

OpenCPI

Benchmarking non-OCPI PCIe Data Throughput on the ML605

OpenCPI Release: v2.4.7

Revision History

Revision	Description of Change	Date
1.0.0-alpha	Initial document creation	2/2017

Table of Contents

1	References	6
2	PCIe Tx data rate, non-OCPI (FPGA -> Host)	6
2.1	Setup Folder and Create a Coregen Project	6
2.2	Use Coregen to recreate PCIe endpoint block for non-OCPI implementation	6
2.2.1	Page 1	6
2.2.2	Page 2	6
2.2.3	Page 3	6
2.2.4	Page 4	7
2.2.5	Page 5	7
2.2.6	Page 6	7
2.2.7	Page 7	7
2.2.8	Page 8	8
2.2.9	Page 9	8
2.2.10	Page 10	8
2.2.11	Page 11	8
2.3	Existing OCPI Params Used As Reference	9
2.4	Compile the PCIe Core	14
2.5	Creating the BMD Design	14
2.6	Program the Flash with PCIe Design	16
2.7	Build Kernel Driver and DMA Test App	17

List of Figures

List of Tables

1 References

2 PCIe Tx data rate, non-OCPI (FPGA -> Host)

2.1 Setup Folder and Create a Coregen Project

```
$mkdir nonocpi
$cd nonocpi
$mkdir coregen
$cd coregen
$coregen&
```

File -> New Project

- Family: Virtex6
- Device: xc6vlx240t
- Package: ff1156
- Speed Grade: -1
- Everything else: default

2.2 Use Coregen to recreate PCIe endpoint block for non-OCPI implementation

View By Name Tab -> Standadr Bus Interfaces -> PCI Express

- Right click on Virtex-6 Intergrated Block for PCI Express, Version 1.7, and select Customize and Generate[[BR]]
- Do **not** select Version 2.5, as this implements an AXI interface, not the TRN interface used in current OCPI designs on the ML605.

Once Generated with the parameters below, check that the output shell file exhibits the same parameters as the existing shell file for the OCPI implementation.

bold - must be changed from the default value

< > - grayed-out field based on previously entered values if a value is not explicitly below, it is to remain at the default value.

2.2.1 Page 1

Component name - v6_pcie.v2.5
 Lane width - x4
 Link Speed - 5 GT/s
 Freq(MHz) - 250

2.2.2 Page 2

Bar0 - **32 bit memory, 16 Megabytes worth, Value FF000000**
 Bar1 - **32 bit memory, 64 Kilobytes worth, value FFFF0000**
 Expansion Rom - 0x00000000

2.2.3 Page 3

Vendor ID - 10EE
 Device ID - **4243**
 Revision ID - **02**
 Subsystem Vendor ID - 10EE
 Subsystem ID - 0007
 Base Class - 05
 Sub-Class - 00

Interface - 00
 Class Code - <050000>
 Base Class - <simple communications controllers>
 Base Class - <07h>
 Sub-Class/Interface Value - <Generic XT compatible serial controller>
 Sub-Class - <00h>
 Interface - <00h>
 Cardbus CIS Pointer - 00000000

2.2.4 Page 4

<all default>
 Capability Version <2>
 Device Port/Type <PCI_Express_Endpoint_device>
 Capabilities Register <0002>

 Max Payload Size <512 bytes>
 Extended Tag Field <False>
 Phantom Functions <No function number bits used>
 Acceptable L0s Latency <Maximum of 64ns>
 Acceptable L1 Latency <No limit>
 Device Capabilities Register <00000E02>

 Completion Timeout Disable Supported <False>
 Completion Timeout Ranges Supported: <Range B>
 Device Capabilities 2 Register <00000002>

BRAM Config - Performance Level - High

2.2.5 Page 5

Supported Link Speeds <2>
 Maximum Link Width <4>
 Link Capabilities Register <0003F442>
 Hardware Autonomous Speed Disable <false>
 Enable Slot Clock Configuration <false>

2.2.6 Page 6

Enable INTx <true>
 Enable MSI Capability Structure <true>
 64-bit Address Capable <true>
 Multiple Message Capable <1 vector>
 Enable MSIx Capability Structure <false>

