Overview

This document provides an overview of how to get started with the i.MX 8/8X DDR tools.

The purpose of the i.MX 8/8X DDR tools is to enable users of the i.MX 8/8X devices to generate and test a custom DRAM initialization based on their device configuration (density, number of chip selects, etc.) and board layout (data bus bit swizzling, etc.). This process equips the user to then proceed with the bring-up of a boot loader and an OS. Once the OS is brought up, it is recommended to run an OS based memory test (like Linux memtester) to further verify and test the DDR memory interface.
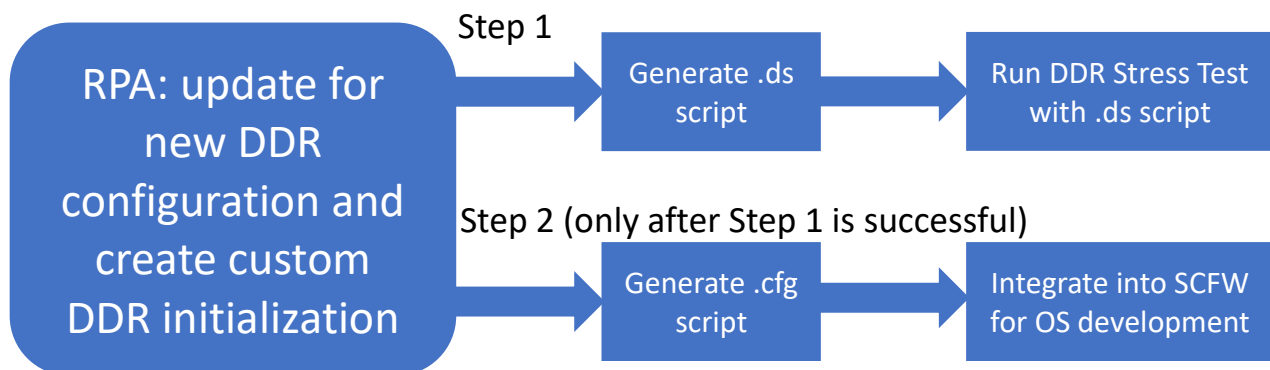
The i.MX 8/8X DDR tools consist of:
- DDR Register Programming Aid (RPA)
- DDR Stress test

The tools described in this document cover the following i.MX 8/8X series SoCs with the System Controller Unit (SCU):
- i.MX 8QuadMax and its derivatives i.MX 8QuadPlus
- i.MX 8QuadXPlus and its derivatives i.MX 8DualXPlus and i.MX 8DualX

Note: Before using the DDR tools on a new, custom board, the user should properly port the SCU Firmware (SCFW) to this new board. The DDR tools will not be able to run without a properly ported and working SCFW.

The following illustrates the DDR tool usage flowchart.

Step 1

```
RPA: update for new DDR configuration and create custom DDR initialization
```

→ Generate .ds script → Run DDR Stress Test with .ds script

Step 2 (only after Step 1 is successful)

→ Generate .cfg script → Integrate into SCFW for OS development

DDR Register Programming Aid (RPA)

The DDR RPA (or simply RPA) is an Excel spreadsheet tool used to develop DDR initialization for a user's specific DDR configuration (DDR device type, density, etc.). The RPA generates DDR initialization in two formats (in separate Excel work sheet tabs):

- DDR Stress Test script: This format is used specifically with the DDR stress test by first copying the contents in this work sheet tab and then pasting it to a text file, naming the document with the ".ds" file extension. The user will select this file when executing the DDR stress test.
- DCD CFG file: This format is the configuration file used specifically by the SCU Firmware (SCFW). In this scenario, the user copies the contents in this work sheet tab and pastes it to a text file, naming the document with the ".cfg" file extension and placing this file in the appropriate SCFW board file directory.

Each of the above formats are essentially equivalent except for differences in syntax. In addition, the DCD CFG file format contains pre-processor DEFINE directives used specifically by the SCFW.

For instructions on how to use the RPA, please refer to the "How To Use" worksheet tab in the RPA tool.

Configuring for different UART ports

The AP UART is critical for use with the DDR stress test. As stated in the Hardware Developers Guide, it is highly recommended for new board designs to use the same AP UART port as is used on NXP development boards, namely UART0. Yet time and again, this is often ignored and board designers will choose a different UART port, complicating the use of the DDR stress test. As such, there is a mechanism which allows the user to manually select a different UART port. The i.MX 8QuadXPlus DDR3L RPA provides an example of how to select a different UART port. For other SoC and DDR device variants, the user can manually add the following line at the end of the DDR stress test file ".ds" script:

```
memory set 0x5C01042C 32 0x0000000<n>  # UART<n> port selection for AP UART
```

Where <n> can be "0" for UART0, "1" for UART1, and "2" for UART2.

In addition, it is required that the UART port selected be associated with IO pads that default to that particular UART port. For example, UART0 is brought out on UART0_TX and UART0_RX dedicated IO pads. The only exception is with i.MX 8QuadXPlus and its derivatives where the user may select UART3 as an option, even though there are no IO pads that default to UART3. In this case, the DDR stress test will configure IO pads FLEXCAN2_TX for UART3_TX and FLEXCAN2_RX for UART3_RX. Other IO mux options are not supported.

It is also highly recommended to bring out and use the SCFW UART port to view debug messages from the SCFW.

Configuring i.MX 8QuadMax for one DDR controller

The i.MX 8QuadMax and its derivatives contain two DDR Controllers (DDRC), each are 32-bit data bus controllers. In some cases, users of these devices may wish to use only one DDRC. As such, the DDR

tools support the option of configuring these devices for one DDRC operation, but this operation is limited to the use of DDRC0 (DDR controller 0) only.

The following details how to configure the DDR tools for one DDRC operation:
- RPA: In the Register Configuration work sheet tab, set the "Total number of DDR controllers in use" option to "1". This option will configure and initialize DDRC0 only. Then copy/paste the DDR Stress Test Script work sheet contents into a text file and name with file extension ".ds".

- DDR stress test: It is first necessary to re-build the SCFW for a one DDRC option. In this case, use the build command option "`DDR_CON=ddr_stress_test_parser_DRC0_only`". The following is an example of building the SCFW for the DDR Stress test for the one DDRC option:
  `make qm R=B0 DDR_CON=ddr_stress_test_parser_DRC0_only`

Should the user wish to build the SCFW for use with u-boot, configure the RPA for one DDRC operation as stated above and copy/paste contents of "DCD CFG file" into the desired ".cfg" file in the appropriate SCFW board directory. Refer to the SCFW porting guide for details on customizing board files.

DDR Stress Test

The DDR stress test tool is used as a mechanism to verify that the DDR initialization is operational prior to building the SCFW for use with u-boot and OS bring-up. The DDR stress test uses the .ds DDR stress test script generated from the RPA tool along with a special build of the SCFW, built with option:
`DDR_CON=ddr_stress_test_parser`

Or in the case of i.MX 8QuadMax use of one DDR Controller:
`DDR_CON=ddr_stress_test_parser_DRC0_only`

The DDR stress test offers a Target option to dictate which SoC is under test. There are two Target options to select from:
1. MX8QM – used to test i.MX 8QuadMax and its derivates i.MX 8QuadPlus
2. MX8QX – used to test i.MX 8QuadXPlus and its derivates i.MX 8DualXPlus/DualX

For more details on the DDR stress test usage, refer to the MX8_DDR_Tool_User_Guide found in the DDR Stress Test tool delivery.