AN14402

Programming Multiple Targets in Parallel by MCU-Link and LinkServer

Rev. 1.0 — 18 October 2024 Application note

Document information

Information	Content
Keywords	AN14402, MCU-Link, LinkServer, Program Multiple Targets
Abstract	This document introduces how to program multiple targets in parallel on a Windows machine, resulting in a simpler and time-saving task.

1 Overview

Programming multiple targets in a row is generally a complex and time-consuming task. In this application note, MCU-Link and LinkServer, which is both our low-cost debugging solution is introduced to program the multiple targets in parallel on a Windows machine. It results in a simpler and time-saving task.

2 System architecture

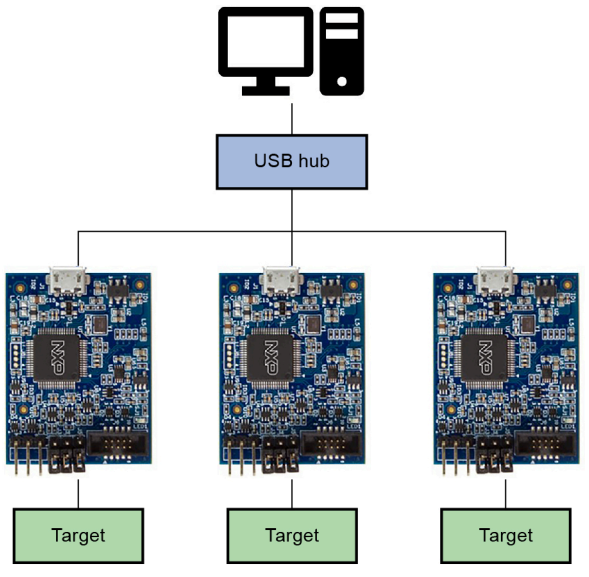
Let us assume that there are three targets to be programmed at the same time.

Figure 1 shows the system diagram to program multiple targets in parallel. One MCU-Link is needed for every target.

MCU-Link is a powerful and cost-effective debug probe that can be used seamlessly with MCUXpresso-IDE. MCUXpresso for Visual Studio Code is compatible with the third-party IDEs that support the CMSIS-DAP protocol. MCU-Link includes a USB to UART bridge feature (VCOM) to provide a serial connection between the target MCU and a host computer.

In this system, LinkServer on the host computer handles three MCU-Links in parallel. LinkServer is a utility for launching and managing GDB servers for NXP debug probes, which also provide a command-line target flash programming capability.

Figure 1. Program multiple targets in parallel



3 Create binary image in MCUXpresso IDE

The binary image generated by MCUXpresso IDE is downloaded to each target. To generate the binary image after building, uncomment out

`arm-none-eabi-objcopy -v -O binary "${BuildArtifactFileName}" ${BuildArtifactFileBaseName}.bin` in the post-build settings as shown in Figure 2.

