

Meet the nRF5340

The next generation in IoT

Webinar

Nordic Semiconductor

February 2020

Duration: 50-60 min

Today's host

Petter Myhre

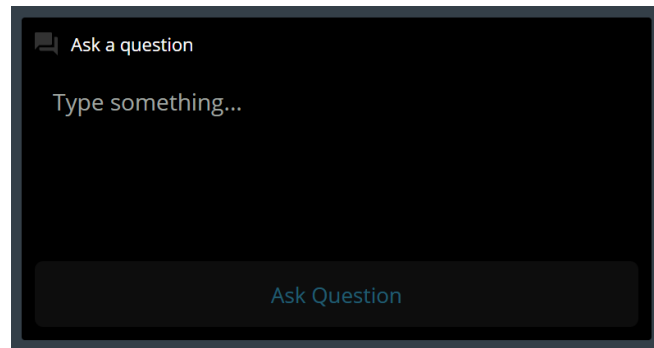


Product Marketing Manager



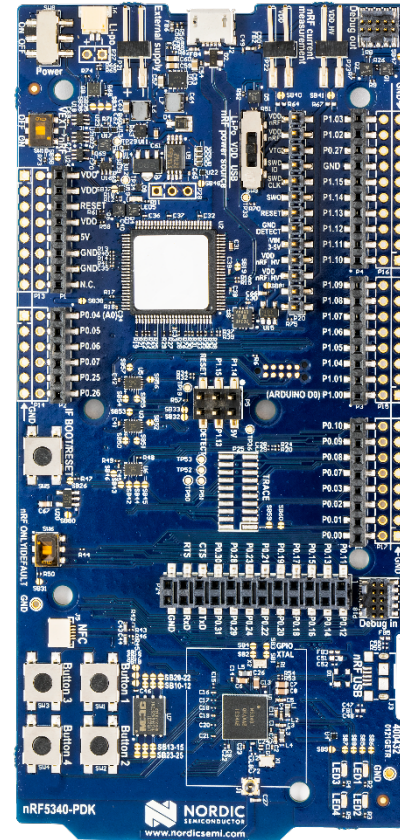
Practicalities

- Duration: 50-60 mins
- Questions are encouraged!
- Please type questions in the top of the right sidebar
 - All questions are anonymous
- We will answer questions towards the end
- If you have more questions please use DevZone
- A recording of the webinar will be available together with the presentation at webinars.nordicsemi.com



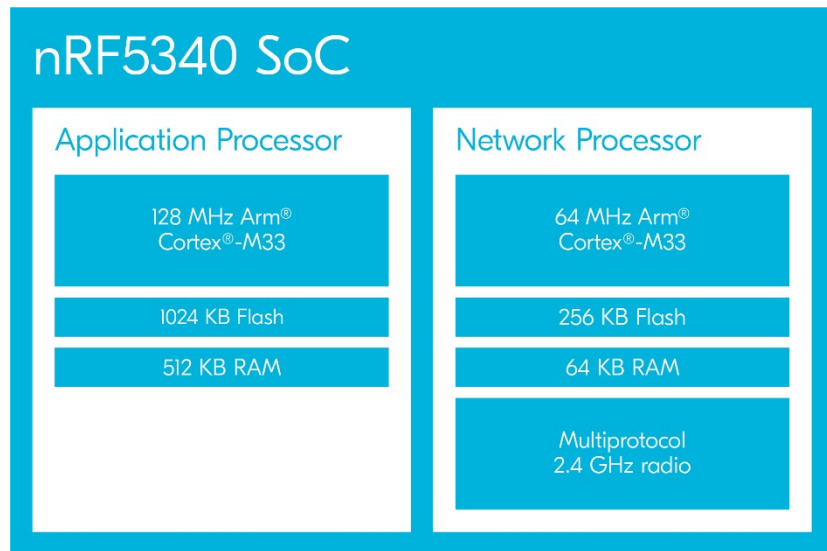
Content

- Overview and highlights
- Markets and applications
- Hardware architecture and feature set
- Software architecture and support
- Security
- Development tools
- Q&A





nRF5340 overview and highlights



- High-performance application processor
- Fully programmable, ultra-low power network processor
- Redesigned multiprotocol radio
- Advanced security features
- 1.7-5.5 V supply range
- -40 to +105°C

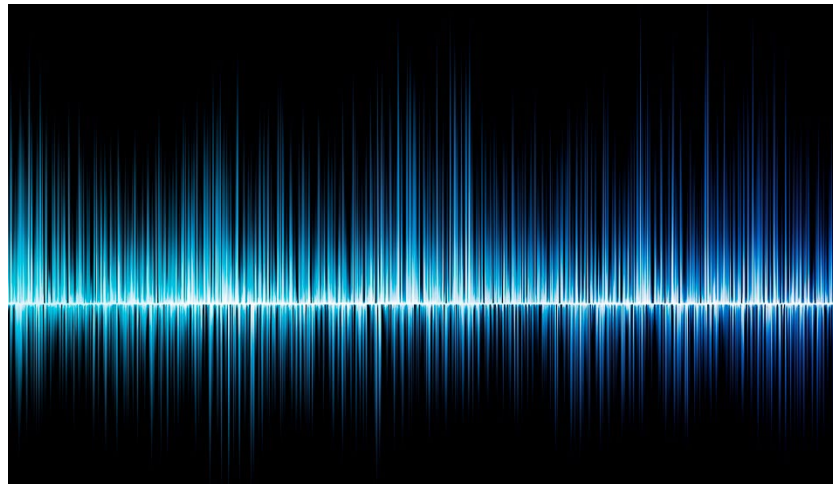
Multi-core flexibility

- High performance and high efficiency – no trade-off
- Distinct optimization
 - Performance
 - Efficiency
- Separation of concerns
 - Real-time requirements
 - Software split



