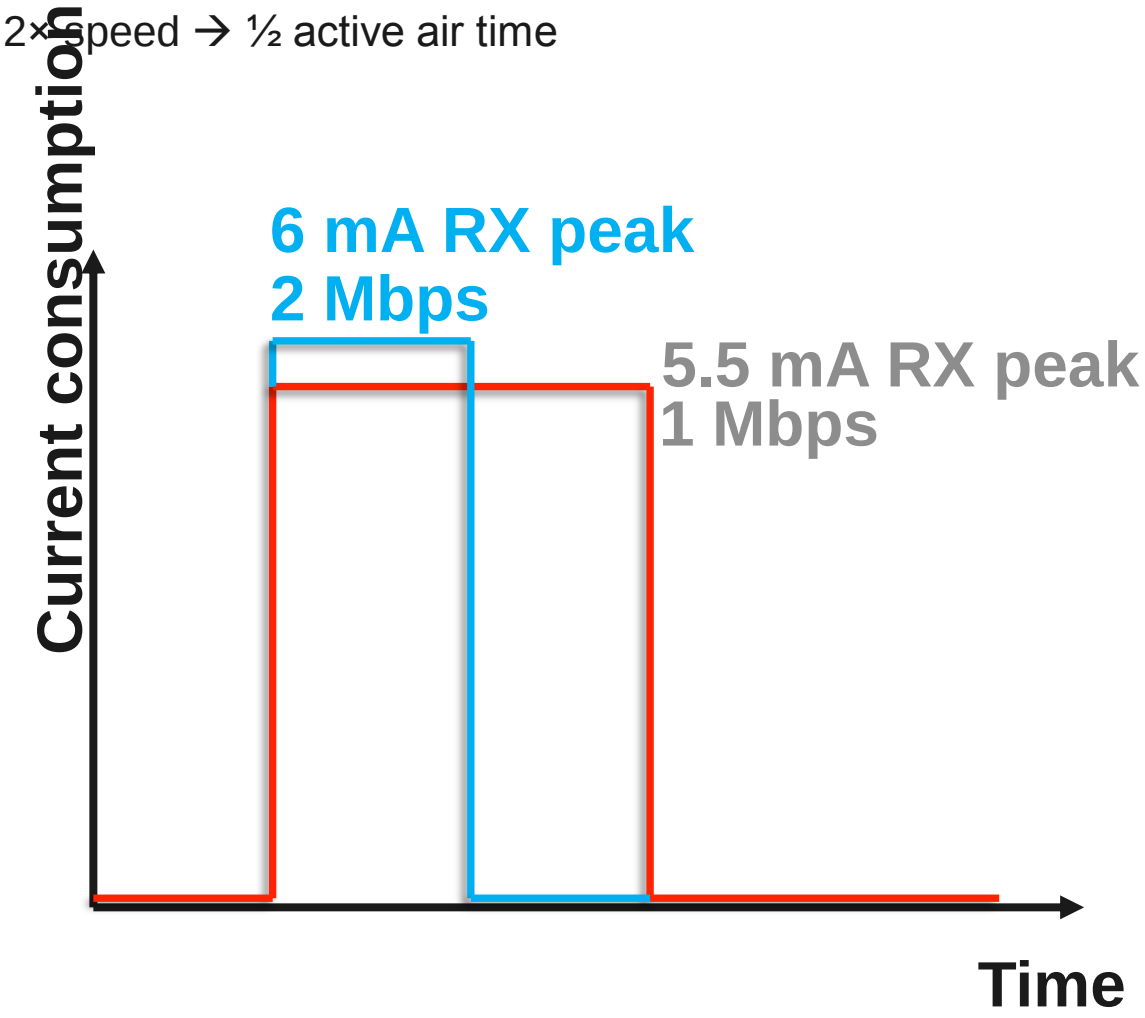
- 2 Mbps over air
- User data throughput 1.4 Mbps

- Faster and more responsive systems
- Improved latency
- New use-cases
  - Streaming data
  - Replacement of Bluetooth BR/EDR ?



