Advanced Wearables for a healthy world

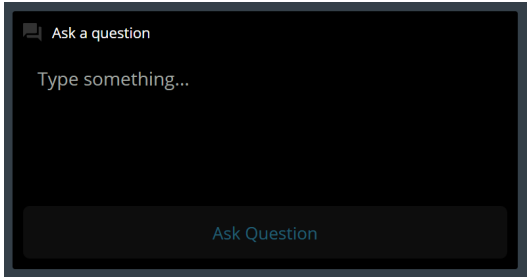
Get started on your Advanced Wearables project!

Hung Bui | March 18th, 2021

NORDIC® SEMICONDUCTOR

Practicalities

- Duration: ~45 mins + Q&A
- 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 towards the end
- The chat is not anonymous, and do not use for questions
- Go to DevZone if you have more questions
- A recording of the webinar will be available together with the presentation at webinars.nordicsemi.com



{ DevZone

Hung Bui – Sr. Application Engineer

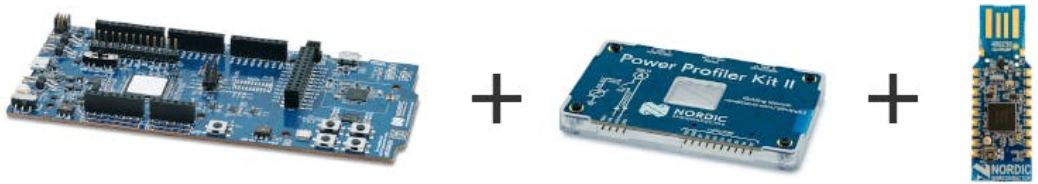
- Msc in Cybernetics
- Joined Nordic Tech support since 2012
- Based in Oslo, Norway
- Handles Devzone supports, customer trainings
- Main expertise in:
  - Bluetooth Low Energy,
  - Bluetooth Mesh
  - DFU
- Hobbies: hiking, FPS video game, photography

The bundles

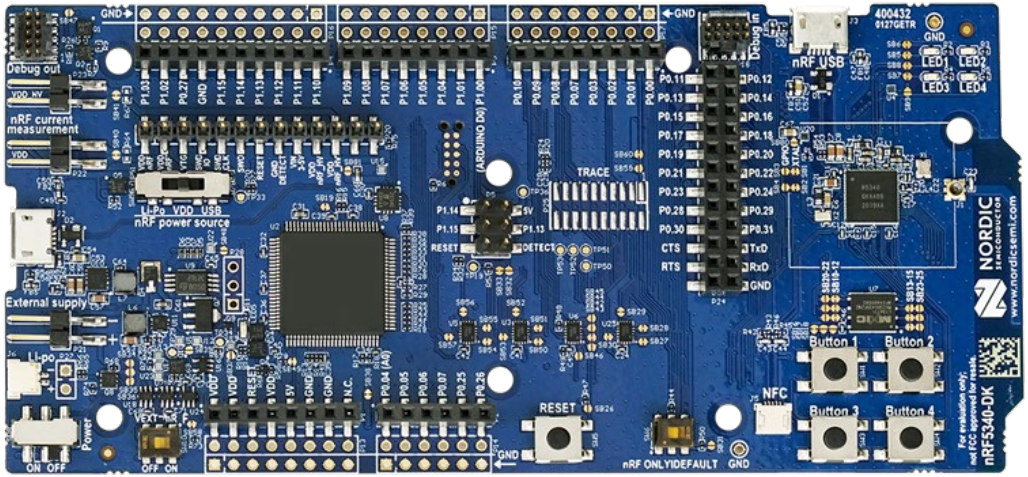
Let’s have a look at what we have sent to you