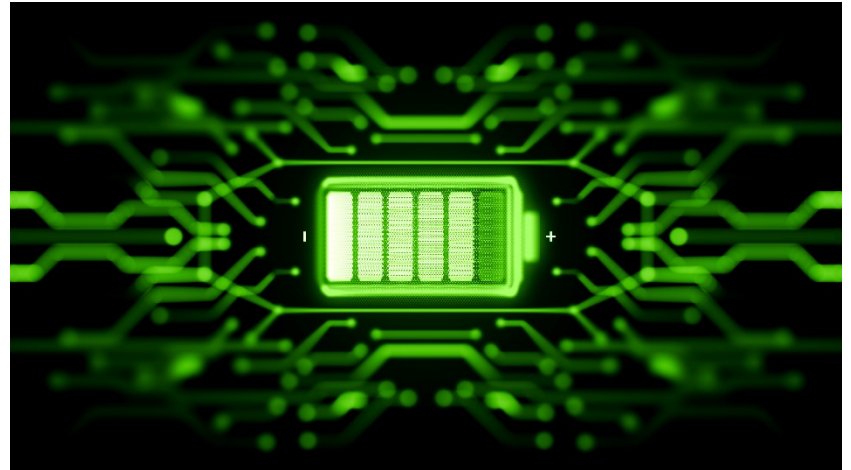
Multiprotocol radio

- Bluetooth 5.2 and beyond
 - 2 Mbps, Long Range and Advertising Extensions
 - Direction Finding
- Bluetooth mesh
- 802.15.4 support
 - Thread
 - Zigbee



Radio improvements

- TX current reduced with **30 %** down to 3.2 mA
- RX current reduced with **40 %** down to 2.6 mA
- -97.5 dBm RX sensitivity
- 1 dB resolution of TX power



A truly secure SoC

- Trusted execution with Arm TrustZone
 - Flash, RAM, GPIOs and peripherals
- State-of-the-art Arm CryptoCell-312
 - Advanced cryptography
 - Hardware Root-of-trust
- Secure key storage with Key Management Unit (KMU)



All-in-one

- nRF52 Series feature superset
 - Bluetooth 5.2, Thread and Zigbee
 - CryptoCell, USB, QSPI, HS-SPI
 - 1.7-5.5 V and up to 105 °C
- More
 - Performance
 - Memory
 - Integration
- While minimizing power consumption



Markets and applications

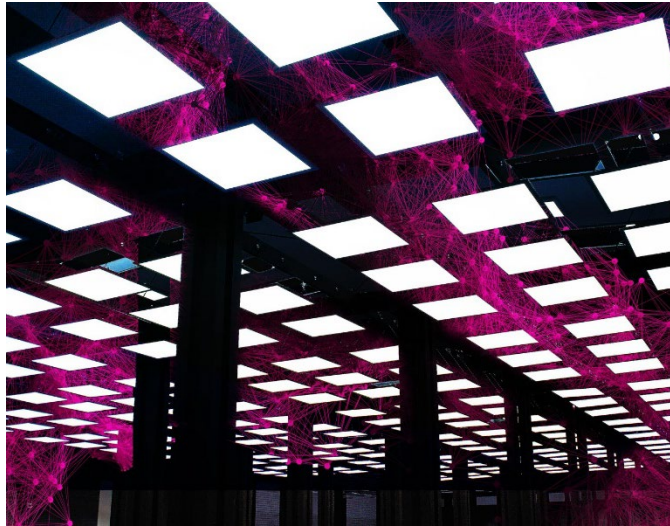
What can it be used for?

Advanced wearables



- High-performance 128 MHz processor with DSP instructions and floating point capabilities
- 512 KB on-chip RAM for data and sensor fusion
- Memory mapped 96 MHz encrypted QSPI interface for external memory
- 32 MHz HS-SPI for displays and fast sensors
- Sensor collection in application or network core depending on bandwidth
- Compact CSP with few external components

Professional lighting and industrial



- Designed for +105°C
- Concurrent Bluetooth LE and Bluetooth mesh/Thread/Zigbee support
- Bluetooth Direction Finding
- Advanced security features
- Dual-core architecture

Smart home

- Designed for +105°C
- Concurrent Bluetooth LE and Bluetooth mesh/Thread/Zigbee support
- Performance and memory for demanding applications
- Advanced security features

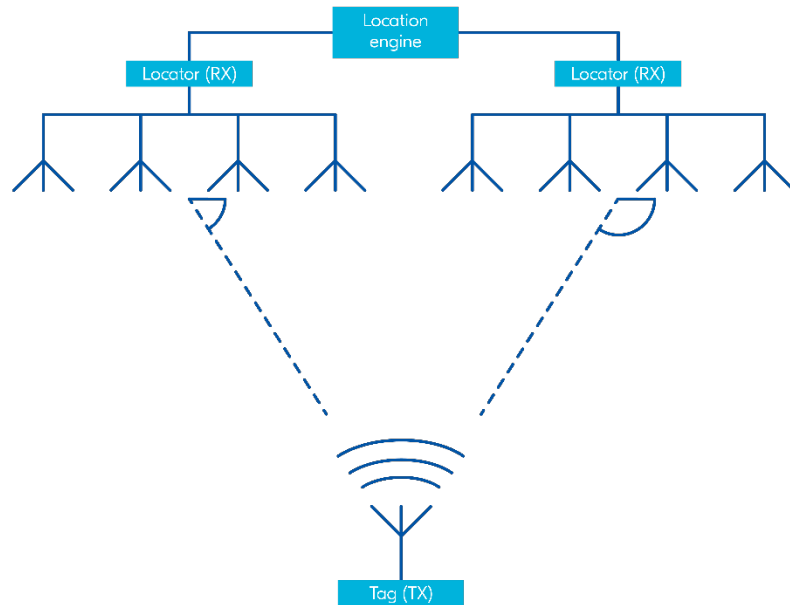


Healthcare and medical



- User application and wireless protocol run in separate cores
- Both cores are programmable
 - enables 2-way supervision!
- Focus on certifications
- Advanced security features