Bluetooth 5 – lower power

- 2× speed → ½ active air time



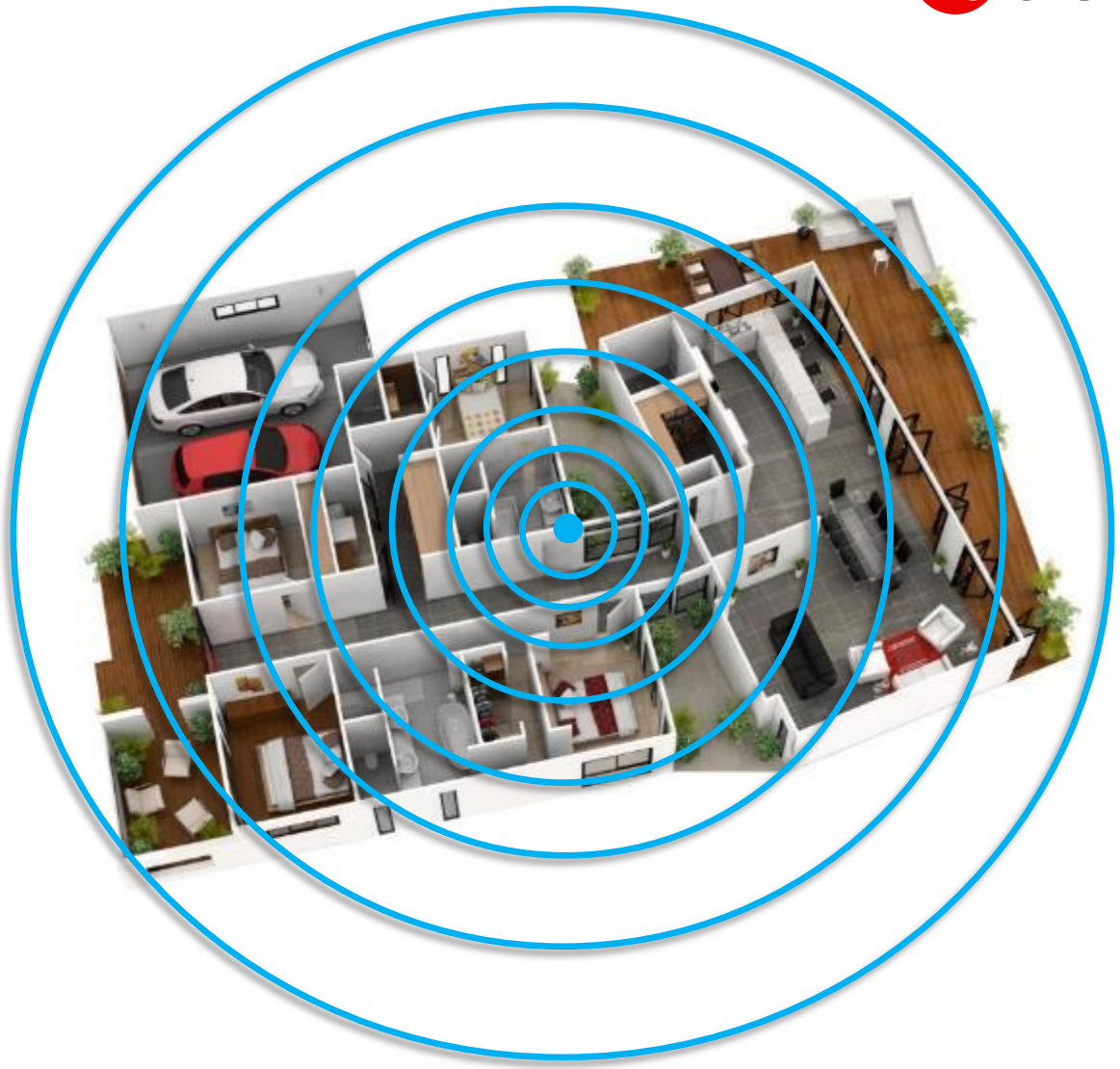
- Close to ½ power consumption
- Improved spectrum efficiency and coexistence