Bundle A: Dream Smart Wearable

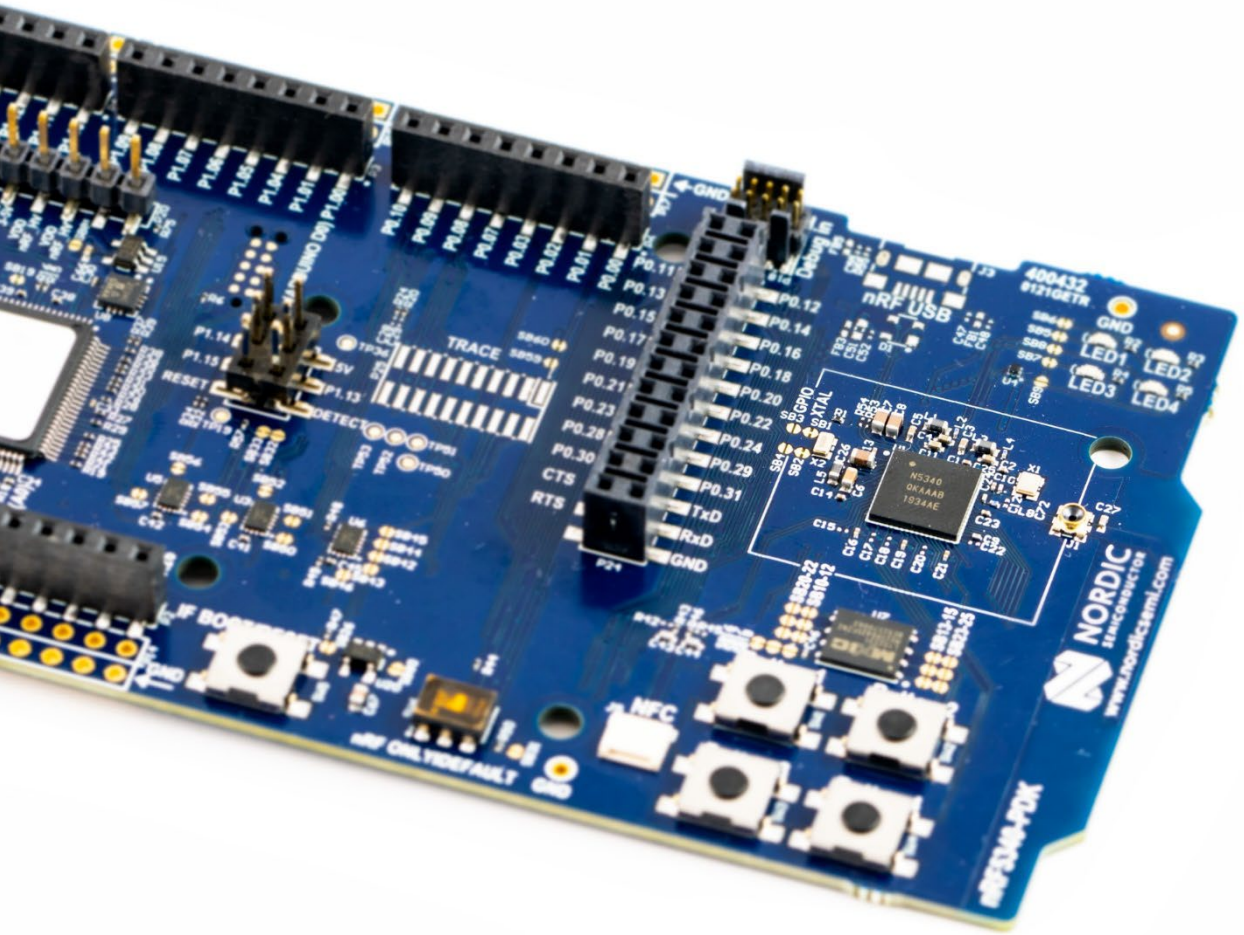
Bundle B: Medical wearable



nRF5340 DK

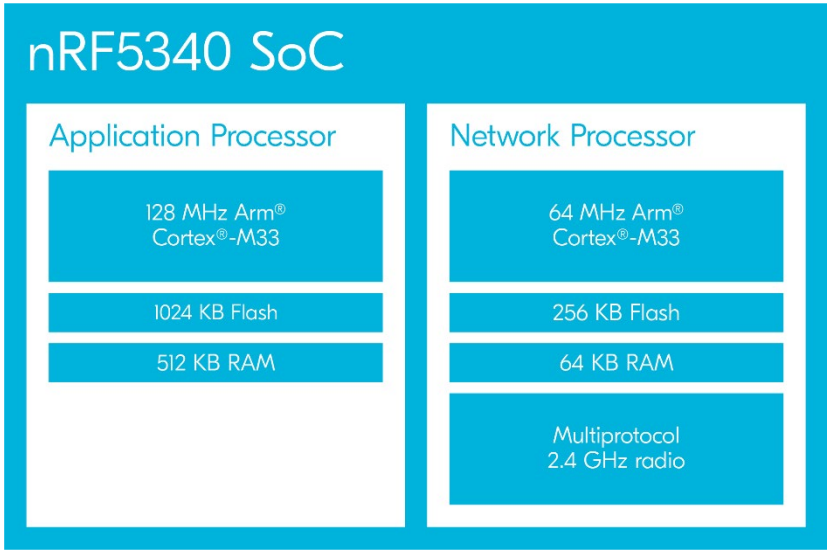


- Development Kit for the nRF5340 SoC
- Arduino Rev3 compatible
- 2.4 GHz and NFC antennas
- SEGGER J-Link OB programmer/debugger
- All I/Os and interfaces available via connectors
- User-programmable LEDs (4) and buttons (4)
- Pins for measuring power consumption
- SWF connector for direct RF measurements
- 1.7-5.0 V supply from USB, external, Li-Po battery or CR2032 coin cell battery


