

# Qorvo Nearby Interaction SDK Quick Start Guide

## Introduction

Qorvo DW3000 chip series are approved by Apple® for the purpose of evaluating UWB enabled accessories to leverage Apple's Nearby Interaction framework. Qorvo DWM3000 and DWM3001C modules can interact with Apple® products that include the U1 chip by performing a Two-Way-Ranging with them.

Apple® Nearby Interaction framework with Third Party Accessories has two phases:

- First, is the initial Out Of Band discovery (BLE/WiFi/etc). In this project BLE is used to exchange configuration settings between U1 enabled device and an Accessory device. To enable background mode During this phase, the Accessory is sending the preferred configuration data (Accessory Configuration Data) to the Apple® device. Apple® unit provides its configuration of choice back to the Accessory (Apple Shareable Configuration Data).
- After exchanging of settings, the U1 enabled device starts the UWB session and runs the Two-Way-Ranging between U1 chip and Accessory.

The Two-Way-Ranging protocol used in Apple® Nearby Interaction with Third Party is powered by FiRa© standard. In this standard either side shall be configured as a Controller+Initiator and another side shall be configured as a Controlee+Responder. The Accessory can be pre-configured for a specific role.

The Qorvo Nearby Interaction iOS application supports camera assistance and AR as described in WWDC22 (video below). The app uses the AR Session, created for camera assistance, to place virtual objects in the Qorvo device position. <https://developer.apple.com/videos/play/wwdc2022/10008/>

The Apple® approved Nearby Interaction Qorvo Development Kits are equipped with Nordic BLE SoCs, which provide the Out Of Band discovery over BLE, while the communication with U1 enabled device is provided with the Qorvo DW3000 series chip.

Qorvo offer a UWB module variant (DWM3001CDK) or an Arduino™ compatible Shield (DWM3000EVB), which can be connected to the Nordic Development Kit. Supported Nordic Development kits:

- nRF52 DK: <https://www.nordicsemi.com/Products/Development-hardware/nRF52-DK>
- nRF52833 DK: <https://www.nordicsemi.com/Products/Development-hardware/nrf52833-dk>
- nRF52840 DK: <https://www.nordicsemi.com/Products/Development-hardware/nrf52840-dk>

This document describes how to get started with the Qorvo solutions for Apple® Nearby Interaction.

## Overview

Qorvo UWB solutions of DWM3000 and DWM3001C integrated modules allows the exploration of Nearby Interaction out of box and using these modules in the end-product designs.

### DWM3000EVB Shield

The DWM3000EVB Shield is an Arduino™ form-factor compatible shield designed for the evaluation of the DWM3000 UWB module, which is composed by a DW3110 UWB IC and a Ceramic UWB antenna.

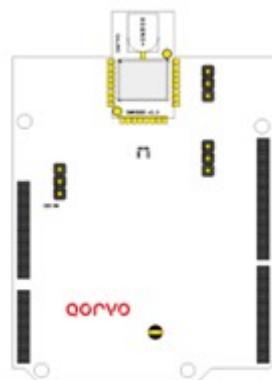


Figure 1.1: DWM3000EVB

As shown below, the DWM3000EVB is attached to the Nordic DK's Arduino™ Interface to provide the UWB functionalities.

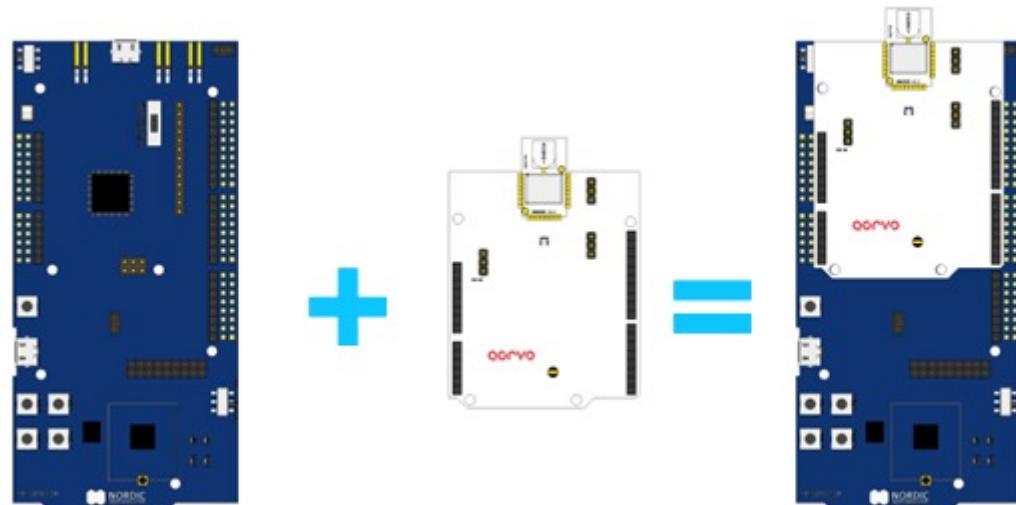


Figure 1.2: DWM3000EVB Arduino and a nRF52840/833 DK

## DWM3001CDK Design Kit

The DWM3001CDK is a Qorvo Design Kit designed for the evaluation of the fully integrated DWM3001C UWB module, supporting a DW3110 UWB IC, PCB UWB antenna, accelerometer and powered by a nRF52833 BLE SoC.

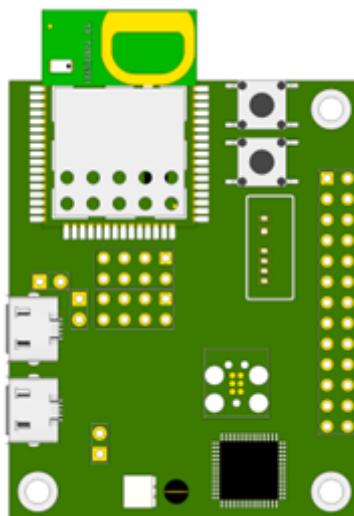


Figure 1.3: DWM3001C Design Kit

The DWM3001CDK has an on-board J-Link for flash and debugging via USB (J9), and a direct connection to the DWM3001C USB Interface (J20).

## Board Connections

### Applying power to the Nordic DKs

The Nordic nRF52840 DK and nRF52833 DK boards have similar layouts, they are divided into two parts: A J-LINK part, located on the upper part of the PCB, and the target nRF52840/833 microcontroller. To power the board, connect the Nordic nRF52840/833 DK board to a USB power supply with a USB 'Type-A to Micro-B' cable attached to the USB connector marked J2.

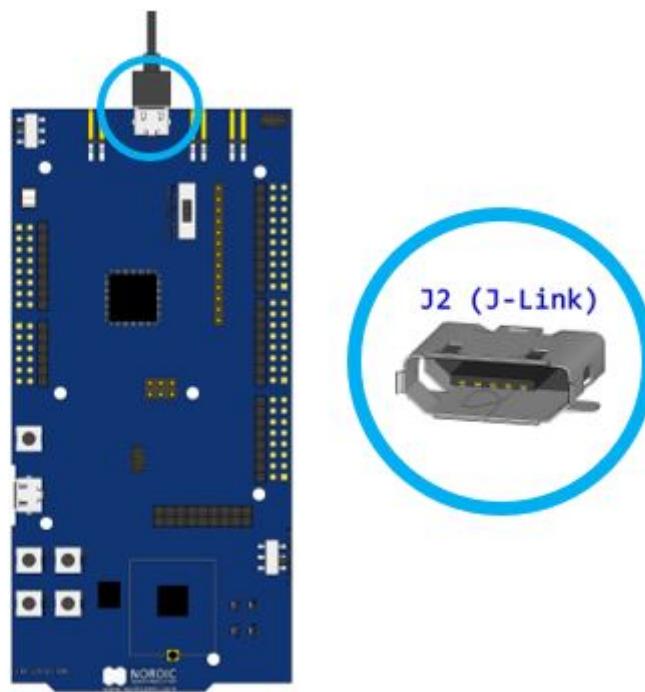


Figure 1.4: Powering the boards (J2 USB connector)

The nRF52840/833 DK has two switches, ***SW8*** and ***SW9***, that define the power supply for the board:

- ***SW9*** (up in the middle): Switches the power supply between Li-PO (J6), VDD (from J-Link) or USB (from nRF USB).
- ***SW8*** (top left): ON/OFF Switch.

