



# Wireless IoT Entwicklung mit Nordic Semiconductor

Einleitung und SDK Überblick

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*February 2026*

# Agenda des Workshops

- Einleitung von Nordic zum nRF Connect SDK
- Hands-on Kapitel 1: IDE Einführung & Blinky Applikation
- Hands-on Kapitel 2: Bluetooth Peripheral LED & Button Service (LBS)
- Hands-on Kapitel 3: Nordic PMIC & Fuel Gauge Integration



# We are Nordic

Simplifying lives through all things connected



Fabless  
semiconductor  
company



Founded in  
Norway, 1983



~1,350  
employees



\$511 MUSD revenue,  
CY 2024  
OSEBX: NOD



ISO 9001  
certified



Global  
presence

# Complete solution

## Faster time-to-market

### Next-gen hardware



ICs, SoCs, SiPs, PMICs



3rd party modules



Embedded SW stacks

### Embedded software



**nRF Connect SDK**  
Unified software



Mobile Apps



Extensive SW/HW  
development tools

### World-class support



Developer community



Online hands-on trainings



Extensive technology  
partner program

### Customer device



Consumer



Healthcare



Industrial

### Cloud lifecycle services



Device management



Embedded observability



Location services








# Nordic product overview

Cloud support across all our wireless connectivity solutions

## Short-Range

**nRF  
54  
SERIES**

Bluetooth®  **THREAD**  
 **MATTER**  **ZIGBEE**

 **nRF  
CLOUD**  
powered by  **Memfault**

## Cellular IoT

**nRF  
91  
SERIES**

**LTE-M**  **NB-IoT**  
 **GNSS**  

 **nRF  
CLOUD**  
powered by  **Memfault**

## Wi-Fi 6 IoT

**nRF  
70  
SERIES**

**Wi-Fi**  **MATTER**

 **nRF  
CLOUD**  
powered by  **Memfault**

## Power Management

**nPM  
FAMILY** 

# nRF Connect SDK

## Introduction



# nRF Connect Platform Overview

## nRF Connect



### nRF Connect SDK

Samples and Applications

Middleware

RTOS

Libraries

Hardware Drivers



### nRF Connect for Desktop

Quickstart

Bluetooth Low Energy

Programmer

Cellular Monitor

Power Profiler

nPM PowerUP



### nRF Connect for VS Code

nRF Terminal

nRF Debug

Memory Report

Command Line and GUI

Create New Board Wizard



### Mobile Applications

nRF Connect for Mobile

nRF Mesh

nRF Toolbox

nRF Blinky

Device Manager

# nRF Connect SDK

Unified code base and toolchain for all Nordic SoCs



- Modern tools and SDK
- In the market since 2018
- Based on Zephyr RTOS
- Strong focus on open-source
- Future-proof, modular approach
- Single SDK for all Nordic product series
- Bluetooth v6 qualified Host and Controller stack since v2.8.0





# nRF Connect SDK Code Base

- Code base consists of several integrated repositories
  - Code coming from **Nordic** (blue)
  - Code coming from **Open Source** (OS) repositories (purple)
- Contains an RTOS, application code, connectivity protocols, wireless stacks, peripheral drivers & more



# nRF Connect SDK Repositories

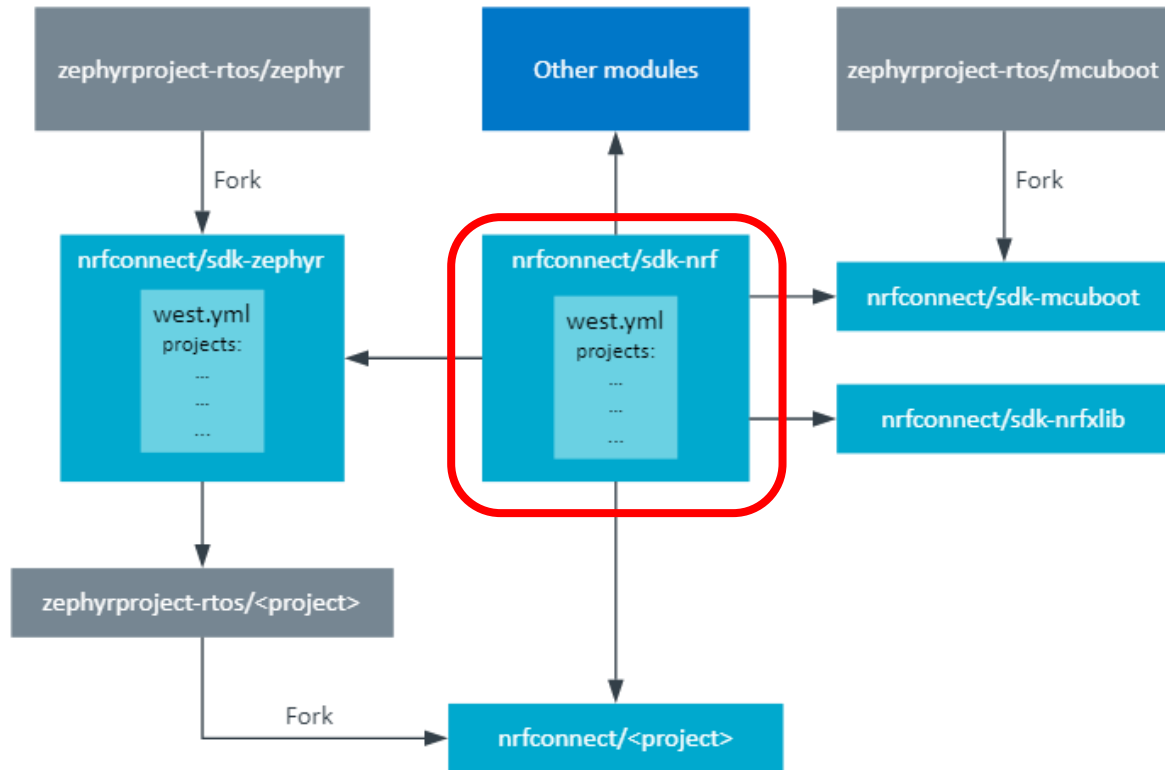
- **nRF**: Application & connectivity protocols
- **nrfxlib**: compiled libraries where Nordic cannot distribute source code
- **nrfx**: peripheral drivers
- **Zephyr**: RTOS & board configuration (OS)
- **MCUboot**: Secure Bootloader (OS)
- Other repositories
  - Trusted Firmware-M, Matter, etc.