nRF USB
TRACE
RESET
DETECT
CTS
RTS
TxD
RxD
GND
NFC
LED1
LED2
LED3
LED4
NORDIC

NRF5340 SOC

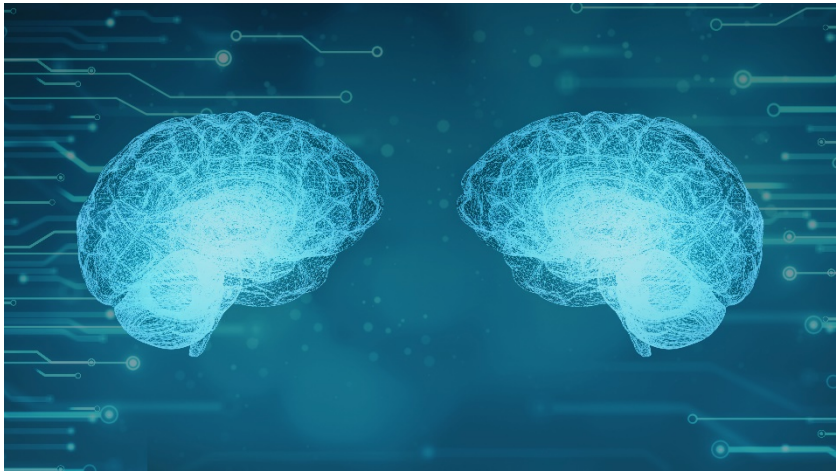
nRF5340 overview and highlights



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

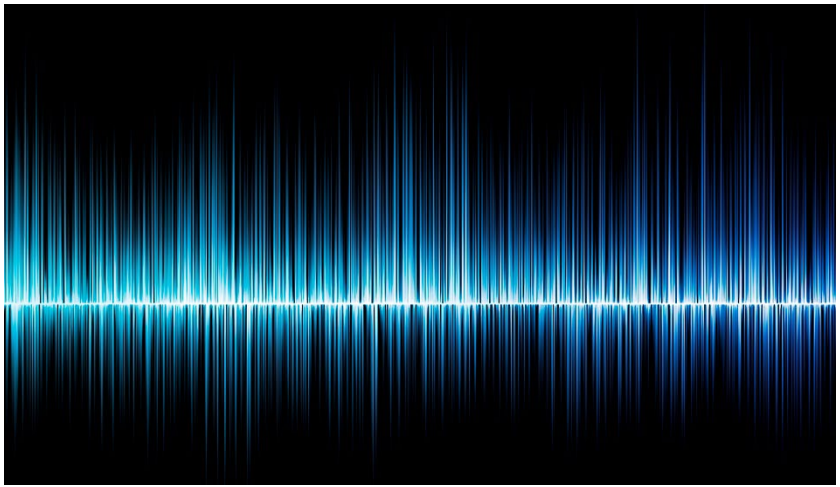
Multi-core flexibility

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



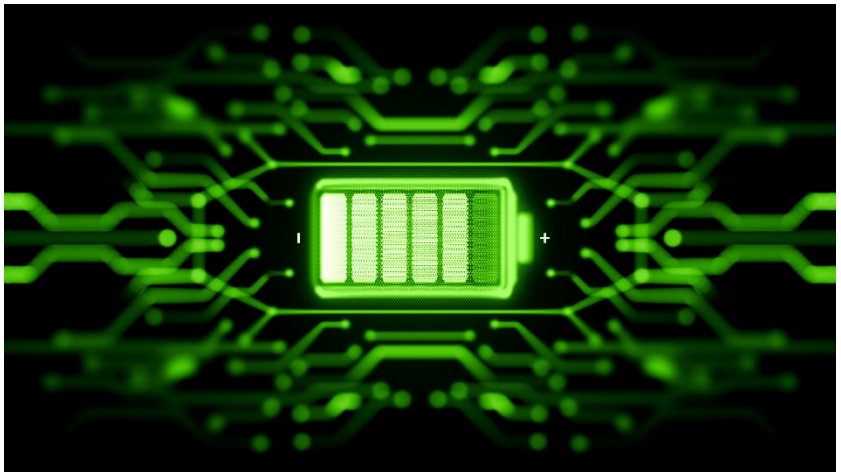
Multiprotocol radio

- Bluetooth 5.1 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



All-in-one

- nRF52 Series feature superset
  - Bluetooth 5.1, Thread and Zigbee
  - CryptoCell, USB, QSPI, HS-SPI
  - 1.7-5.5 V and up to 105 °C
- More
  - Performance
  - Memory
  - Integration
- But less power