Asset tracking - RTLS



Getting into the details

nRF5340 SoC

Power and clock

Power supply

LDO

Buck DC/DC

POR

BOR

Oscillators

32 MHz RC/XO

32 kHz RC/XO

Audio PLL

Debug

Debug

Application Processor

64/128 MHz
Arm®
Cortex®-M33,
DSP, FPU,
TrustZone

1024 KB Flash

512 KB RAM

8 KB I-Cache

IPC

AHB / APB / EasyDMA / DPPI

System Peripherals

3×TIMER

2×RTC

2×WDT

6×EGU

Security

Arm CryptoCell-312

SPU

KMU

Digital, analog I/F and GPIO

USB

QSPI

HS-SPI

4×UART/SPI/TWI

I2S

PDM

4×PWM

2×QDEC

NFC-A Tag

SAADC

LPCOMP

COMP

GPIOE

Shared 48-pin crossbar

Network Processor

64 MHz Arm®
Cortex®-M33

256 KB Flash

64 KB RAM

2 KB I-Cache

IPC

AHB / APB / EasyDMA / DPPI

System Peripherals

3×TIMER

2×RTC

WDT

EGU

RNG

TEMP

ECB

AAR

CCM

Digital I/F and GPIO

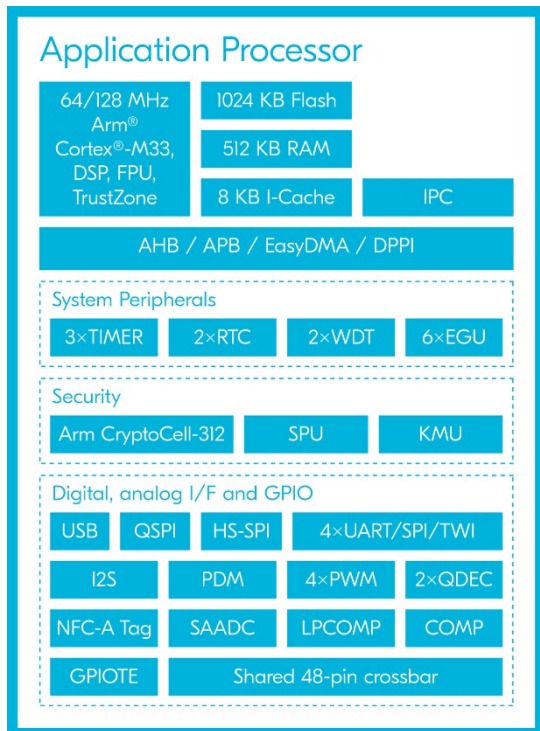
UART/SPI/TWI

GPIOE

Shared 48-pin crossbar

Multiprotocol
2.4 GHz radio

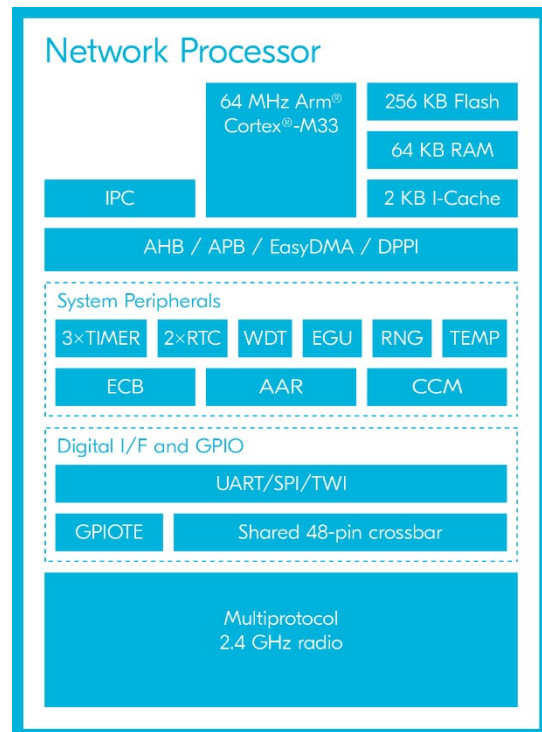
Application processor



- Arm Cortex-M33 with DSP and floating point instructions
- 128 MHz and 64 MHz clock speeds
- Voltage-frequency scaling
- Optimized for performance
- TrustZone support
- 8 KB 2-way set associative cache
- 1024 KB flash
- 512 KB RAM

Network processor

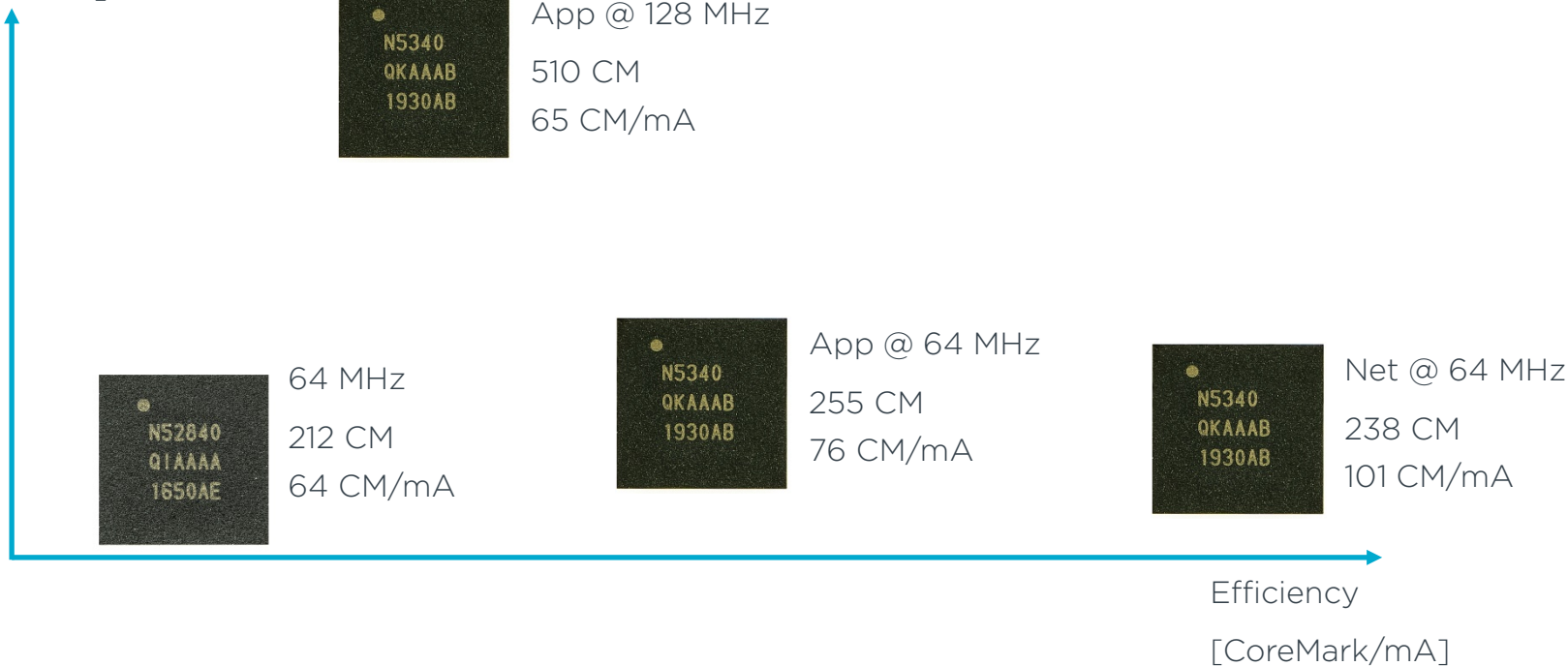
- Arm Cortex-M33
- 64 MHz clock speed
- Optimized for efficiency
- Fully programmable
- 2 KB instruction cache
- 256 KB Flash
- 64 KB RAM



