

Technical note

How to use the BlueNRG family devices with a CMSIS-DAP compliant probe

Introduction

This document describes how to use a CMSIS-DAP compliant probe with the BlueNRG-LP, and also with the BlueNRG-1 and the BlueNRG-2 systems-on-chip (SoC).

The evaluation board of the BlueNRG-LP (STEVAL-IDB011V1) implements a customized version of the ARM open source project DAPLink. For this reason, the user can program and debug the BlueNRG-LP device directly using the USB connector of the board itself. Furthermore, the board can also be used to program and debug external devices such as the BlueNRG-1, BlueNRG-2 and BlueNRG-LP.

Moreover, some vendors have produced their own version of CMSIS-DAP compliant probe and STMicroelectronics has tested one of them in order to provide an example.

1 CMSIS-DAP specifications

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The CMSIS-DAP specifications provide a standardized way to access the Coresight Debug Access Port (DAP) of an ARM Cortex microcontroller, via USB. It has been defined by ARM and ARM itself has provided an open source implementation called DAPLink project.

A CMSIS-DAP compliant probe is a board where the DAPLink project or, in general, a CMSIS-DAP implementation is running. The connection to the target device can be over JTAG or SWD.

A CMSIS-DAP compliant probe can provide the following main features, all over a single USB connection.

HID interface for CMSIS-DAP based debugging

The driver-less HID interface provides a channel over which the CMSIS-DAP debug protocol runs. This enables all the leading industry standard toolchains to program and debug the target device.

MSC interface for USB drag and drop programming⁽¹⁾

A CMSIS-DAP compliant probe can appear on the host computer as a USB disk. Program files in binary (.bin) and hex (.hex) formats can be copied into the USB disk, which then programs the image into the memory of the target device.

CDC interface for virtual serial port

A CMSIS-DAP compliant probe can appear as a USB serial port, which can be bridged through a TTL UART on the target device. The USB serial port appears on a Windows machine as a COM port, or on a Linux machine as a /dev/tty interface.

1. Valid for the selected device only because the Flashloader is inside the debugger itself.



2 ST CMSIS-DAP compliant probe

The STEVAL-IDB011V1 evaluation kit for the BlueNRG-LP provides the CMSIS-DAP capability. The customized version of the ARM open source project DAPLink offers:

- Windows 10 driver free
- Capable to program and debug the BlueNRG-LP, BlueNRG-1 and BlueNRG-2
- It shows itself as a composite device which offers:
 - A HID interface for CMSIS-DAP based programming and debugging.
 - A CDC interface for virtual serial port that acts as a USB-to-serial port bridge, connecting the UART port of the BlueNRG-LP.
 - An MSC interface for USB drag&drop programming that allows to program the BlueNRG-LP by copying and pasting a binary or hex file inside the mass storage of the target board.
- Maintenance mode to upgrade the firmware with the latest version.

Figure 1. STEVAL-IDB011V1 BlueNRG-LP evaluation board





3 Third party CMSIS-DAP compliant probe tested

STMicroelectronics has tested the following debug probe from Electrodragon: www.electrodragon.com/product/ daplink-cmsis-dap-debugger-arm-cortex-stm32-mdk.

- It is a Windows 10 driver free
- Capable to program all ARM Cortex M core chips, including: BlueNRG-LP, BlueNRG-1 and BlueNRG-2
- Firmware designed and supported by ARM
- It includes a USB-TTL serial port
- Very low-cost debugger.

Figure 2. CMSIS-DAP debugger board from Electrodragon



4 Debugger connection to evaluation kits

The following table shows how to connect the 3rd party debugger to the BlueNRG evaluation kits.

| ELECTRODRAGON DEBUGGER pin | STEVAL-IDB007VX STEVAL-IDB008VX | STEVAL- IDB011VX | Functional name |
|-------------------------------|------------------------------------|---------------------|--|
| DIO | CN7.7 | JP4.1 | SWD data signal |
| CLK | CN7.9 | JP3.1 | SWD clock signal |
| RST ⁽¹⁾ | CN7.15 | JP5.1 | Reset pin |
| 3V3 | CN7.1 | VBLUE | 3.3V connected to VBLUE |
| GND | CN7.4 | GND | GND |
| V1TXO ⁽²⁾ | CN3.1 | CN3.1 | Pin UART TX of the debugger connected to the pin UART RX of the BLE board. |
| V1RXO ⁽²⁾ | CN3.2 | CN3.2 | Pin UART RX of the debugger connected to the pin UART TX of the BLE board. |

Table 1. Electrodragon debugger connection to the BlueNRG evaluation kits

1. If HW reset is used.

2. Optional for UART TTL connection.

The following table shows how to connect the STEVAL-IDB011VX used as CMSIS-DAP debugger to the evaluation kit STEVAL-IDB007VX and STEVAL-IDB008VX.

