**User Guide**

**For**

**QDMA DPDK Driver**

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# 1 Introduction

## 1.1 Document Overview

The Xilinx PCI Express Multi Queue DMA (QDMA) IP provides high-performance direct memory access (DMA) via PCI Express. The PCIe QDMA can be implemented in UltraScale devices.

Xilinx provides a DPDK software release that incorporates the low-level driver functionality that runs on a PCI Express root port host PC to interact with the QDMA endpoint IP via PCI Express. This User Guide provides the setup procedure and software usage instructions.

## 1.2 Document References

| Document References | Version |
|---|---|
| [1] QDMA Subsystem for PCI Express (PG302) | 2.0 |
| [2] https://github.com/Xilinx/dma_ip_drivers/QDMA/DPDK | |

*Table 1-1: Document References*

## 1.3 Glossary

| Acronym / Term | Description |
|---|---|
| BDF | Bus, Device, Function of a PCIe device |
| C2H | Card to Host |
| CLI | Command Line Interface |
| FPGA | Field Programmable Gate Array |
| H2C | Host to Card |
| IP | Intellectual Property |
| MM | Memory Mapped Mode |
| PF | Physical Function |
| PMD | Poll Mode Driver |
| QDMA | Multi Queue Direct Memory Access |
| ST | Streaming Mode |
| VF | Virtual Function |
| VM | Virtual Machine |

*Table 1-2: Glossary*

# 2 QDMA DPDK Driver

This User Guide document describes the following for QDMA DPDK Driver that will be generally available for customers:

- System Setup
- Compiling and loading the driver and test application
- Sample commands to use the driver and test application

## *2.1 System Setup*

This release was tested with the following system configuration.

| Directory | | Description |
|---|---|---|
| Host System Configuration | Operating System | Ubuntu 16.04.3 LTS |
| | Linux Kernel | 4.4.0-93-generic |
| | RAM | 32GB on local NUMA node |
| | Qemu version | QEMU emulator version 2.5.0 (Debian 1:2.5+dfsg-5ubuntu10.15) |
| Guest System (VM) Configuration | Operating System | Ubuntu 18.04 LTS |
| | Linux Kernel | 4.15.1-20-generic |
| | RAM | 4GB |
| | Cores | 4 |

*Table 2-1: System Configuration*

The following modifications must be made to the /boot/grub/grub.cfg on the Host system:

- Add hugepages for DPDK
  - Add following parameter to /etc/default/grub file

    ```
    GRUB_CMDLINE_LINUX="default_hugepagesz=1GB    hugepagesz=1G
    hugepages=20"
    ```

    The example below adds 20 1GB hugepages, which is required to support 2048 queues, with descriptor ring of 1024 entries and each descriptor buffer length of 4KB.

    The number of hugepages required should be changed if the above configuration (queues, ring size, buffer size) changes.
- Enable IOMMU for VM testing.
  - Update /etc/default/grub file as below.

    ```
    GRUB_CMDLINE_LINUX="default_hugepagesz=1GB    hugepagesz=1G
    hugepages=20 iommu=pt intel_iommu=on"
    ```

- Execute the following command to modify the /boot/grub/grub.cfg with the configuration set in the above steps and permanently add them to the kernel command line:
    - `update-grub`

Reboot host after making the above modifications.

### 2.2 Environment

To execute the QDMA DPDK driver and test application on the example design, following system requirements are to be met:

1. Host System with at least one Gen 3 x16 PCIe slot and minimum 32GB RAM on same CPU node for 2K queues. For VM testing, host system must support virtualization and it must be enabled in the BIOS.
2. Execution of the steps mentioned in section 2.1
3. TULVU9P or VCU1525 FPGA Board
4. USB digilent cables to connect to the chosen board to the Host System.
5. Xilinx 2018.3 Vivado tools for programming the FPGA.