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
- GPIOTE
- 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
- GPIOTE
- Shared 48-pin crossbar

Multiprotocol 2.4 GHz radio

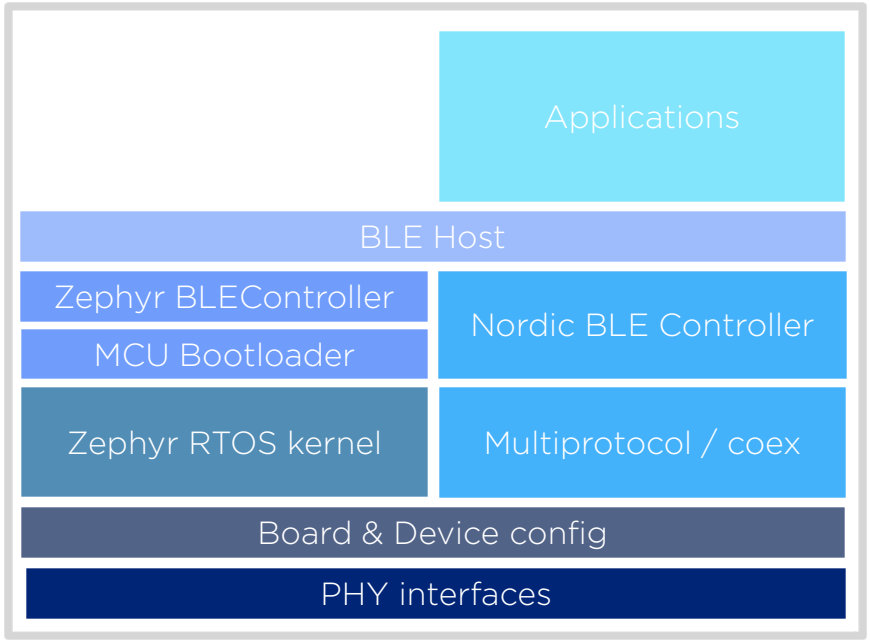
Software support

nRF Connect SDK

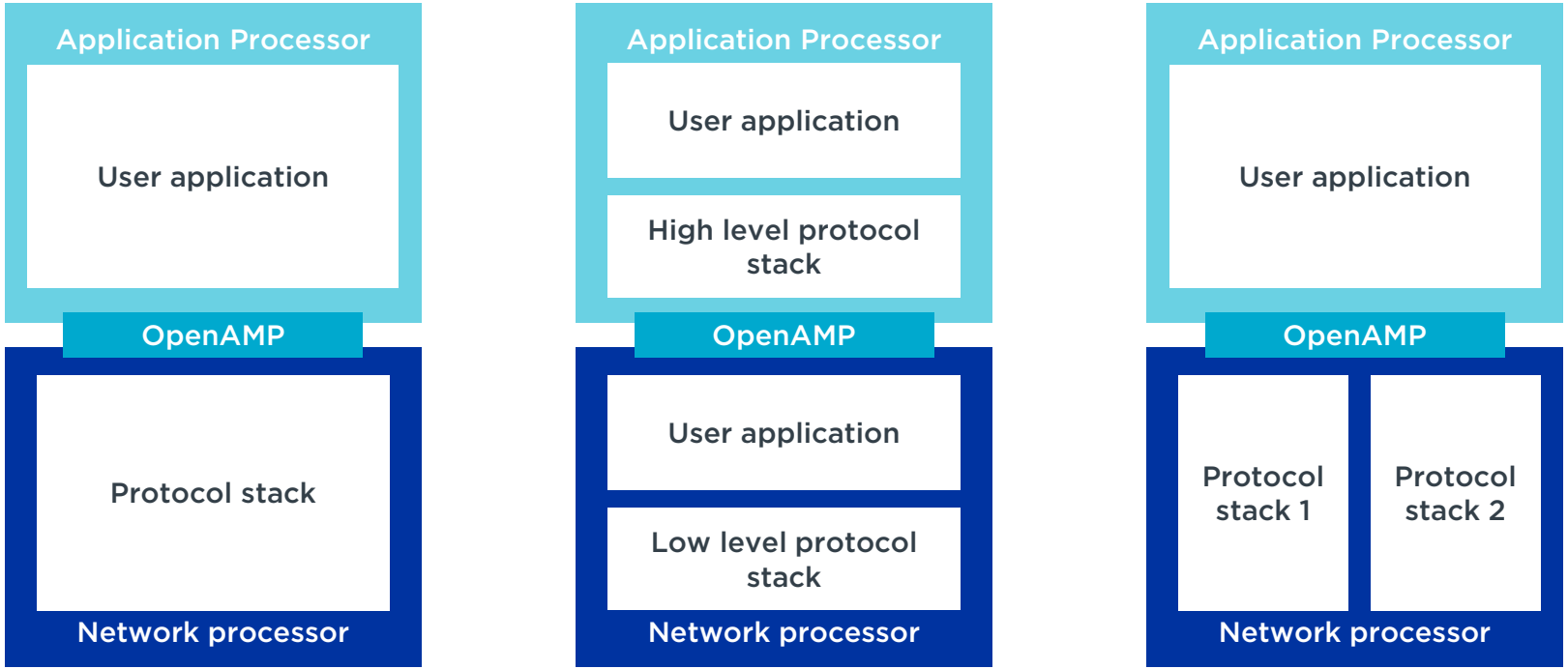
- Software development kit for nRF5340 and nRF9160
- Common platform for cellular IoT and short-range development
- Integrates the Zephyr RTOS
- Publicly hosted on GitHub, version control management with Git
- SEGGER Embedded Studio support for free