2.2.7 Page 7

Power Management Registers
 Device Specific Initialization <false>
 D1 Support <false>
 D2 Support <false>
 PME Support from:
 D0 <true>
 D1 <true>

D2 <true>
 D3hot <true>
 D3cold <false>
 No Soft Reset <true>

Power Consumption

D0 <0> x <0>
 D0 <0> x <0>
 D0 <0> x <0>
 D0 <0> x <0>

Power Dissipation

D0 <0> x <0>
 D0 <0> x <0>
 D0 <0> x <0>
 D0 <0> x <0>

2.2.8 Page 8

Enable DSN Capability true
 Enable VC Capability false
 Enable VSEC Capability false
 PCI Configuration Space Enable false?
 PCI Express Extended Configuration Space Enable false?

2.2.9 Page 9

Generate Xilinx Development Board specific UCF true
 PCIe Block Location Selection *grayed out*

2.2.10 Page 10

Trim TLP Digest ECRC false
 Endpoint: Unlock false
 Endpoint: PME_Turn_Off false
 Pipeline Registers for Transaction Block RAM Buffers none

Link Layer Module Advanced Settings

Override ACK/NAK Latency false
 Override Replay Timer true
 Override Function add
 Override Value 0026

2.2.11 Page 11

Disable Lane Reversal false
 Force No Scrambling false

Upconfigure Capable - Default
 Disable TX ASPM LOs - Default

Pipeline for PIPE Interface None
 Link Number - Default
 PCIe DRP Ports false

Reference Clock Frequency - 250MHz

2.3 Existing OCPI Params Used As Reference

The ML605 PCIe IP core used within the OCPI framework is at `opencpi/hdl/primitives/pcie_4243_trn.v6_gtx.x4_250`, and the ip customization selections are in the file `v6_pcie.v1_7.v`, and are as follows:

```
// Project      : Virtex-6 Integrated Block for PCI Express
// File         : v6_pcie.v1_7.v
// Version      : 1.7
//--F
/-- Description: Virtex6 solution wrapper : Endpoint for PCI Express
(* CORE_GENERATION_INFO = "v6_pcie.v1_7, v6_pcie.v1_7, {LINK_CAP_MAX_LINK_SPEED=2,
LINK_CAP_MAX_LINK_WIDTH=04,
PCIE_CAP_DEVICE_PORT_TYPE=0000,
DEV_CAP_MAX_PAYLOAD_SUPPORTED=2,
USER_CLK_FREQ=3,
REF_CLK_FREQ=2,
MSI_CAP_ON=TRUE,
MSI_CAP_MULTIMSGCAP=0,
MSI_CAP_MULTIMSG_EXTENSION=0,
MSIX_CAP_ON=FALSE,
TL_TX_RAM_RADDR_LATENCY=0,
TL_TX_RAM_RDATA_LATENCY=2,
TL_RX_RAM_RADDR_LATENCY=0,
TL_RX_RAM_RDATA_LATENCY=2,
TL_RX_RAM_WRITE_LATENCY=0,
VC0_TX_LAST_PACKET=29,
VC0_RX_RAM_LIMIT=7FF,
VC0_TOTAL_CREDITS_PH=32,
VC0_TOTAL_CREDITS_PD=308,
VC0_TOTAL_CREDITS_NPH=12,
VC0_TOTAL_CREDITS_CH=36,
VC0_TOTAL_CREDITS_CD=308,

VC0_CPL_INFINITE=TRUE,
DEV_CAP_PHANTOM_FUNCTIONS_SUPPORT=0,
DEV_CAP_EXT_TAG_SUPPORTED=FALSE,
LINK_STATUS_SLOT_CLOCK_CONFIG=FALSE,
ENABLE_RX_TD_ECRC_TRIM=FALSE,
DISABLE_LANE_REVERSAL=TRUE,
DISABLE_SCRAMBLING=FALSE,
DSN_CAP_ON=TRUE,
PIPE_PIPELINE_STAGES=0,
REVISION_ID=02,
VC_CAP_ON=FALSE}" *)

module v6_pcie.v1_7 # (
    parameter    ALLOW_X8_GEN2 = "FALSE",
    parameter    BAR0 = 32'hFF000000,
    parameter    BAR1 = 32'hFFFF0000,
    parameter    BAR2 = 32'h00000000,
    parameter    BAR3 = 32'h00000000,
    parameter    BAR4 = 32'h00000000,
    parameter    BAR5 = 32'h00000000,

    parameter    CARDBUS_CIS_POINTER = 32'h00000000,
```