### 2.3 Modifying the driver for your own PCIe device ID

During the PCIe DMA IP customization in Vivado user can specify a PCIe Device ID. This Device ID must be recognized by the driver to properly recognize the PCIe QDMA device. The current driver is designed to recognize the PCIe Device IDs that get generated with the PCIe example design when this value has not been modified. If the PCIe Device ID is modified during IP customization, one needs to modify QDMA PMD to recognize this new ID.

User can also remove PCIe Device IDs that will not be used by the end solution. To modify the PCIe Device ID in the driver,

```
Update struct rte_pci_id qdma_pci_id_tbl[] inside
drivers/net/qdma/qdma_ethdev.c for PF devices.

Update struct rte_pci_id qdma_vf_pci_id_tbl[] inside
drivers/net/qdma/qdma_vf_ethdev.c for VF devices.

Also add the device IDs in usertools/dpdk-devbind.py in
xilinx_qdma_pf for PF device and xilinx_qdma_vf for VF device as
specified in section 2.4.
```

Once modified, the driver and application must be recompiled.

### 2.4 Building the QDMA DPDK Software

DPDK requires certain packages to be installed on host system. For a full list, refer to the official DPDK documentation:

https://doc.dpdk.org/guides/linux_gsg/sys_reqs.html.

Note: If the NUMA library is missing, it should be installed. For example:

```
ubuntu:> sudo apt-get install libnuma-dev

red hat:> sudo yum install numactl-devel
```

Below Table describes the DPDK software database structure and its contents on the Xilinx GitHub (https://github.com/Xilinx/dma_ip_drivers/QDMA/DPDK).

| Directory | Description |
| --- | --- |
| drivers/net/qdma | Xilinx QDMA DPDK Poll mode driver |
| examples/qdma_testapp | Xilinx CLI based test application for QDMA |
| tools/0001-PKTGEN-3.4.7-Patch-to-add-Jumbo-packet-support.patch | dpdk-pktgen patch based on dpdk-pktgen v3.4.7. This patch extends dpdk-pktgen application to handle packets with packet sizes more than 1518 bytes and it disables the packet size classification logic to remove application overhead in performance measurement. This patch is used for performance testing with dpdk-pktgen application. |
| tools/DPDK_qdma_driver_user_guide.pdf | This document (User guide) |
| RELEASE.txt | Release Notes |

*Table 2-2: DPDK software database content*

### *2.4.1 Setup: Download and modifications*

The reference driver code requires DPDK version 17.11.1. Follow the steps below to download the proper version of DPDK and apply driver code and test application supplied in the GitHub.

Extract the DPDK software database from GitHub to the server where VCU1525 is installed. Henceforth, this area is referred as `<dpdk_sw_database>`.

Create a directory for the DPDK download on the server where the VCU1525 is installed and move to this directory.

```
mkdir <server_dir>/<dpdk_test_area>
cd <server_dir>/<dpdk_test_area>
git clone http://dpdk.org/git/dpdk-stable
cd dpdk-stable
git checkout v17.11.1
cp -r <dpdk_sw_database>/drivers/net/qdma ./drivers/net/
cp -r <dpdk_sw_database>/examples/qdma_testapp ./examples/
```

Additionally, make below changes to the DPDK 17.11.1 tree to build QDMA driver, support 2K queues and populate Xilinx devices for binding.

1. To build QDMA driver

a. Add below lines to `./config/common_base` in DPDK 17.11.1 tree

```
#
#Complie Xilinx QDMA PMD driver
#
CONFIG_RTE_LIBRTE_QDMA_PMD=y
CONFIG_RTE_LIBRTE_QDMA_DEBUG_DRIVER=n
```

To enable driver debug logs, set

```
CONFIG_RTE_LIBRTE_QDMA_DEBUG_DRIVER=y
```

b. Add below lines to `drivers/net/Makefile`, where PMDs are added

```
DIRS-$(CONFIG_RTE_LIBRTE_QDMA_PMD) += qdma
```

c. Add below lines to `mk/rte.app.mk`, where PMDs are added

```
_LDLIBS-$(CONFIG_RTE_LIBRTE_QDMA_PMD) += -lrte_pmd_qdma
```

