GETTING STARTED WITH THE EMP FRAMEWORK – PART 2

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THE MAGIC OF IPBUS/EMP

- The magic of IPbus is that it automagically talks to a PC
  - Assuming that the PC knows how to speak IPbus, of course

PREREQUISITES: XILINX

- Install Xilinx's Voodoo for controlling PCIe from https://github.com/Xilinx/dma_ip_drivers
- plus

Already installed: Included here for completeness

```
sudo wget
      https://github.com/RHSResearchLLC/XilinxAR65444/raw/master/Linux
/Xilinx_Answer_65444_Linux_Files/etc/udev/rules.d/xdma-udev-command.sh
      https://github.com/RHSResearchLLC/XilinxAR65444/raw/master/Linux
/Xilinx_Answer_65444_Linux_Files/etc/udev/rules.d/60-xdma.rules
      -P /etc/udev/rules.d/

sudo udevadm control --reload-rules

sudo udevadm trigger
```

PREREQUISITES: IPBUS & EMP

```
sudo yum install epel-release
```

Already installed: Included here for completeness

```
sudo curl http://serenity.web.cern.ch/serenity/emp-fwk/_downloads/emp.centos7.x86_64.repo -o /etc/yum.repos.d/emp.repo

sudo curl http://ipbus.web.cern.ch/ipbus/doc/user/html/_downloads/ipbus-sw.centos7.x86_64.repo -o /etc/yum.repos.d/ipbus-sw.repo

sudo yum clean all

sudo yum groupinstall uhal emp

sudo pip install click click_didyoumean pytest
```

PREREQUISITES

- The tools are installed in /opt/cactus, so add them to the Linux paths to your environment (i.e. in ~/.bashrc)

```
export PATH=/opt/cactus/bin/emp:$PATH
export LD_LIBRARY_PATH=/opt/cactus/lib:$LD_LIBRARY_PATH
```

Already installed: Included here for completeness

LET'S TALK TO OUR BOARD

- *In a new terminal*[1]
- Create a software directory and move into it

```
mkdir my-software

cd my-software
```

[1]Cannot run EMP software within an IPBB virtual environment

CONNECTING TO A DEVICE

- We need to give the device a name to know how to talk to it
- uHAL uses an XML file to give all known devices names
- Open connections.xml
- Add

```
<connections>
  <connection
    id="my-board"
    uri="ipbuspcie-2.0:///dev/xdma/card0/h2c0,/dev/xdma/card0/c2h0"
    address_table="file://../my-firmware/proj/my_algo/package/src/addrtab/top_emp_slim.xml"
  />
</connections>
```

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The name we give our board

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Protocol

Protocol parameters – in this case PCIe endpoints
(For IP protocols it is would be the IP address)

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```

The top-level address table in the directory created by IPBB

AND WE ARE GOOD-TO-GO

- So how? What now?

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- EMPbutler
  - Command-line utility for doing “common” tasks in the EMP infrastructure without having to know anything that is going on under-the-hood

AND WE ARE GOOD-TO-GO

- Can we reset the EMP clocking infrastructure?

```
empbutler -c connections.xml do my-board reset internal
```

AND PLAY DATA THROUGH OUR ALGO!

- Configure inputs to play data through our firmware

```
empbutler -c connections.xml do my-board buffers rx PlayOnce -c 0-31
--inject generate://pattern
```