To work from J2 (J-Link) power, SW9 must be switched to VDD (middle position) and SW8 should be in the position ON.

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**Note:** For more details on the power modes, check the User Manual of your Nordic Development Kit

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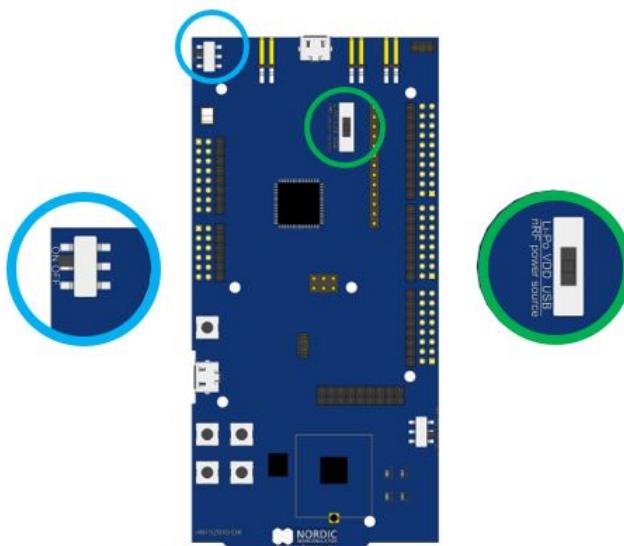


Figure 1.5: SW8 (blue) and SW9 (green) position

## DWM3001CDK

Connect the two micro-USB connectors available on the board as in [DWM3001CDK connections](#)

- J9 (interface MCU): used for flashing/debugging via J-Link OB and UART communication with MCU through a virtual COM port.
- J20 (nRF USB): used for UART/USB communication with MCU.

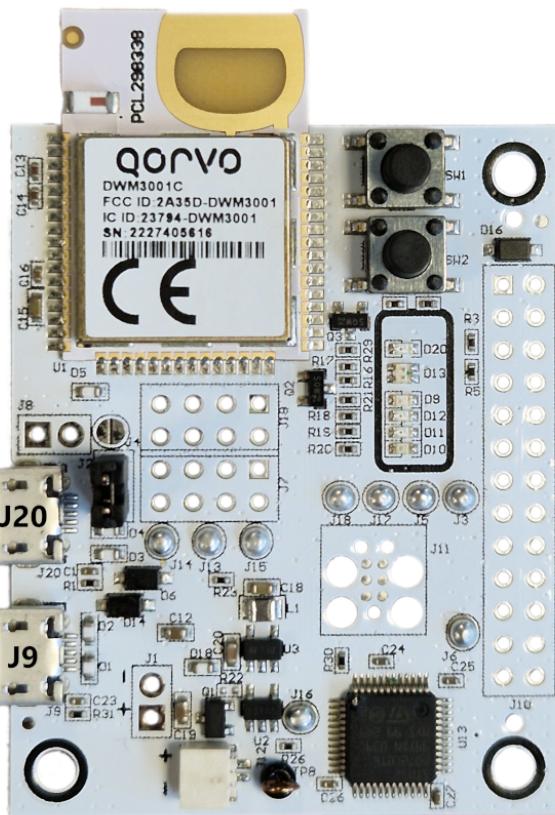


Figure 1.6: DWM3001CDK connections

### Communication Interfaces on DWM3001CDK

In SDK for DWM3001CDK, two different communication interfaces can be utilized for the communication:

- UART over USB (USB CDC ACM) allows for the communication with the MCU over USB connection, enabled by default.
- UART allows for the communication with the MCU through the UART pins, disabled by default.

### Applying power to the DWM3001CDK

Like the Nordic DKs, the DWM3001CDK has an on-board J-Link and a User USB. The board can be powered by both USBs (J20 or J9), or via the RPI interface (from the Raspberry Pi compatible IO) and/or the VBAT connector.

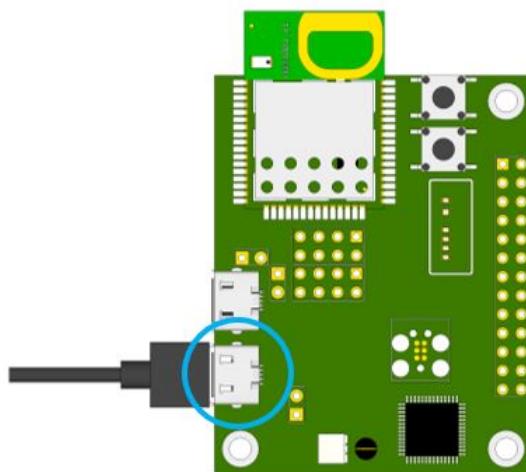


Figure 1.7: Powering the DWM3001CDK (J9 USB connector - J-Link OB)

By default, the power supply for the DWM3001CDK is the J9 USB connector, which is also the J-Link OB USB connection used for programming and debugging.

## Flashing Firmware

The Nordic nRF52840/833/832 DKs and the DWM3001CDK have an on-board SEGGER J-LINK debugger, allowing to program and debug the target microcontroller. The J-LINK should be connected to a PC, to program the Nearby Interaction example firmware in the boards.

### Application and Drivers

The application to program the Nordic SoCs is the “J-Link Software and Documentation pack”, it is available free of charge for any SEGGER J-LINK devices at:

<https://www.segger.com/downloads/jlink/>

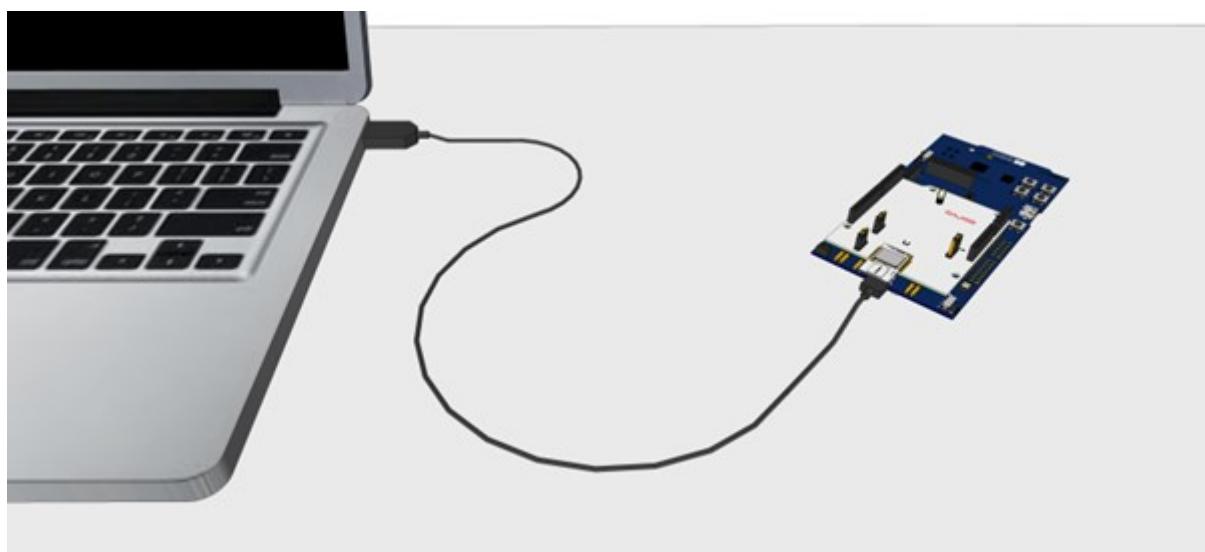


Figure 1.8: Connect J-Link (J2) to PC

The Nordic DK, JTAG-OB and DWM3000EVB shield are by default powered from J2 (J-Link) connection ([Applying power to the Nordic DKs](#)). Connecting J2 to the PC will provide both, power to nRF52840/833/832 SoC and connectivity for the J-Link.