2. To add Xilinx devices for device binding, add below lines to `./usertools/dpdk-devbind.py` after `cavium_pkx` class, where PCI base class for devices are listed.

```
xilinx_qdma_pf = {'Class':  '05', 'Vendor': '10ee',
'Device':
'9011,9111,9211,9311,9014,9114,9214,9314,9018,9118,9218,
9318,901f,911f,921f,931f,9021,9121,9221,9321,9024,9124,9
224,9324,9028,9128,9228,9328,902f,912f,922f,932f,9031,91
31,9231,9331,9034,9134,9234,9334,9038,9138,9238,9338,903
f,913f,923f,933f,9041,9141,9241,9341,9044,9144,9244,9344
,9048,9148,9248,9348',
              'SVendor': None, 'SDevice': None}
xilinx_qdma_vf = {'Class':  '05', 'Vendor': '10ee',
'Device':
'a011,a111,a211,a311,a014,a114,a214,a314,a018,a118,a218,
a318,a01f,a11f,a21f,a31f,a021,a121,a221,a321,a024,a124,a
224,a324,a028,a128,a228,a328,a02f,a12f,a22f,a32f,a031,a1
31,a231,a331,a034,a134,a234,a334,a038,a138,a238,a338,a03
f,a13f,a23f,a33f,a041,a141,a241,a341,a044,a144,a244,a344
,a048,a148,a248,a348',
              'SVendor': None, 'SDevice': None}
```

Update entries in network devices class in `./usertools/dpdk-devbind.py` to add Xilinx devices

```
network_devices = [network_class, cavium_pkx,
xilinx_qdma_pf, xilinx_qdma_vf]
```

3. To support 2K queues and 256 PCIe functions, update below configurations in `./config/common_base`

```
CONFIG_RTE_MAX_MEMZONE=7680
CONFIG_RTE_MAX_ETHPORTS=256
CONFIG_RTE_MAX_QUEUES_PER_PORT=2048
```

### *2.4.2 Setup: Huge Pages*

DPDK requires that hugepages are setup on the server. Perform steps outlined in section 2.1 to reserve hugepages.

### 2.4.3 Setup: Make Commands

Execute the following to compile the driver:

```
cd <server_dir>/<dpdk_test_area>/dpdk-stable

make config T=x86_64-native-linuxapp-gcc

make
```

```
#In the make output, verify that the QDMA files are being
built. Below figure shows the QDMA files that are built as
part of make.
```

```
== Build drivers/net/qdma
  CC qdma_ethdev.o
  PMDINFO qdma_ethdev.o.pmd.c
  CC qdma_ethdev.o.pmd.o
  LD qdma_ethdev.o
  CC qdma_vf_ethdev.o
  PMDINFO qdma_vf_ethdev.o.pmd.c
  CC qdma_vf_ethdev.o.pmd.o
  LD qdma_vf_ethdev.o
  CC qdma_devops.o
  CC qdma_common.o
  CC qdma_rxtx.o
  CC qdma_flow.o
  CC xcmac.o
  CC xcmac_rsfec.o
  AR librte_pmd_qdma.a
  INSTALL-LIB librte_pmd_qdma.a
```

```
#The following should appear when make completes:

      Build complete [x86_64-native-linuxapp-gcc]

#Verify that librte_pmd_qdma.a is installed in ./build/lib
directory.
```

Additionally, for memory mapped mode, BRAM size can be configured with make command. Default BRAM size is set to 512KB in the driver makefile.

```
make BRAM_SIZE=<BRAM size in bytes in decimal>
```

Change to root user and compile the application:

```
sudo su

cd examples/qdma_testapp

make RTE_SDK=`pwd`/../..  RTE_TARGET=build
```

```
#The following should appear when make completes:
INSTALL-MAP qdma_testapp.map
```

Additionally, for memory mapped mode, BRAM size can be configured with make command. Default BRAM size is set to 512KB in the driver makefile.

```
make BRAM_SIZE=<BRAM size in bytes in decimal> RTE_SDK=`pwd`/../..
RTE_TARGET=build


#*NOTE: If any of above steps are missed and require code
modifications, perform 'make clean' before re-running make.
```

## 2.5 Running the DPDK software test application

The below steps describe the step by step procedure to run the DPDK QDMA Test Application and to interact with the QDMA PCIe device.