Nordic and Open Source (OS) code

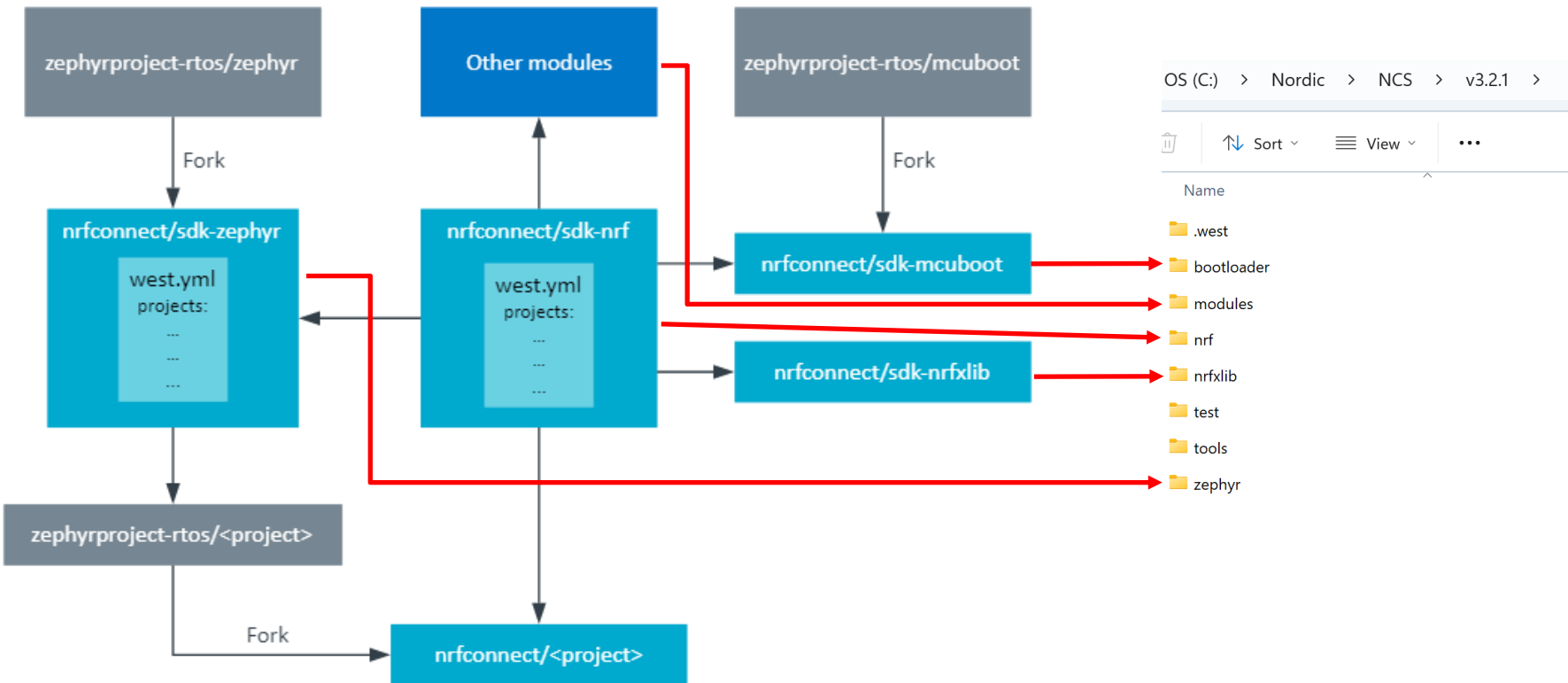


# nRF Connect SDK Structure

- The nRF Connect SDK is structured as star topology, with the sdk-nrf repository being in the center.
- The [sdk-nrf](#) repository contains the manifest file `west.yml` in its root folder, which lists and points to all other repositories included in the SDK.