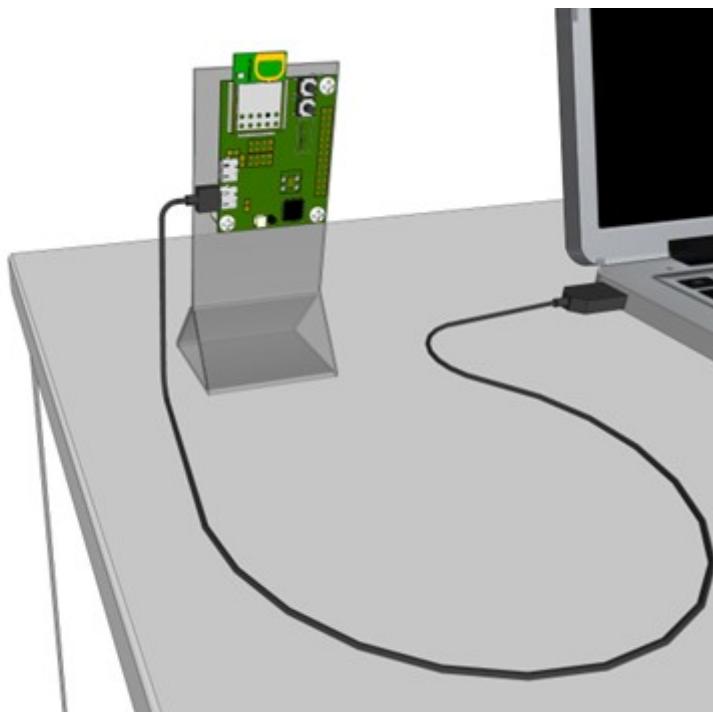


Figure 1.9: Connect J-Link (J9) to PC, it will also power the DWM3001CDK

In the DWM3001CDK, the J-Link is connected to the USB (J9) connection, the board can be powered from there and it is the only connection required.

## Programming/Upgrading firmware

To program the Nordic nRF52840/833/832 SoCs with the Nearby Interaction firmware provided by Qorvo, the board must be powered and the J-LINK section needs to be connected to a PC using the USB connector (Figure 7 and Figure 8). This will enable the programming of the development board. Open the SEGGER J-Flash Lite application, it will detect a J-LINK connected to the PC. Check the device selected, for the nRF52 DK select “NRF52832\_xxAA” device, for the nRF52840 DK select “NRF52840\_xxAA” device, for nRF52833 DK and DWM3001CDK select “NRF52833\_xxAA” by clicking on the “three dots” button as shown below in [SEGGER J-Flash Lite, first screen](#)

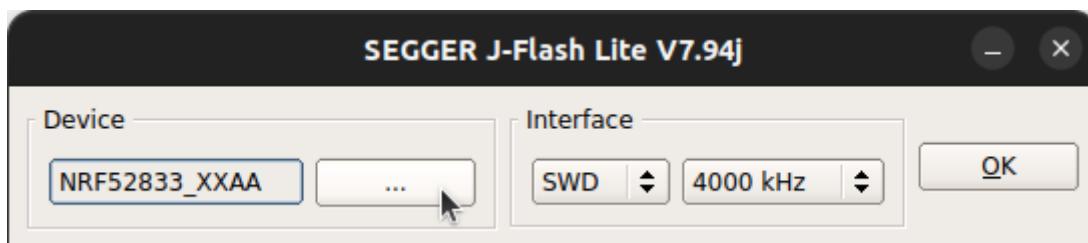


Figure 1.10: SEGGER J-Flash Lite, first screen

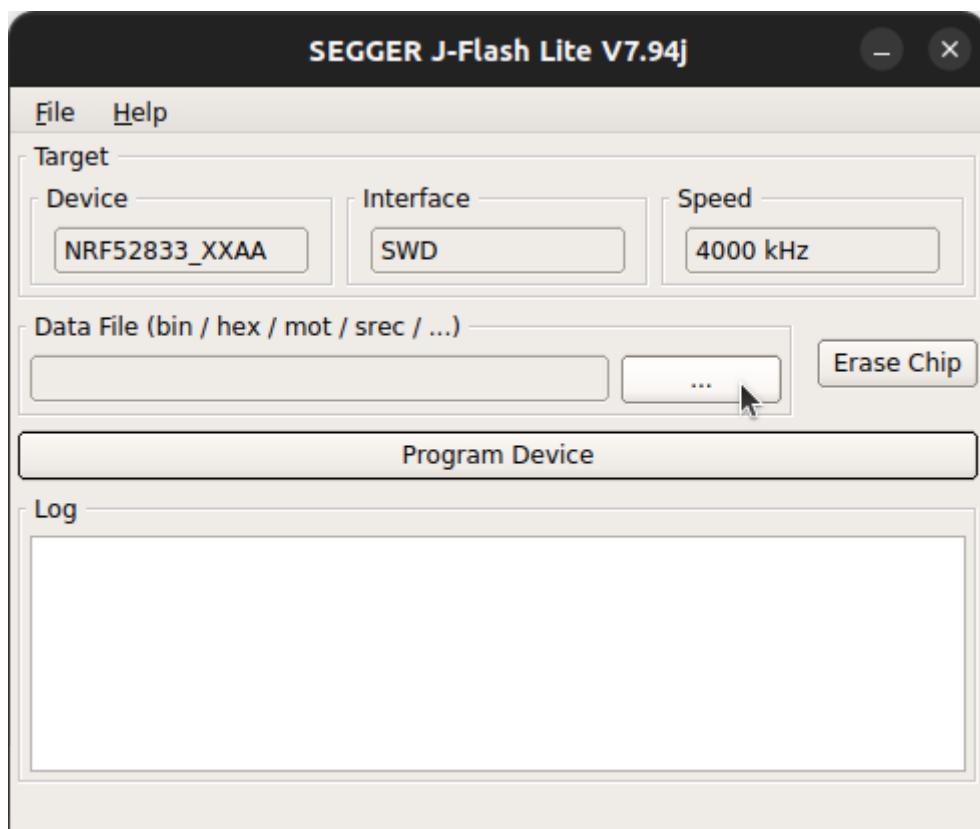


Figure 1.11: Three dots button to select the Nearby Interaction example binary

On the new screen click on the three dots button to load the binary file to be programmed to the board. Select the binary file for the correct target pre-built by Qorvo and then click on the “Program Device” button.

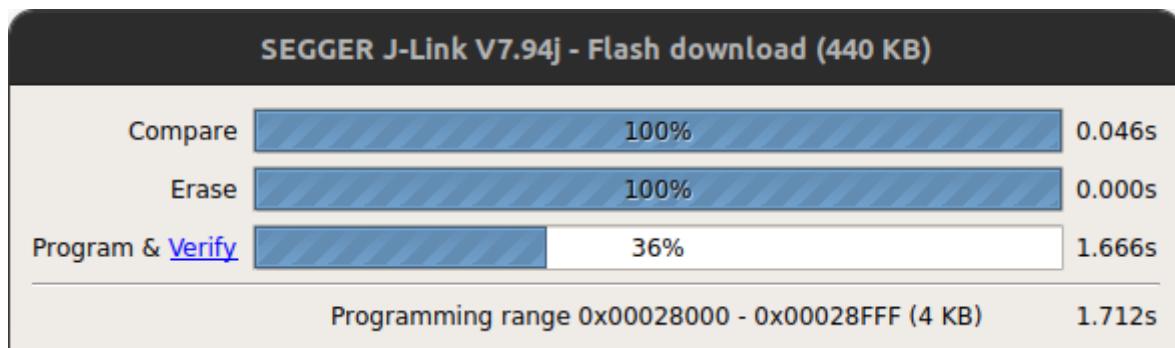


Figure 1.12: Programming progress window

The programming process takes a few seconds to finish.

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**Note:** If a ‘programming’ error occurs, try to ‘erase’ the chip first (“Erase Chip” button) and then try again to program the board as described in the previous section.

## Qorvo Nearby Interaction Application

Nearby Interaction with Third Party Accessories was introduced starting from iOS 15. It is required to update an iPhone to the iOS 15 version or later. The “Qorvo Nearby Interaction” iOS App is available for download on the Apple App Store:



<sup>1</sup>

Figure 1.13: QR Code to the Apple App Store and direct download link

Also, you can obtain the “Qorvo Nearby Interaction” sample code from Qorvo, instructions are provided on how to compile and run the app in a compatible iPhone device. After install, open the “*Qorvo Nearby Interaction*” iOS App by tapping the icon on your iOS device.