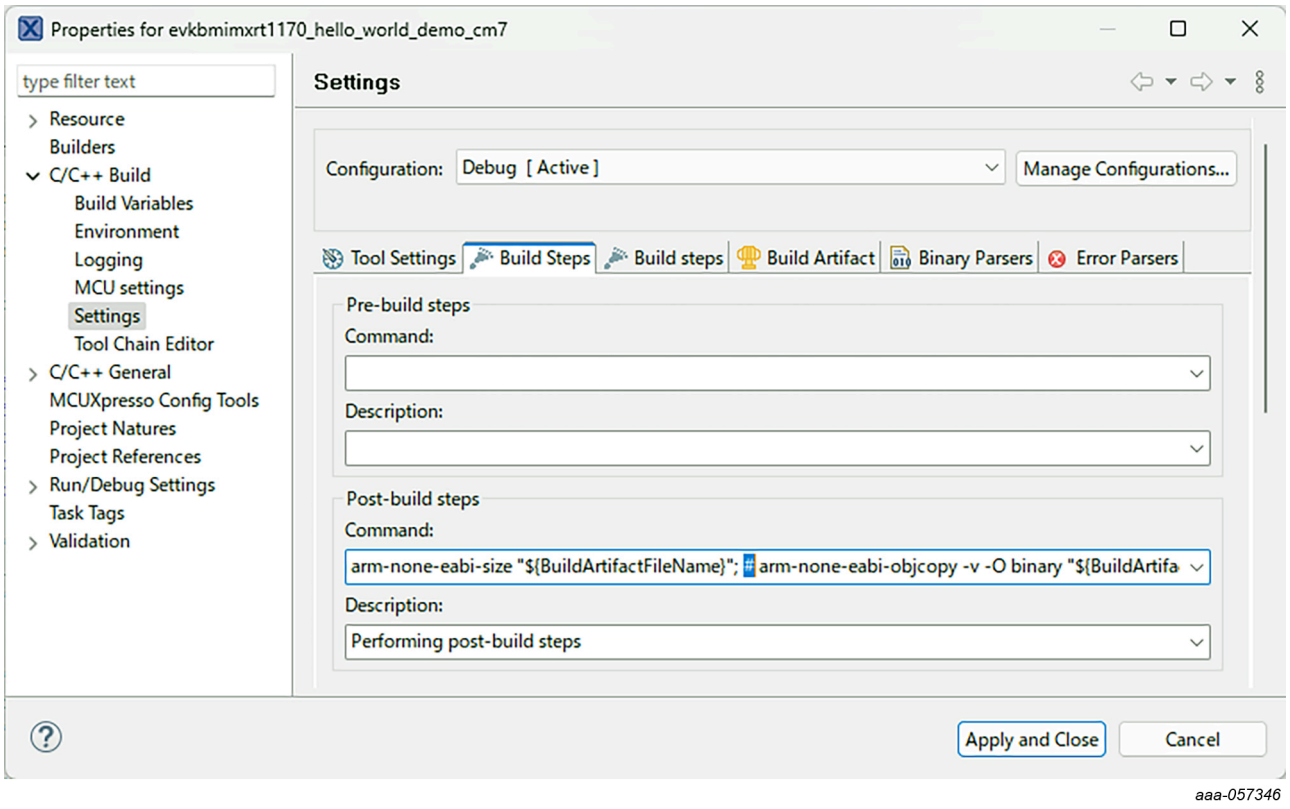


Figure 2. Post-build settings

You can confirm that the binary image is generated from the execution file as shown in Figure 3.

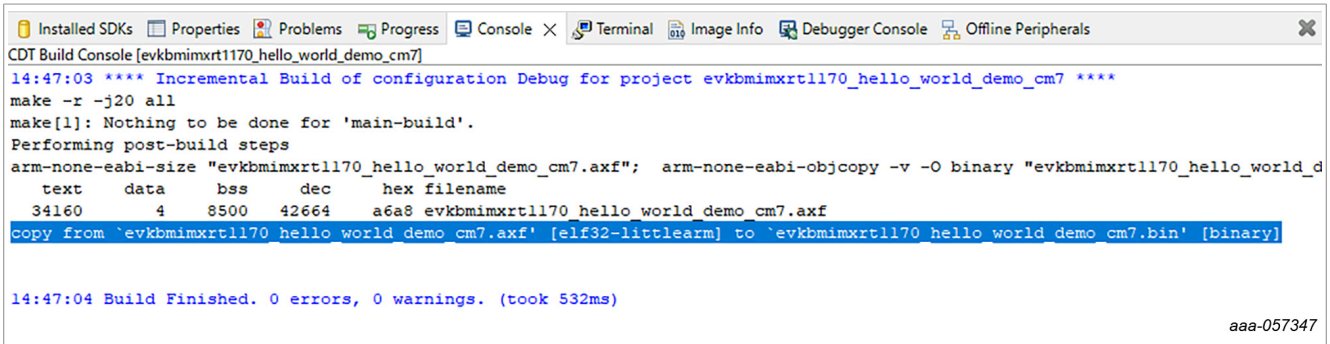


Figure 3. Binary image generated from ARM executable format

4 LinkServer script

Some scripts are needed to handle multiple MCU-Link targets parallelly by LinkServer. In this section, two batch files (*program_all_probes.bat* and *program_probe.bat*) associated with this application note are explained.

