PATHPARTNER

DecaWave: UWB-IOT tools Infrastructure
BSP UserGuide

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1. About this Manual

This document describes how to build and work with the BSP for Decawave on RIOT for Nordic NRF52840 and STM32F401RE Nucleo platforms. The BSP package for Decawave on RIOT serves to provide a software platform for development, deployment and execution of DecaRange RTLS ARM application.

In this context, the document contains instructions for:

- Setting up the Environment
- Build the DecaRange RTLS ARM application for defined platform
- Flash the DecaRange RTLS ARM application for defined platform

2. Getting Started

2.1. System Requirements

Refer to 'Dependencies' section of release notes

2.1.1. Installing Jlink

- To flash the binary JLink is use, please install the tool manually from *https://www.segger.com/downloads/jlink*.
- Expand J-Link Software and Documentation Pack and select the suitable package and click download.
- Double click on the downloaded package to install.

2.2. Running DecaRange RTLS ARM Application on Nordic NRF52840 and STM32F401RE Nucleo platforms

This section describes how to run the application involving BSP for Decawave on RIOT

2.2.1. Common Steps for all examples

- To initialize the Environment Variables, installing Dependent Libraries (First time), setup (clone the RIOT repo and sym link creation for dw1000) and building the application
- Inside the cloned repo, run the script – "**source ./build_setup.sh INITIAL**"
- To initialize the Environment Variables, setup (clone the RIOT repo and sym link creation for dw1000) and building the application (Next Time on Wards)
- Inside the cloned repo, run the script – "**source ./build_setup.sh UPDATE**"
- To build the DecaRange RTLS ARM application for Nordic nrf52840 platform.
- Inside the cloned repo, run the script -- "**source ./build_setup.sh**"
- To build the DecaRange RTLS ARM application for STM32F401RE Nucleo platform.
- Modify the setenv.sh as "**DW_HW_PLATFORM=nucleo-f401**"
- Inside the cloned repo, run the script -- "**source ./build_setup.sh**"
- To connect EVB1000 board to Nordic NRF52840 or STM32F401RE Nucleo External Microcontroller
- Turn off S2 DIP switches
- Turn off S3-1 DIP switch
- Remove the jumper J10
- Make sure the pins of Nordic NRF52840 or STM32F401RE Nucleo Platforms and EVB1000 Device are wired as defined below

EVB 1000 to Nordic NRF52840

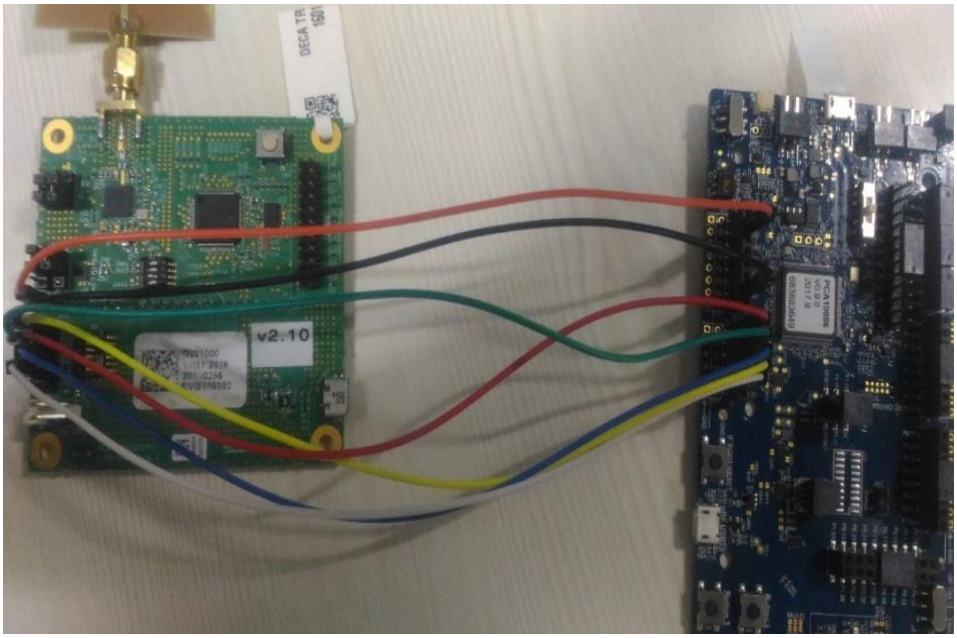
Pin	EVB1000	Nordic NRF52840
IRQ	J6: Pin4	P0.30
MISO	J6: Pin5	P0.28
MOSI	J6: Pin8	P0.04
SCLK	J6: Pin7	P0.03
CS	J6: Pin9	P0.29
GND	J6: Pin10	GND
VDD	J10: Pin2	VDD