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empbutler -c connections.xml do my-board buffers rx PlayOnce -c 0-31
--inject generate://pattern
```
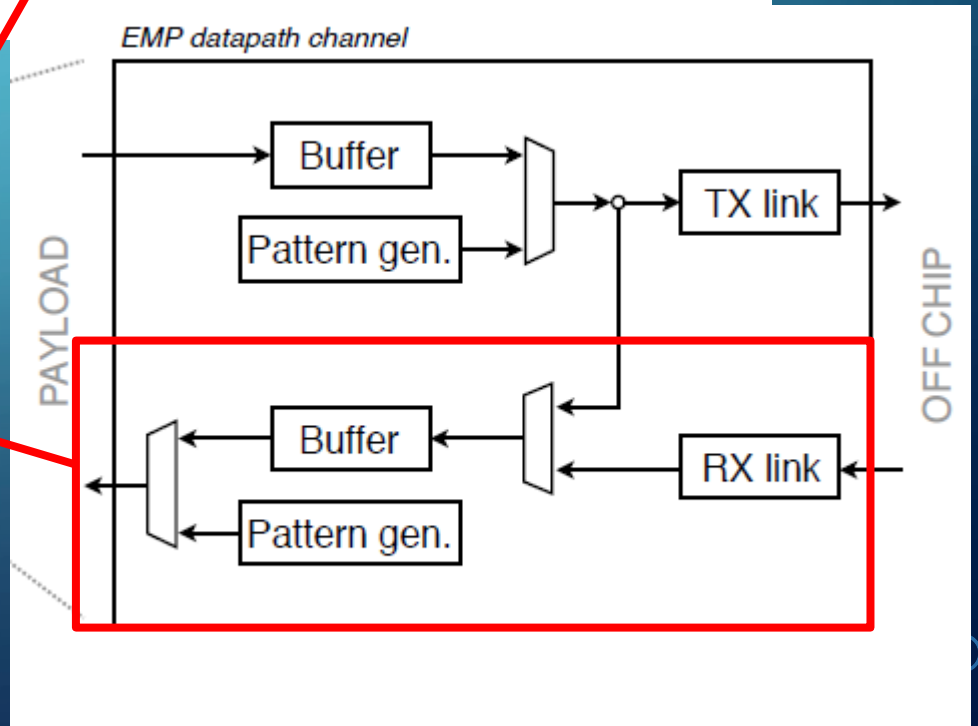

We are pretending the data is coming off the link



AND PLAY DATA THROUGH OUR ALGO!

- Configure inputs to play data through our firmware

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empbutler -c connections.xml do my-board buffers rx PlayOnce -c 0-31
--inject generate://pattern
```

We need to specify which links

AND PLAY DATA THROUGH OUR ALGO!

- Configure inputs to play data through our firmware

```
empbutler -c connections.xml do my-board buffers rx PlayOnce -c 0-31
--inject generate://pattern
```

We use the inbuilt pattern generator

- Could also do

```
file://path/to/input_data.txt
generate://empty
generate://random
```

AND PLAY DATA THROUGH OUR ALGO!

- Configure outputs to capture data from our firmware

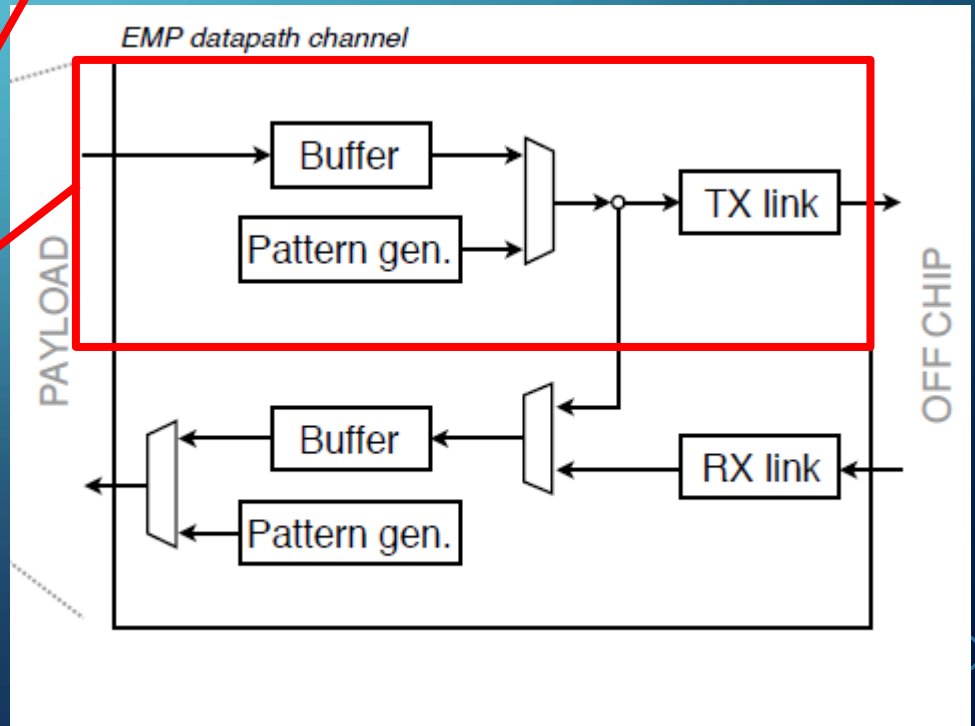
```
empbutler -c connections.xml do my-board buffers tx Capture -c 0-31
```