Bluetooth 5 – extended range

- New coding 125+500 kbps

- Better link budget
- Up to 4× range
- Full house coverage through walls
- Extreme line-of-sight range ~1km

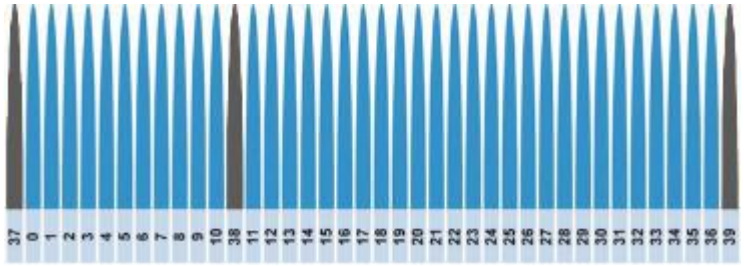
- Higher output power allowed
- Depending on country



What is Bluetooth 5 and why is it good? - 8× advertising data

- 8× more broadcast data
- From 31 to 255 bytes data
- Chaining of advertising packages for >255 bytes
- Less broadcast time
- Richer beacon-based solutions:
  more sensor data, long URL support, data streaming

- More channels for broadcast data
- From 3 to 37 channels
- Offloads the 3 advertising channels



u-blox - introducing Bluetooth 5!

How will u-blox support the Bluetooth 5 features?

1. 2× speed
2. 8× broadcast data
3. 4× range

NINA-B1

SW Upgrade

Supports feature 1 and 2

Available as:
u-blox connectivity software
Development SDK (Nordic)

NINA-B3

NEW

Supports feature 1, 2 **and 3**

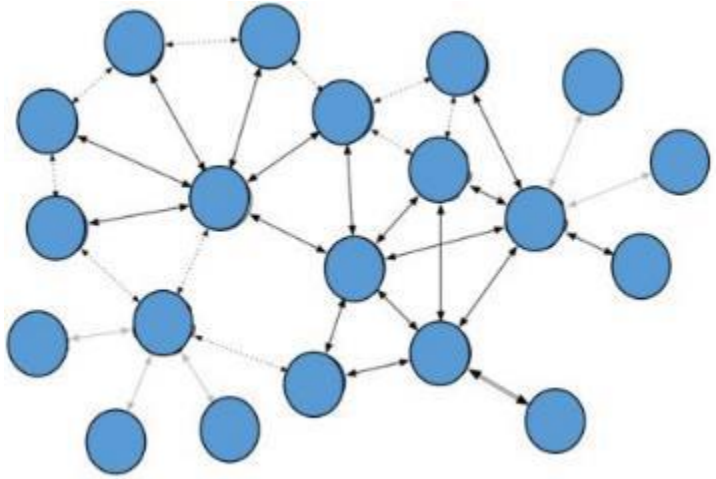
Available as:
u-blox connectivity software
Development SDK (Nordic)

Bluetooth mesh

Bluetooth mesh

- Devices relay data to each other
- Many-to-many topology
- Improved coverage

- Version 1.0
- Operates on Bluetooth 4.0 or later
- Managed flooding on advertising channels
- Planning for optimal operation
- Networks of hundreds of nodes
- Industrial grade security - mandatory



Features

Publish – subscribe model

Keys

- Network Key - need one key to allow every device to help relay messages throughout a network
- Application Key - need to separate different applications from each other
- Device Key - similar to AppKey, used for Configuration messages

TTL – Time to Live, Heartbeats

- All packets include a field known as the TTL - this may be used to limit the number of hops that a message takes as it is relayed