EVB 1000 to STM32F401RE Nucleo

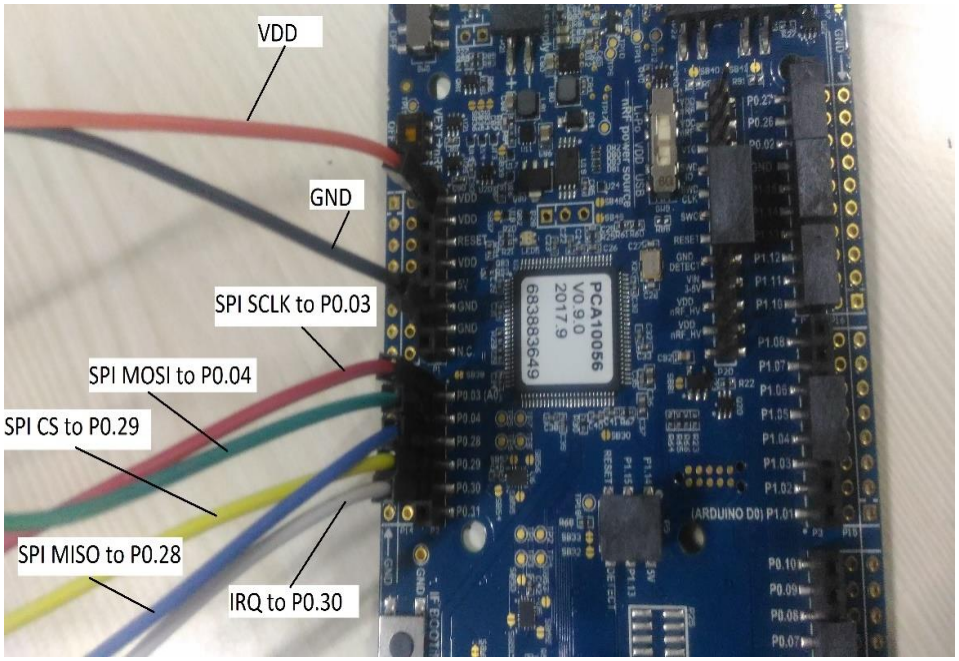
Pin	EVB1000	STM32F401RE Nucleo
IRQ	J6: Pin4	PA06
MISO	J6: Pin5	PB04
MOSI	J6: Pin8	PB05
SCLK	J6: Pin7	PB03
CS	J6: Pin9	PA04
GND	J6: Pin10	GND
VDD	J10: Pin2	3V3