nRF Connect SDK for nRF5340

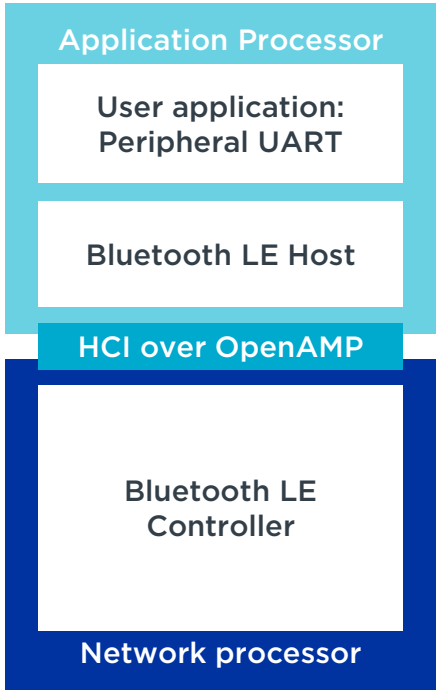
- SoftDevice Controller is available in nRF Connect SDK as a library
- Zephyr Controller is also available (open source contributed by Nordic)
- The Host is open source
  - Offers best integration with the RTOS
  - Reduces complexity in the API
- Nordic contribute to, test and certify the whole BLE stack
  - QDIDs for product listings work the same as SoftDevices