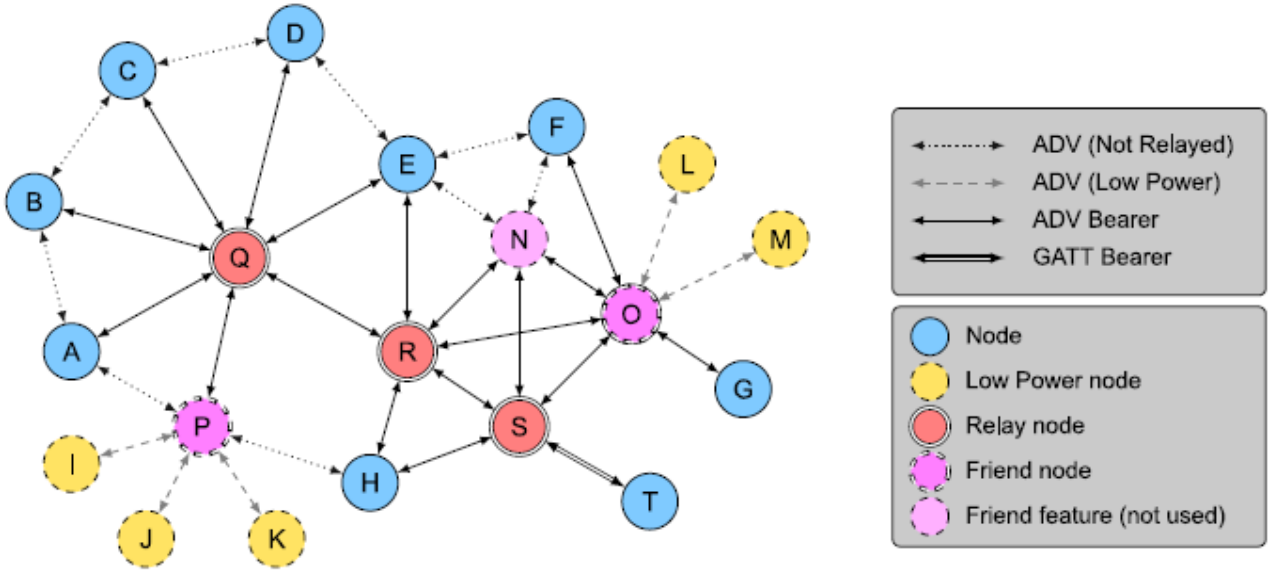
Low Power Nodes

- Friendship - not all nodes must listen all the time so duty cycles do not have to be near 100%

…and more

Relaying steps

1. Receive a mesh message
2. Check if mesh message NID is one of known NIDs
3. Authenticate message against Network Key
4. If TTL ≥ 2 then decrement TTL, re-encrypt and transmit



New use cases enabled by Bluetooth 5 & mesh

Example of new industrial use cases

- *Building automation*
- *Street lighting*
- *Device firmware upgrade*
- *Asset tracking*
- *Medical – patient tracking*
- *Capillary sensor network*

Building automation

Applications

- Lighting control
- Heating Ventilation and Air Con (HVAC)
- Access control
- Presence detection
- etc.