1. Navigate to `examples/qdma_testapp` directory.
   ```
   # cd <server_dir>/<dpdk_test_area>/dpdk-
   stable/examples/qdma_testapp
   ```

2. Run the `'lspci'` command on the console and verify that the PFs are detected as shown below. Here, '81' is the PCIe bus number on which Xilinx QDMA device is installed.
   ```
   # lspci | grep Xilinx
   81:00.0 Memory controller: Xilinx Corporation Device 903f
   81:00.1 Memory controller: Xilinx Corporation Device 913f
   81:00.2 Memory controller: Xilinx Corporation Device 923f
   81:00.3 Memory controller: Xilinx Corporation Device 933f
   ```

3. Execute the following commands required for running the DPDK application:
   ```
   # mkdir /mnt/huge
   # mount -t hugetlbfs nodev /mnt/huge
   # modprobe uio
   # insmod ../../build/kmod/igb_uio.ko
   ```

4. Bind PF ports to the igb_uio module as shown below:
   ```
   # ../../usertools/dpdk-devbind.py -b igb_uio 81:00.0
   # ../../usertools/dpdk-devbind.py -b igb_uio 81:00.1
   # ../../usertools/dpdk-devbind.py -b igb_uio 81:00.2
   # ../../usertools/dpdk-devbind.py -b igb_uio 81:00.3
   ```

5. The execution of steps 3 and 4 creates a max_vfs file entry in /sys/bus/pci/devices/0000:<bus>:<device>.<function>. Enable VFs for each PF by writing the number of VFs to enable to this file as shown below. This example adds 8 VFs to each PF.
   ```
   # echo 8 > /sys/bus/pci/devices/0000\:81\:00.0/max_vfs
   # echo 8 > /sys/bus/pci/devices/0000\:81\:00.1/max_vfs
   # echo 8 > /sys/bus/pci/devices/0000\:81\:00.2/max_vfs
   # echo 8 > /sys/bus/pci/devices/0000\:81\:00.3/max_vfs
   ```

6. Run the lspci command on the console and verify that the VFs are listed in the output as shown below:

```
# lspci | grep Xilinx
81:00.0 Memory controller: Xilinx Corporation Device 903f
81:00.1 Memory controller: Xilinx Corporation Device 913f
81:00.2 Memory controller: Xilinx Corporation Device 923f
81:00.3 Memory controller: Xilinx Corporation Device 933f
81:00.4 Memory controller: Xilinx Corporation Device a03f
81:00.5 Memory controller: Xilinx Corporation Device a03f
81:00.6 Memory controller: Xilinx Corporation Device a03f
81:00.7 Memory controller: Xilinx Corporation Device a03f
81:01.0 Memory controller: Xilinx Corporation Device a03f
81:01.1 Memory controller: Xilinx Corporation Device a03f
81:01.2 Memory controller: Xilinx Corporation Device a03f
81:01.3 Memory controller: Xilinx Corporation Device a03f
81:01.4 Memory controller: Xilinx Corporation Device a13f
81:01.5 Memory controller: Xilinx Corporation Device a13f
81:01.6 Memory controller: Xilinx Corporation Device a13f
81:01.7 Memory controller: Xilinx Corporation Device a13f
81:02.0 Memory controller: Xilinx Corporation Device a13f
81:02.1 Memory controller: Xilinx Corporation Device a13f
81:02.2 Memory controller: Xilinx Corporation Device a13f
81:02.3 Memory controller: Xilinx Corporation Device a13f
81:02.4 Memory controller: Xilinx Corporation Device a23f
81:02.5 Memory controller: Xilinx Corporation Device a23f
81:02.6 Memory controller: Xilinx Corporation Device a23f
81:02.7 Memory controller: Xilinx Corporation Device a23f
81:03.0 Memory controller: Xilinx Corporation Device a23f
81:03.1 Memory controller: Xilinx Corporation Device a23f
81:03.2 Memory controller: Xilinx Corporation Device a23f
81:03.3 Memory controller: Xilinx Corporation Device a23f
81:03.4 Memory controller: Xilinx Corporation Device a33f
81:03.5 Memory controller: Xilinx Corporation Device a33f
81:03.6 Memory controller: Xilinx Corporation Device a33f
81:03.7 Memory controller: Xilinx Corporation Device a33f
81:04.0 Memory controller: Xilinx Corporation Device a33f
81:04.1 Memory controller: Xilinx Corporation Device a33f
81:04.2 Memory controller: Xilinx Corporation Device a33f
81:04.3 Memory controller: Xilinx Corporation Device a33f
```