AND PLAY DATA THROUGH OUR ALGO!

- Configure outputs to capture data from our firmware

```
empbutler -c connections.xml do my-board buffers tx Capture -c 0-31
```

We are capturing the data which would be going out on the link



AND PLAY DATA THROUGH OUR ALGO!

- Configure outputs to capture data from our firmware

```
empbutler -c connections.xml do my-board buffers tx Capture -c 0-31
```

Again, we need to specify which links

AND PLAY DATA THROUGH OUR ALGO!

- And then do the capture

```
empbutler -c connections.xml do my-board capture --rx 0-31 --tx 0-31
```

- The captured rx/tx data is written to data/rx_summary.txt and data/tx_summary.txt respectively
  - Although the directory can be changed using the -o argument

IT SHOULD LOOK LIKE

```
Board my-board
 Quad/Chan :        q00c0             q00c1             q00c2             q00c3             q01c0             q01c1
      Link :          000               001               002               003               004               005
Frame 0000 : 0v0000000000000000 0v0000000000010000 0v0000000000020000 0v0000000000030000 0v0000000000040000 0v0000000000050000
Frame 0001 : 0v0000000000000000 0v0000000000010000 0v0000000000020000 0v0000000000030000 0v0000000000040000 0v0000000000050000
Frame 0002 : 0v0000000000000000 0v0000000000010000 0v0000000000020000 0v0000000000030000 0v0000000000040000 0v0000000000050000
Frame 0003 : 0v0000000000000000 0v0000000000010000 0v0000000000020000 0v0000000000030000 0v0000000000040000 0v0000000000050000
Frame 0004 : 0v0000000000000000 0v0000000000010000 0v0000000000020000 0v0000000000030000 0v0000000000040000 0v0000000000050000
Frame 0005 : 0v0000000000000000 0v0000000000010000 0v0000000000020000 0v0000000000030000 0v0000000000040000 0v0000000000050000