Bluetooth 5 features

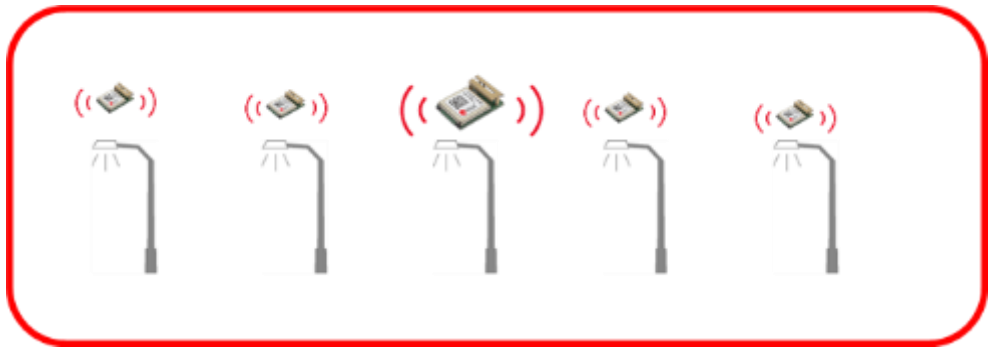
Extended range – penetrate walls

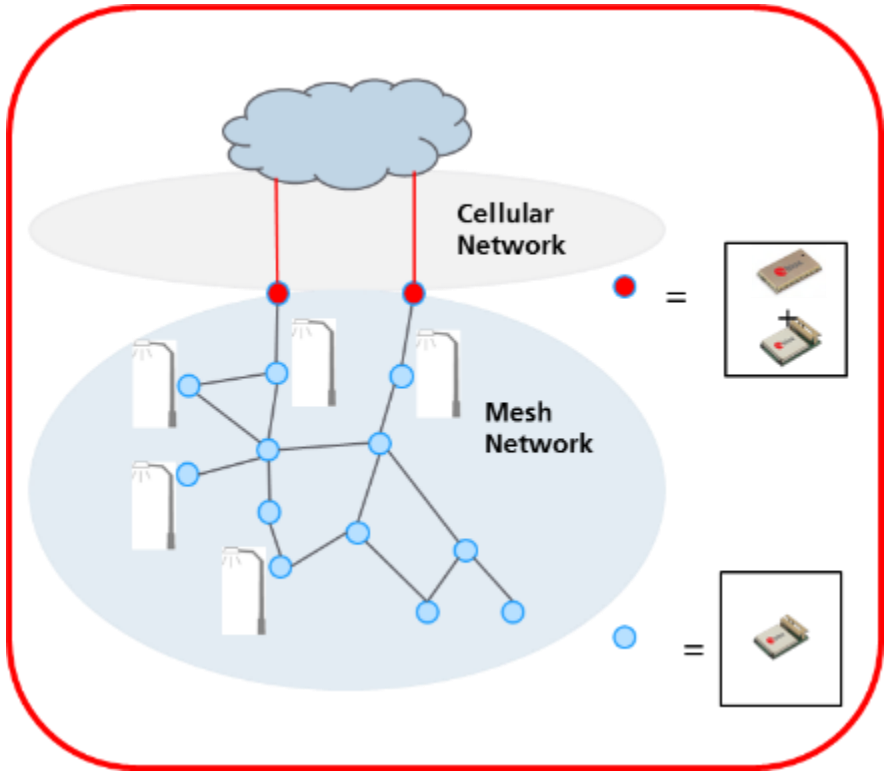
Bluetooth mesh – further extension

Smart street lighting

Applications

- Low latency communication between streetlights
- Sensor driven graceful dimming
- Cloud connectivity via mesh and cellular capillary gateway





Bluetooth 5 features

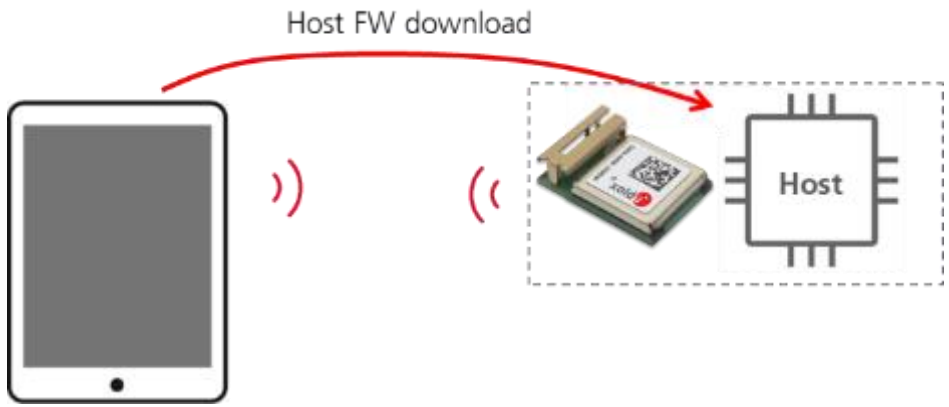
Extended range – several streetlights within direct reach

Bluetooth mesh – further extension

Device firmware upgrade

Application

- Over The Air – Device Firmware Upgrade
- Embedded systems with few MB firmware
- 1 MB takes less than 7s