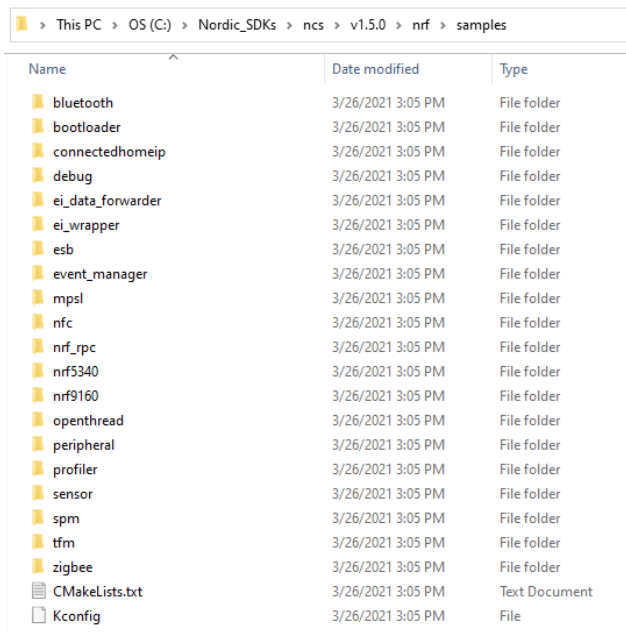


# Repository Structure vs. Installation Paths



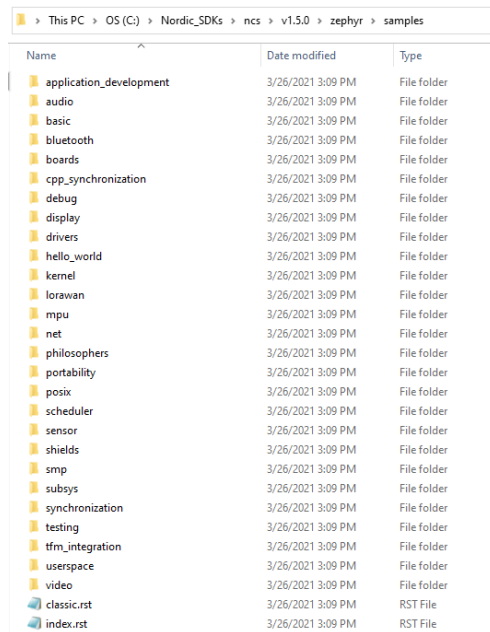
# Code Examples

Code Examples can be found from Nordic or Zephyr.



Name	Date modified	Type
bluetooth	3/26/2021 3:05 PM	File folder
bootloader	3/26/2021 3:05 PM	File folder
connectedhomeip	3/26/2021 3:05 PM	File folder
debug	3/26/2021 3:05 PM	File folder
ei_data_forwarder	3/26/2021 3:05 PM	File folder
ei_wrapper	3/26/2021 3:05 PM	File folder
esb	3/26/2021 3:05 PM	File folder
event_manager	3/26/2021 3:05 PM	File folder
mpsl	3/26/2021 3:05 PM	File folder
nfc	3/26/2021 3:05 PM	File folder
nrf_rpc	3/26/2021 3:05 PM	File folder
nrf5340	3/26/2021 3:05 PM	File folder
nrf9160	3/26/2021 3:05 PM	File folder
openthread	3/26/2021 3:05 PM	File folder
peripheral	3/26/2021 3:05 PM	File folder
profiler	3/26/2021 3:05 PM	File folder
sensor	3/26/2021 3:05 PM	File folder
spm	3/26/2021 3:05 PM	File folder
tfm	3/26/2021 3:05 PM	File folder
zigbee	3/26/2021 3:05 PM	File folder
CMakeLists.txt	3/26/2021 3:05 PM	Text Document
Kconfig	3/26/2021 3:05 PM	File

Nordic examples -> nrf/samples



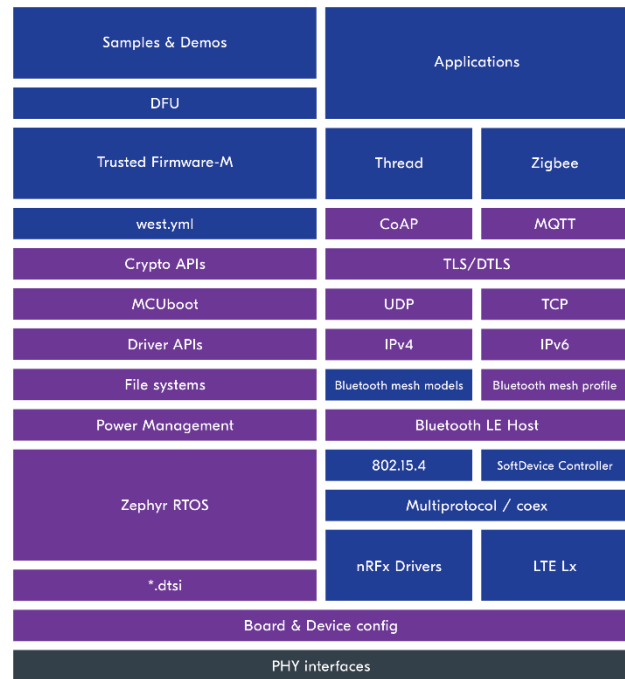
Name	Date modified	Type
application_development	3/26/2021 3:09 PM	File folder
audio	3/26/2021 3:09 PM	File folder
basic	3/26/2021 3:09 PM	File folder
bluetooth	3/26/2021 3:09 PM	File folder
boards	3/26/2021 3:09 PM	File folder
cpp_synchronization	3/26/2021 3:09 PM	File folder
debug	3/26/2021 3:09 PM	File folder
display	3/26/2021 3:09 PM	File folder
drivers	3/26/2021 3:09 PM	File folder
hello_world	3/26/2021 3:09 PM	File folder
kernel	3/26/2021 3:09 PM	File folder
lorawan	3/26/2021 3:09 PM	File folder
mpu	3/26/2021 3:09 PM	File folder
net	3/26/2021 3:09 PM	File folder
philosophers	3/26/2021 3:09 PM	File folder
portability	3/26/2021 3:09 PM	File folder
posix	3/26/2021 3:09 PM	File folder
scheduler	3/26/2021 3:09 PM	File folder
sensor	3/26/2021 3:09 PM	File folder
shields	3/26/2021 3:09 PM	File folder
smp	3/26/2021 3:09 PM	File folder
subsys	3/26/2021 3:09 PM	File folder
synchronization	3/26/2021 3:09 PM	File folder
testing	3/26/2021 3:09 PM	File folder
tfm_integration	3/26/2021 3:09 PM	File folder
userspace	3/26/2021 3:09 PM	File folder
video	3/26/2021 3:09 PM	File folder
classic.rst	3/26/2021 3:09 PM	RST File
index.rst	3/26/2021 3:09 PM	RST File