Table 2. STEVAL-IDB011V1 debugger connection to the BlueNRG-1, BlueNRG-2 evaluation kits

| STEVAL-IDB011VX DEBUGGER PIN | STEVAL-IDB007VX STEVAL-IDB008VX | Functional name |
|---------------------------------|------------------------------------|---|
| JP4.2 | CN7.7 | SWD data signal |
| JP3.2 | CN7.9 | SWD clock signal |
| JP5.2 ⁽¹⁾ | CN7.15 | Reset pin |
| VBRD | CN7.1 | 3.3V connected to VBLUE |
| GND | CN7.4 | GND |
| CN3.2 ⁽²⁾ | CN3.1 | Pin UART TX of the debugger connected to the pin UART RX of the BLE board |
| CN3.1 ⁽²⁾ | CN3.2 | Pin UART RX of the debugger connected to the pin UART TX of the BLE board |

1. If HW reset is used.

2. Optional for UART TTL connection.



5 Software configuration

Here follows a quick summary about how to select the CMSIS-DAP debugger.

5.1 The BlueNRG-X Flasher utility setting

The BlueNRG-X Flasher utility allows the BlueNRG-X products to be connected through their UART port (using the internal bootloader) or through the SWD port. Inside the SWD tab, the user can choose the SWD interface to program the board: the CMSIS-DAP interface is also supported.