Example: vehicle diagnostics device

Bluetooth 5 feature

Enhanced data rate

Asset tracking

Application

- Keep track of / find assets
- Temporary mesh to locate
- Use existing mesh network

Bluetooth 5 feature
Bluetooth mesh

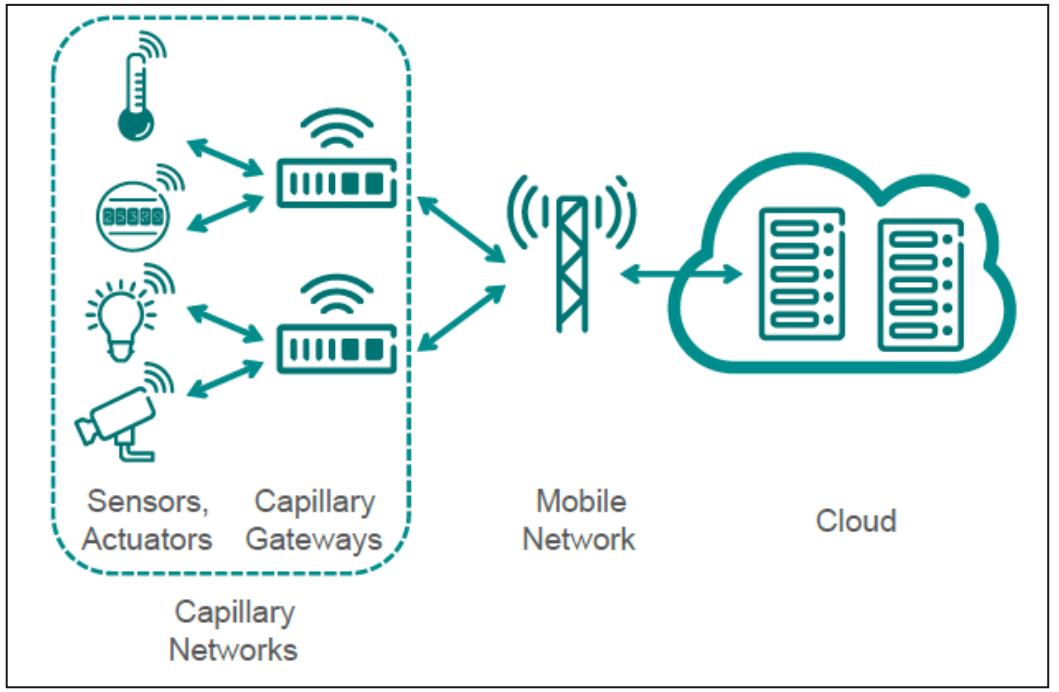
