**Overview**

**Cadence® IP Factory** delivers custom, synthesizable IP to support specific design requirements.

The **Cadence NAND Flash ONFI 3 Embedded Controller IP** provides the logic required to integrate a NAND flash memory controller into any system-on-chip (SoC).

Supporting ONFI 3.x, ONFI 2.x, and Toggle Mode DDR-1/2 NAND Flash devices, the **Cadence NAND Flash ONFI 3 Embedded Controller IP** has many configurable features and input parameters to customize the controller for the specific needs of any application.

The **Cadence NAND Flash ONFI 3 Embedded Controller IP** is architected to quickly and easily integrate into any SoC. Client applications access the controller through industry standard ARM® AMBA® 3 AXI, ARM AMBA AHB interfaces, or OCP.

The **Cadence NAND Flash ONFI 3 Embedded Controller IP** is silicon proven, and has been extensively validated in many processes, FPGAs, and with multiple hardware platforms.

**Cadence IP Factory** offers a comprehensive IP solution that is in volume production, and has been successfully implemented in dozens of applications.

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**Key Features**

- Universal Flash support across all vendors
- Support for high speed memories (up to 533MT/s)
- Single-level cell (SLC) and multi-level cell (MLC) boot operation
- Scatter-gather DMA supports 32-bit or 64-bit memory addressing
- Supports pages sizes from 256B to 16kB
- Support for multi-LUN modes
- Read/write cache command support

- ONFI 1, 2, 3, and Toggle 1, 2 support
- Pipelined read-ahead and write commands for enhanced read and write throughput
- Advanced ECC supports correction factors from 2 to 64 and higher
- Standard bus support including 32-bit AHB, 32- or 64-bit AXI, and OCP
- 8- and 16-bit Flash devices support
- Hardware-assisted bad block management
- Optional Slave DMA interface directly to data buffer
Product Details

The Cadence NAND Flash ONFI 3 Embedded Controller IP supports many popular NAND devices with both standard and legacy interfaces as shown in Table 1.

Controller Core

The Controller Core handles all command sequencing and Flash memory device interactions, allowing intelligent hardware abstraction.

Master DMA Interface

The scatter-gather DMA controller speeds up data transfer between a device on the system bus and the NAND Flash memory, as well as decreases the CPU load.

Bad Block Management

The Cadence NAND Flash ONFI 3 Embedded Controller IP supports a Bad Block Management (BBM) mechanism to offload system software from time-consuming operations such as finding the physical address for a given linear address in a requested operation.

The remapping table can be stored internally, in dedicated memory, or externally, in system memory.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Device Type</th>
<th>Capacity</th>
<th>Width</th>
<th>Special Functions</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samsung</td>
<td>SLC/MLC</td>
<td>1 to 32Gb</td>
<td>8 or 16</td>
<td>MP/CR/W</td>
<td>All known devices</td>
</tr>
<tr>
<td>Toshiba</td>
<td>SLC/MLC</td>
<td>1 to 32Gb</td>
<td>8 or 16</td>
<td>MP/CR/W</td>
<td>All known devices, LBA supported</td>
</tr>
<tr>
<td>Hynix</td>
<td>SLC/MLC</td>
<td>1 to 32Gb</td>
<td>8 or 16</td>
<td>MP/CR/W</td>
<td>All known devices</td>
</tr>
<tr>
<td>Micron</td>
<td>SLC/MLC</td>
<td>1 to 32Gb</td>
<td>8 or 16</td>
<td>QP/MP/CR/W/LUN</td>
<td>All known devices</td>
</tr>
<tr>
<td>ONFI 1</td>
<td>SLC/MLC</td>
<td>1 to 32Gb</td>
<td>8</td>
<td>MP/CR/W</td>
<td>All known devices, mode 1-5</td>
</tr>
<tr>
<td>ONFI 2</td>
<td>SLC/MLC</td>
<td>2 to 64Gb</td>
<td>8</td>
<td>QP/MP/CR/W/LUN</td>
<td>All known devices, mode 1-5</td>
</tr>
<tr>
<td>ONFI 3</td>
<td>SLC/MLC</td>
<td>2 to 64Gb</td>
<td>8</td>
<td>QP/MP/CR/W/LUN</td>
<td>All known devices, mode 1-8</td>
</tr>
<tr>
<td>Toggle 1</td>
<td>SLC/MLC</td>
<td>2 to 32Gb</td>
<td>8</td>
<td>MP/CR/W</td>
<td>All known devices 166MHz</td>
</tr>
<tr>
<td>Toggle 2</td>
<td>SLC/MLC</td>
<td>2 to 64Gb</td>
<td>8</td>
<td>MP/CR/W</td>
<td>All known devices 200MHz</td>
</tr>
<tr>
<td>EZ NAND</td>
<td>SLC/MLC</td>
<td>4 to 64Gb</td>
<td>8</td>
<td>MP/CR/W</td>
<td>Standard and enhanced ClearNAND</td>
</tr>
</tbody>
</table>

Table 1: Supported NAND Devices

Benefits

• Highly integrated IP offering—speeds system integration and reduces design costs
• Super sequence mode—reduces software overhead
• Unique optimization process—improves system performance
• Wide support of standards enables system flexibility

Deliverables

• Clean, readable, synthesizable Verilog RTL
• Synthesis and STA scripts
• Documentation—integration and user guide, release notes
• Sample verification testbench with test sets

Available Products

• NAND Flash ONFI 3 Embedded Controller IP

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