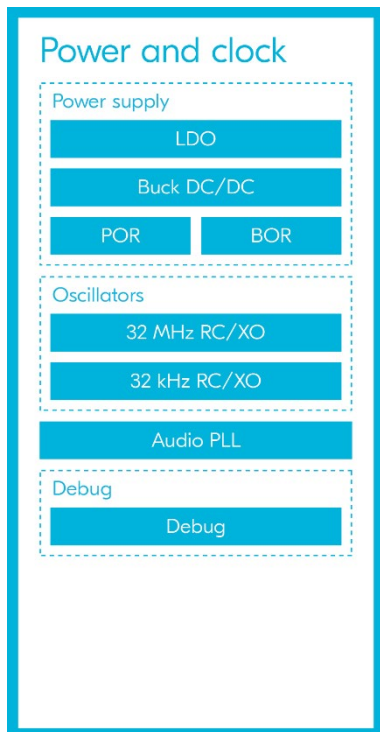
Multi-core flexibility

Performance

[CoreMark]



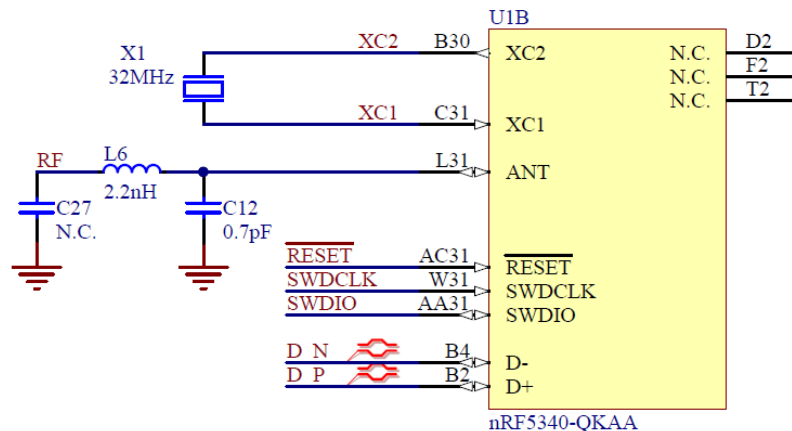
Power and clock



- Power supply
 - 1.7 to 5.5 V
 - LDO and DC/DC options
 - Direct supply from USB
- Oscillators
 - Integrated load capacitors
 - 32 MHz and optional 32 kHz crystals
- Tunable on-chip Audio PLL
 - 11.289 or 12.288 MHz
 - Low jitter, suitable for audio applications

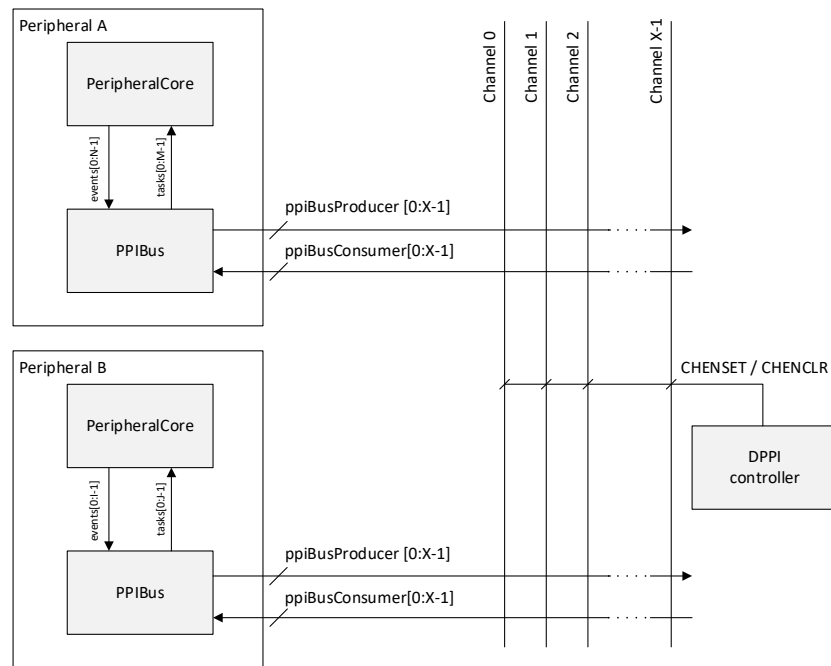
External component reduction

- Integrated on-chip XTAL load capacitors
- For both 32 MHz and 32.762 kHz crystals
- Cuts 2/4 external components