In total, 36 ports are serially arranged as shown above, where 81.0.0 represents port 0, 81.0.1 represents port 1 and so on. Therefore, 81.04.3 being the last one which represents port 35.

7. Execute the following commands to bind the VF ports to igb_uio module

```
# ../../usertools/dpdk-devbind.py -b igb_uio 81:00.4
# ../../usertools/dpdk-devbind.py -b igb_uio 81:00.5
# ../../usertools/dpdk-devbind.py -b igb_uio 81:00.6
# ../../usertools/dpdk-devbind.py -b igb_uio 81:00.7
# ../../usertools/dpdk-devbind.py -b igb_uio 81:01.0
# ../../usertools/dpdk-devbind.py -b igb_uio 81:01.1
# ../../usertools/dpdk-devbind.py -b igb_uio 81:01.2
# ../../usertools/dpdk-devbind.py -b igb_uio 81:01.3
```

```
# ../../usertools/dpdk-devbind.py -b igb_uio 81:01.4
# ../../usertools/dpdk-devbind.py -b igb_uio 81:01.5
# ../../usertools/dpdk-devbind.py -b igb_uio 81:01.6
# ../../usertools/dpdk-devbind.py -b igb_uio 81:01.7
# ../../usertools/dpdk-devbind.py -b igb_uio 81:02.0
# ../../usertools/dpdk-devbind.py -b igb_uio 81:02.1
# ../../usertools/dpdk-devbind.py -b igb_uio 81:02.2
# ../../usertools/dpdk-devbind.py -b igb_uio 81:02.3
# ../../usertools/dpdk-devbind.py -b igb_uio 81:02.4
# ../../usertools/dpdk-devbind.py -b igb_uio 81:02.5
# ../../usertools/dpdk-devbind.py -b igb_uio 81:02.6
# ../../usertools/dpdk-devbind.py -b igb_uio 81:02.7
# ../../usertools/dpdk-devbind.py -b igb_uio 81:03.0
# ../../usertools/dpdk-devbind.py -b igb_uio 81:03.1
# ../../usertools/dpdk-devbind.py -b igb_uio 81:03.2
# ../../usertools/dpdk-devbind.py -b igb_uio 81:03.3
# ../../usertools/dpdk-devbind.py -b igb_uio 81:03.4
# ../../usertools/dpdk-devbind.py -b igb_uio 81:03.5
# ../../usertools/dpdk-devbind.py -b igb_uio 81:03.6
# ../../usertools/dpdk-devbind.py -b igb_uio 81:03.7
# ../../usertools/dpdk-devbind.py -b igb_uio 81:04.0
# ../../usertools/dpdk-devbind.py -b igb_uio 81:04.1
# ../../usertools/dpdk-devbind.py -b igb_uio 81:04.2
# ../../usertools/dpdk-devbind.py -b igb_uio 81:04.3
```

8. Run the qdma_testapp using the following command:
   `#./build/app/qdma_testapp -c 0xf -n 4`
   "-c" is for processor mask

   "-n" for number memory channels.