Zephyr examples -> zephyr/samples



# nRF Connect SDK Code Base in Detail

- Code management, build and configuration tools allow developers to focus on the components required for their specific designs while having a powerful solution toolbox available
- Zephyr includes a lot of fundamental pieces of code and functionality
  - Middleware & messaging protocols (IP, HTTP, MQTT, CoAP, Modbus, ...)
  - Device drivers (e.g. sensors)
- Use Zephyr as building block with the pieces that you need!

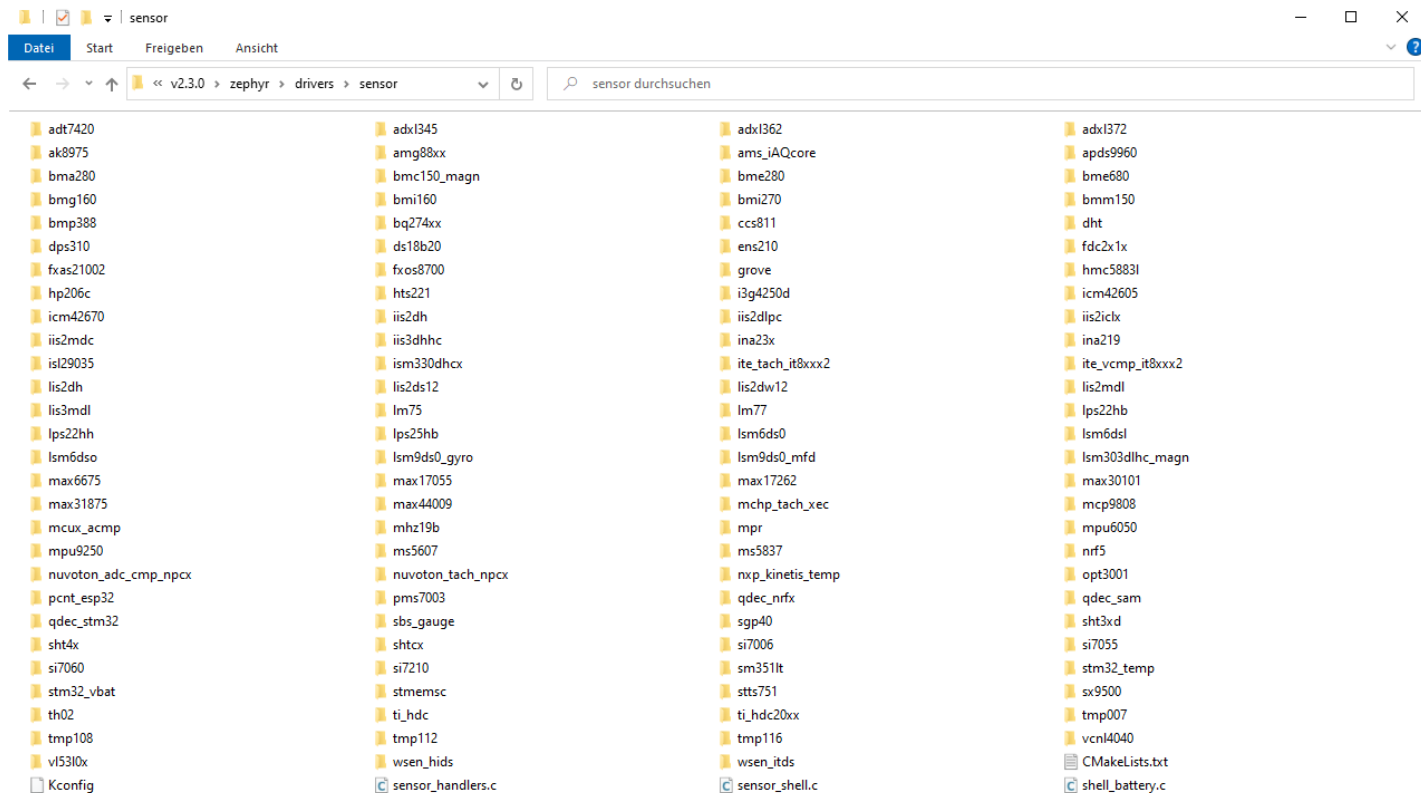


# Why the Zephyr RTOS?

- Zephyr is designed & built for low power wireless
- Zephyr is an independent technology project
  - › Governed under the Linux Foundation
  - › Contributions made by over 1000 industry embedded experts
- Zephyr is scalable
  - › Very small configurations for memory constrained devices
  - › Powerful, feature-rich, configurations for large memory, high-processing power devices (multiple MBs)
  - › Designed for low power applications
- Zephyr includes a lot of fundamental pieces of code
  - › Nordic can focus on other important features
- Nordic has been a member & contributor since 2016