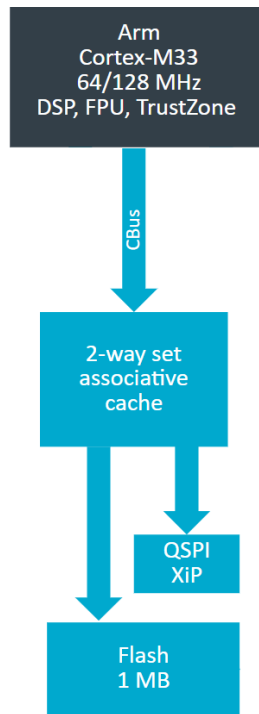
DPPI

- Distributed programmable peripheral interconnect
- Replaces the PPI in nRF52 series
 - New interconnect interface for peripherals
- Enables new connection types
 - One-to-one (PPI)
 - One-to-many (1-to-2 with PPI fork)
 - Many-to-one
 - Many-to-many
- New interconnect paradigm
 - A Task subscribes to a channel
 - An Event publishes to a channel

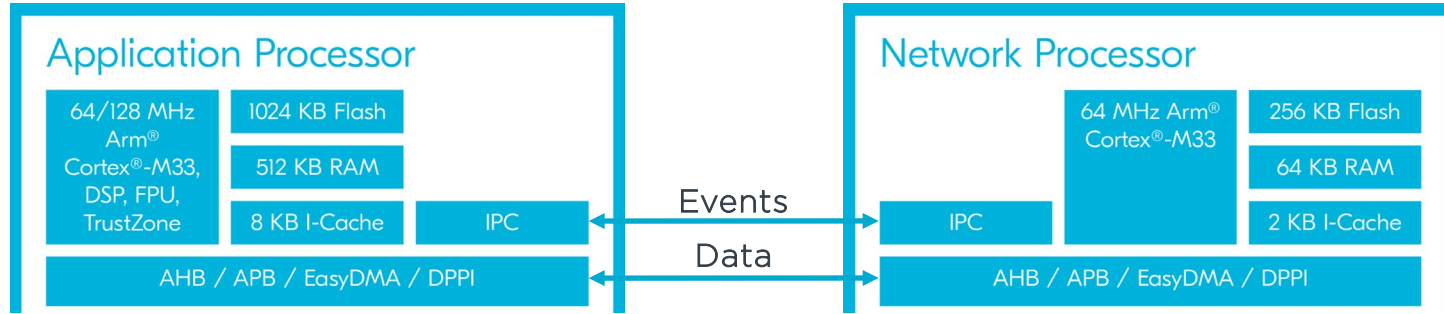


External memory – Execute in place (XiP)

- CPU cache
 - Two-way associative
 - Serves both internal and external memory
- Improved QSPI interface
 - Up to 96 MHz clock frequency
 - 40 MHz clock in low power mode
 - On-the-fly AES-128 encryption and decryption



Communication between the cores



- Inter-processor communication (IPC)
 - Generates events
 - Wake-up source
- AMLI bridge
 - Cross-domain memory and peripheral access
- OpenAMP
 - Software framework for Asymmetric Multiprocessing (AMP) systems

Software support

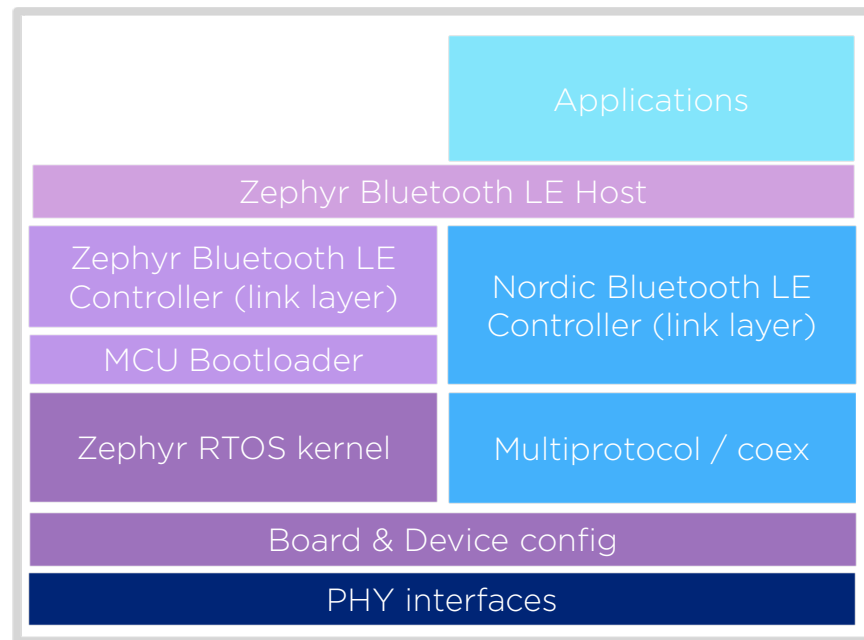
nRF Connect SDK

- Software development kit for nRF5340 and nRF9160
- Common platform for cellular IoT and short-range development
- Integrates the Zephyr RTOS
- Publicly hosted on GitHub, version control management with Git
- SEGGER Embedded Studio IDE support for free

