

PCIe Enumeration of a Speedster7t FPGA Device (AN027)



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Application Note

Introduction

PCIe device enumeration is necessary to allow a device with a PCIe interface to be discovered in a system. This Application Note provides the steps to attain enumeration from a non-enumerated device with a PCIe interface and from an already enumerated device. Use these steps to enumerate a Speedster®7t FPGA configured as a PCIe endpoint device.

First Case: PCIe Device Has Not Enumerated

If the device is powered on and has not enumerated, follow these steps to discover the device:

1. Program the FPGA with the desired bitstream. For more information on programming the FPGA, refer to the [Speedster7t Configuration User Guide \(UG094\)](#).
2. Enter the following command to perform a warm reboot on the system.

```
$ sudo -S systemctl --force --force reboot
```

3. Ensure that the device has been enumerated by using the `lspci` command as shown to display PCI devices and identify the device. The `-d` flag can be used to show only devices with the specified vendor, device, and class ID. The numbers are given in hexadecimal or can be omitted:


```
$ lspci -d <Vendor ID>:<Device ID>
```

An example command using the Achronix Vendor ID and a Device ID of 1 is shown below.

```
$ lspci -d 1b59:0001
```

```
01:00.0 Non-Essential Instrumentation [1300]: Device 1b59:0001 (rev 01)
```

4. If the device has **not** been enumerated, i.e., the device is not present in the `lspci` output from the previous step, repeat instructions 1 through 3 in this section.
If the device has been enumerated, verify the intended functionality.

 **Note**

On some systems it has been observed that the device might not have enumerated. This can be due to the state of the device prior to performing the steps in this section. During system boot, if the device is not programmed (as can be the case during cold boot), the system does not detect the device as active and therefore does not provide a necessary clock resource. In this state, since the device has been programmed and rebooted, it should now have the clock resource needed and only requires another iteration of programming and reboot.

It has been observed that warm reboot currently causes some registers, such as the BAR size registers, to reset which affects functionality. This issue is to be addressed in a future update. For now, if the device PCIe functionality is invalid, continue with the steps in the following section to ensure functional transactions on the PCIe link.


Second Case: Reconfiguration of an Enumerated Device

If the device is powered on and has already enumerated, follow these instructions to reconfigure the device:

1. Identify the PCI domain number and Bus:Device.Function (BDF) numbers for the endpoint device to be reconfigured and its associated upstream device. The PCI domain number and BDF numbers can be displayed by using the `lspci` command. The numbers are located at the beginning of each PCI device entry of the displayed list. The PCI domain number is the first four hexadecimal digits followed by the BDF number for the device. An example is shown below in which `0000` is the PCI domain number, `00:01.0` is the BDF number for the upstream device, and `01:00.0` is the BDF number for the endpoint device to be reconfigured:

```
$ lspci -D -PP -d <Vendor ID>:<Device ID>
```

```
0000:00:01.0/01:00.0 Non-Essential Instrumentation [1300]: Device 1b59:0001 (rev 01)
```

 **Note**

By default, the `lspci` command does not display the domain number if the machine only has domain 0. The `-D` flag can be used to always display the PCI domain number. The `-PP` flag displays the path of devices to the PCI device. In this path, the upstream device BDF number precedes the BDF number of the endpoint device. The `-d` flag can be used to show only devices with the specified vendor, device, and class ID. The numbers are given in hexadecimal or can be omitted.

2. Remove the PCI driver module. Removing the driver module also removes the previous device files and, upon rescan, new devices are given an ID starting from 0.

```
$ sudo rmmod <PCI driver>
```

The following example is for removing the BittWare driver, `bwpci`, which is used for the VectorPath® S7t-VG6 accelerator card.

```
$ sudo rmmod bwpci
```

**Note**

If an error message similar to the one shown below appears, it can be ignored. Additionally, the `lsmod` command can be used to confirm that the `bwpci` module is no longer loaded.

```
rmmod: ERROR: Module bwpci is not currently loaded
```

3. Remove the upstream device using the commands shown below. The device is located in the `/sys/bus/pci/devices/<device>` directory and is identified by its PCI domain and BDF numbers.

```
$ sudo chmod 777 /sys/bus/pci/devices/<PCI domain>:<device BDF>/remove
```

```
$ sudo echo 1 > /sys/bus/pci/devices/<PCI domain>:<device BDF>/remove
```

An example command using the PCI domain and BDF numbers from the first step is shown below:

```
$ sudo chmod 777 /sys/bus/pci/devices/0000:00:01.0/remove
```

```
$ sudo echo 1 > /sys/bus/pci/devices/0000:00:01.0/remove
```

**Note**

Only removing the endpoint device instead of the upstream device can result in enumeration, but it has been observed that some functionality might be missing.

4. Program the FPGA with the desired bitstream. For more information on programming the FPGA, refer to the [Speedster7t Configuration User Guide \(UG094\)](#).
5. Rediscover the PCI device by performing a rescan of all PCI buses in the system:

```
$ sudo chmod 777 /sys/bus/pci/rescan
```

```
$ sudo echo 1 > /sys/bus/pci/rescan
```

6. Load the PCI driver module.

```
$ sudo modprobe <PCI driver>
```

The following example illustrates loading the BittWare driver for the VectorPath accelerator card.

```
$ sudo modprobe bwpci
```

The device should be enumerated and ready for subsequent PCIe operations using the new programmed bitstream. If the device has not enumerated, contact [Achronix support](#) for assistance.

Revision History

Version	Date	Description
1.0	25 Oct 2022	<ul style="list-style-type: none">Initial Achronix Release.

Achronix[®]

Data Acceleration

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