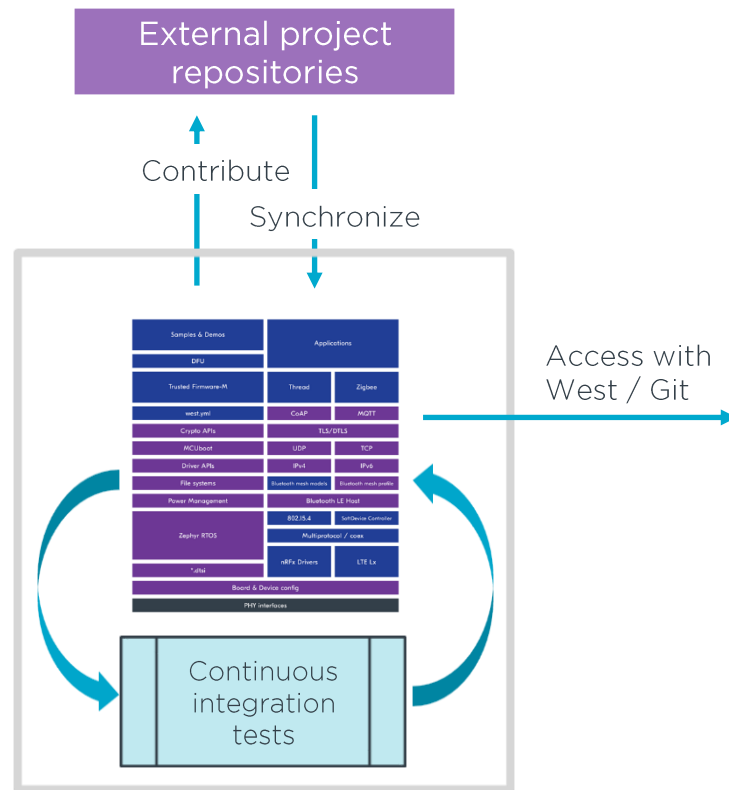


# Leverage code that is fully integrated



# Nordic Synchronizes with External Repos

- nRF Connect SDK is a single platform
- All source code is distributed by Nordic
- Includes open-source code from external projects
- Nordic contributes to, and synchronizes with external projects
- Nordic runs integration test on all source code and manages configuration
- Customers clone a tag using git and west



## Toolchain

## Toolchain



# Manage Source Code and Configurations

**West**  
Multi-repository  
management tool

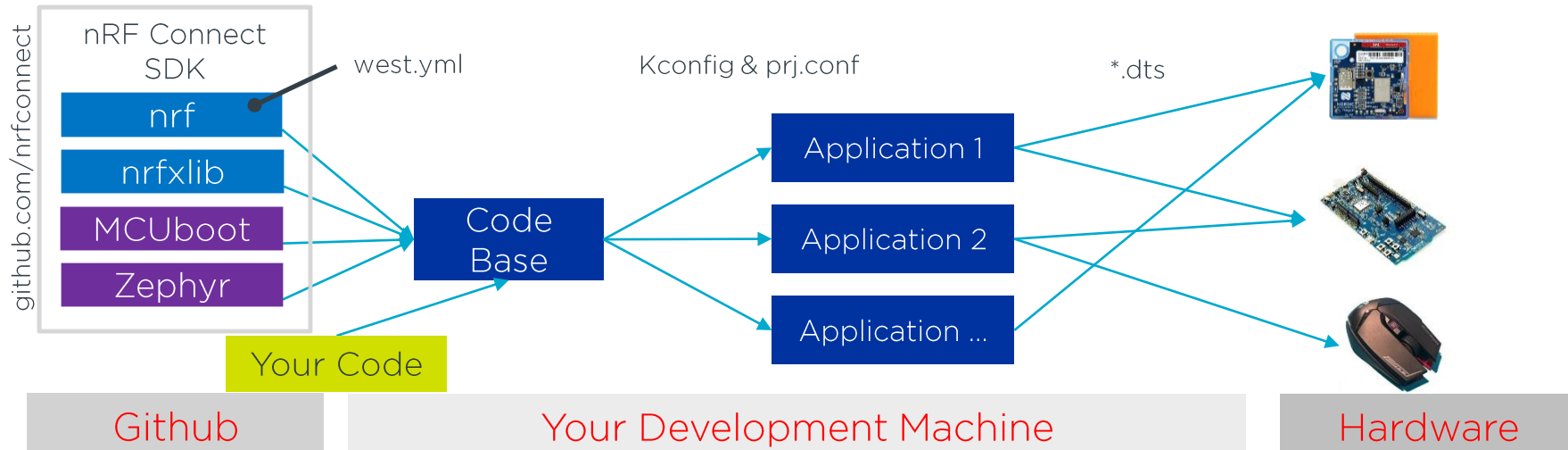
**Kconfig**  
Source module / feature  
configuration for compile