<sup>1</sup> <https://apps.apple.com/us/app/qorvo-nearby-interaction/id1615369084>

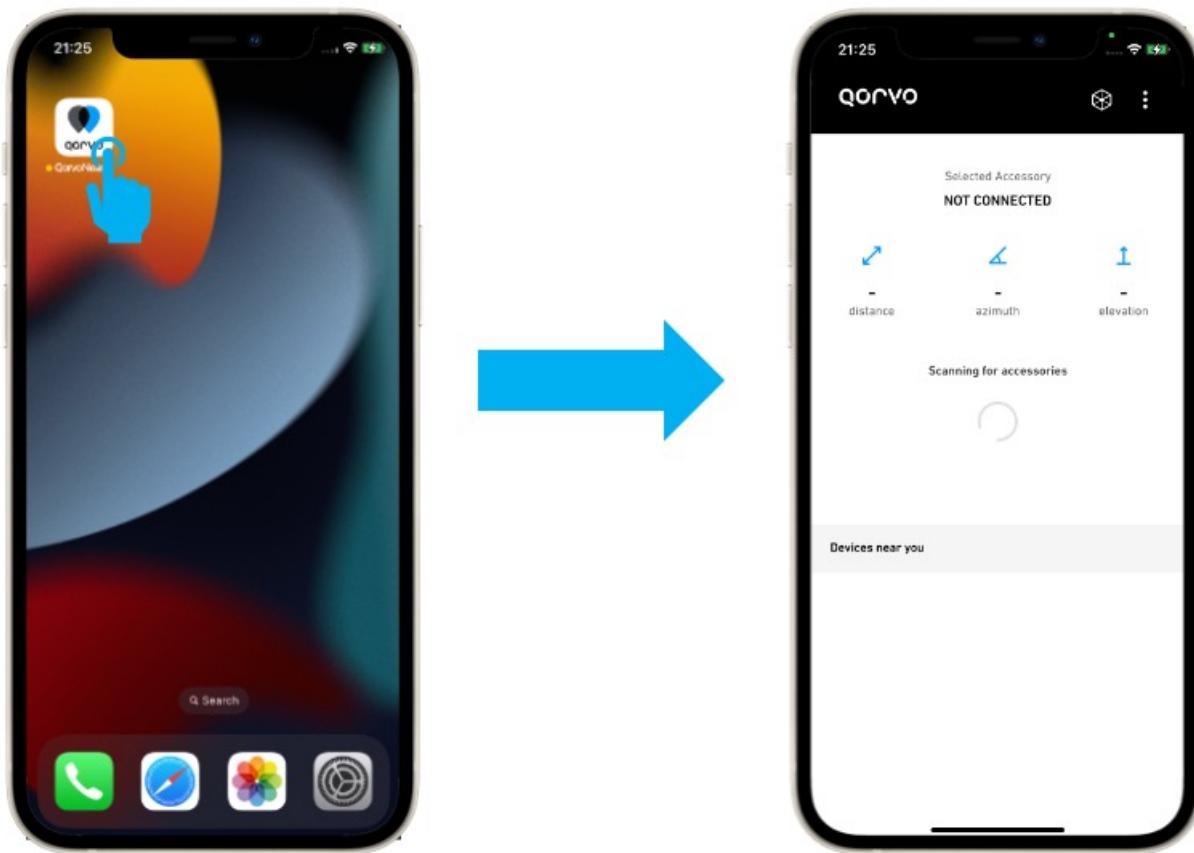


Figure 1.14: “Qorvo Nearby Interaction” iOS App and its main screen

When “Qorvo Nearby Interaction” opens it starts scanning for nearby accessories using QNIS and NUS BLE services<sup>2</sup>. When a Qorvo device is found, it is added to a list “Devices near you”, *click on the button “Connect”* (on the right of the Qorvo device name) to command the Qorvo device to start ranging.

<sup>2</sup> NUS BLE Service is supported for compatibility with previous versions of QNI.

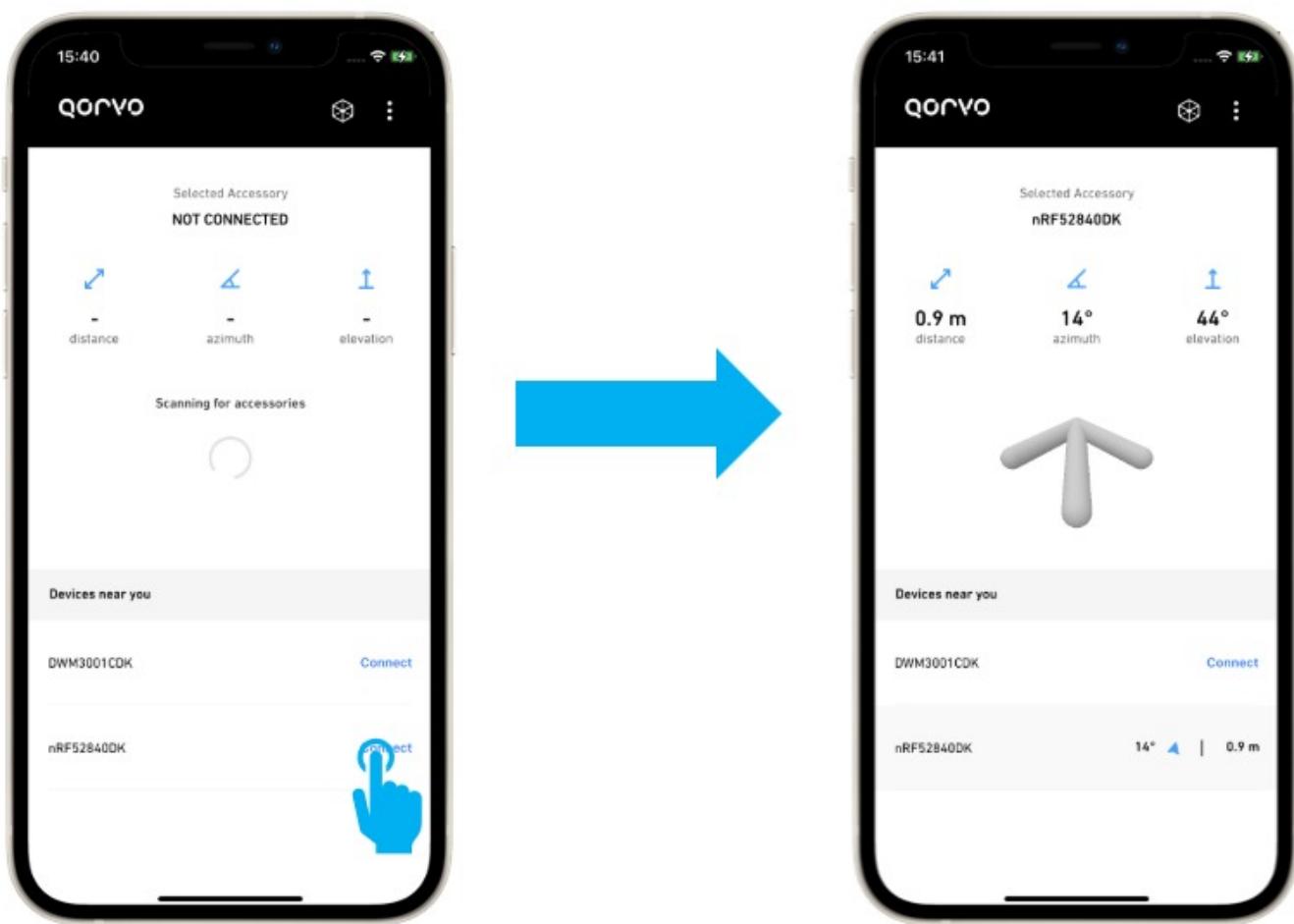


Figure 1.15: Click on “Connect” to command the Qorvo device to start ranging

After every ranging round, new position information will be available on the screen: Distance; Azimuth and Elevation.