| Tools Help | | | | | | | | | | | | | | | | | | | | | | |
|---|--|---|---|---------------------------------------|--------------------------------------|---|------------------------------------|------------------------------------|---|---|-------------------------------|--|-----------------------------------|-----------------------------------|-------------------------------------|---------------------------------------|---|--|---------------|---------|-------------------|----------|
| ect Image file | No Ima | age file | loaded | i. | | | | | | | | | | | | | | | | | | |
| h from Addre | iss: 0 | ×1004 | 0000 | | | | | | | | | Flash | | Sto | р | | | | | | | |
| UART SWD | | | | | | | | | | | | | | MAC A | ddress | | | | | | | |
| Actions | | | u | st of co | nnecte | d interf | aces: | | | | | | MA | C Add | ress: | | Start: 0x0 | 000000 | 00000 - Er | nd: 0x0 | 00000000 | 0000 |
| √ Verify | | | Ī | 072 | 00001 | 979699 | 908a5a | 5a5, I | nterface | e: CM | SIS-DAP | • • | МА | C Flas | h Loc | ation | | | | | | |
| Readout P | rotecti | on | | | | | | | | Select | All | | | Save N | AC Ac | ldress L | .og | | | | | |
| Update De | e evice M | lemory | | | | | | 1 | ι | Inselec | t All | | File | Nam | e | | | | | | timesta | imp |
| | | | | | | | | | | | | | | | | | | | | | | |
| h Memory Re | Mode ading | Devi | ce ID: la5a5a | < 07200 5a5066 | 001979 fff3332: | 69908a 315450 | 15a5a5a 430842 | > 5066ff | f33323: Image | Invert 154504 File | All E I Comp | Device are Devi | Type: ce Mer | BlueN mory w | RG-LP | (max fl age File | Set Mac Ad ash address: 0x10 Compare Two | 07ffff) Files | Inter | face: | CMSIS-D | АР 10 |
| h Memory Re evice ID: 07200 | Mode ading | Devie 969908 | ce ID: la5a5a | < 07200 5a5066 | 001979 fff3332: | 69908a 315450 | 5a5a5a 430842 | > a5066ff 59 | f33323: Image Size | Invert 154504 File 0x3000 | All Comp | Device | Type: ce Mer | BlueN mory w | RG-LP rith Im | (max fl age File | Set Mac Ad ash address: 0x100 Compare Two | o Files | Inter | face: | CMSIS-D | ар 10 |
| Plug&Play h Memory Re evice ID: 07200 | Mode ading 1001979 | Devie 969908 040000 | ce ID: la5a5a | < 07200 5a5066 | 001979 fff3332: | 69908a 315450 | 5a5a5a 430842 | > 5066ff | f33323: Image Size [| Invert 154504 File 0x3000 | All Comp | Device are Devi | Type: ce Mer | BlueN mory w | RG-LP /ith Im | (max fl age File | Set Mac Ad ash address: 0x100 Compare Two Dentire Mer | opress opression opressional files oprove and the second secon | Inter | face: | CMSIS-DA | AP 10 |
| Plug&Play h Memory Re avice ID: 07200 Start Address 0x10040000 | Mode ading 1001979 | Devia 969908 040000 1 00 | ce ID: ia5a5a 0 | < 07200 5a5066 3 20 | 001979 fff3332: 4 31 | 69908a 315450 5 0A | 15a5a5a 430842 6 04 | > 15066ff 59 7 10 | f33323: Image Size [8 D9 | Invert 154504 File 0x3000 9 07 | Comp 10 04 | Device | Type: ce Mer 12 DB | BlueN mory w 13 | RG-LP /ith Im- | (max fl age File 15 | Set Mac Ad ash address: 0x100 Compare Two Entire Met ASCII | o Files | Inter Read | face: | CMSIS-D. Write | AP 10 |
| Plug&Play h Memory Re avice ID: 07200 Start Address 0x10040000 0x10040010 | Mode ading 001979 0x100 0 00 AA | Devia 969908 040000 1 00 55 | ce ID: la5a5a 2 01 55 | < 07200 5a5066 3 20 AA | 001979 (ff33332: 4 31 00 | 69908a 315450 5 0A 00 | 5a5a5a 430842 6 04 00 | > 5066ff 59 7 10 00 | f33323: Image Size [8 D9 10 | Invert 154504 File 0x3000 9 07 85 | All Comp 10 04 08 | Device are Devi 11 10 00 | Type: ce Mer 12 DB 4B | BlueN mory w 13 07 43 | RG-LP /ith Im- 14 04 01 | (max fl age File 15 10 68 | Set Mac Ad ash address: 0x101 Compare Two | o Files | Inter Read | face: | CMSIS-D. Write | AP 10 |
| Plug&Play h Memory Re evice ID: 07200 Start Address 0x10040000 0x10040010 how Log | Mode ading 001979 0x100 00 AA | Devia 969908 040000 1 00 55 | ce ID: la5a5a 2 01 55 | < 07200 5a5066 3 20 AA | 001979 fff33332: 4 31 00 | 69908a 315450 5 0A 00 | 15a5a5a 430842 6 04 00 | > 5066ff 59 7 10 00 | F33323: Image Size [8 D9 10 | Invert 154504 File 0x3000 9 07 85 | Comp 10 04 08 | Device are Devi 11 10 00 | Type: ce Mer 12 DB 4B | BlueN mory w 13 07 43 | RG-LP //th Im/ 14 04 01 | (max fl age File 15 10 68 | Set Mac Ad ash address: 0x10 Compare Two Entire Med ASCII 1 Ù Û *UU ^a µ KC h | o Files | Inter Read | face: | CMSIS-D. Write | AP 10 |
| Plug&Play h Memory Re evice ID: 07200 Start Address 0x10040000 0x10040010 how Log 19:41119.09 | Mode ading 1001979 0x100 00 AA 9: De | Devia 969908 040000 1 00 55 | ce ID: a5a5a5a 2 01 55 | < 07200 5a5066 3 20 AA | 001979 (ff3332: 4 31 00 | 69908a 315450 5 0A 00 | 5a5a5a 430842 6 04 00 | > 59 7 10 00 | F33323: Image Size D9 10 | Invert 154504 File 0x3000 9 07 85 | All Comp 10 04 0B | Device T are Devi 11 10 00 | Type: ce Mer 12 DB 4B | BlueN mory w 13 07 43 | RG-LP //th Im- 14 04 01 | (max fl age File 15 10 68 | Set Mac Ad ash address: 0x10 Compare Two Entire Med ASCII 1 Ú Ú ^a UU ^a µ KC h | o Files mory | Inter Read | face: | CMSIS-D | |
| Plug&Play h Memory Re evice ID: 07200 Start Address 0x10040000 0x10040010 how Log 18:41:19.40 18:41:20.45 | Mode ading 1001979 10019 1001979 1001979 1001979 1001979 1001979 1001979 1001979 1001979 1001979 1001979 1001979 1001979 1001979 1001979 10019 1001979 1001979 1001979 10019 10019 10019 10019 10019 1000 | Devie 969908 040000 1 00 55 vice ad Fl vice | ce ID: la5a5a 0 2 01 55 Ident ash M Disco | < 07200 5a5066 3 20 AA | 001979 fff3332: 4 31 00 | 699088 315450 5 0A 00 >> B10 | 15a5a5a 430842 6 04 00 | > 5066fH | f33323: Image Size [8 D9 10 | Invert 154504 File 0x3000 9 07 85 | All Comp 10 04 08 | Device are Devi 11 10 00 | Type: ce Mer 12 DB 4B | BlueN mory w 13 07 43 | RG-LP vith Im 14 04 01 | (max fl age File 15 10 68 | Set Mac Ad ash address: 0x10 Compare Two Entire Mee ASCII 1 Ŭ Ũ aUUa µ KC h | o Files | Inter | face: | CMSIS-D. Write | |

Figure 3. BlueNRG-X Flasher utility GUI

5.2 The BlueNGR-X Flasher Launcher

The BlueNRG-X Flasher Launcher is a command line version of the BlueNRG-X Flasher Utility. The command to list all the connected SWD HW tools (including the CMSIS-DAP ones) is: > BlueNRG-X_Flasher_Launcher.exe swd

Then, it is possible to execute all the commands, such as: program and read the Flash memory, verify the memory content, and perform a mass erase of the Flash memory.