**Device Tree**  
Target Board / Device  
description

Clone / update

Configure features

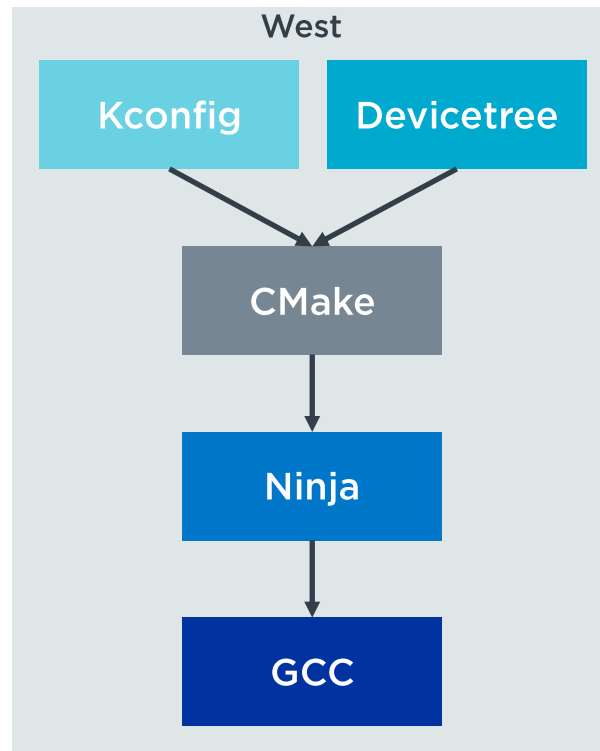
Configure target



# nRF Connect SDK

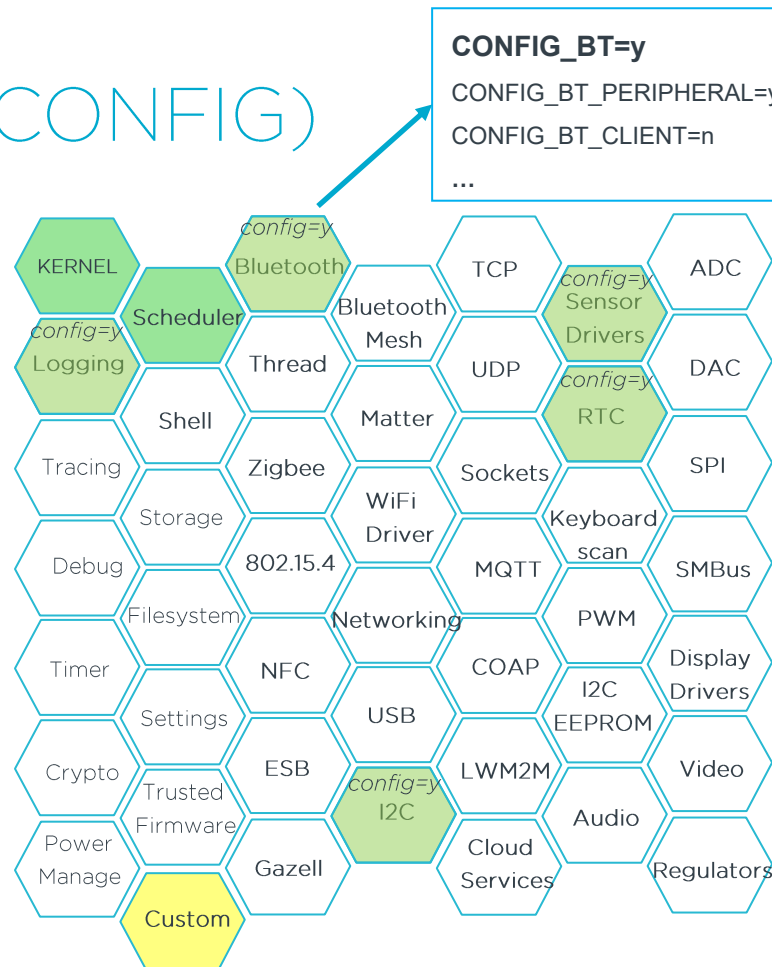
## Toolchain

- Kconfig
  - Describes SW and system features, generates C definitions to configure the system and include libraries without changing the source code (e.g. BLE, sensors, RTOS services (logging, shell))
  - Kconfig and prj.conf files are merged into one .config file for CMake (see *build/<proj.name>/zephyr/.config*)
- DeviceTree (dts,dtsi)
  - Describes HW, pin layout
  - Allows for flexible HW modification via an overlay file
  - → Build for different PCB designs and SoCs without changing source code
  - [Zephyr Documentation: Device Tree Guide](#)