Flexible software architecture



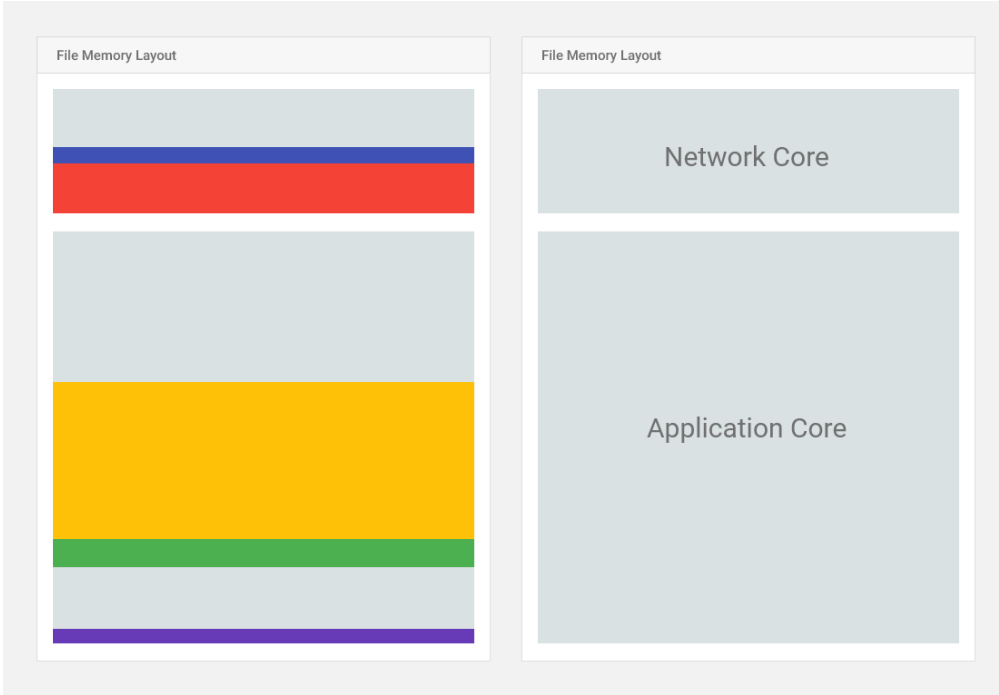
Bluetooth LE Peripheral UART sample



- Application processor
  - Bluetooth LE Peripheral UART example
  - Zephyr Bluetooth LE Host (higher level protocol stack)
- Host Controller Interface (HCI) over OpenAMP
  - Communication between the processors
- Network processor
  - Zephyr Bluetooth LE Controller (lower level protocol stack)

Programmer

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



nRF Connect for Cloud

Browser-based development platform for test, evaluation and verification of Bluetooth Low Energy devices

- Devices and data can be graphically represented
- Ability to create a custom UI to represent your data
- Based on AWS

nRF Cloud Gateway

- An app on the phone to connect your BLE device to nRF Connect for Cloud
- All configuration happens from the browser interface of nRF Connect for Cloud.

Complete development solution

nRF5340 SoC

Multi-core flexibility

Truly secure

All-in-one

nRF Connect

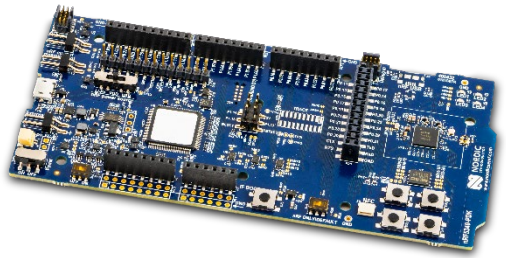
nRF Connect SDK

nRF Connect for Desktop

nRF Connect for Cloud

nRF Connect for Mobile

nRF5340 DK



Development kit for the nRF5340 SoC

Makes all features of the nRF5340 SoC available to the developer

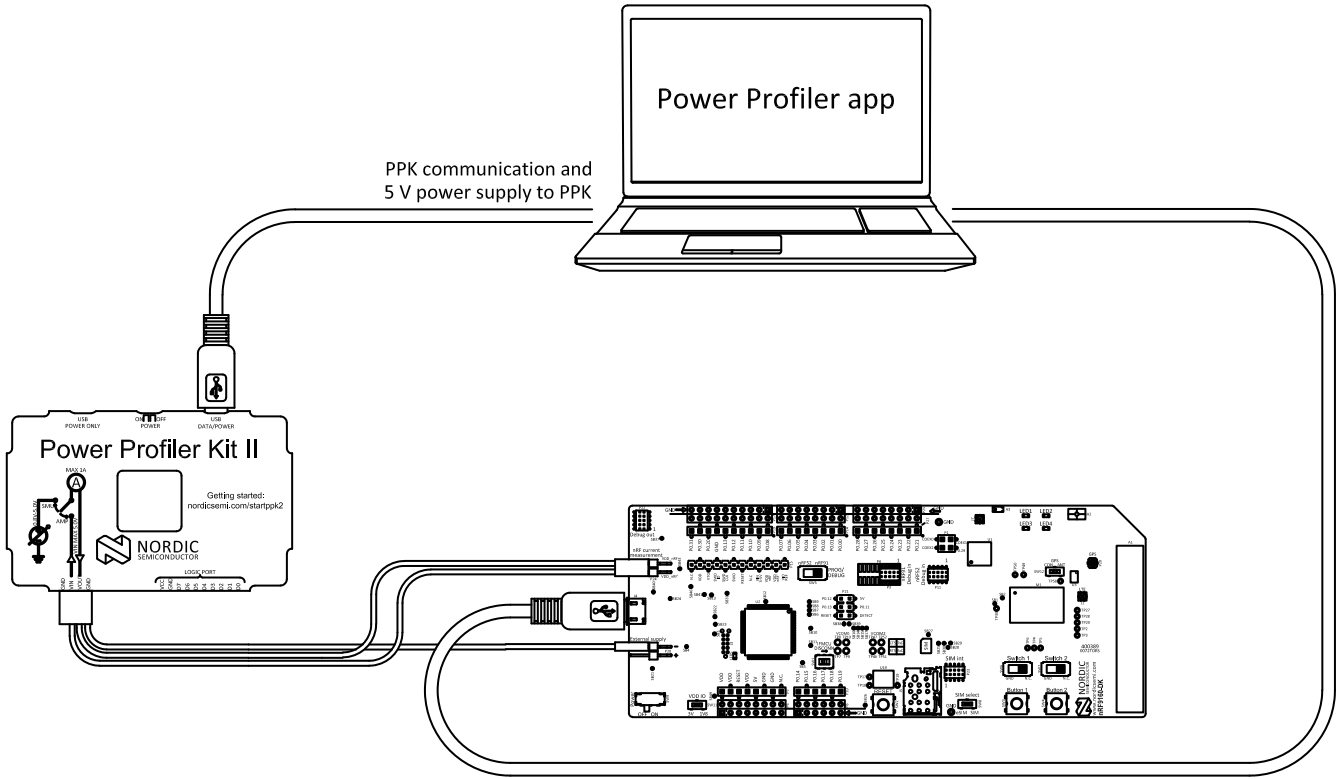
Power Profiler Kit II (PPK2)