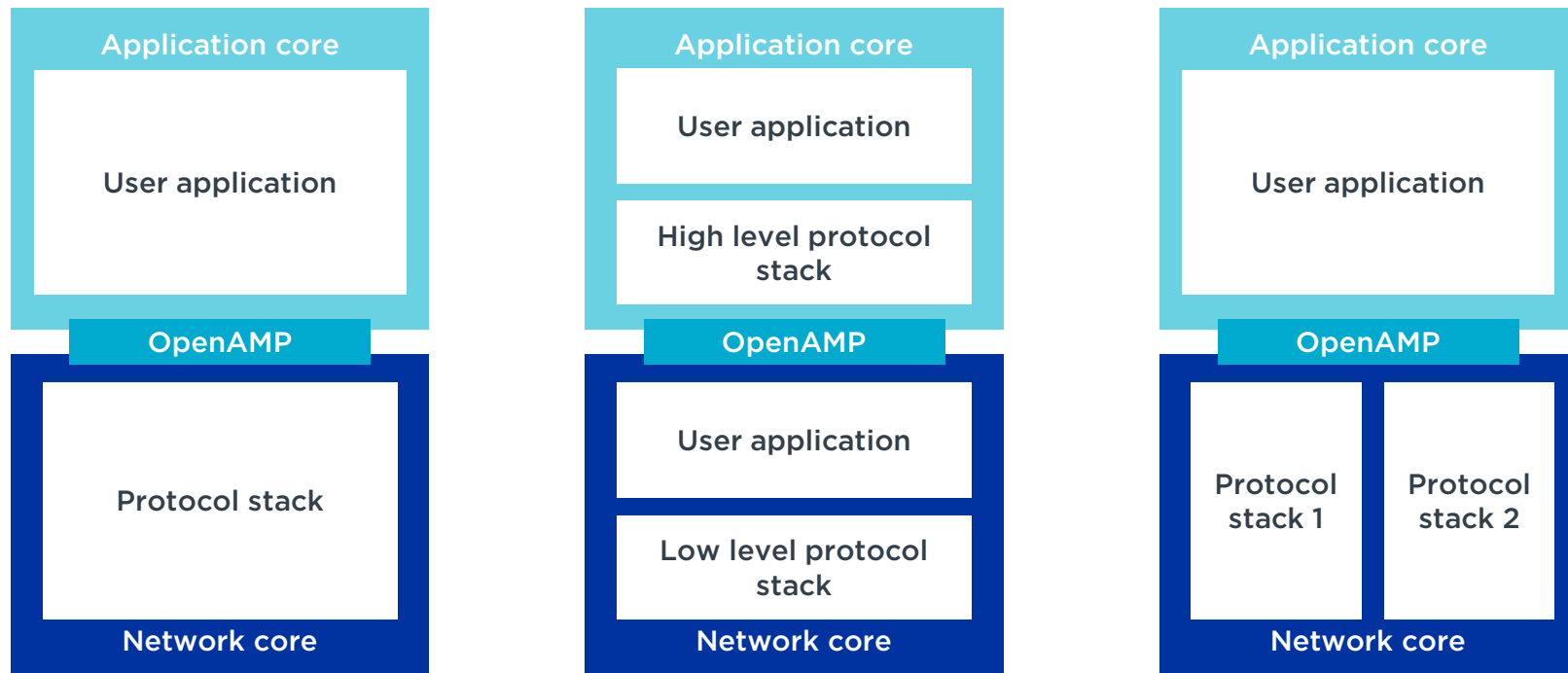


nRF Connect SDK for nRF5340

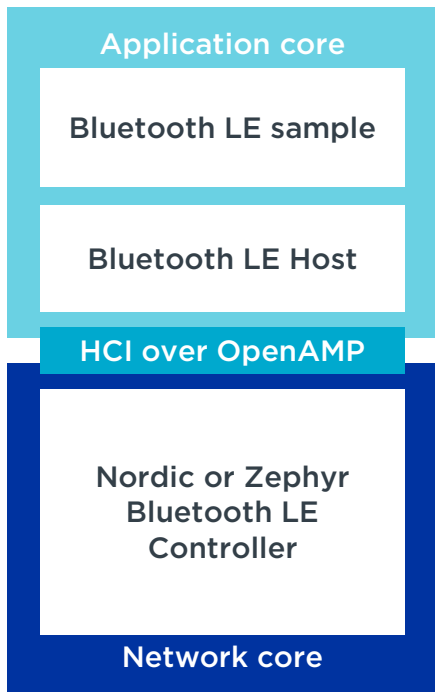
- Nordic Bluetooth Low Energy (LE) Controller (link layer) is available as a library. Same as in our SoftDevices
- Zephyr Bluetooth LE Controller is available as open source (contributed by us)
- Zephyr Host is available as open source
 - Offers best integration with the Zephyr RTOS
 - Reduces complexity in the API
- Nordic contribute to, test and certify the whole Bluetooth LE stack
 - QDIDs for product listings work the same as SoftDevices



Flexible software architecture



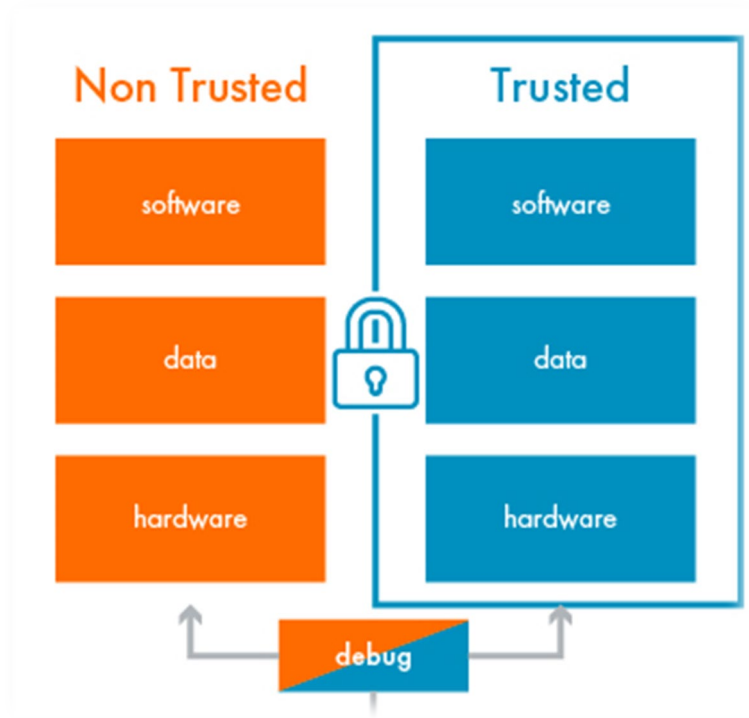
Bluetooth Low Energy samples



- Application core
 - Bluetooth LE sample from nRF Connect SDK or Zephyr
 - Zephyr Bluetooth LE Host (higher level protocol stack)
- Host Controller Interface (HCI) over OpenAMP
 - Communication between the processors
- Network core (choose one)
 - Nordic or Zephyr Bluetooth LE Controller (link layer)