At first, all probes connected to the host computer are shown below by a low-level command, called `probelist`:

```
C:\nxp\LinkServer_1.5.30\binaries>redlinkserv --commandline
redlink>probelist
Index = 1
Manufacturer = NXP Semiconductors
Description = MCU-LINK on-board (r0E2) CMSIS-DAP V3.133
```

```
Serial Number = FDNX2FVTNFTVJ
VID:PID = 1FC9:0143
Path = 0002:000a:00
redlink>exit
```

To identify a probe among multiple probes on a host computer, use the corresponding serial number of the probe.

A target can be programmed by identifying the probe. An example command is given below:

```
C:\nxp\LinkServer_1.5.30>LinkServer flash --probe FDNX2FVTNFTVJ MIMXRT1176xxxxx:MIMXRT1170-EVK load
 --addr 0x300
00000 C:/Users/<userID>/Downloads/evkbmimxrt1170_hello_world_demo_cm7.bin --erase-all
INFO: Exact match for MIMXRT1176xxxxx:MIMXRT1170-EVK found
INFO: Selected device MIMXRT1176xxxxx:MIMXRT1170-EVK
…
…
Wc: VTOR = 0x30002000
Wc: Set DEMCR = 0x010007F1
Wc: ============= END SCRIPT ============================
```

Note: *`--erase-all` can be omitted for optimization.*

In the batch file *program_all_probes.bat*, `probelist` is used to get the serial number of the probes and the batch file *program_probe.bat* is started as a new process.

An example script is given below:

```
set DOWNLOAD_BIN=./evkbmimxrt1170_hello_world_demo_cm7.bin
set LINKSERVER_BIN=C:/nxp/LinkServer_1.5.30
(
    echo probelist
    echo exit
) | "%LINKSERVER_BIN%/binaries/redlinkserv" --commandline | findstr "Serial Number" > probelist.txt

for /f "tokens=4 delims= " %%A in (probelist.txt) do (
    echo Probe %%A found.
    start program_probe.bat %%A "%DOWNLOAD_BIN%" %LINKSERVER_BIN%
    timeout 3 > nul
)
```

You can erase, program, and verify the flash in the identified target by the batch file *program_probe.bat*. An example script is given below:

```
%3/LinkServer flash --probe %1 MIMXRT1176xxxxx:MIMXRT1170-EVKB load   --addr 0x30000000 %2 --erase-
all   > probe_%1.log 2>&1
%3/LinkServer flash --probe %1 MIMXRT1176xxxxx:MIMXRT1170-EVKB verify --addr 0x30000000 %2
     >> probe_%1.log 2>&1
exit 0
```

5 Running the demo

To run the demonstration, perform the following steps:

1. Install LinkServer version 1.5.30 on the host computer.
2. Connect a USB cable between the host computer and the OpenSDA USB port on an arbitrary number of RT1170-EVKB.
3. Run the batch file *program_all_probes.bat*.

All probes are automatically detected. New windows are opened as the same number of multiple probes shown in Figure 4.

An example script detecting the connected multiple probes is given below:

```
>program_all_probes.bat
Probe F0NU2JRCKEWYT found.
Probe FDNX2FVTNFTVJ found.
Probe 0P0NJTEBAJR1G found.
```