- Nordic Dev Tool for current measurement and analysis
  - 200nA to 1A current range with resolution varying between 100nA and 1mA
  - 10x faster sampling than first generation PPK
- Measure and analyze any embedded HW, including all Nordic DKs
- Supported by the new Power Profiler app in nRF Connect for Desktop
- Standalone product

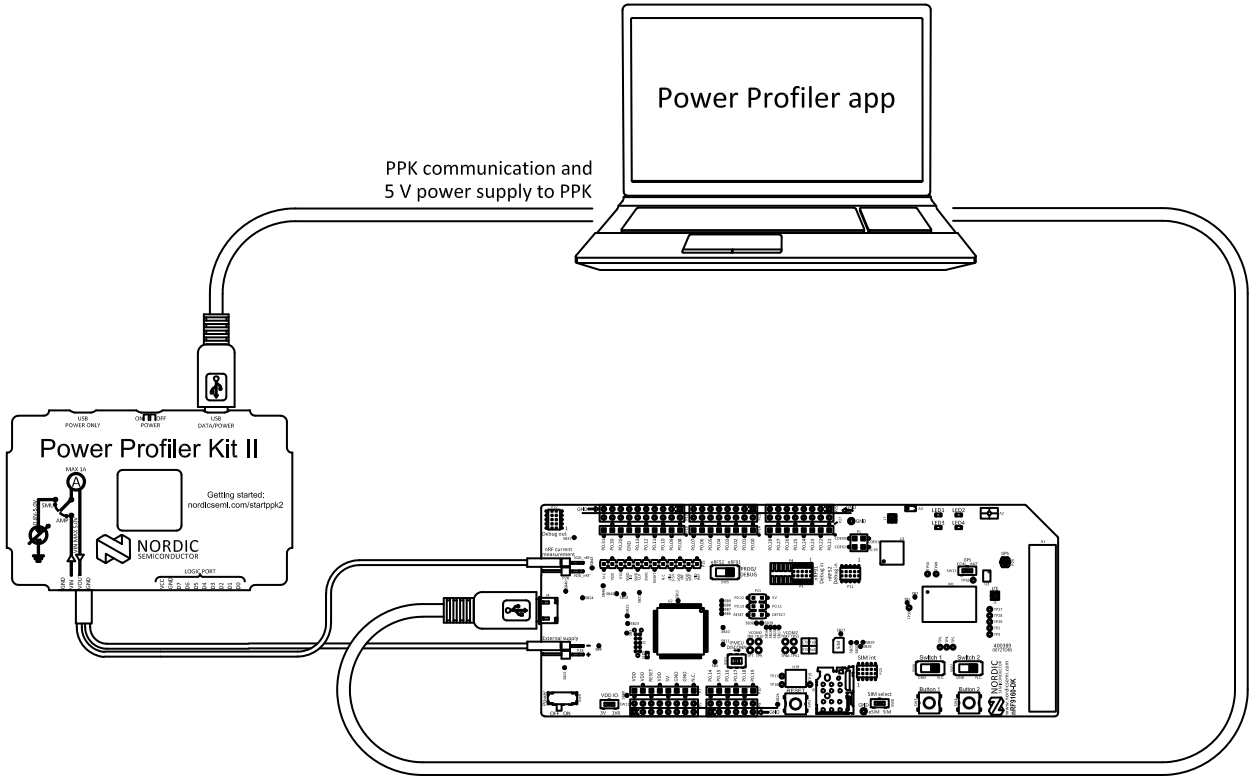
Why do developers need this?

