NORTHWEST LOGIC

Expresso Solution For PCI Express®

User Guide

To The Point Solutions

Version 3.06

Table Of Contents

1 Revision History

This section tracks revisions made to this document by version number

Revision	Date	Changes
3.05	02/09/2009	Added revision history section to the document.
3.06	05/21/2012	Updated to include latest DMA IP Core options Removed details that were only relevant for one DMA Core option Noted support for PCIe 3.0 and more recent FPGA PCIe hard cores

2 Overview

The Expresso Solution is a family of high-performance IP Cores, reference designs, and software that enables rapid development of high performance systems based on PCI Express®, DMA, and (optionally) SDRAM. The Expresso Solution has been ported to numerous development cards for PCI Express and has been validated across a wide variety of systems.

Northwest Logic supports its Expresso 3.0/2.0 PCI Express soft cores as well as all Xilinx and Altera FPGA hard IP Cores for the PCI Express interface.

Northwest Logic offers several different DMA IP Cores as part of the Expresso Solution. Please see Section 2.2 for details.

Northwest Logic offers Memory Controllers for several different SDRAM standards.

Figure 2-1 illustrates the components of the Expresso Solution for PCI Express. Shaded components indicate portions of the solution while non-shaded components illustrate typical application-specific expansions.

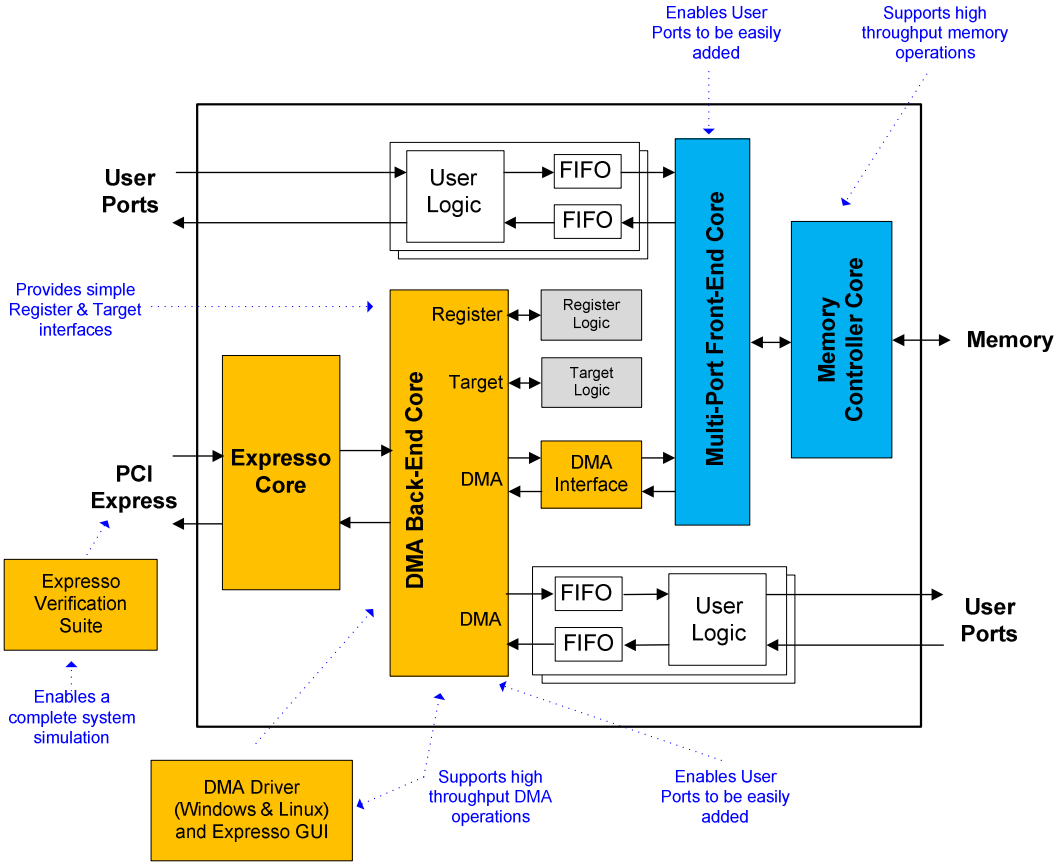

Figure 2-1 DMA Back-End Core Expresso Solution (Other DMA Cores Diagrams are Similar)