Frame 0006 : 0v0000000000000000 0v0000000000010000 0v0000000000020000 0v0000000000030000 0v0000000000040000 0v0000000000050000
Frame 0007 : 1v0000000000000000 1v0000000000010000 1v0000000000020000 1v0000000000030000 1v0000000000040000 1v0000000000050000
Frame 0008 : 1v0000000000000001 1v0000000000010001 1v0000000000020001 1v0000000000030001 1v0000000000040001 1v0000000000050001
Frame 0009 : 1v0000000000000002 1v0000000000010002 1v0000000000020002 1v0000000000030002 1v0000000000040002 1v0000000000050002
Frame 0010 : 1v0000000000000003 1v0000000000010003 1v0000000000020003 1v0000000000030003 1v0000000000040003 1v0000000000050003
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Frame 0017 : 1v000000000000000a 1v000000000001000a 1v000000000002000a 1v000000000003000a 1v000000000004000a 1v000000000005000a
Frame 0018 : 1v000000000000000b 1v000000000001000b 1v000000000002000b 1v000000000003000b 1v000000000004000b 1v000000000005000b
Frame 0019 : 1v000000000000000c 1v000000000001000c 1v000000000002000c 1v000000000003000c 1v000000000004000c 1v000000000005000c
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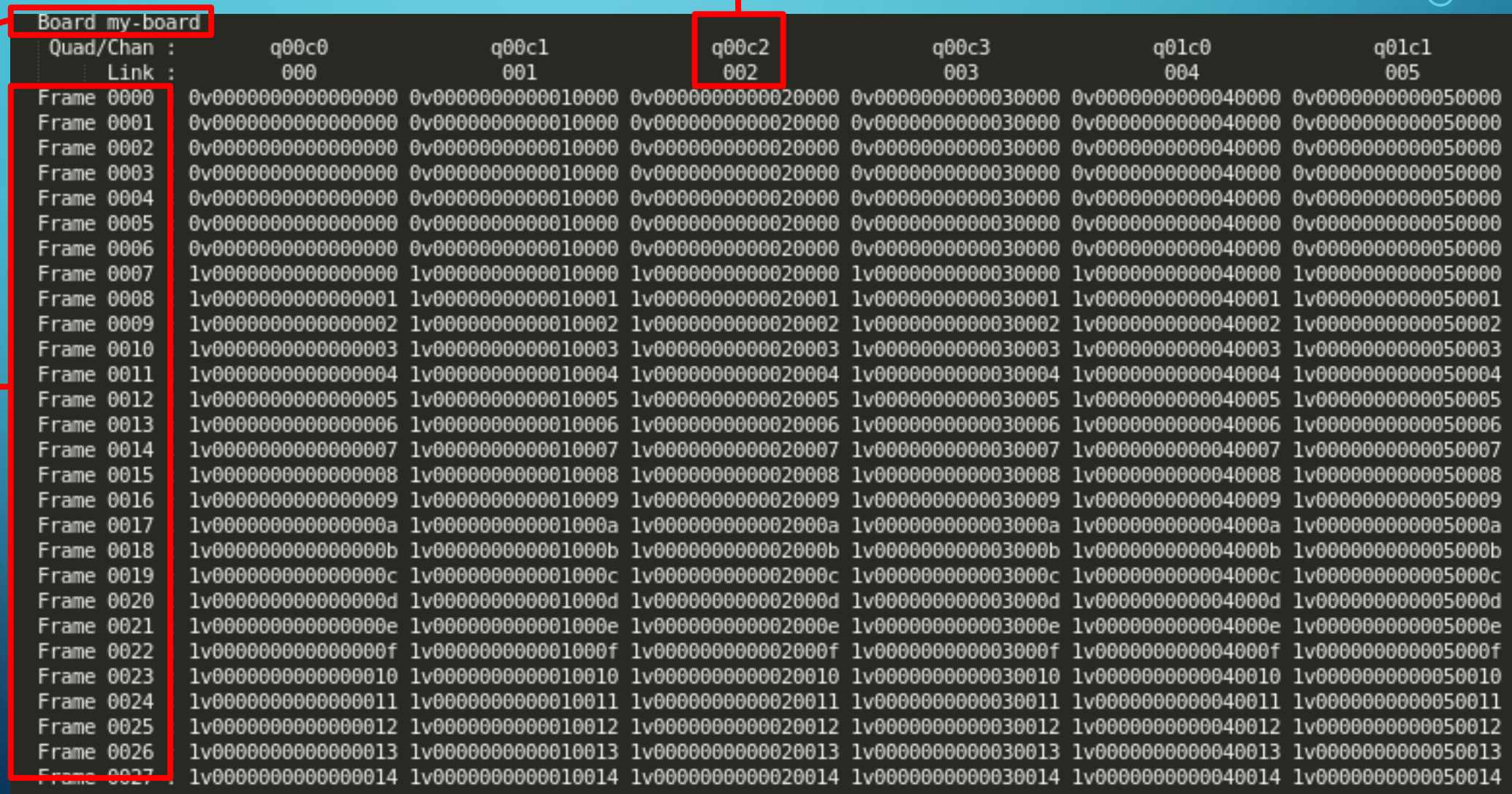
Frame 0026 : 1v0000000000000013 1v0000000000010013 1v0000000000020013 1v0000000000030013 1v0000000000040013 1v0000000000050013
Frame 0027 : 1v0000000000000014 1v0000000000010014 1v0000000000020014 1v0000000000030014 1v0000000000040014 1v0000000000050014
```

IT SHOULD LOOK LIKE

Quad+Channel
Logical channel

Board name
is included

Clock cycles since
the event reset



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IT SHOULD LOOK LIKE

Invalid data

Valid data

```
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      Link :         000              001              002              003              004              005
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