Industrial sensor networks

Capillary networks

- Application
- Capillary network

  Bluetooth mesh

  Gateway
- Cost efficiency with high density of sensors



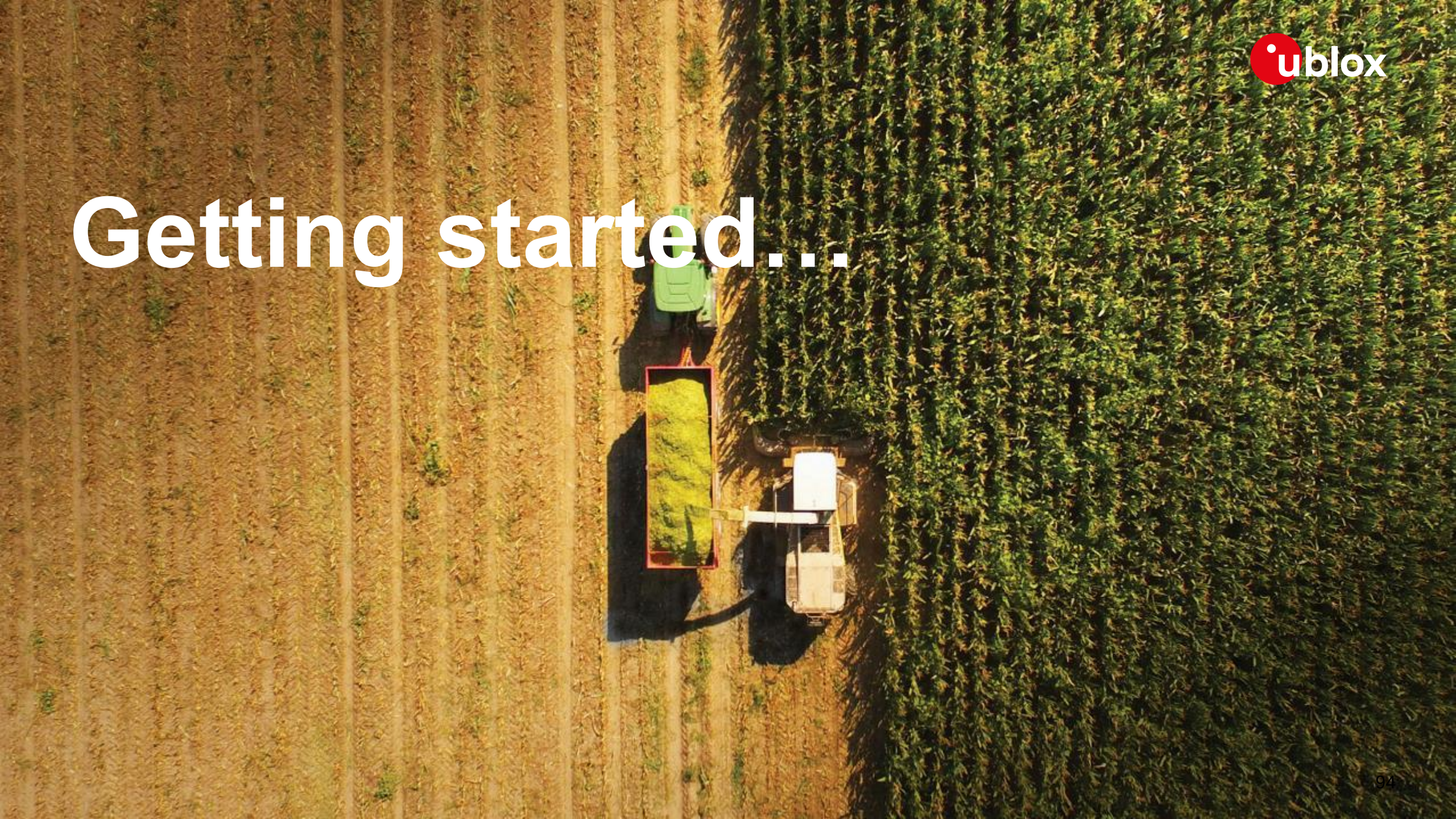
Source: Ericsson ”Capillary Networks”