2.1 Features

Key features:

- PCI Express Core
  - High-*performance, low-level PCI Express interface (soft or hard core)*
    - Northwest Logic x1/x2/x4/x8 Expresso 3.0 Core for PCI Express (PCIe 3.0/2.1/1.1)
    - Northwest Logic x1/x2/x4/x8 Expresso 2.0 Core for PCI Express (PCIe 2.1/1.1)
    - Xilinx Virtex-7XT PCI Express Hard IP Block (hard core; PCIe 3.0/2.1/1.1)
    - Xilinx Virtex-7 PCI Express Hard IP Block (hard core; PCIe 2.1/1.1)
    - Xilinx Kintex-7 PCI Express Hard IP Block (hard core; PCIe 2.1/1.1)
    - Xilinx Virtex-6 PCI Express Hard IP Block (hard core; PCIe 2.1/1.1)
    - Xilinx Virtex-5 PCI Express Hard IP Block (hard core; PCIe 1.1)
    - Xilinx Spartan-6 PCI Express Hard IP Block (hard core; PCIe 1.1)
    - Altera Stratix V PCI Express Hard IP Block (hard core; PCIe 3.0/2.1/1.1)
    - Altera Stratix IV PCI Express Hard IP Block (hard core; PCIe 2.1/1.1)
    - Altera Arria V PCI Express Hard IP Block (hard core; PCIe 2.1/1.1)
    - Altera Arria II PCI Express Hard IP Block (hard core; PCIe 1.1)
    - Altera Cyclone IV PCI Express Hard IP Block (hard core; PCIe 1.1)
- DMA IP Core
  - Three DMA IP Core options:
    - Expresso DMA Core (recommended for new designs)
    - AXI DMA Back-End Core
    - DMA Back-End Core
- Memory Controller Core
  - Northwest Logic high-performance DDR3/DDR2/DDR/LPDDR2/LPDDR SDRAM Memory Controller
  - Highest possible bus utilization; cascading, bank management, queued interface
- Multi-Port Front-End Core
  - High-performance Memory Controller arbiter with request prioritization and extended burst size
  - Built-in Memory Self Test
  - Enables user ports to be easily integrated into the solution
- Expresso Testbench
  - Full-featured PCI Express Bus Functional Model and simulation environment
  - Self checking, native Verilog, easy-to-use
  - Enables simple, powerful system simulations
- DMA Driver
  - Available for Windows & Linux; see DMA Driver and Expresso DMA Driver User Guides for version information
  - DMA and Target command line test application for Windows/Linux
- Expresso GUI
  - PCI Express throughput characterization and demonstration (Windows
    - DMA Back-End and AXI DMA Back End only
- Hardware Reference Designs
  - Complete example designs are available targeted at off-the-shelf development boards from numerous providers including Northwest Logic, Altera, Avnet, Hi-Tech Global, Paltek, Toyko Electron, and Xilinx

2.2 Selecting the appropriate DMA IP Core

Northwest Logic offers three different DMA IP Cores. The Expresso DMA Core is the newest and most feature-rich and is recommended for new designs. The DMA Back-End Core and AXI DMA Back-End Core are also good options, especially for existing customers using these cores.