For example, a mass erase command if only one device is connected to the PC is:

> BlueNRG-X_Flasher_Launcher.exe mass_erase -c -swd -all

Further information is in the dedicated user manual UM2406.

5.3 Open OCD settings

The BlueNRG-X Flasher utility GUI includes the folder OpenOcd that can be used directly by a user.

The common path is C:{Installation path}\ST\BlueNRG-X Flasher Utility x.x.x\Application\OpenOcd. The folders include the configuration files to connect the BlueNRG-LP, the BlueNRG-1 and the BlueNRG-2.

Here follows an example of command line to read the first 100 kB of memory Flash. The command line is at the folder level "Application".

> "./OpenOcd/bin/openocd.exe" -c "set cmsisdap 1" -c "set fName flash_dump_100KB.bin" -c "set fSize 0x19000" -c "set fOffset 0x0" -f "./OpenOcd/read_flash.cfg"

The command has stored inside the file flash_dump_100KB.bin the content of the Flash memory for 100 kB.

5.4 Keil settings

Open the options of a project and select the tab "Debug". Then select the "CMSIS-DAP Debugger" as shown in Figure 4. Debug setting of Keil.

| Options for Target 'BSP_LedButton' | × |
|---|--|
| Device Target Output Listing User C/C++ Asm | Linker Debug Utilities |
| © Use Simulator <u>with restrictions</u> Settings | |
| Load Application at Startup Initialization File: Initialization File: Initialization File: | Load Application at Startup Run to main() Initialization File: |
| Restore Debug Session Settings Breakpoints Toolbox Watch Windows & Performance Analyzer Memory Display System Viewer | Restore Debug Session Settings Breakpoints Toolbox Watch Windows Memory Display System Viewer |
| CPU DLL: Parameter: SARMCM3.DLL -REMAP | Driver DLL: Parameter: SARMCM3.DLL |
| Dialog DLL: Parameter: DARMCM1.DLL pCM0+ | Dialog DLL: Parameter: TARMCM1.DLL -pCM0+ |
| Wam if outdated Executable is loaded Manage Component Vie | Wam if outdated Executable is loaded |
| OK Car | ncel Defaults Help |

Figure 4. Debug setting of Keil

5.5 IAR settings

Open the options of a project and select Debugger. Then select "CMSIS DAP" as shown in Figure 5. Debug setting of IAR.

Figure 5. Debug setting of IAR

| Category: | Factory Settings |
|--|---|
| General Options Static Analysis Runtime Checking C/C++ Compiler Assembler Output Converter Custom Build Build Actions Linker Debugger Simulator CADI CMSIS DAP | Setup Download Images Extra Options Multicore Plugins Driver Run to CMSIS DAP Main Setup macros Use macro file(s) |
| GDB Server I-jet/JTAGjet J-Link/J-Trace TI Stellaris Nu-Link PE micro ST-LINK Third-Party Driver TI MSP-FET TI XDS | Device description file Override default \$TOOLKIT_DIR\$\CONFIG\debugger\ST\BlueNRG-LP.ddf OK Cancel |

6 Reference

Table 3. References

| What | Where | Description |
|------------------|--|---------------------------------------|
| BlueNRG-LP | www.st.com/bluenrg-lp | BlueNRG-LP device web page |
| BlueNRG-2 | www.st.com/bluenrg-2 | BlueNRG-2 device web page |
| BlueNRG-1 | www.st.com/bluenrg-1 | BlueNRG-1 device web page |
| STSW-BNRGFLASHER | https://www.st.com/content/st_com/en/ products/embedded-software/ wireless-connectivity-software/stsw- bnrgflasher.html | BlueNRG-X Flasher Utility web page |
| UM2406 | https://www.st.com/resource/en/ user_manual/dm00498829-the- bluenrgxflasher-sw-package stmicroelectronics.pdf | BlueNRG-X Flasher Utility User Manual |
| Arm Mbed DAPLink | https://armmbed.github.io/DAPLink/ | ARM MBED DAPLink web page |
| Arm Mbed DAPLink | https://os.mbed.com/handbook/DAPLink | Arm Mbed DAPLink handbook |
| CMSIS-DAP | https://os.mbed.com/handbook/CMSIS- DAP | CMSIS-DAP handbook web page |

Revision history

Table 4. Document revision history

| Date | Version | Changes |
|-------------|---------|------------------|
| 29-Nov-2020 | 1 | Initial release. |

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