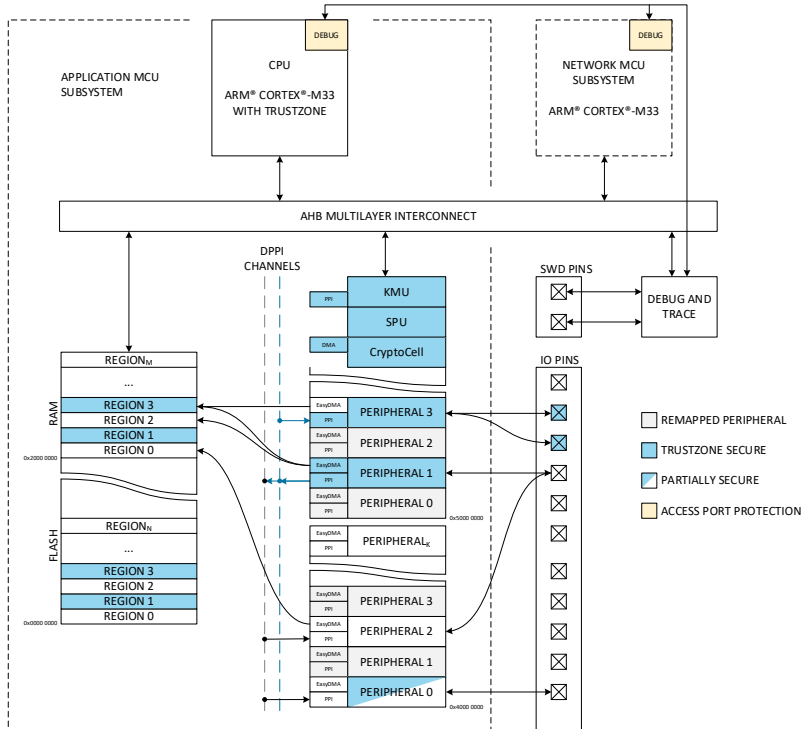
Security

Arm TrustZone enabled application core



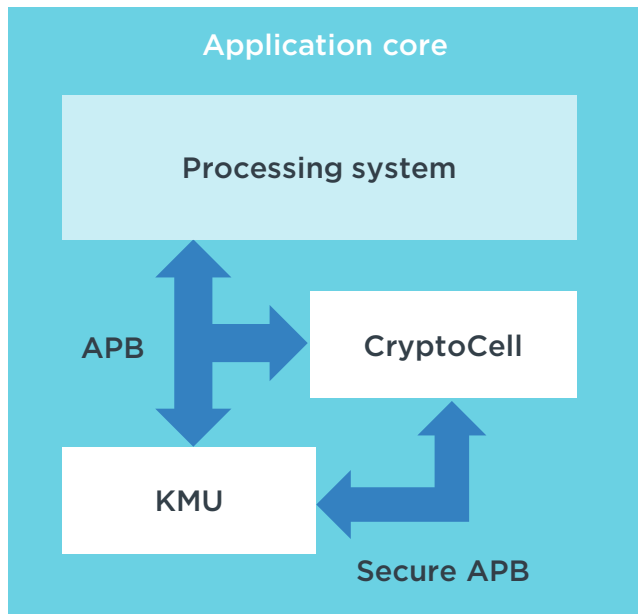
- Hardware implemented separation of:
 - Secure regions
 - Non-secure regions
 - Applicable to memory and peripherals
- Introduced with Armv8
 - System wide implementation
 - Special instructions to call secure code
 - Works in Thread Mode and Handler Mode
- Flexible debugger access
 - Access to all or only Non-secure

Arm TrustZone implementation details



- System Protection Unit (SPU)
 - Memory: Secure, non-secure, non-secure callable
 - Peripherals: Always secure, always non-secure, or configurable
- Special features
 - CryptoCell, SPU, KMU, and UICR are always secure
 - GPIO, NVMC, and DPPIC are split: both secure and non-secure

Key Management Unit - KMU



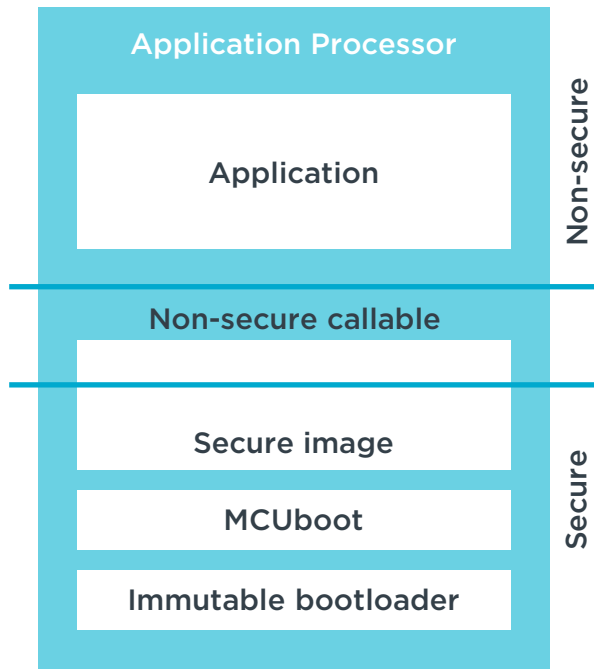
- Secure key storage
 - 128 keys slots, 128-bit keys
 - Combine key slots for larger keys
 - OTP emulation
- Features
 - Key memory physically isolated from CPU
 - Write over APB -> Read disable
 - Key transfer over secure APB
 - Key revocation