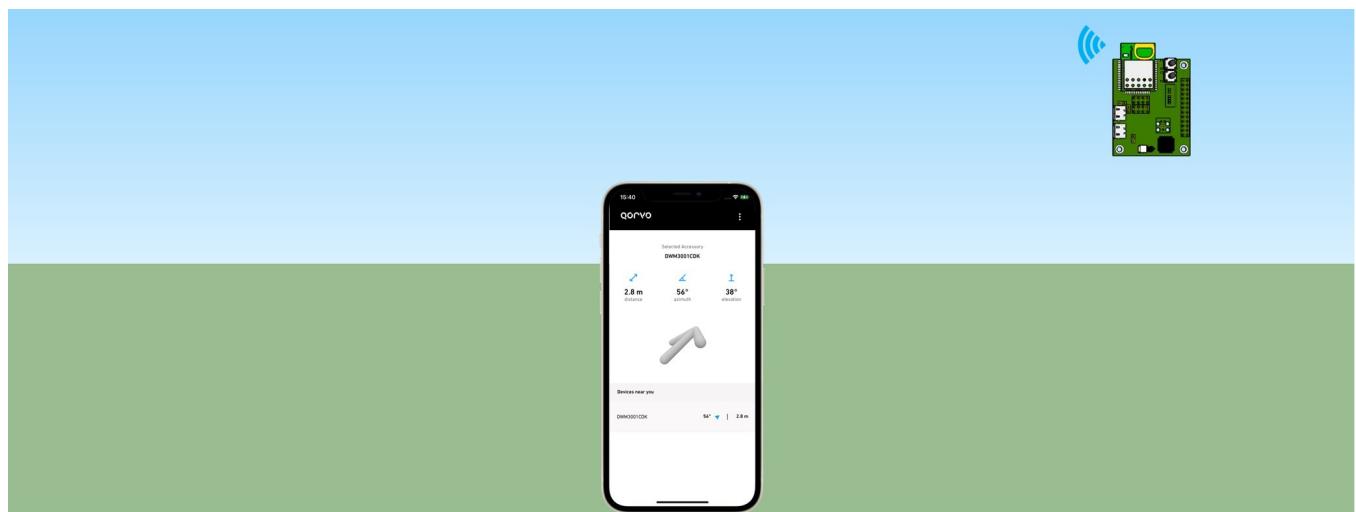


Figure 1.16: Real Time positioning information

Moving the Qorvo device towards or away from the iPhone will change the information displayed on the app as shown in [Real Time positioning information](#) and [Change the Qorvo device position to see the positioning info changing](#).

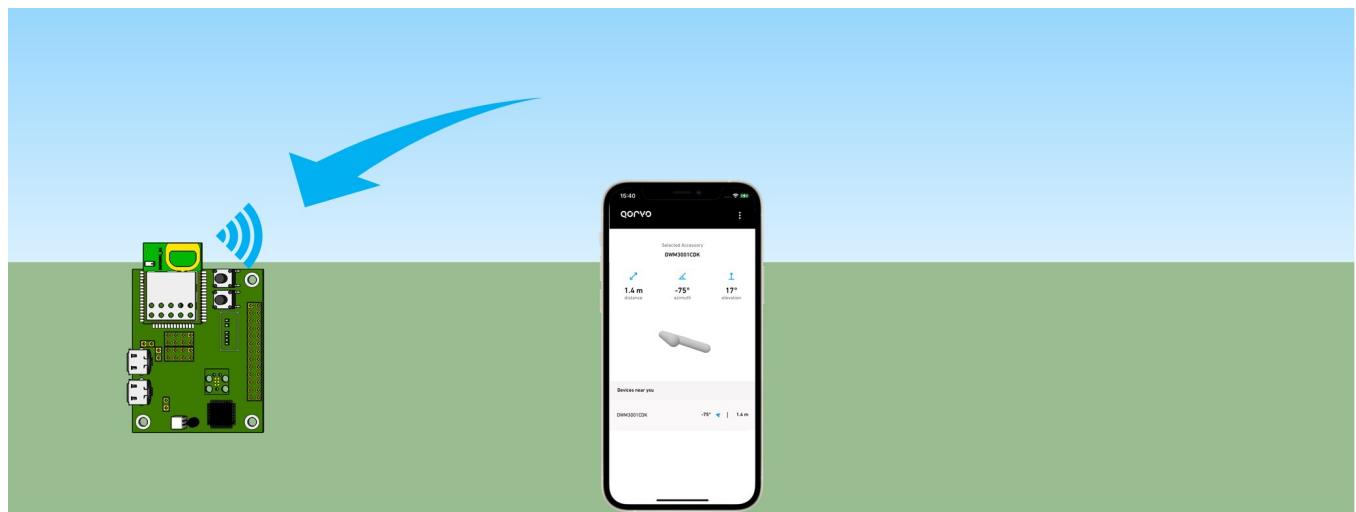


Figure 1.17: Change the Qorvo device position to see the positioning info changing

For high and low angles (close to  $\pm 90^\circ$ ) the Apple NI API may not return directions, in such cases the “Qorvo Nearby Interaction” app will show the latest valid information received greyed out, to indicate that the data is out of date as shown in *Directions (Azimuth and Elevation)*. The distance will continue to update.

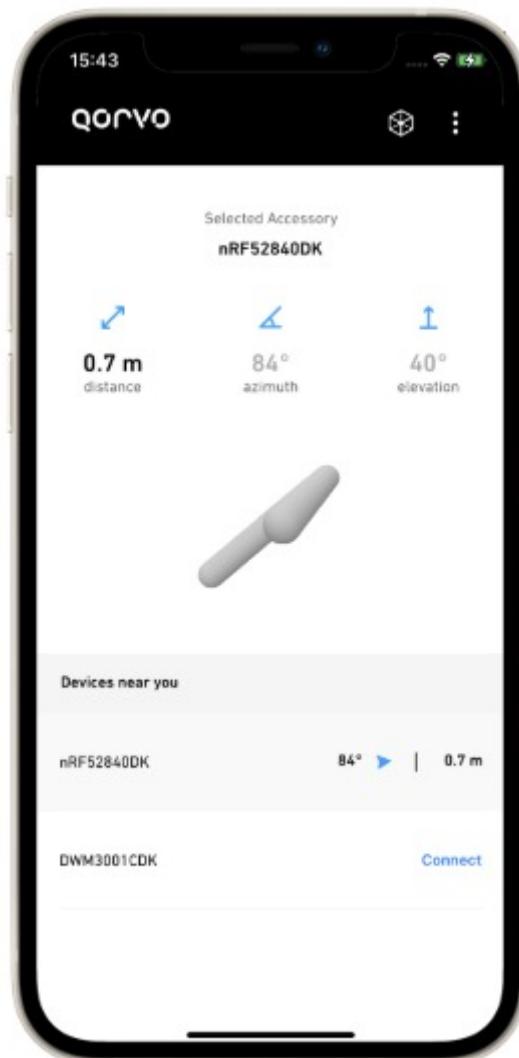


Figure 1.18: Directions (Azimuth and Elevation) are not updated

If there are more than one Qorvo device able to interact with the iPhone, [click on the device name](#) (the list under “Devices Near You”) to select another device, the selected device will appear in the main view with the 3D arrow pointing to its position. Devices not selected will have Distance and Azimuth information updated in their mini pannels.