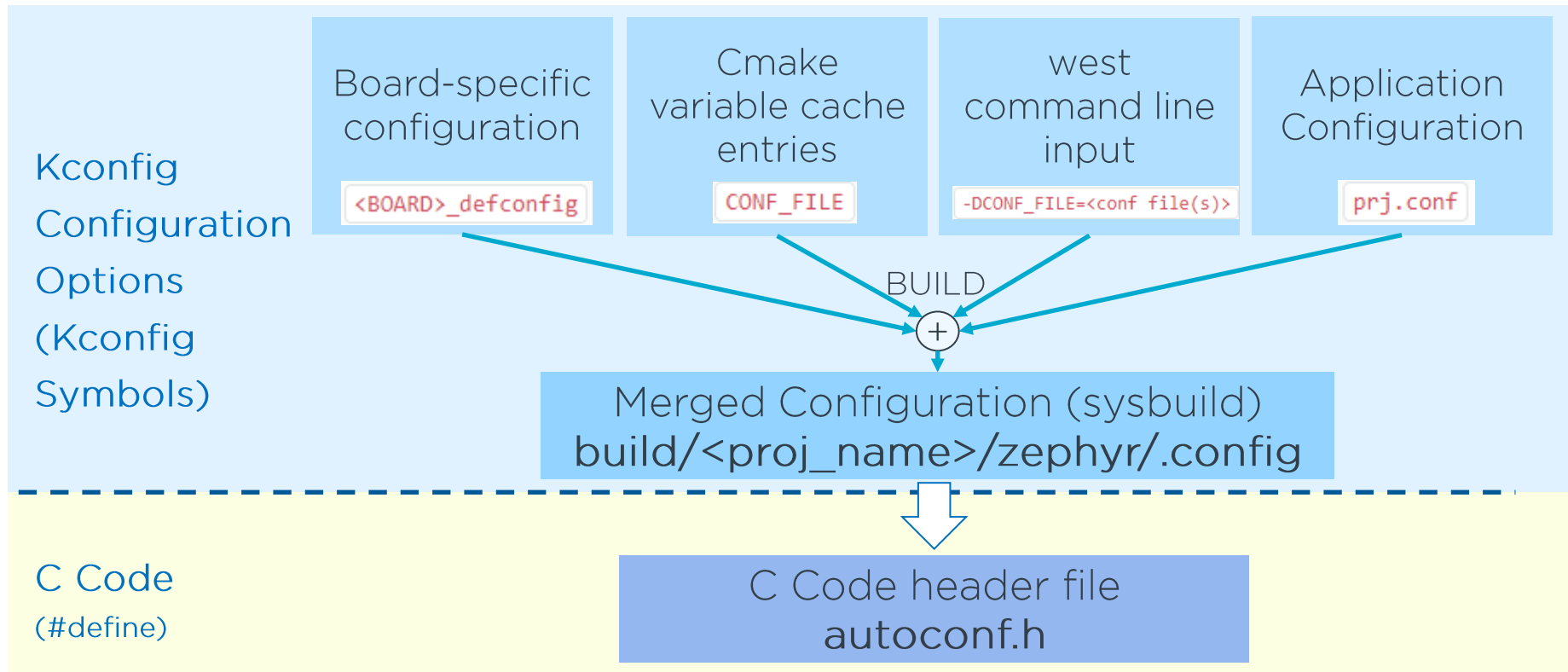


# Configuration System (KCONFIG)

- Zephyr Kernel and Sub-System can be configured at build time
  - Add software modules to your project
  - If a software module was added, further CONFIG symbols appear and allow you to configure the module
- Custom Kconfig is possible
- Goal: Configure software features without changing source code



# Configuration for an Application



# nRF Connect SDK

## Toolchain cont.

### CMake

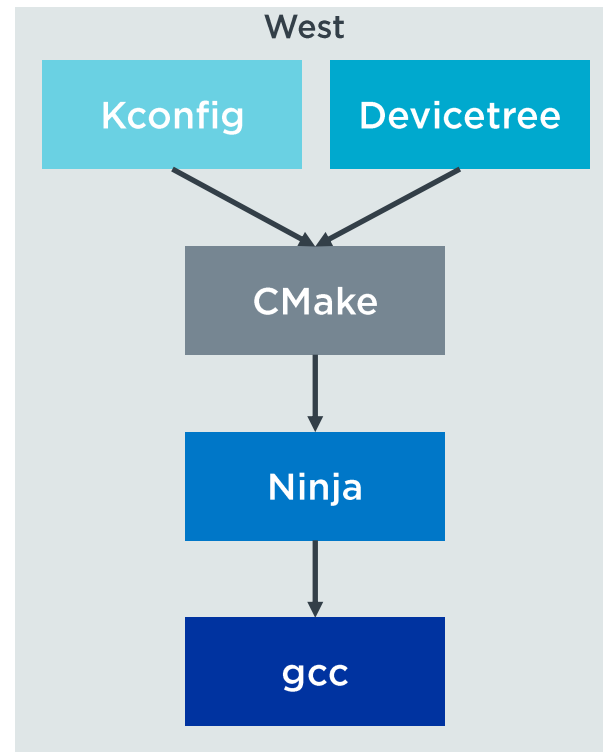
- Uses the information from Kconfig and the devicetree to generate build files.

### Ninja

- Similar to make
- Faster than make when performing incremental builds
- Requires CMake in order to generate build files

### gcc

- The gcc compiler is used to create the executables (hex/elf files)



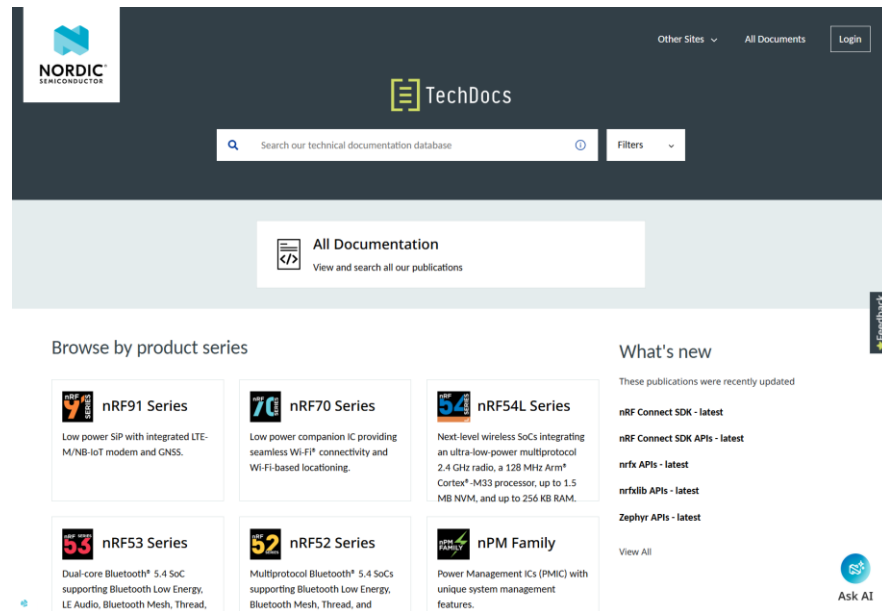


## Documentations & Help

### Guidance

# Where do I find documentation?

- Nordic created a new, unified website for its documentation called TechDocs:
- [www.docs.nordicsemi.com](http://www.docs.nordicsemi.com)
- **HW:** Tiles represent the product series on the main page
- **SW:** Navigation found on the right-hand side
  - Links to various repositories that are part of the nRF Connect SDK
  - (Entry Page: “nRF Connect SDK – latest”)