parameter	CLASS.CODE = 24'h050000 ,
parameter	CMD.INTX.IMPLEMENTED = "TRUE" ,
parameter	CPL.TIMEOUT.DISABLE.SUPPORTED = "FALSE" ,
parameter	CPL.TIMEOUT.RANGES.SUPPORTED = 4'h2 ,
parameter	DEV.CAP.ENDPOINT.L0S.LATENCY = 0 ,
parameter	DEV.CAP.ENDPOINT.L1.LATENCY = 7 ,
parameter	DEV.CAP.EXT.TAG.SUPPORTED = "FALSE" ,
parameter	DEV.CAP.MAX.PAYLOAD.SUPPORTED = 2 ,
parameter	DEV.CAP.PHANTOM.FUNCTIONS.SUPPORT = 0 ,
parameter	DEVICE.ID = 16'h4243 ,
parameter	DISABLE.LANE.REVERSAL = "TRUE" ,
parameter	DISABLE.SCRAMBLING = "FALSE" ,
parameter	DSN.BASE.PTR = 12'h100 ,
parameter	DSN.CAP.NEXTPTR = 12'h000 ,
parameter	DSN.CAP.ON = "TRUE" ,
parameter	ENABLE.MSG.ROUTE = 11'h000000000000 ,
parameter	ENABLE.RX.TD.ECRC.TRIM = "FALSE" ,
parameter	EXPANSION.ROM = 32'h00000000 ,
parameter	EXT.CFG.CAP.PTR = 6'h3F ,
parameter	EXT.CFG.XP.CAP.PTR = 10'h3FF ,
parameter	HEADER.TYPE = 8'h00 ,
parameter	INTERRUPT.PIN = 8'h1 ,
parameter	LINK.CAP.DLL.LINK.ACTIVE.REPORTING.CAP = "FALSE" ,
parameter	LINK.CAP.LINK.BANDWIDTH.NOTIFICATION.CAP = "FALSE" ,
parameter	LINK.CAP.MAX.LINK.SPEED = 4'h2 ,
parameter	LINK.CAP.MAX.LINK.WIDTH = 6'h04 ,
parameter	LINK.CAP.SURPRISE.DOWN.ERROR.CAPABLE = "FALSE" ,
parameter	LINK.CTRL2.DEEMPHASIS = "FALSE" ,
parameter	LINK.CTRL2.HW.AUTONOMOUS.SPEED.DISABLE = "FALSE" ,
parameter	LINK.CTRL2.TARGET.LINK.SPEED = 4'h2 ,
parameter	LINK.STATUS.SLOT.CLOCK.CONFIG = "FALSE" ,
parameter	LLACK.TIMEOUT = 15'h0000 ,
parameter	LLACK.TIMEOUT.EN = "FALSE" ,
parameter	LLACK.TIMEOUT.FUNC = 0 ,
parameter	LL.REPLAY.TIMEOUT = 15'h0026 ,
parameter	LL.REPLAY.TIMEOUT.EN = "TRUE" ,
parameter	LL.REPLAY.TIMEOUT.FUNC = 1 ,
parameter	LTSSM.MAX.LINK.WIDTH = 6'h04 ,
parameter	MSLCAP.MULTIMSGCAP = 0 ,
parameter	MSLCAP.MULTIMSG.EXTENSION = 0 ,
parameter	MSI.CAP.ON = "TRUE" ,
parameter	MSLCAP.PER.VECTOR.MASKING.CAPABLE = "FALSE" ,
parameter	MSI.CAP.64.BIT.ADDR.CAPABLE = "TRUE" ,
parameter	MSIX.CAP.ON = "FALSE" ,
parameter	MSIX.CAP.PBA.BIR = 0 ,
parameter	MSIX.CAP.PBA.OFFSET = 29'h0 ,
parameter	MSIX.CAP.TABLE.BIR = 0 ,
parameter	MSIX.CAP.TABLE.OFFSET = 29'h0 ,