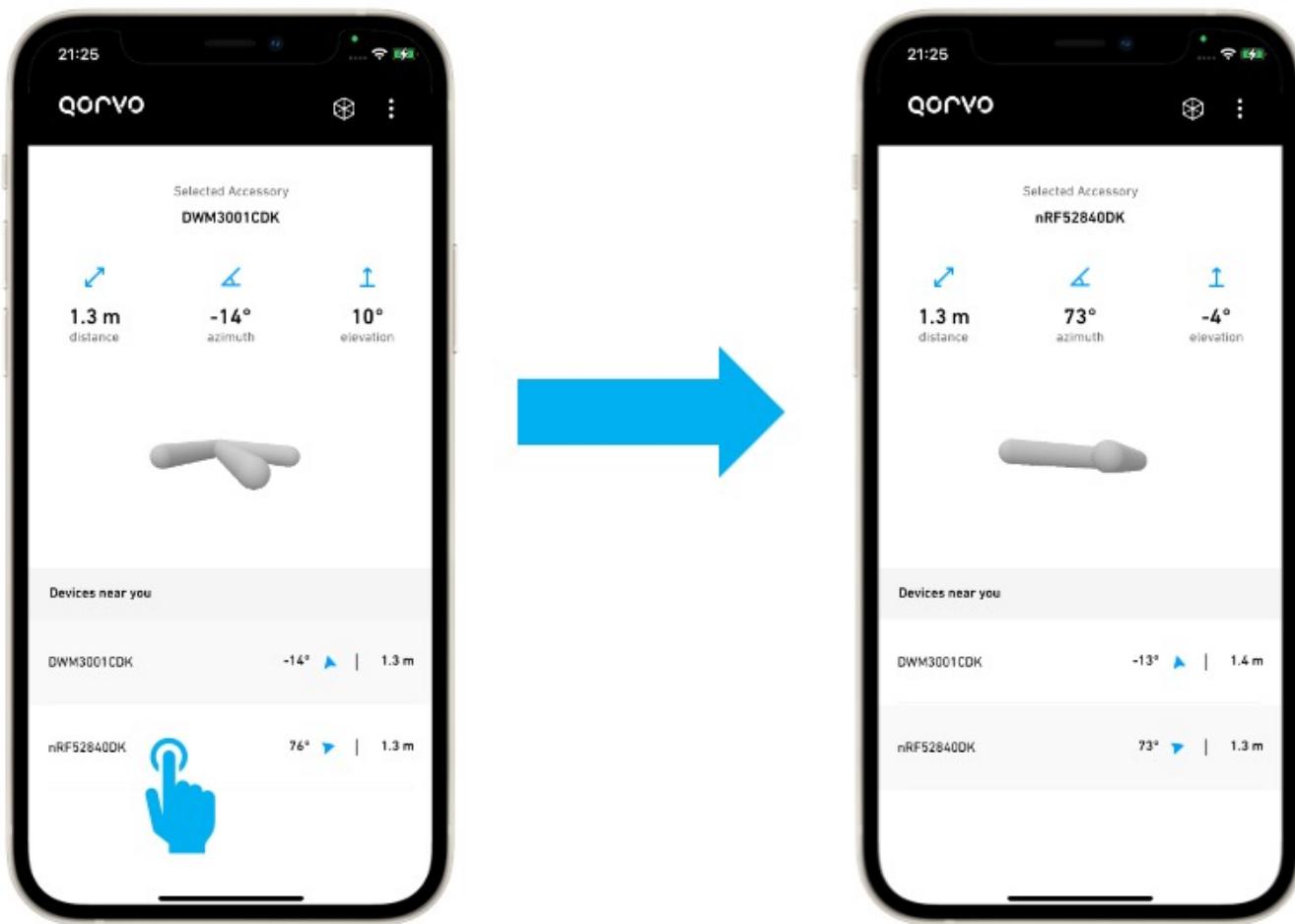


Figure 1.19: Click on the device name to select another device

Click on the “three dots” button (top right) to access the Settings screen, all nearby devices are shown with their status, and the “3D Arrow” and “Audio-Haptic Feedback” can be enabled/disabled.

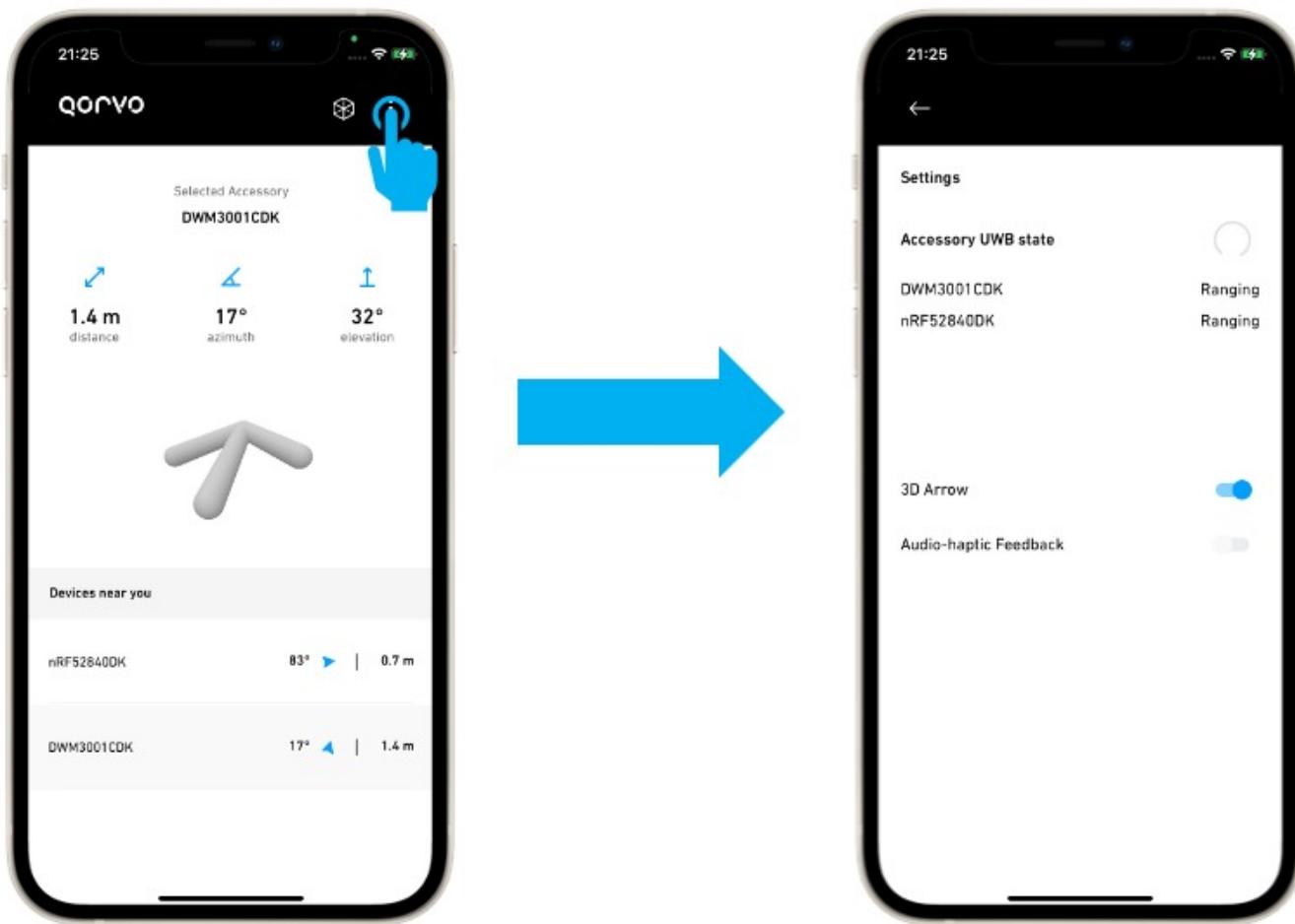


Figure 1.20: Click on the “three dots” button to open the Settings screen

The “3D Arrow” mode can be turned off by clicking on the switch on the right. The arrow will turn in a 2D plane, like a compass, using only the Azimuth angle making it easier to visualise.

