ABSTRACT

This application report describes ROM bootloader (RBL) differences between silicon revision 2.1 and 2.3 of the TMS320DM644x Digital Media System-on-Chip (DMSoC).

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1 Overview

1.1 ROM Bootloader (RBL)

The RBL is firmware that is stored in ROM on the DM644x, and responsible for starting the boot process. When the boot process is initiated, it senses the state of the BOOTSEL[0:1] pins and, based on that state, loads a user bootloader (UBL) from external media, which branches to the entry point of the UBL. For details, see the TMS320DM644x Digital Media System-on-Chip (DMSoC) ARM Subsystem Guide (SPRUE14).

1.2 ROM Bootloader (RBL) Change Summary

This section summarizes the changes in the RBL. The RBL used on silicon revision 2.3:

• Makes several changes to its support for NAND boot
• Added SPI-boot mode (as a fall back to NAND-boot mode)

1.2.1 Changes to the NAND Boot Functionality

Silicon revision 2.3 introduces the following changes to NAND boot functionality:

• ONFI support
• 4th byte read support
• 4/8K page support
Figure 1 illustrates the NAND-boot mode code flow in silicon revision 2.3.

1.2.2 SPI-Boot Mode
Silicon revision 2.3 introduces the SPI-boot mode, which is a fallback in case the NAND-boot mode fails.

2 NAND Boot Changes
This section discusses the differences between the ROM bootloader (RBL) support for NAND boot on silicon revision 2.1 and 2.3.

2.1 Support for 4K and 8K NAND Devices Added
The RBL used in silicon revision 2.1 supported NAND page sizes of 256 bytes, 512 bytes and 2048 bytes.
The RBL used in silicon revision 2.3 supports page sizes of 256 bytes, 512 bytes, 2048 bytes, 4096 bytes, and 8192 bytes.

No 8K devices were available for testing when this document was prepared, so 8K has not been tested. However, the RBL contains support for these devices.

2.2 4th Bytes ID Support

If the NAND device is not found in the look-up table, the RBL reads the fourth byte of the NAND ID table and attempts to decode it to obtain the necessary parameters.

For the purpose of determining the NAND block and page size, the information from the fourth byte is considered as follows:

- Bits 5 and 4 determine the block size
  - Bits 5, 4 = 00: 64KB
  - Bits 5, 4 = 01: 128KB
  - Bits 5, 4 = 10: 256KB
  - Bits 5, 4 = 11: 512 KB

- Bits 1 and 0 determine the page size
  - Bits 1, 0 = 00: 1KB
  - Bits 1, 0 = 01: 2KB
  - Bits 1, 0 = 10: 4KB
  - Bits 1, 0 = 11: 8KB

In silicon revision 1.4, the latest Samsung (manufacturer ID: 0xEC) 4th ID definition has been added as follows:

- Bits 5 and 4 determine the block size
  - Bits 5, 4 = 00: 128KB
  - Bits 5, 4 = 01: 256KB
  - Bits 5, 4 = 10: 512KB
  - Bits 5, 4 = 11: 1024 KB

- Bits 1 and 0 determine the page size
  - Bits 1, 0 = 00: 2KB
  - Bits 1, 0 = 01: 3KB
  - Bits 1, 0 = 10: 4KB
  - Bits 1, 0 = 11: reserved

2.3 UBL Size Support for the NAND-Boot mode

The size of NAND UBL supported by RBL depends on the page size of the NAND used. Table 1 details the maximum UBL size support.

<table>
<thead>
<tr>
<th>NAND Page Size</th>
<th>Maximum UBL Size Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 KB</td>
<td>13.5 KB</td>
</tr>
<tr>
<td>2, 4 KB</td>
<td>12 KB</td>
</tr>
<tr>
<td>8 KB</td>
<td>8 KB</td>
</tr>
</tbody>
</table>

3 SPI-Boot Changes

This section discusses the SPI-boot mode, which has been introduced in silicon revision 2.3.

In SPI-boot mode, DM644x loads the UBL data in the following locations, ARM TCM RAM received via SPI0. The UBL data is received from a serial device like serial EEPROM.
3.1 **SPI Key Features**

The key features for SPI are as follows:
- Master interface to a serial EEPROM/Flash for initial code load
- Support for fast-boot mode through UBL descriptor (see Table 2)
- Support for prescaler through UBL descriptor
- Support for 16-bit and 24-bit addressable EEPROMs through the UBL descriptor

3.2 **SPI Boot - Detailed Flow**

The following list describes the flow of the SPI boot:
- RBL configures the pinmultiplexing settings to bring out the SPI0 signals.
- RBL configures the EEPROM initially in 24-bit addressable mode and reads the first byte. Based on the first byte, it configures the EEPROM to 16-bit or 24-bit addressable modes.
- Bootloader reads the entire UBL descriptor and finds out the properties of slave EEPROM. The UBL descriptor contains the prescaler value, which is the divider used to generate the SPI clock. The FAST_READ flag is used to indicate fast/normal mode. RBL uses FAST_READ command if the flag is set; otherwise, it uses standard READ command.
- RBL validates the other UBL header parameters.
- Downloads the UBL to ARM internal memory
- RBL passes control to the entry point given in the UBL descriptor.

<table>
<thead>
<tr>
<th>Byte Range</th>
<th>32 Bits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>0xA1ACED0X</td>
<td>Magic Number</td>
</tr>
<tr>
<td></td>
<td>0xA1ACED00 – 24 bit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0xA1ACED01 – 16 bit</td>
<td></td>
</tr>
<tr>
<td>4-7</td>
<td>Entry Point</td>
<td>Entry point address for the UBL (absolute address) in ARM internal memory</td>
</tr>
<tr>
<td>8-11</td>
<td>UBL size</td>
<td>Size of UBL in bytes</td>
</tr>
<tr>
<td>12</td>
<td>Prescaler</td>
<td>Prescaler value to be used for dividing the clock for SPI</td>
</tr>
<tr>
<td>13</td>
<td>FASTREAD</td>
<td>Flag for enabling fast read</td>
</tr>
<tr>
<td></td>
<td>0 - Fast read disabled</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 - Fast read enabled</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Note: FAST READ option may not be valid for a specific EEPROM. Please note the EEPROM specifications before settings this parameter.</td>
<td></td>
</tr>
<tr>
<td>14-15</td>
<td>0x0000</td>
<td>Dummy bytes</td>
</tr>
<tr>
<td>16-19</td>
<td>Start address of UBL</td>
<td>Start address of UBL in EEPROM</td>
</tr>
<tr>
<td>20-23</td>
<td>Load address</td>
<td>Load address of UBL in ARM internal memory</td>
</tr>
</tbody>
</table>

4 **ROM Version ID**

The ROM ID is stored at address 0x00005FFC and is four bytes long. To identify which revision of the silicon you are running, examine the values at this address and compare with those in Table 3.

<table>
<thead>
<tr>
<th>ROM Version</th>
<th>ID Stored at 0x00005FFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon Revision 2.1 (and earlier)</td>
<td>0x00000000</td>
</tr>
<tr>
<td>Silicon Revision 2.3</td>
<td>0x00010001</td>
</tr>
</tbody>
</table>
5 References

- TMS320DM644x Digital Media System-on-Chip (DMSoC) ARM Subsystem Guide (SPRUE14)
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