## 2.6 Controlling and Configuring the QDMA IP

### 2.6.1 Supported Device arguments (module parameters)

Device specific parameters can be passed to a device by using the '-w' EAL option. Xilinx supports following device arguments to configure PCIe device.

| Devargs options | Description |
|---|---|
| queue_base | Absolute base queue id to use for the given PCIe function. User needs to make sure that the queue belonging to different PCIe functions do not share same absolute queue id. Default value of queue base is 0.<br><br>Example usage:<br><br>`./build/app/qdma_testapp -c 0x1f -n 4 -w 81:00.0,queue_base=0 -w 81:00.1,queue_base=64` |

| Devargs options | Description |
| --- | --- |
| | In this example, the device "81:00.0" uses absolute queue id starting from 0, and the device "81:00.1" uses absolute queue id starting from 64. |
| config_bar | Specifies the PCIe BAR number where QDMA configuration register space is mapped. Valid values are 0 to 5. Default is set to 0 i.e. BAR 0 in the driver.<br>Example usage:<br>`./build/app/qdma_testapp -c 0x1f -n 4 -w 81:00.0,queue_base=0,config_bar=2 -w 81:00.1,queue_base=64,config_bar=4`<br>This example configures BAR 2 as QDMA configuration BAR for device "81:00.0" and BAR 4 as QDMA configuration BAR for device "81:00.1". |
| desc_prefetch | Enable or disable descriptor prefetch on C2H streaming (ST-mode) queues. Default is prefetch disabled.<br>Example usage:<br>`./build/app/qdma_testapp -c 0x1f -n 4 -w 81:00.0,queue_base=0,desc_prefetch=1 -w 81:00.1,queue_base=64,desc_prefetch=0`<br>This example enables descriptor prefetch on all the streaming C2H queues of the device "81:00.0", and disables descriptor prefetch on all the streaming C2H queues of the device "81:00.1". |
| cmpt_desc_len | Sets the completion entry length of the completion queue. Valid lengths are 8, 16 and 32 bytes. Default length is 8 bytes.<br>Example usage:<br>`./build/app/qdma_testapp -c 0x1f -n 4 -w 81:00.0,queue_base=0,cmpt_desc_len=8 -w 81:00.1,queue_base=64,cmpt_desc_len=32`<br>This example sets completion entry length to 8 bytes on all the completion queues of the device "81:00.0", and to 32 bytes on all the completion queues of the device "81:00.1". |
| trigger_mode | Sets the trigger mode for completion. Possible values for trigger_mode is:<br>0 - DISABLE<br>1 – Trigger on EVERY event<br>2 – Trigger when USER_COUNT threshold is reached<br>3 – Trigger when USER defined event is reached<br>4 - Trigger when USER_TIMER threshold is reached |

| Devargs options | Description |
|---|---|
| | 5 - Trigger when either of USER_TIMER or COUNT is reached.<br>Default value configured in the driver is 5.<br>Example usage:<br>`./build/app/qdma_testapp -c 0x1f -n 4 -w 81:00.0,queue_base=0, trigger_mode=1`<br>This example sets the trigger mode to every event for all the completion queues of the device “81:00.0”. |
| wb_acc_int | Sets the interval at which completions are generated for for MM or H2C stream queues running in non-bypass mode.<br>Supported values are 0 to 7. Completions are generated 4 * 2 ^ (configured wb_acc_int) number of descriptors are available. Default value configured in the driver is 4 i.e. 64 descriptors.<br>Example usage:<br>`./build/app/qdma_testapp -c 0x1f -n 4 -w 81:00.0,queue_base=0, wb_acc_int=5`<br>This example sets the completion interval to 128 descriptors for all the MM or H2C stream queues of the device “81:00.0”. |
| c2h_byp_mode | Sets the C2H stream mode. Valid values are 0 (Bypass disabled), 1 (Cache bypass mode) and 2 (Simple bypass mode). Default is internal mode i.e. bypass disabled.<br>Example usage:<br>`./build/app/qdma_testapp -c 0x1f -n 4 -w 81:00.0,c2h_byp_mode=2`<br>This example sets simple bypass mode on all the C2H queues belonging to the PCIe device "81:00.0". |
| h2c_byp_mode | Sets the H2C bypass mode. Valid values are 0 (Bypass disabled) and 1 (Bypass enabled). Default is Bypass disabled.<br>Example usage:<br>`./build/app/qdma_testapp -c 0x1f -n 4 -w 81:00.0,h2c_byp_mode=1`<br>This example sets bypass mode on all the H2C queues belonging to the PCIe device "81:00.0". |