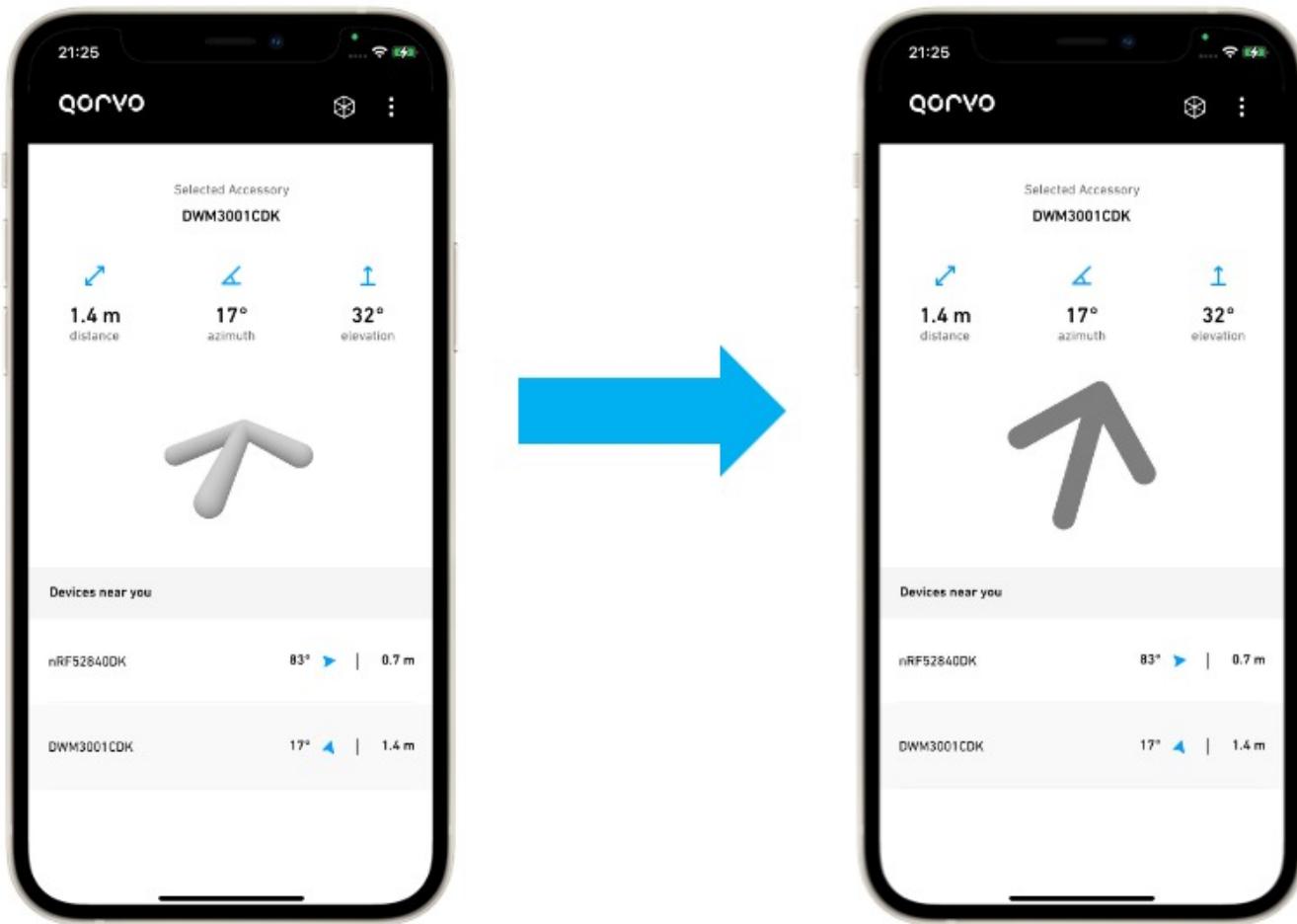


Figure 1.21: Arrow in 3D mode and 2D mode

Audio-haptic feedback is available for distance of the selected Qorvo device, by clicking on the Audio-haptic feedback switch on the Settings screen. Audio-haptic feedback will use the phone vibration to report the distance varying from long, weak vibrations when far, to short and strong vibrations when close. Audio feedback will work similarly, with audio volume varying with the reported range.

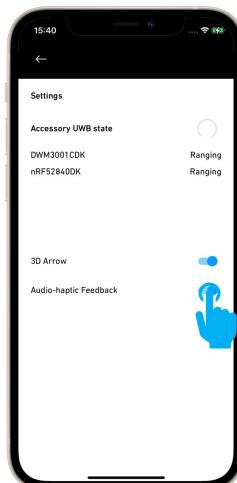


Figure 1.22: Enabling Audio-haptic feedback

Audio-haptic feedback has three different thresholds triggered by distance: Higher than 4 meters, between 4 and 2 meters, and closer than 2 meters as shown in [Feedback levels based on Qorvo's device distance](#).

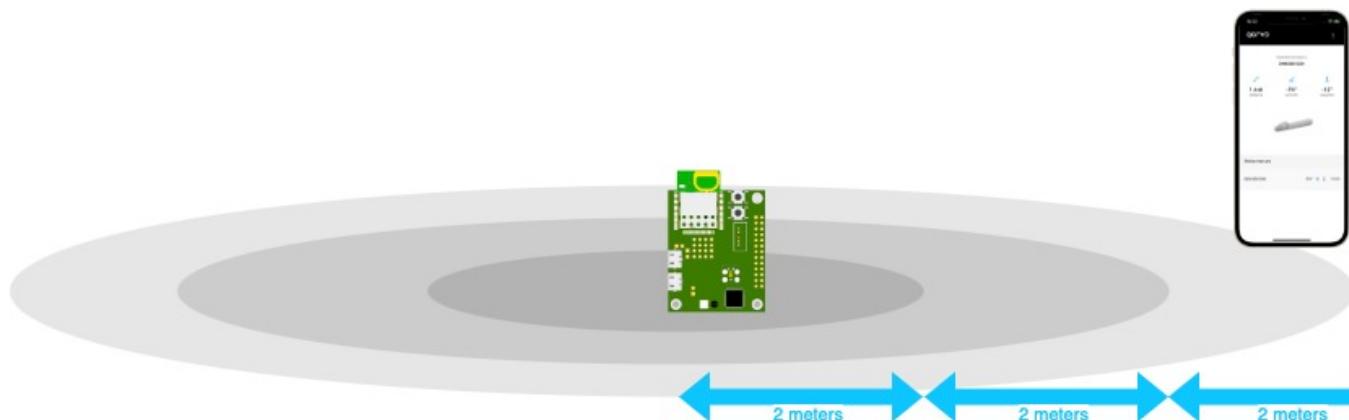


Figure 1.23: Feedback levels based on Qorvo's device distance

After start ranging, to stop the running NI Session slide the device name to the left, a “Delete” button will appear on the right, then click on the button. It will command the Qorvo device to stop ranging, and the “Connect” button will appear again, the session can be started again by clicking the “Connect” button.