2.2.2. Connecting Hardware Platform to EVB1000 with SPI Interface

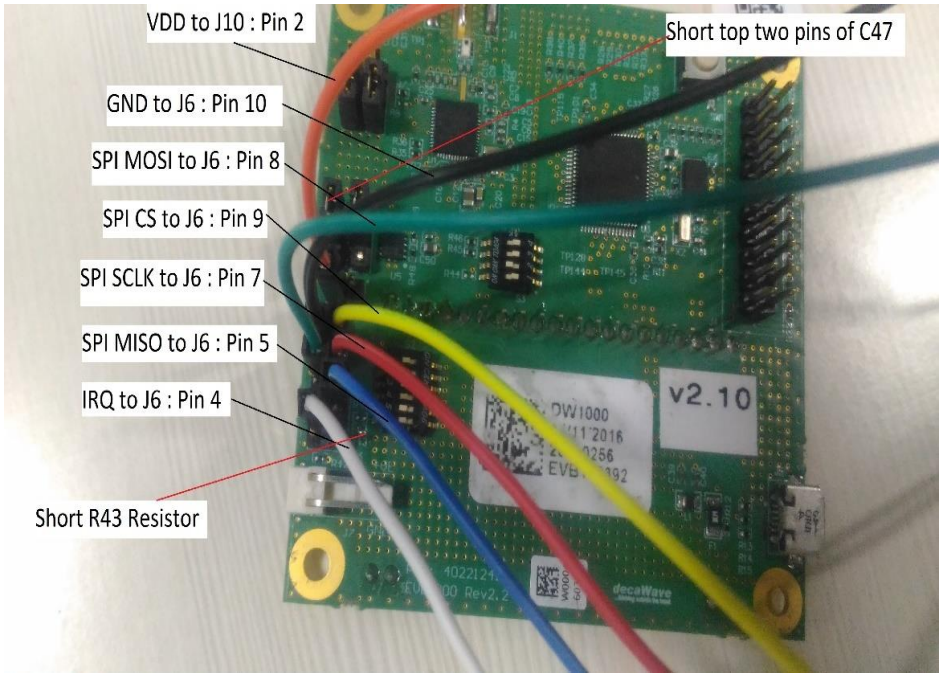
2.2.2.1 NRF52840 Nordic Platform



Connectors for SPI Interface on NRF52840 Nordic Platform to EVB1000



Connection Details of SPI Interface on NRF52840 Nordic Platform

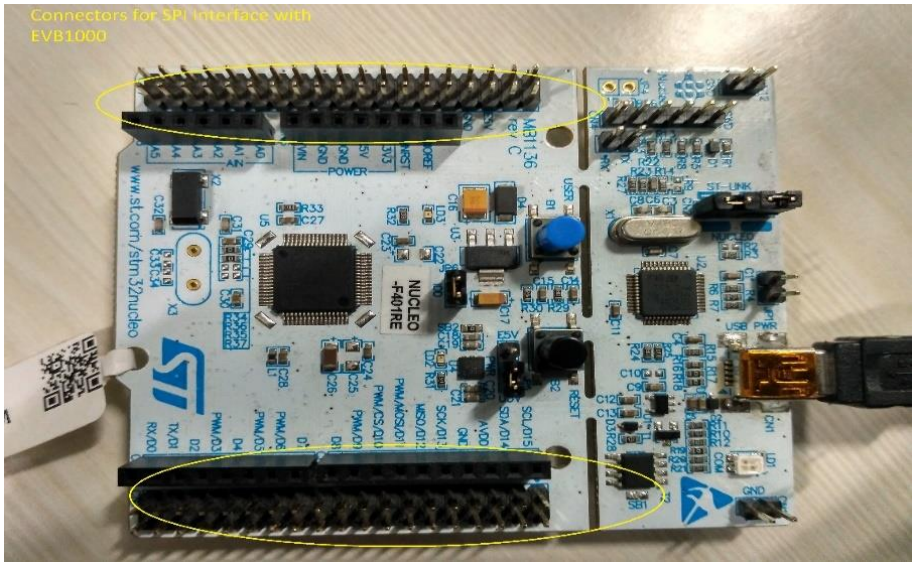


Connection Details of SPI Interface on EVB1000

2.2.2.2 STM32F401RE Nucleo Platform

Interfaces

SPI interface with EVB1000 is highlighted below



Connectors for SPI Interface on STM32F401RE Nucleo Platform to EVB1000

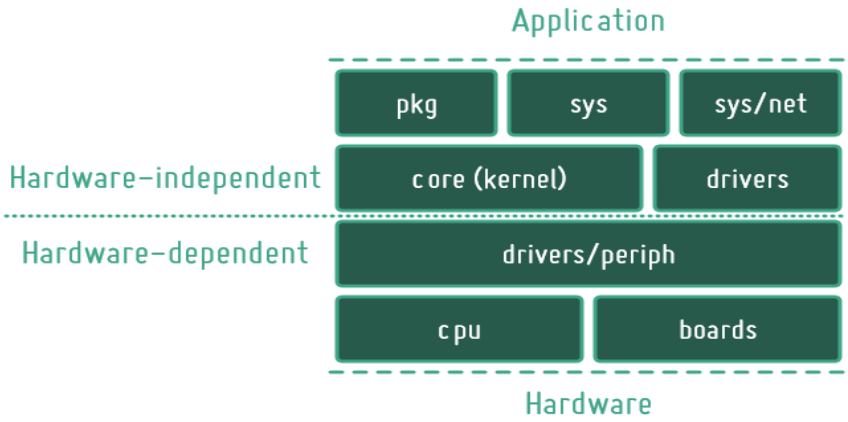
2.2.3. Running DecaRange RTLS ARM Application

- Inside Ubuntu, open a terminal and input –
- To Flash –
  "sudo make –C $RIOT_ROOT/examples/dw1000_rtls_arm BOARD=$DW_HW PLATFORM flash"
- open a new terminal and input –
  "cd $RIOT_ROOT/RIOT/dist/tools/pyterm"
  "sudo ./pyterm -p /dev/ttyACM0"
- Select the EVB1000 device configuration such as Mode(Mode1/Mode2/Mode3/Mode4), UNIT(Tag/Anchor) and UNIT ID (0 to 2)
  For Example:
  - If the user selects Mode as 'Mode1', UNIT as 'Tag' and UNIT ID as '0' then EVB1000 with Nordic NRF52840 or STM32F401RE Nucleo is configured for Tag0 with Mode1 Configuration
- In case of Nordic NRF52840, Configure A0, A1 and A2 for Mode 1 configuration as defined above
- In case of STM32F401RE Nucleo, Select the EVB1000 with STM32F10x (internal controller) as A0, A1 and A2 for Mode 1 configuration
- Now calculated range distance is printed on the terminal

2.3. BSP Overview

RIOT Board support package supports generic BSP module for different H/W Platforms which helps to integrate an application easily for different H/W Platforms. Based on RIOT, we have come up with BSP module-specific design for Decawave peripheral.