Bluetooth 5 feature

Bluetooth mesh

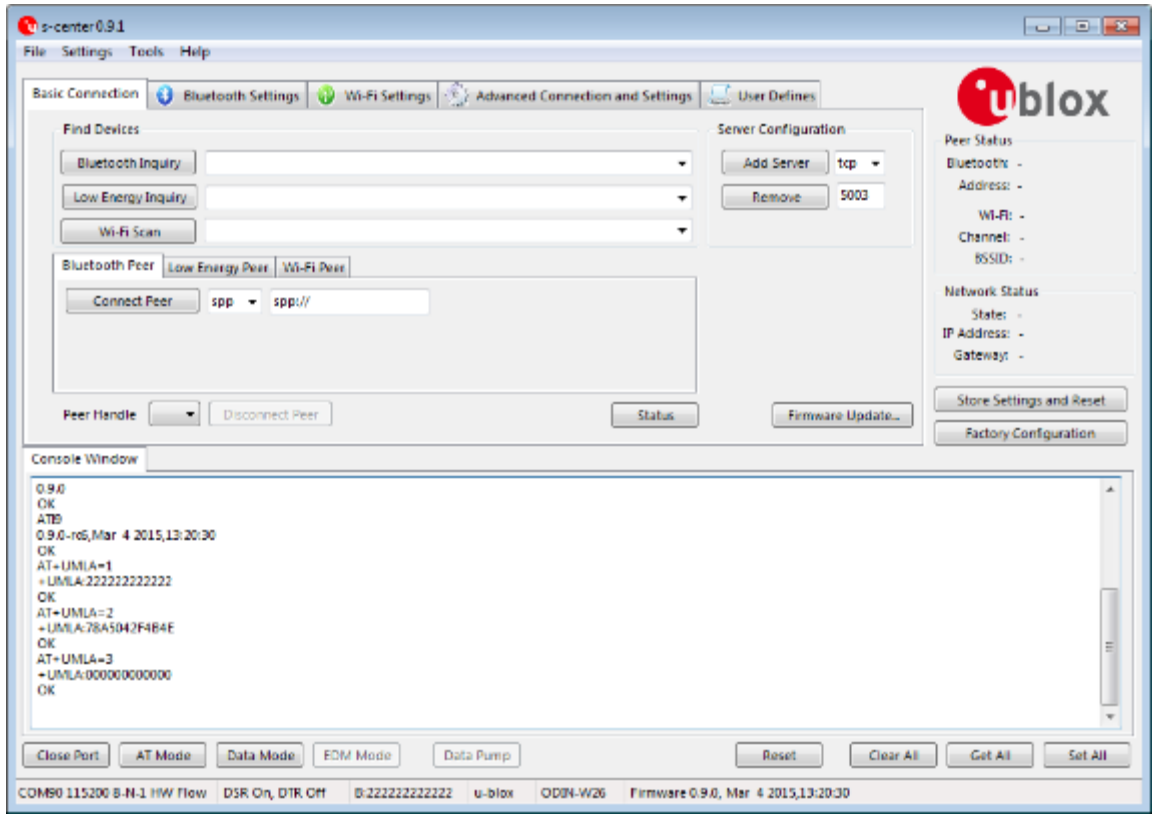
Bluetooth long range

Getting started…



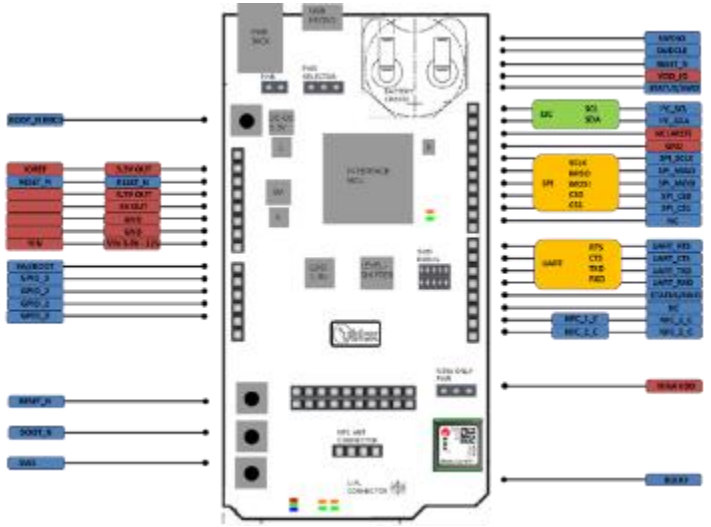
s-center PC evaluation software

- Evaluation of features and performance
- Easy to
  - Scan for devices
  - Set up connections
  - Configure module and settings
- Throughput testing
- AT command terminal window
- Save/restore complete module configuration
- Module firmware flash tool



Evaluation kit - EVK-NINA-B

- Evaluation of u-blox Connectivity Software using s-center
- Development of customer application (Open CPU)
  - Segger debugger on-board
  - Connector for external debugger
  - Breakout pin list for sensors
  - Compatible with Arduino shields
  - Power source
    - Coin cell
    - USB
    - External (5-12 VDC)



THANK YOU FOR YOUR ATTENTION

2018