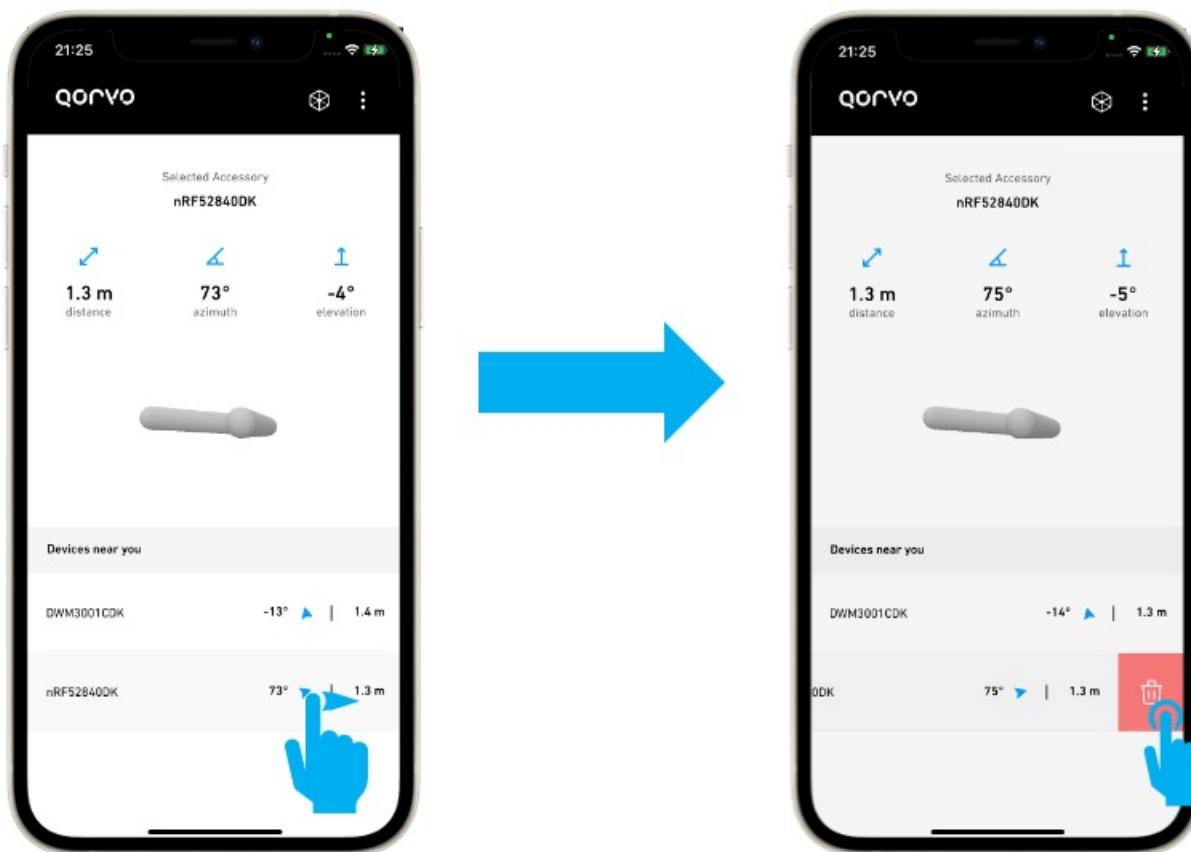


Figure 1.24: Slide the device name to see the stop button for that Qorvo device

An AR Session can be started anytime by [pressing the AR button](#) (“cube” icon on the top right). A virtual object will be placed on screen for each connected device ranging with the iPhone, moving the device will move the virtual object too.

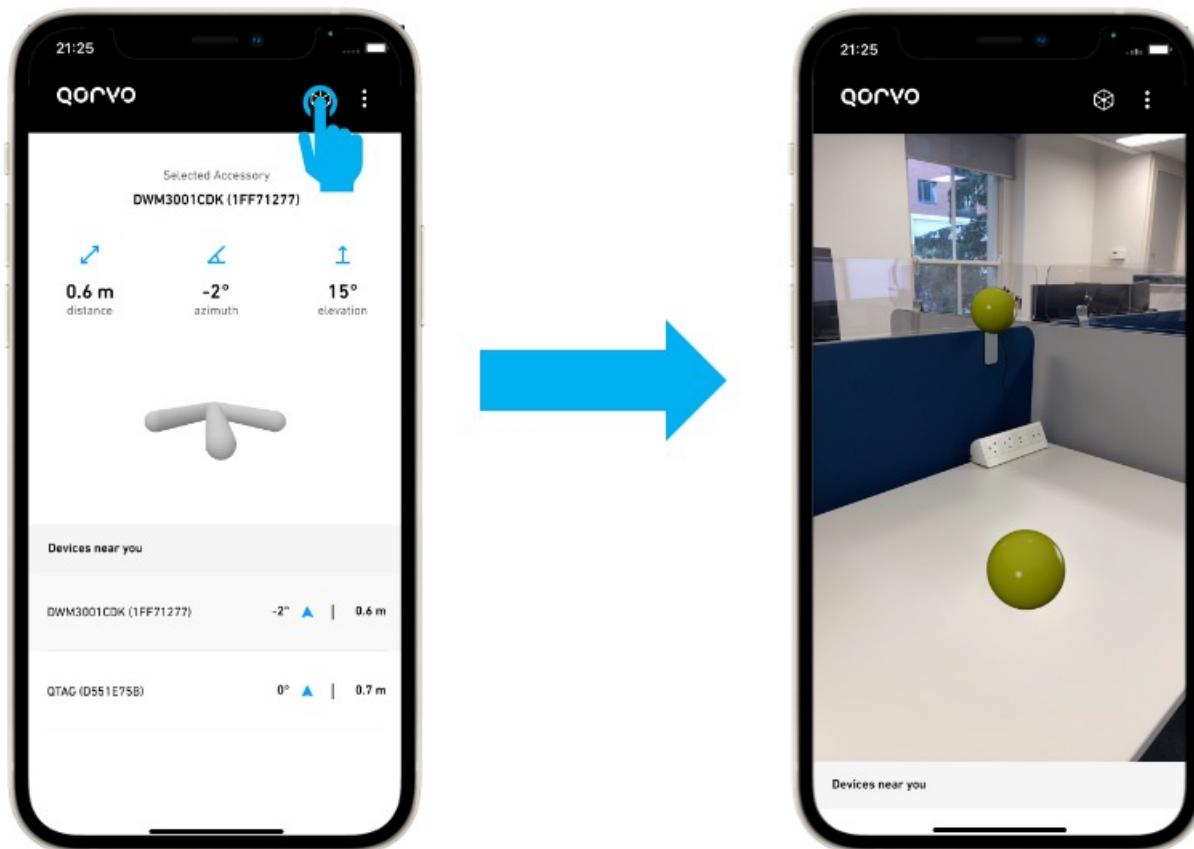


Figure 1.25: Press the AR button to switch to AR View

The AR window will start maximized, to access the device list again *slide “Devices near you” up* to access the device list in AR mode. Slide down to dismiss the device list.

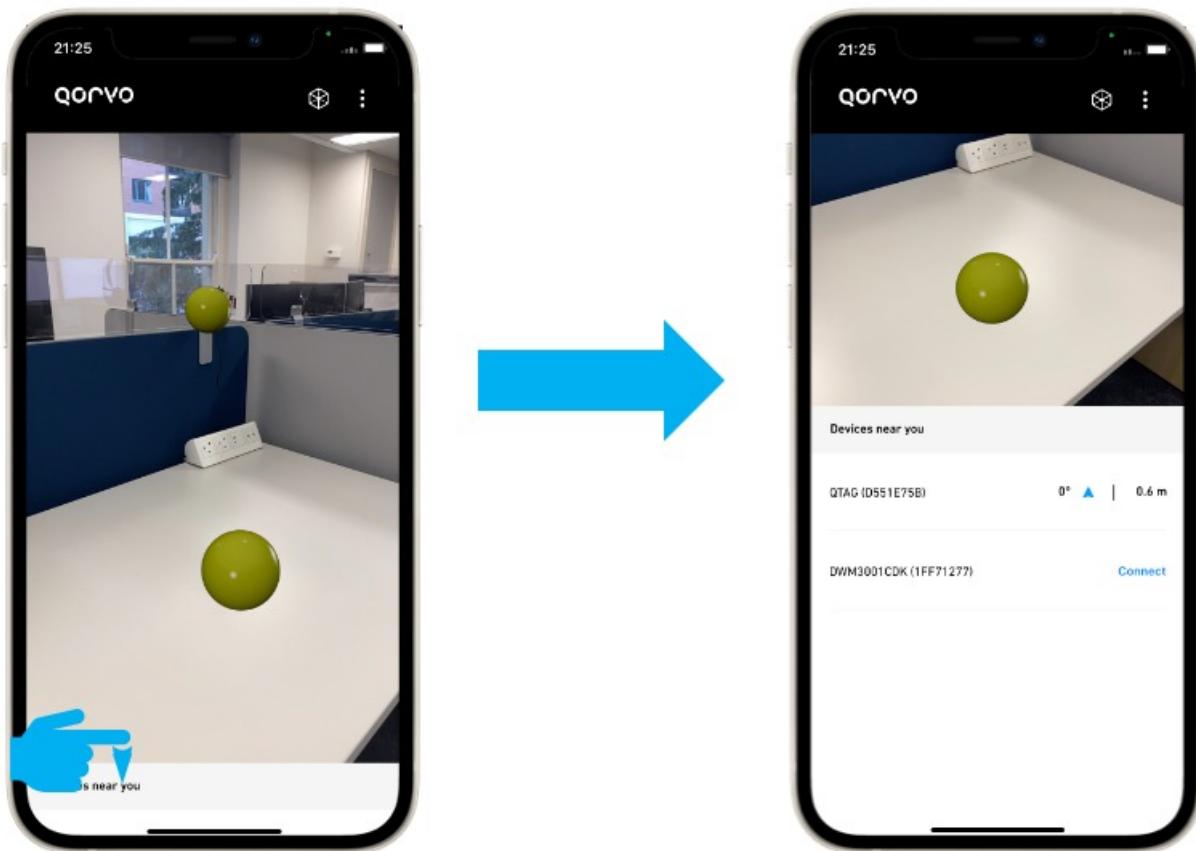


Figure 1.26: Slide “Devices near you” up to access the device list in AR mode