*Table 2-3: Device arguments supported by DPDK driver*

### 2.6.2 CLI support in qdma_testapp

After running the qdma_testapp as described in section 2.5, command line prompt appears on the console like below:

```
#./build/app/qdma_testapp -c 0xf -n 4

======Sample output log of the testapp execution on command-line interface=====

QDMA testapp rte eal init...

EAL: Detected 8 lcore(s)

EAL: Probing VFIO support...

EAL: PCI device 0000:01:00.0 on NUMA socket -1

EAL:   probe driver: 10ee:903f net_qdma

EAL: PCI device 0000:01:00.1 on NUMA socket -1

EAL:   probe driver: 10ee:913f net_qdma

Ethernet Device Count: 1

Logical Core Count: 4

Setting up port :0.

xilinx-app>
```

***Commands supported by the qdma_testapp CLI:***

xilinx-app> help

| Command | Format | Description |
|---|---|---|
| port_init | <port-id> <base-queue-id> <num-queues> <num-st-queues> <ring-depth> <pkt-buff-size> | Port initialization, queue allocation and programming |
| port_close | <port-id> | Port close, queue clear and deallocation |
| reg_read | <port-id> <bar-num> <address> | Reads specified register |
| reg_write | <port-id> <bar-num> <address> <value> | Writes specified register |
| dma_to_device | <port-id> <num-queues> <input-filename> <dst_addr> <size> <iterations> | Transfer data to the queues |
| dma_from_device | <port-id> <num-queues> <output-filename> <src_addr> <size> <iterations> | Receive data from queues |
| reg_dump | <portid> | Dumps all valid registers |
| queue_dump | <port-id> <queue-id> | Dumps queue-context of the specified queue number |

| Command | Format | Description |
|---|---|---|
| desc_dump | <port-id> <queue-id> | Dumps descriptor fields of the specified queue number |
| load_cmds | <file_name> | Executes the list of commands from the file |
| help | | Help menu |
| Ctrl-D | | Quit the command line interface and application |

*Table 2-4: qdma_testapp CLI Commands format and usage*

#### 2.6.2.1 Example usage of the commands

##### 2.6.2.1.1 port_init command

This command is used to allocate the required memory and configure all the queues associated with the port. It accepts the following parameters:

*port_init <port-id> <base-queue-id> <num-queues> <num-st-queues> <ring-depth> <pkt-buff-size>*

*port-id*: Port number. Port number represents a logical numbering for PCIe functions in the order they are bind to igb_uio driver. The first PCIe function that is bound will have port number as 0.

*base-queue-id*: The hardware queue-id from where the assignment of the queues to the port <port-id> starts

*num-queues*: Total number of queues to be assigned to port <port-id>

*num-st-queues*: Number of queues to be configured in streaming mode.

*ring-depth*: Length of the C2H and H2C queues

*pkt-buff-size*: Size of the packet that a single C2H or H2C descriptor can support

The number of queues that are configured in memory mapped mode are (num-queues - st-queues)

For example:

- `port_init 0 0 32 32 1024 4096`
  - Initializes PF-0 with 32 queues in ST-mode, in queue-range 0-to-31
- `port_init 1 32 32 16 1024 4096`
  - Initializes PF-1 with First 16-queues in ST-mode and remaining 16-queues configured in MM-mode, in queue-range 32-to-63

##### 2.6.2.1.2 dma_to_device command

This command is used to transmit the data to DMA. This command accepts following parameters:

*dma_to_device <port-id> <num-queues> <input-filename> <dst-addr> <size> <iterations>*

*port-id:* Port Number to transmit the data.

*num-queues*: Number of queues to use for transmitting the data.