parameter	MSIX.CAP.TABLE.SIZE = 11'h000 ,

```

parameter    PCIE_CAP_DEVICE_PORT_TYPE = 4'b0000 ,
parameter    PCIE_CAP_INT_MSG_NUM = 5'h1 ,
parameter    PCIE_CAP_NEXTPTR = 8'h00 ,
parameter    PCIE_DRP_ENABLE = "FALSE" ,
parameter    PIPE_PIPELINE_STAGES = 0 ,                                // 0 - 0 stages , 1 - 1 stage , 2 -

parameter    PM_CAP_DSI = "FALSE" ,
parameter    PM_CAP_D1SUPPORT = "FALSE" ,
parameter    PM_CAP_D2SUPPORT = "FALSE" ,
parameter    PM_CAP_NEXTPTR = 8'h48 ,
parameter    PM_CAP_PMESUPPORT = 5'h0F ,
parameter    PM_CSR_NOSOFTRST = "TRUE" ,

parameter    PM_DATA_SCALE0 = 2'h0 ,
parameter    PM_DATA_SCALE1 = 2'h0 ,
parameter    PM_DATA_SCALE2 = 2'h0 ,
parameter    PM_DATA_SCALE3 = 2'h0 ,
parameter    PM_DATA_SCALE4 = 2'h0 ,
parameter    PM_DATA_SCALE5 = 2'h0 ,
parameter    PM_DATA_SCALE6 = 2'h0 ,
parameter    PM_DATA_SCALE7 = 2'h0 ,

parameter    PM_DATA0 = 8'h00 ,
parameter    PM_DATA1 = 8'h00 ,
parameter    PM_DATA2 = 8'h00 ,
parameter    PM_DATA3 = 8'h00 ,
parameter    PM_DATA4 = 8'h00 ,
parameter    PM_DATA5 = 8'h00 ,
parameter    PM_DATA6 = 8'h00 ,
parameter    PM_DATA7 = 8'h00 ,

parameter    REF_CLK_FREQ = 2 ,                                       // 0 - 100 MHz, 1 - 125 MHz, 2 -
parameter    REVISION_ID = 8'h02 ,
parameter    SPARE_BIT0 = 0 ,
parameter    SUBSYSTEM_ID = 16'h0007 ,
parameter    SUBSYSTEM_VENDOR_ID = 16'h10EE ,

parameter    TL_RX_RAM_RADDR_LATENCY = 0 ,
parameter    TL_RX_RAM_RDATA_LATENCY = 2 ,
parameter    TL_RX_RAM_WRITE_LATENCY = 0 ,
parameter    TL_TX_RAM_RADDR_LATENCY = 0 ,
parameter    TL_TX_RAM_RDATA_LATENCY = 2 ,
parameter    TL_TX_RAM_WRITE_LATENCY = 0 ,

parameter    UPCONFIG_CAPABLE = "TRUE" ,
parameter    USER_CLK_FREQ = 3 ,
parameter    VC_BASE_PTR = 12'h0 ,
parameter    VC_CAP_NEXTPTR = 12'h000 ,
parameter    VC_CAP_ON = "FALSE" ,
parameter    VC_CAP_REJECT_SNOOP_TRANSACTIONS = "FALSE" ,

parameter    VC0_CPL_INFINITE = "TRUE" ,
parameter    VC0_RX_RAM_LIMIT = 13'h7FF ,
parameter    VC0_TOTAL_CREDITS_CD = 308 ,
parameter    VC0_TOTAL_CREDITS_CH = 36 ,
parameter    VC0_TOTAL_CREDITS_NPH = 12 ,