CryptoCell 312



- Upgrade from CryptoCell 310
 - Stronger encryption:
256-bit AES with GCM, 3072-bit RSA
 - Cryptographic operations in flash
- Features
 - Cryptographic backend to **Mbed TLS**
 - FIPS-140-2 certified TRNG
 - Firmware image validation
 - Hardware root-of-trust

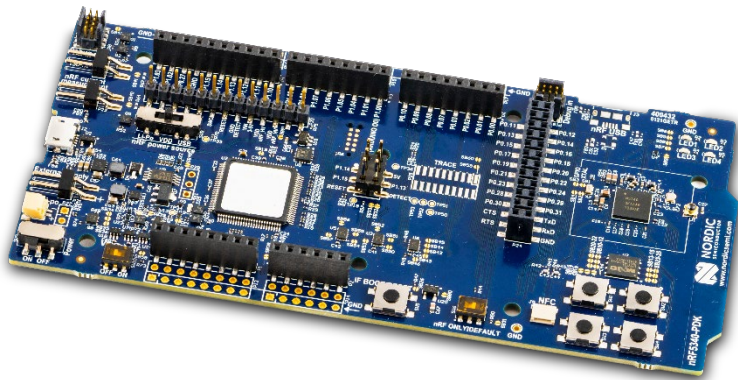
Security software support



- Immutable bootloader
 - Not changeable, not upgradable
- MCUboot
 - Secure boot of the system
 - Upgradable over the air
- Secure image
 - Secure partition manager
 - Cryptographic toolbox

Development tools

nRF5340 PDK

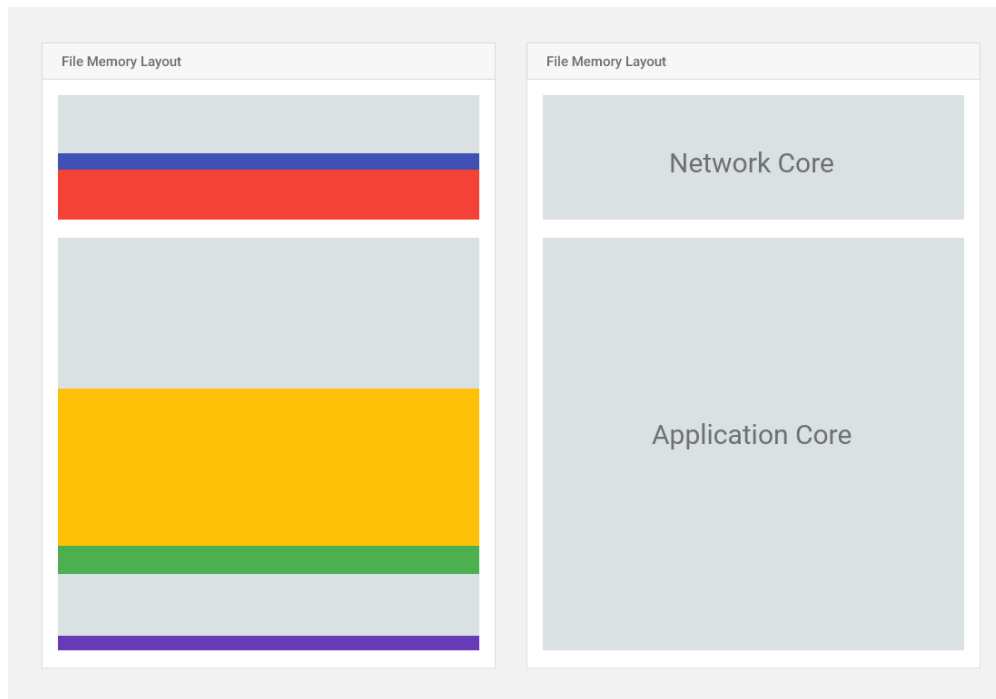


- Preview development kit
- Similar to nRF52833/nRF52840 DKs
- Arduino Rev3 compatible
- 2.4 GHz and NFC antennas
- SEGGER J-Link OB programmer/debugger
- All I/Os and interfaces available via connectors
- User-programmable LEDs (4) and buttons (4)
- Pins for measuring power consumption
- SWF connector for direct RF measurements
- 1.7-5.0 V supply from USB, external, Li-Po battery or CR2032 coin cell battery
- Will be replaced by a nRF5340 DK when the nRF5340 SoC is closer to being production ready

Programmer



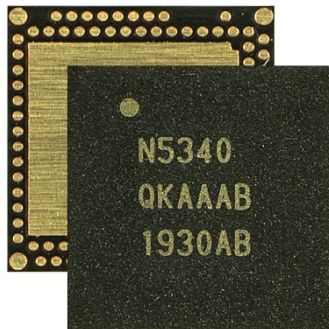
- Cross-platform programming and memory visualization tool
- Visualizes firmware in memory layout before writing
- Supports memory read
- App in nRF Connect for Desktop



Package variants

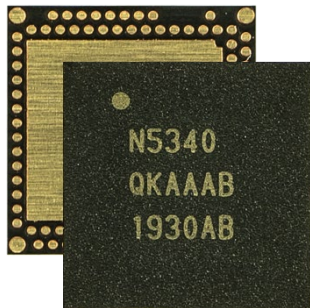
7x7 mm

aQFN94 with 48 GPIOs



Complete development solution

nRF5340 SoC



Multi-core flexibility

Truly secure

All-in-one

nRF Connect



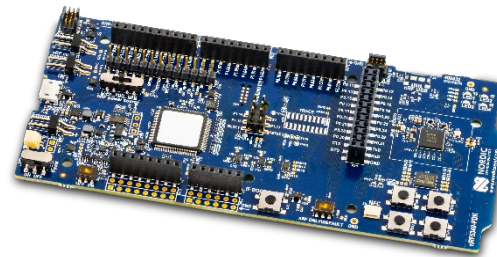
nRF Connect SDK

nRF Connect for Desktop

nRF Connect for Cloud

nRF Connect for Mobile

nRF5340 PDK



Preview development kit for the
nRF5340 SoC

Makes all features of the nRF5340
SoC available to the developer