Software layer structure of the DecaRange RTLS ARM application based on RIOT is shown below



Software layer for DecaRange RTLS ARM application

RIOT Board support package is structured into five groups.

- The kernel (core)
- Platform specific code (cpu; boards)
- Device drivers (drivers)
- Libraries and network code (sys; pkg)
- Applications for demonstrating features and for testing (examples; tests)

The following list gives a more detailed description of BSP top-level directories

2.3.1. core

It contains the actual kernel. The kernel consists of the scheduler, inter-process-communication (messaging), threading, thread synchronization, and supporting data-structures and type definitions

2.3.2. boards

The platform dependent code is split into two logic elements: CPUs and boards, a board has exactly one CPU, while a CPU can be part of multiple boards. This configuration mainly includes the peripheral configuration and pin-mapping, the configuration of on-board devices, and the CPU's clock configuration

2.3.3. cpu

It contains all CPU specific configurations, such as implementations of power management, interrupt handling and vectors, startup code, clock initialization code and thread handling code

2.3.4. cpu/periph

It contains CPU's peripheral drivers like SPI, UART, GPIO, etc.,

2.3.5. drivers

It contains the drivers for external devices such as network interfaces, sensors and actuators. All of device drivers are based on the peripheral driver API (e.g. SPI, GPIO, etc.) and other modules like the xtimer. This way the drivers are completely platform agnostic and they don't have any dependencies into the CPU and board code

2.3.6. sys

It contains modules that are not part of the hardware abstraction nor device. The libraries include data structures (e.g. bloom, color), crypto libraries (e.g. hashes, AES), high-level APIs (e.g. Posix implementations), memory management (e.g. malloc), the RIOT shell etc.,

2.3.7. sys/net

The sys/net contains networking code

2.3.8. pkg

It comes with support for a number of external libraries (e.g. ccn-lite, microcoap)

2.3.9. examples

It contains example applications that demonstrate certain features

2.3.10. tests

It contains test application of many features/modules in RIOT

2.3.11. dist and doc

It contains all the tooling around RIOT

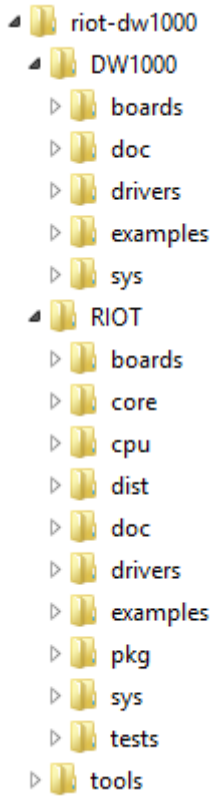
"doc" contains the doxygen configuration and also contains the compiled doxygen output after running "make doc"

"dist" contains tools for help with RIOT. These include the serial terminal application pyterm, generic scripts for flashing, debugging, resetting (e.g. support for OpenOCD, Jlink), as well as code for enabling easy integration to open testbeds such as the IoT-LAB

2.4. BSP Code / Directory Organization

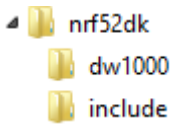
2.4.1. Top Level

BSP source code directory will have following folders. Let's consider 01_00_03 version release as an example



2.4.2. Decawave Board Module for Nordic NRF52840

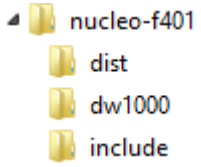
The boards folder contains platform specific folder such as nrf52dk etc., The EVB1000 related changes for Nordic NRF52840 has been defined in "boards/nrf52dk/dw1000" folder. This configures peripheral, interrupt configuration and pin-mapping specific to EVB1000. Any special programming needed by the EVB1000 board is also added here.



2.4.3. Decawave Board Module for STM32F401RE Nucleo

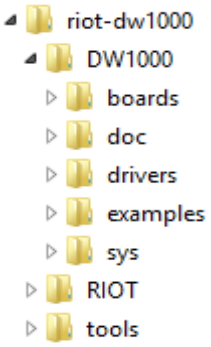
The boards folder contains platform specific folder such as nucleo-f401 etc., The EVB1000 related changes for STM32F401-Nucleo has been defined in "boards/ nucleo-f401/dw1000" folder. This configures peripheral, interrupt configuration and pin-mapping specific to

EVB1000. Any special programming needed by the EVB1000 board is also added here.



2.4.4. Docs

The doc folder contains release notes, user guide and test Reports for Nordic NRF52840 and STM32F401RE Nucleo platforms. The relnotes_archive folder contains the user guides and release notes for the previous releases.



2.4.5. Examples

The examples folder is the root folder for all the DecaRange RTLS ARM application for various supported platforms.