```

parameter	VC0_TOTAL_CREDITS_PD = 308,
parameter	VC0_TOTAL_CREDITS_PH = 32,
parameter	VC0_TX_LAST_PACKET = 29,
parameter	VENDOR_ID = 16'h10EE,
parameter	VSEC_BASE_PTR = 12'h0,
parameter	VSEC_CAP_NEXT_PTR = 12'h000,
parameter	VSEC_CAP_ON = "FALSE",
parameter	AER_BASE_PTR = 12'h128,
parameter	AER_CAP_ECRC_CHECK_CAPABLE = "FALSE",
parameter	AER_CAP_ECRC_GEN_CAPABLE = "FALSE",
parameter	AER_CAP_ID = 16'h0001,
parameter	AER_CAP_INT_MSG_NUM_MSI = 5'h0a,
parameter	AER_CAP_INT_MSG_NUM_MSIX = 5'h15,
parameter	AER_CAP_NEXT_PTR = 12'h160,
parameter	AER_CAP_ON = "FALSE",
parameter	AER_CAP_PERMIT_ROOTERR_UPDATE = "TRUE",
parameter	AER_CAP_VERSION = 4'h1,
parameter	CAPABILITIES_PTR = 8'h40,
parameter	CRM_MODULE_RSTS = 7'h00,
parameter	DEV_CAP_ENABLE_SLOT_PWR_LIMIT_SCALE = "TRUE",
parameter	DEV_CAP_ENABLE_SLOT_PWR_LIMIT_VALUE = "TRUE",
parameter	DEV_CAP_FUNCTION_LEVEL_RESET_CAPABLE = "FALSE",
parameter	DEV_CAP_ROLE_BASED_ERROR = "TRUE",
parameter	DEV_CAP_RSVD_14_12 = 0,
parameter	DEV_CAP_RSVD_17_16 = 0,
parameter	DEV_CAP_RSVD_31_29 = 0,
parameter	DEV_CONTROL_AUX_POWER_SUPPORTED = "FALSE",
parameter	DISABLE_ASPM_L1_TIMER = "FALSE",
parameter	DISABLE_BAR_FILTERING = "FALSE",
parameter	DISABLE_ID_CHECK = "FALSE",
parameter	DISABLE_RX_TC_FILTER = "FALSE",
parameter	DNSTREAM_LINK_NUM = 8'h00,
parameter	DSN_CAP_ID = 16'h0003,
parameter	DSN_CAP_VERSION = 4'h1,
parameter	ENTER_RVRY_EIL0 = "TRUE",
parameter	INFER_EI = 5'h0c,
parameter	IS_SWITCH = "FALSE",
parameter	LAST_CONFIG_DWORD = 10'h3FF,
parameter	LINK_CAP_ASPM_SUPPORT = 1,
parameter	LINK_CAP_CLOCK_POWER_MANAGEMENT = "FALSE",
parameter	LINK_CAP_L0S_EXIT_LATENCY_COMCLK_GEN1 = 7,
parameter	LINK_CAP_L0S_EXIT_LATENCY_COMCLK_GEN2 = 7,
parameter	LINK_CAP_L0S_EXIT_LATENCY_GEN1 = 7,
parameter	LINK_CAP_L0S_EXIT_LATENCY_GEN2 = 7,
parameter	LINK_CAP_L1_EXIT_LATENCY_COMCLK_GEN1 = 7,
parameter	LINK_CAP_L1_EXIT_LATENCY_COMCLK_GEN2 = 7,
parameter	LINK_CAP_L1_EXIT_LATENCY_GEN1 = 7,
parameter	LINK_CAP_L1_EXIT_LATENCY_GEN2 = 7,
parameter	LINK_CAP_RSVD_23_22 = 0,
parameter	LINK_CONTROL_RCB = 0,

```

parameter      MSI_BASE_PTR = 8'h48,
parameter      MSI_CAP_ID = 8'h05,
parameter      MSICAP_NEXT_PTR = 8'h60,
parameter      MSIX_BASE_PTR = 8'h9c,
parameter      MSIX_CAP_ID = 8'h11,
parameter      MSIXCAP_NEXT_PTR = 8'h00,
parameter      N_FTS_COMCLK_GEN1 = 255,
parameter      N_FTS_COMCLK_GEN2 = 254,
parameter      N_FTS_GEN1 = 255,
parameter      N_FTS_GEN2 = 255,

parameter      PCIE_BASE_PTR = 8'h60,
parameter      PCIE_CAP_CAPABILITY_ID = 8'h10,
parameter      PCIE_CAP_CAPABILITY_VERSION = 4'h2,
parameter      PCIE_CAP_ON = "TRUE",
parameter      PCIE_CAP_RSVD_15_14 = 0,
parameter      PCIE_CAP_SLOT_IMPLEMENTED = "FALSE",
parameter      PCIE_REVISION = 2,
parameter      PGL0_LANE = 0,
parameter      PGL1_LANE = 1,
parameter      PGL2_LANE = 2,
parameter      PGL3_LANE = 3,
parameter      PGL4_LANE = 4,
parameter      PGL5_LANE = 5,
parameter      PGL6_LANE = 6,
parameter      PGL7_LANE = 7,
parameter      PL_AUTO_CONFIG = 0,
parameter      PL_FAST_TRAIN = "FALSE",

parameter      PM_BASE_PTR = 8'h40,
parameter      PMCAP_AUXCURRENT = 0,
parameter      PM_CAP_ID = 8'h01,
parameter      PMCAP_ON = "TRUE",
parameter      PMCAP_PME_CLOCK = "FALSE",
parameter      PMCAP_RSVD_04 = 0,
parameter      PMCAP_VERSION = 3,
parameter      PM_CSR_BPCCEN = "FALSE",
parameter      PM_CSR_B2B3 = "FALSE",

parameter      RECRC_CHK = 0,
parameter      RECRC_CHK_TRIM = "FALSE",
parameter      ROOT_CAP_CRD_SW_VISIBILITY = "FALSE",
parameter      SELECT_DLL_IF = "FALSE",
parameter      SLOT_CAP_ATT_BUTTON_PRESENT = "FALSE",
parameter      SLOT_CAP_ATT_INDICATOR_PRESENT = "FALSE",
parameter      SLOT_CAP_ELEC_INTERLOCK_PRESENT = "FALSE",
parameter      SLOT_CAP_HOTPLUG_CAPABLE = "FALSE",
parameter      SLOT_CAP_HOTPLUG_SURPRISE = "FALSE",
parameter      SLOT_CAP_MRL_SENSOR_PRESENT = "FALSE",
parameter      SLOT_CAP_NO_CMD_COMPLETED_SUPPORT = "FALSE",
parameter      SLOT_CAP_PHYSICAL_SLOT_NUM = 13'h0000,
parameter      SLOT_CAP_POWER_CONTROLLER_PRESENT = "FALSE",
parameter      SLOT_CAP_POWER_INDICATOR_PRESENT = "FALSE",
parameter      SLOT_CAP_SLOT_POWER_LIMIT_SCALE = 0,
parameter      SLOT_CAP_SLOT_POWER_LIMIT_VALUE = 8'h00,
parameter      SPARE_BIT1 = 0,
parameter      SPARE_BIT2 = 0,