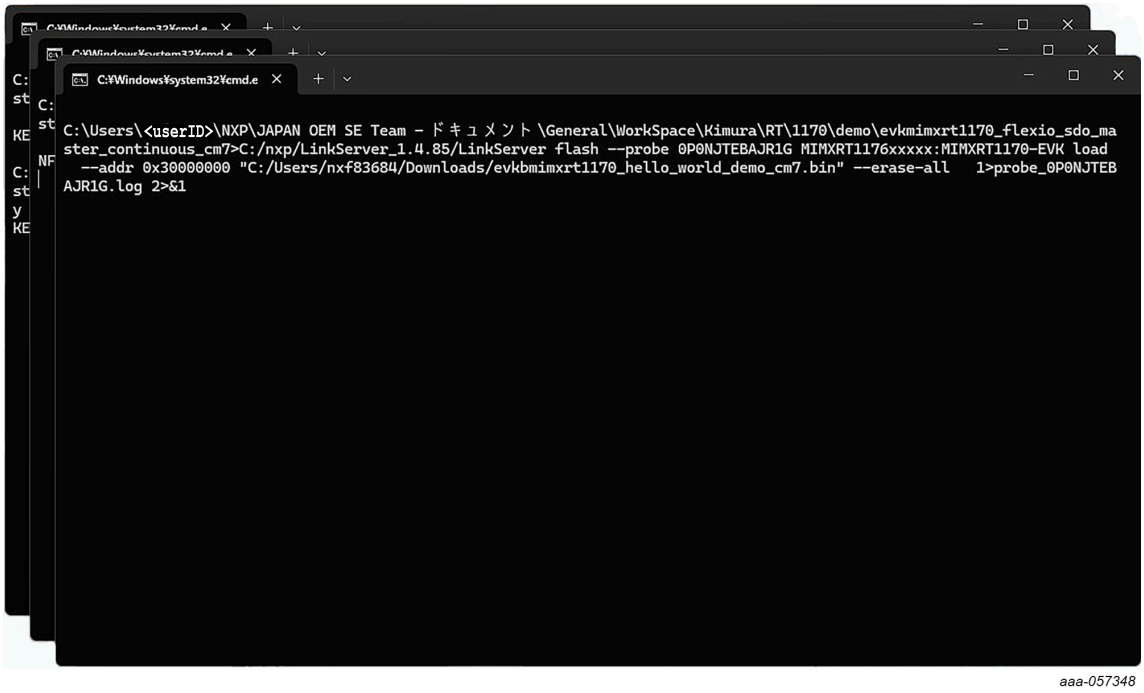


Figure 4. New windows are opened as the same number of multiple probes

Windows disappear automatically after erase, program, and verify operations. The logs are saved in the *./probe_{serial number}.log* file. Verify succeeds if the demo runs correctly.

Observation: In the experiment, it is observed that the processing time is about three times faster than serial programming, when three targets are connected as shown in Table 1:

Table 1. Serial programming versus Parallel programming

Programming	Processing Time [s]
Serial	424
Parallel	150

6 Conclusion

MCU-Link and LinkServer can be used to program multiple targets in parallel. It can be extended to other platforms like MacOS or Linux.

7 Note about the source code in the document

Example code shown in this document has the following copyright and BSD-3-Clause license:

Copyright 2024 NXP Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. Neither the name of the copyright holder nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

8 Revision history

Table 2 summarizes the revisions to this document.

Table 2. Revision history

Document ID	Release date	Description
AN14402 v.1.0	18 October 2024	Initial public release

Legal information

Definitions

Draft — A draft status on a document indicates that the content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included in a draft version of a document and shall have no liability for the consequences of use of such information.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at https://www.nxp.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Suitability for use in non-automotive qualified products — Unless this document expressly states that this specific NXP Semiconductors product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NXP Semiconductors accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NXP Semiconductors' warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

HTML publications — An HTML version, if available, of this document is provided as a courtesy. Definitive information is contained in the applicable document in PDF format. If there is a discrepancy between the HTML document and the PDF document, the PDF document has priority.

Translations — A non-English (translated) version of a document, including the legal information in that document, is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Security — Customer understands that all NXP products may be subject to unidentified vulnerabilities or may support established security standards or specifications with known limitations. Customer is responsible for the design and operation of its applications and products throughout their lifecycles to reduce the effect of these vulnerabilities on customer's applications and products. Customer's responsibility also extends to other open and/or proprietary technologies supported by NXP products for use in customer's applications. NXP accepts no liability for any vulnerability. Customer should regularly check security updates from NXP and follow up appropriately.

Customer shall select products with security features that best meet rules, regulations, and standards of the intended application and make the ultimate design decisions regarding its products and is solely responsible for compliance with all legal, regulatory, and security related requirements concerning its products, regardless of any information or support that may be provided by NXP.

NXP has a Product Security Incident Response Team (PSIRT) (reachable at PSIRT@nxp.com) that manages the investigation, reporting, and solution release to security vulnerabilities of NXP products.

NXP B.V. — NXP B.V. is not an operating company and it does not distribute or sell products.

Trademarks

Notice: All referenced brands, product names, service names, and trademarks are the property of their respective owners.

NXP — wordmark and logo are trademarks of NXP B.V.

Contents