	DMA Back-End	AXI DMA Back-End	Expresso DMA (Recommended for New Designs)
DMA Architecture	Each DMA Channel has Independent Data Path	Each DMA Channel has Independent Data Path	Single Shared Data Path
Number of DMA Channels	Up to 4 S2C, 4 C2S	Up to 4 S2C, 4 C2S	Up to 1024 Channels
DMA Data Flows Supported	PCIe->Local, Local->PCIe	PCIe->AXI, AXI->PCIe	PCIe->AXI, AXI->PCIe PCIe->PCIe, AXI->AXI
DMA Size Per Channel	Medium	Medium	Small (RAM-based state storage)
DMA Throughput	**High** (Separate DMA Interfaces - Proprietary)	**High** (Separate AXI Interfaces-AXI 3/4 or AXI4-Stream)	**High** (Use Master & Slave Interfaces - AXI3/4)
SGL & Status Queue Locations	PCIe CPU Memory Space	PCIe CPU Memory Space	PCIe or AXI CPU Memory Space
Independent SGL & Status Queues	No	No	Yes
Independent Source and Destination SGL Queues	No	No	Yes
Control DMA from PCIe CPU	Yes	Yes	Yes
Control DMA from AXI CPU	No	No	Yes
Driver Support	DMA Driver Windows & Linux	DMA Driver Windows & Linux	Expresso DMA Driver Windows & Linux
Master Interface Throughput	**Low** (Target and Register Interfaces - Proprietary)	**High** (Target Interface - AXI3/4)	**High** (Master Interface - AXI3/4)
Slave Interface Throughput	**Low** (Master Interface)	**Low** (Master Interface - AXI4-Lite)	**High** (Slave Interface - AXI3)
Independent User Clock Domain(s)	No	7Yes	Yes
Supports SR-IOV & Root Port Apps	No	No	Yes
Interrupt Support	PCIe MSI-X/MSI/Legacy	PCIe MSI-X/MSI/Legacy	PCIe MSI-X/MSI/Legacy and Local AXI Interrupt
Deliver without DMA Support	Yes	Yes	Yes

2.3 Detailed Information

Please see the associated User Guides for detailed information on each of the IP Core components:

- Northwest Logic (available at www.nwlogic.com); request secure access for access to detailed User Guides
  - Expresso Solution User Guide (this document)
  - Expresso 3.0 Core User Guide (recommended for new designs)
  - Expresso 2.0 Core User Guide
  - Expresso DMA Core User Guide
  - DMA Back-End Core User Guide
  - AXI DMA Back-End Core User Guide
  - Expresso Testbench User Guide
  - DMA Driver User Guide
  - Expresso GUI User Guide
  - DDR SDRAM Controller Core User Guide
  - DDR2 SDRAM Controller Core User Guide
  - DDR3 SDRAM Controller Core User Guide
  - Multi-Port_Front-End_Core_User Guide
- Xilinx PCI Express Hard IP Blocks (www.xilinx.com)
- Altera PCI Express Hard IP Blocks (www.altera.com)

2.4 Certification

The Expresso Solution has been validated at PCI SIG PCI Express Compliance Workshops.

Please see the Integrator's List on the PCI SIG website for details:
http://www.pcisig.com/developers/compliance_program/integrators_list

3 Software

The Expresso Solution includes Drivers and a command line test program for both Windows and Linux. For the AXI DMA Back End and DMA Back End Core, there is also a GUI demonstration application for Windows availble. See the Expresso DMA Driver, DMA Driver, and Expresso GUI User Guides for more information.

4 Speed & Size

For speed & size information, see the target device family document: ***Speed & Size Overview***

This document can be found on Northwest Logic's secure website. Request access to the secure website by sending an email to **nwl@nwlogic.com**.

5 Free Evaluation Core

To receive a free evaluation core, follow the following steps:

1. Request access to Northwest Logic's secure website by sending an e-mail to **nwl@nwlogic.com**
2. Log into the secure website section of Northwest Logic's website at **www.nwlogic.com**
3. Download the Evaluation Request Form for the core you are interested in
4. Fill in Table 3-2
5. E-mail the Evaluation Request Form to **nwl@nwlogic.com**
6. You should receive the Evaluation Core within 24 hours

6 For More Information

For more information including licensing options, pricing and the latest version of this document:

- Visit our website at **www.nwlogic.com**
- Send an e-mail to **nwl@nwlogic.com**
- Call us at **503-533-5800 x309**

Northwest Logic is located at:

Address: 1100 NW Compton Drive, Suite 100
Beaverton, Oregon 97006
United States

Phone: 503-533-5800

Fax: 503-533-5900