```

```

parameter    SPARE_BIT3 = 0 ,
parameter    SPARE_BIT4 = 0 ,
parameter    SPARE_BIT5 = 0 ,
parameter    SPARE_BIT6 = 0 ,
parameter    SPARE_BIT7 = 0 ,
parameter    SPARE_BIT8 = 0 ,
parameter    SPARE_BYTE0 = 8'h00 ,
parameter    SPARE_BYTE1 = 8'h00 ,
parameter    SPARE_BYTE2 = 8'h00 ,
parameter    SPARE_BYTE3 = 8'h00 ,
parameter    SPARE_WORD0 = 32'h00000000 ,
parameter    SPARE_WORD1 = 32'h00000000 ,
parameter    SPARE_WORD2 = 32'h00000000 ,
parameter    SPARE_WORD3 = 32'h00000000 ,

parameter    TL_RBYPASS = "FALSE" ,
parameter    TL_TFC_DISABLE = "FALSE" ,
parameter    TL_TX_CHECKS_DISABLE = "FALSE" ,
parameter    EXIT_LOOPBACK_ON_EI = "TRUE" ,
parameter    UPSTREAM_FACING = "TRUE" ,
parameter    UR_INV_REQ = "TRUE" ,

parameter    VC_CAP_ID = 16'h0002 ,
parameter    VC_CAP_VERSION = 4'h1 ,
parameter    VSEC_CAP_HDR_ID = 16'h1234 ,
parameter    VSEC_CAP_HDR_LENGTH = 12'h018 ,
parameter    VSEC_CAP_HDR_REVISION = 4'h1 ,
parameter    VSEC_CAP_ID = 16'h000b ,
parameter    VSEC_CAP_IS_LINK_VISIBLE = "TRUE" ,
parameter    VSEC_CAP_VERSION = 4'h1

