Benchmarking non-OCPI PCIe Data Throughput on the ML605

Version 1.0

Revision History

Revision	Description of Change	Date
1.0.0-alpha	Initial document creation	02/22/2017

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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

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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

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<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

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

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Enable INTx <true>
Enable MSI Capability Structure <true>
64-bit Adress Capable <true>
Multible Message Capable <1 vector>

Enable MSIx Capability Structure <false>

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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>

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

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

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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

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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_LASTPACKET=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'h00000000000,
  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           LL_ACK_TIMEOUT = 15'h0000,
parameter           LL_ACK_TIMEOUT_EN = "FALSE",
parameter           LL_ACK_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           MSI_CAP_MULTIMSGCAP = 0,
parameter           MSI_CAP_MULTIMSG_EXTENSION = 0,
parameter           MSI_CAP_ON = "TRUE",
parameter           MSI_CAP_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_LASTPACKET = 29,

parameter           VENDOR_ID = 16'h10EE,
parameter           VSEC_BASE_PTR = 12'h0,
parameter           VSEC_CAP_NEXTPTR = 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_NEXTPTR = 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_EI_L0 = "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           MSI_CAP_NEXTPTR = 8'h60,
parameter           MSIX_BASE_PTR = 8'h9c,
parameter           MSIX_CAP_ID = 8'h11,
parameter           MSIX_CAP_NEXTPTR = 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           PM_CAP_AUXCURRENT = 0,
parameter           PM_CAP_ID = 8'h01,
parameter           PM_CAP_ON = "TRUE",
parameter           PM_CAP_PME_CLOCK = "FALSE",
parameter           PM_CAP_RSVD_04 = 0,
parameter           PM_CAP_VERSION = 3,
parameter           PM_CSR_BPCCEN = "FALSE",
```

```
parameter           PM_CSR_B2B3 = "FALSE",

parameter           RECRC_CHK = 0,
parameter           RECRC_CHK_TRIM = "FALSE",
parameter           ROOT_CAP_CRS_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/application_r

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_pci_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_pci_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 contraint file preferences
   (a) Change line 381 of implement_dma.pl to use the right constraints file:

   ```
   #$NGDBUILD_UCF ="${dir}${l}ucf${l}xilinx_pci_exp_${prod}_${link_width}_lane_ep_${board

   $NGDBUILD_UCF ="${dir}${l}ucf${l}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 a 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_p 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 xc6vlx240t 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."'