# nRF Connect SDK Documentation

- nRF Connect SDK: [Documentation link](#)
- Ensure to view the documentation corresponding to your NCS version in use
  - Click on the version field / drop down menu
  - “Latest” refers to the current development branch
  - Other versions listed as per SDK releases
- Note that not all sub pages list all SDK release versions, as the respective sub page might not exist in that SDK release

Home > nRF Connect SDK - latest > Introduction

## Introduction

Version: nRF Connect SDK latest | Last Updated Jan 21, 2025 | 2 minute read | [Summarize](#)

# nRF Connect SDK latest # nRF9151 # nRF9161 # nRF9160 # Thingy:91 # Thingy:91X # nRF70 Series

# nRF Connect SDK v2.9.0 22 >

# nRF Connect SDK v2.9.0-nRF54H20-rc1

The nRF Connect SDK is a unified software development kit for building low-power wireless applications based on the Nordic Semiconductor nRF52, nRF53, nRF54, nRF70, and nRF91 Series wireless devices. It supports [Microsoft Windows](#), [Linux](#), and [macOS](#) for development.

The nRF Connect SDK has the following distinguishing features:

**Based on Zephyr and open source**

# Have you seen this button?

It's found on following web pages:

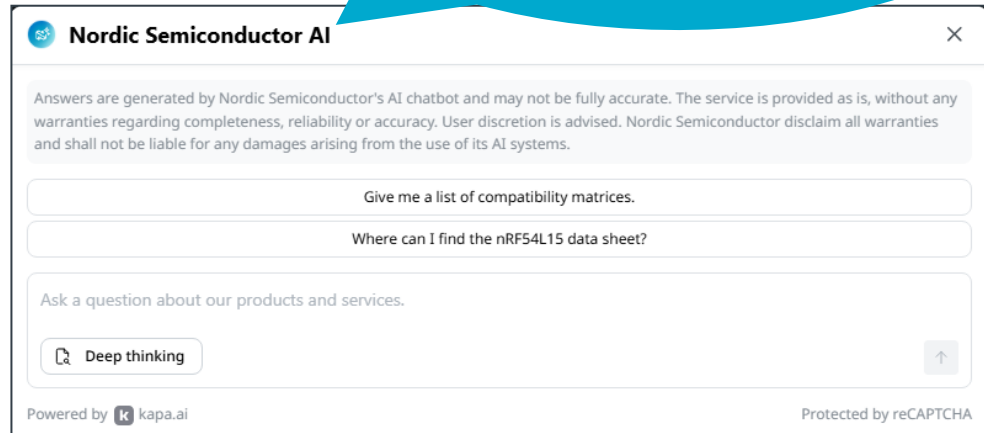
- [Nordic Semiconductor's TechDocs](#)
- [Nordic Semiconductor's DevZone](#)



# Nordic Semiconductor AI Agent

- Answering questions about Nordic Semiconductor's products, solutions, and documentation.
- AI Agent uses Nordic Semiconductor resources to look for an answer:
  - Official Nordic Semiconductor documentation
  - Nordic Semiconductor Blog posts
  - Nordic Semiconductor Forum Discussions
  - Nordic Semiconductor Support Resources
- Different Languages are supported

I am specialized in answering questions about Nordic Semiconductor's products, solutions, and documentation. If you have questions about Nordic products or technologies, I am happy to help!



The screenshot shows a chatbot window titled "Nordic Semiconductor AI" with a close button (X) in the top right corner. Below the title is a disclaimer: "Answers are generated by Nordic Semiconductor's AI chatbot and may not be fully accurate. The service is provided as is, without any warranties regarding completeness, reliability or accuracy. User discretion is advised. Nordic Semiconductor disclaim all warranties and shall not be liable for any damages arising from the use of its AI systems." There are two example input fields: "Give me a list of compatibility matrices." and "Where can I find the nRF54L15 data sheet?". Below these is a larger input field with the placeholder text "Ask a question about our products and services." and a "Deep thinking" button with a circular arrow icon. A "Send" button with an upward arrow icon is on the right. At the bottom, it says "Powered by kapa.ai" and "Protected by reCAPTCHA".



# Recommendation: Nordic DevAcademy !



## DevAcademy

- Interactive Learning Platform around Nordic's Software Solution and Products
- Start with [nRF Connect SDK Fundamentals](#)
- Enhance Knowledge with [BLE Fundamentals](#)
- Advanced topics in [nRF Connect SDK Intermediate](#)

# Nordic Support

## Webinars



Regular webinars about our products and technologies

[www.nordicsemi.com/Events/Webinars](http://www.nordicsemi.com/Events/Webinars)

## Tech Support & Forum



Dedicated Application Engineering Support from Norway and open community forum: DevZone Portal

<https://devzone.nordicsemi.com>