```

2.4 Compile the PCIe Core

The following command will use Xilinx ISE to run map, place&route, bitgen, etc. for the newly generated PCIe core. The results will be written to implement.log. Modify implement.sh to customize the build process.

```

$cd nonocpi/coregen/v6_pcie_v2_5/implement
$implement.sh > implement.log 2>&1

```

Copy the attached files, ace.sh and pcie_ace.cmd, to the nonocpi directory, then the following command will use Xilinx Impact to generate the ace file.

```
ace.sh
```

2.5 Creating the BMD Design

Xilinx provides a reference BMD (Bus Master DMA) Design. The instructions that follow are customized from a Xilinx pdf, titled "Bus Master Performance Demonstration Reference Design for the Xilinx Endpoint PCI Express Solutions. The file was too big to attach, but currently it is located here:[<http://www.xilinx.com/support/documentation/applications/notes/xapp1052.pdf>]

You will need a (free) account with Xilinx to download and use the BMD design.

There is some prep work:

1. Copy needed coregen files to a new working directory.

```

$cd nonocpi
$mkdir ise_dma_pcie_performance
$cd ise_dma_pcie_performance
$cp -r ../coregen/v6_pcie_v1_7/* .

```

2. Change line 4 of `nonocpi/ise_dma_pcie_performance/dma_performance_demo/fpga/implement/xst/xst_v6_ml605_prod.scr` argument, `-ifmt VERILOG` to:

```
-ifmt mixed
```

3. Overwrite the contents of `xilinx_pcie_exp_v6_ep_inc_prod.xst` to accomodate mixed languages and new xst formatting requirements:

```
vhdl include ../../../../source/v6_pcie_v1_7.vhd
vhdl include ../../../../source/pcie_2_0_v6.vhd
vhdl include ../../../../source/pcie_upconfig_fix_3451_v6.vhd
vhdl include ../../../../source/gtx_drp_chanalign_fix_3752_v6.vhd
vhdl include ../../../../source/pcie_gtx_v6.vhd
vhdl include ../../../../source/gtx_wrapper_v6.vhd
vhdl include ../../../../source/gtx_tx_sync_rate_v6.vhd
vhdl include ../../../../source/gtx_rx_valid_filter_v6.vhd
vhdl include ../../../../source/pcie_bram_top_v6.vhd
vhdl include ../../../../source/pcie_brams_v6.vhd
vhdl include ../../../../source/pcie_bram_v6.vhd
vhdl include ../../../../source/pcie_clocking_v6.vhd
vhdl include ../../../../source/pcie_pipe_v6.vhd
vhdl include ../../../../source/pcie_pipe_lane_v6.vhd
vhdl include ../../../../source/pcie_pipe_misc_v6.vhd
vhdl include ../../../../source/pcie_reset_delay_v6.vhd
```

#BMD Source

```
verilog include ../BMD/common/BMD_PCIE_20.v
vhdl include ../../../../example_design/xilinx_pcie_2_0_ep_v6.vhd
verilog include ../BMD/v6_pcie_exp_64b_app.v
#vhdl include ../../../../example_design/pcie_app_v6.vhd
```

```
verilog include ../BMD/common/BMD.v
verilog include ../BMD/BMD_64_RX_ENGINE.v
verilog include ../BMD/BMD_64_TX_ENGINE.v
verilog include ../BMD/common/BMD_GEN2.v
verilog include ../BMD/common/BMD_CFG_CTRL.v
verilog include ../BMD/common/BMD_EP.v
verilog include ../BMD/common/BMD_EP_MEM.v
verilog include ../BMD/common/BMD_EP_MEM_ACCESS.v
verilog include ../BMD/common/BMD_INTR_CTRL.v
verilog include ../BMD/common/BMD_INTR_CTRL_DELAY.v
verilog include ../BMD/common/BMD_RD_THROTTLE.v
verilog include ../BMD/common/BMD_TO_CTRL.v
```

4. Update constraint file preferences

- (a) Change line 381 of `implement_dma.pl` to use the right constraints file:

```
#$NGDBUILD_UCF = "${dir}${1}ucf${1}xilinx_pcie_exp-${prod}-${link_width}_lane_ep-${board}
#$NGDBUILD_UCF = "${dir}${1}ucf${1}xilinx_pcie_2_0_ep-${prod}_0${link_width}_lane-${gen}.
```

- (b) `cp` the coregen-generated file `coregen/v6_pcie_v2_5/example_design/xilinx_pcie_2_0_ep_v6_04_lane_gen2_xc6vlx240t-ff1156-1-PCIE_X0Y0.ucf` to `ise_dma_pcie_performance/dma_performance_demo/fpga/implement/ucf/`

BMD instructions

1. Download `xapp1052.zip`
2. Extract the `xapp1052.zip` file to your top-level hierarchy. A directory called `dma_performance_demo` will be added to the core hierarchy.