- Useful tool to track power consumption
- Ampere meter mode and Source mode
- Detailed data to estimate power consumption and battery life
- Spot and debug unwanted current drain during entire engineering cycle
- Simple and cost-efficient ($89 retail price)

Measuring in Ampere Meter mode



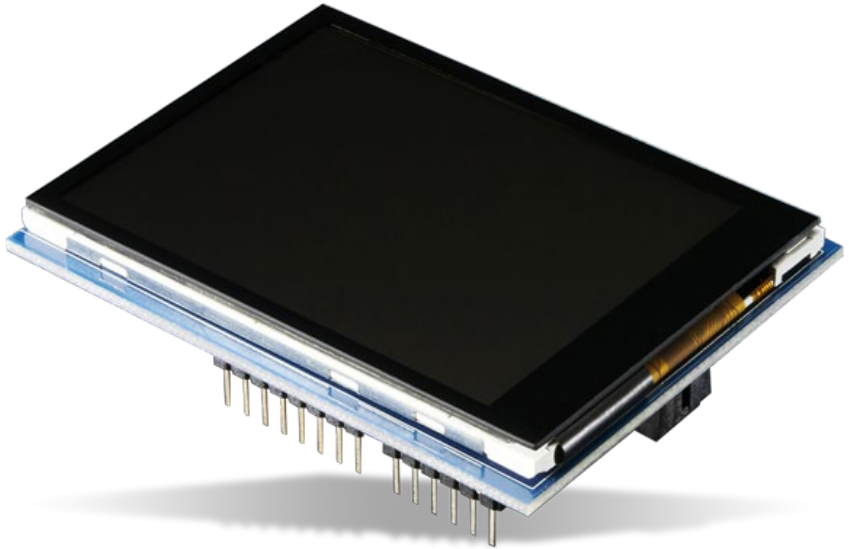
Measuring in Source Meter mode



nRF52840 Dongle

- Based on a nRF52840 Soc
- Designed to be used with nRFConnect for Desktop
  - Emulate BLE central/peripheral device
  - Debug and verify your BLE DUT
- Multiple protocols supported
  - BLE
  - Zigbee
- Can be used as a sniffer for BLE or 801.15.4
- Doesn't contain a debugger/programmer. Not suggested as a development platform.

2.8" TFT Touch Screen Shield



- 240x320 resolution
- 16 bit color mode
- High speed SPI display with digital I2C touchscreen driver
- Single-touch capacitive touch bonded on top
- Supported by LittleVGL library in Zephyr

Getting started

Step by step guide

Getting started guide

1. Install nRFConnect SDK v1.5.0 and the toolchains
   - https://tinyurl.com/yj99lvrx
2. Install nRFConnect for desktop (BLE)
3. Build and flash the blinky (helloworld) example at \zephyr\samples\basic\blinky
4. Build and flash the first BLE example at \nrf\samples\bluetooth\peripheral_lbs
   - Don't forget to flash the netcore with \zephyr\samples\bluetooth\hci_rpmsg
5. Verify the BLE operation with nRF Connect for desktop + nRF52840 Dongle
   - Alternatively, you can use your phone to verify
6. Bundle B: Verify the power consumption and debugging with the PPK2
   - Don't forget to turn off logging on both network core and application core to achieve low power
7. Bundle A: Run the LVGL examples on the display
   - Helloworld example: \zephyr\samples\display\lvgl (requires patch for nRF53 DK)
   - BLE example: https://github.com/NordicPlayground/ncs-display-ble-example
     - Don't forget to run the patch for nRF53 DK
     - LVGL documentation: https://docs.lvgl.io/latest/en/html/overview/index.html

Tips and tricks

- Update nrfjprog to the latest version (10.12.1) if you have issue with nRF53 recovery
- Try achieving low power from the ground up.
- When you do current measurement:
  - Turn off logging on both App core and Net core
  - Use battery power source instead of computer's USB.
  - There could be a bug with AMD processor when running the power profiler, we are working on it.
- Mesh sounds interesting but it has drawbacks.
- Aim high but be realistic. It's important to have a working prototype, only 63 days left.
  - Don't spend too much time on polishing the UI.
- Checkout getting started guides and tutorials:
  - Getting started with NCS: https://tinyurl.com/22uerckc
  - Building a BLE application in NCS: https://tinyurl.com/ykpawzas
  - Adding a peripheral (SPI) to NCS project: https://tinyurl.com/ew3hawuy
  - Become an expert in power profiling your app: https://tinyurl.com/ctjcp4a8
- Don't forget to have fun ! ☺

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Technology intros and trainings

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Nordic Developer Zone

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Q&A

Happy developing!