*input-filename*: Valid existing input file, with proper size.

*dst-addr*: Destination address (in offset) of the BRAM. (This parameter is ignored for streaming mode)

*size*: size of data to be transferred from the above input-file.

*iterations*: number of loops, to repeat the same transfer.

For example:

- `dma_to_device 0 2048 mm_datafile_1MB.bin 0 524288 0`
  - Segments the 524288 bytes from the mm_datafile_1MB.bin file equally to 2048 queues and transmits the segmented data on each queue starting at destination BRAM offset 0 for 1st queue, offset 1*524288/2048 for 2nd queue, and so on.

#### 2.6.2.1.3 dma_from_device command

This command is used to receive data from DMA. This command accepts following parameters:

*dma_from_device <port-id> <num-queues> <output-filename> <src-addr> <size> <iterations>*

*port-id:* Port Number to receive the data from

*num-queues*: Number of queues used to receive the data

*output-filename*: Output file to dump the received data

*src-addr*: Source address of the BRAM. (This parameter is ignored for streaming mode)

*size*: size of data to be received

*iterations*: number of loops, to re-peat the same transfer.

- `dma_from_device 0 2048 port0_qcount2048_size524288.bin 0 524288 0`
  - Receives the 524288 bytes from 2048 queues and writes to port0_qcount2048_size524288.bin file. 1st queue receives data from BRAM offset 0, 2nd queue receives data from BRAM offset 1*524288/2048, and so on.

#### 2.6.2.1.4 port_close command

This command frees up all the allocated memory and de-configures the queues associated with the port. This command accepts following parameters:

*port_close <port-id>*

*port-id*: Port number

For example:

- `port_close 0`
  - closes the PF-0.

## 2.7 VM Testing

This section assumes that the VM image has been created with the Guest system configuration outlined in Table 2-1: System Configuration.

Follow below steps to execute and test qdma_testapp on VMs

1. Enable the VFs on host system by writing the number of VFs to enable to 'max_vfs' file under /sys/bus/pci/devices/0000:<bus>:<device>.<function>.
```
# echo 8 > /sys/bus/pci/devices/0000\:81\:00.0/max_vfs
```
   lspci should show new entries for VFs.
```
81:00.4 Memory controller: Xilinx Corporation Device a03f
81:00.5 Memory controller: Xilinx Corporation Device a03f
81:00.6 Memory controller: Xilinx Corporation Device a03f
81:00.7 Memory controller: Xilinx Corporation Device a03f
81:01.0 Memory controller: Xilinx Corporation Device a03f
81:01.1 Memory controller: Xilinx Corporation Device a03f
81:01.2 Memory controller: Xilinx Corporation Device a03f
81:01.3 Memory controller: Xilinx Corporation Device a03f
```

2. Start the VM using below command by attaching the VF (81:00.4 in this example)
```
qemu-system-x86_64 -cpu host -enable-kvm -m 4096 -object
memory-backend-file,id=mem,size=4096M,mem-
path=/mnt/huge,share=on -numa node,memdev=mem -mem-prealloc
-smp sockets=2,cores=4 -hda <vm_image.qcow2> -device pci-
assign,host=81:00.4
```

3. Bind all the PFs for the VFs being tested on VM with the igb_uio driver and start qdma_testapp application on the host system.

4. Once the VM is launched, repeat steps in section 2.3 to build the DPDK on VM.

5. Bind the VF device in VM to igb_uio driver and execute qdma_testapp in VM as per Section 2.5 and 2.6. Make sure to use the queue_base such that none of the queues assigned to a function overlaps with other function.

# 3 Document Revision History

| Version | Date | Description | State |
|---|---|---|---|
| 3 | 24-Aug-2018 | QDMA 2018.2 DPDK user guide | Released |
| 5 | 19-Sep-2018 | DPDK user guide for QDMA 2018.2 update release | Released |
| 8 | 10-Dec-2018 | Updates for 2018.3 QDMA DPDK driver release | Released |

*Table 3-1: Document Review History*