3. Navigate to the following directory: `dma_performance_demo/fpga/implement`
4. Type `xilperl implement_dma.pl` and hit return. The PERL script will present a series of prompts requesting user input. Based on this user input, the script will grab the necessary files to synthesize and build the design.
 - (a) At the first prompt, select '1' to indicate targeting of a Xilinx Development Platform.
 - (b) At the second prompt, select '4' to indicate the PCI Express solution as a Virtex-6 Integrated Block for PCI Express.
 - (c) At the third prompt, select '1' to confirm the platform as an ML605.
 - (d) At the fourth prompt, select '4' to indicate a x4 Gen 2 speed.
 - (e) At the fifth prompt, select '2' to indicate C-grade silicon.

2.6 Program the Flash with PCIe Design

1. Open Xilinx Impact


```
impact&
```
2. File -> New Project -> create a new project (click on ok)
3. Select Prepare a PROM File (click on ok)
4. In the first window of the PROM File Formatter, select BPI Flash: Configure Single FPGA, and click on the first green arrow.
5. In the second window of the PROM File Formatter, select the following:
 - Target FPGA: Virtex6
 - Storage Device: xcf128x
6. Click "add storage device", and then the second green arrow.
7. Make the "Output File Name" `ml605_pcie_x4_gen2_bmd`, and the "Output File Location" point to the `nonocpi/ise_dma_pcie_performance` directory (click on ok).
8. When prompted, add `routed.bit` from `nonocpi/ise_dma_pcie_performance/dma_performance_demo/fpga/implement/results` (and no other devices to add to Revision:0) (click ok until returned to the main screen)
9. From the main Impact Menu, select Operations -> Generate File
10. Once the "Generate Succeeded" banner appears, double-click on Boundary Scan from the iMPACT Flows screen.
11. From the main Impact Menu, select File -> Initialize Chain, and verify that the `xccace` and `xc6vtx240t` devices appear. Close any windows offering configuration options.
12. Right click on the blue square, titled SPI/BPI?, and select Add SPI/BPI Flash.
13. Browse to `nonocpi/` and select `ml605_pcie_x4_gen2_bmd.mcs`. Click "open"
14. In the "Select PROM attached to FPGA:" window, click "ok", as the defaults are correct.
15. Right click on the FLASH icon, and select "Program".
16. Ensure that the "Erase Before Programming" box is checked, and click on "ok". The programming will take a while, >10min.
17. Reboot the machine so that the new Flash contents are recognized.
18. Confirm pcie device is recognized:


```
$ lspci | grep Xilinx
08:00.0 RAM memory: Xilinx Corporation Device 6024
```

2.7 Build Kernel Driver and DMA Test App

1. Copy the xbmd directory to root.

```
$ su
# cp -r nonocpi/ise_dma_pcie_performance/dma_performance_demo/linux_sw/xbmd /root
```

2. Modify xbmd.c with correct PCI Device ID

When following instructions in xapp1052.pdf, before installing the kernel driver, change xbmd.c:

```
//#define PCI_DEVICE_ID_XILINX_PCIE 0x0007
#define PCI_DEVICE_ID_XILINX_PCIE 0x6024
```

3. Build the kernel driver and application.

```
# cd /root/xbmd
# ./run_bmd.csh
```

4. Run application and execute benchmarking test.

```
./run_xbmd
```

- Select the "Write" checkbox.
- Set "TLP Size" and "TLP's to Transfer" fields both to 32.
- Set the "Run Count" field to 100
- Click "Start"
- The Mb/s will show in red in the "Write Results" field

5. Running on an Intel Corporation Xeon E5/Core with a 128-byte payload capability, PCIe writes consistently ran at "883MB/s."