# UDP Encoder Interface (rix Mono Encoder)

## Overview

## Data Format 1.0.0

At each trigger, the UDP Encoder sends one header structure followed by up to eight channel structures.

See the definitions of encoder_header_t and encoder_channel_t in github: UdpEncoder.hh

Zach writes:

> *...we're currently taking the PLC's internal encoder numerator, which is a floating point number less than zero, multiplying it by 10^6, and sending it as an integer. So, the "unit" of the output is baked into the protocol.*

## Data Format 2.0.0

Version 2.0.0 of encoder_channel_t adds a uint16_t field 'scaleDenom.' If nonzero, it is the denominator of a rational scale value.

'encoderValue' (shape: 1): 23563414
'timing' (shape: 1): 505870
'scale' (shape: 1): 1
**'scaleDenom' (shape: 1): 150**
'mode' (shape: 1): 0
'error' (shape: 1): 0
'majorVersion' (shape: 1): **2**
'minorVersion' (shape: 1): 0
'microVersion' (shape: 1): 0

See the definitions of encoder_header_t and encoder_channel_t in github: UdpEncoder.hh

Zach writes:

> *...if the denominator is used, we do no pre or post multiplication of the values. If I need to express something like numerator = 1.16 and denominator = 5.0, I would send 116 and 500 which maintains the same ratio as the original.*
>
> *In the specific case of this encoder, I send 1 and 150 exactly and your code on the other side simply doesn't do the *1e-6 step because a denominator is present.*

Along with the introduction of data format 2.0.0, encoder detector version was updated to 2.0.0 as well. Here is the first run to be recorded with version 2.0.0:

**detnames -r**

```
$ detnames -r /cds/data/psdm/rix/rixlx9720/xtc/rixlx9720-r0263-s000-c000.xtc2
----------------------------------------------
Name         | Det Type  | Data Type | Version
----------------------------------------------
chunkinfo    | chunkinfo | chunkinfo | 0_0_1
runinfo      | runinfo   | runinfo   | 0_0_1
mono_encoder | encoder   | raw       | 2_0_0
----------------------------------------------
```

## Testing With Encoder Simulator (sim_udpencoder)

To test with the simulator, run sim_udpencoder on the same host as drp_udpencoder and use the matching "-p <partition>" setting. The simulator sends packets to drp_udpencoder via localhost (127.0.0.1).

**sim_udpencoder usage**

```
$ sim_udpencoder -h
Usage: sim_udpencoder [options]
Options: -r <rate> (0:929kHz,1:71kHz,..)
         -e <evcode>
         -p <partition>
         -d <data port>  (default 5006)
         -v (verbose)
Either -r or -e or -p is required
```

Send SIGUSR1 to the sim_udpencoder process to simulate a dropped UDP packet.

$ kill -USR1 *pid*

Send SIGUSR2 to the sim_udpencoder process to simulate 4 consecutive dropped UDP packets.

$ kill -USR2 *pid*

# Testing With Loopback Mode (drp_udpencoder -L <loopback_port>)

## Configuring TPR On DAQ Partition

**tprtrig**

```
You can get tprtrig to trigger the EVR on a DAQ partition, then sleep, like so:
    $ tprtrig -t a -c 0 -o 1 -d 2 -w 10 -p 4 -z
programs EVR /dev/tpra (-t a) to generate a TTL trigger using logic channel 0 (-c 0) on output 0 (-o 1 [bit
mask]) with delay of 2 119MHz clocks (-d 2) and width 10 119 MHz clocks (-w 10) for every L1Accept on partition
4 (-p 4).
```

## Configuring TPR Standalone

**tprtrig**

```
Generate 1Hz triggers on output 0 with a width of 54 nanoseconds, then sleep.

    $ tprtrig -t a -c 0 -o 1 -d 1 -w 10 -r 6 -z
```

## Loopback Mode

In loopback mode no encoder or PLC or added process is required, as drp_udpencoder sends and receives simulated data via localhost.

Run drp_udpencoder with the -L <loopback_port> flag to enable loopback mode.  For example, "-L 5007" loops back on localhost port 5007.

## Monitoring UDP packets with netcat

```
-bash-4.2$ hostname
drp-neh-cmp015

-bash-4.2$ nc -lvu 192.168.0.8 5006
Ncat: Version 7.50 ( https://nmap.org/ncat )
Ncat: Listening on 192.168.0.8:5006
Ncat: Connection from 192.168.0.3.
'plc-tst-proto6w?
                 ?bdSimEncoder
(plc-tst-proto6Q?
                 ?zdSimEncoder
)plc-tst-proto6+g
                 ??dSimEncoder
*plc-tst-proto6
               ??dSimEncoder
+plc-tst-proto6
               ??dSimEncoder^C
-bash-4.2$
```

## Updates to rix.cnf file

```
$ diff rix.cnf rix.cnf.ENCODER
67a68,69
>  { host: 'drp-neh-ctl002', id:'tprtrig',     flags:'sp',             cmd:'tprtrig -t a -c 0 -o 1 -d 2 -w 10 -
z'},
>  { host: 'drp-neh-cmp015', id:'encoder_0',   flags:'spu', rtprio:50, cmd:f'drp_udpencoder -l 0x8 -o
{data_dir} -P {hutch} -d /dev/datadev_0 -C {collect_host}'},
```

## Recording Experiment rixdaq18 Run 23

**encoder_0 log file**

```
rix-drp_udpencoder[70415]: <I> UDP receiver thread started
rix-drp_udpencoder[70415]: <I> setting lane 0
rix-drp_udpencoder[70415]: <I> PGPReader saw Configure transition @ 985133577.575584342 (0004674c799500)
rix-drp_udpencoder[70415]: <I> EbReceiver saw Configure transition @ 985133577.575584342 (0004674c799500)
rix-drp_udpencoder[70415]: <I> received key = beginrun
Opening file /ffb01/data/rix/rixdaq18/xtc/rixdaq18-r0023-s002-c000.xtc2
rix-drp_udpencoder[70415]: <I> Opening file '/ffb01/data/rix/rixdaq18/xtc/rixdaq18-r0023-s002-c000.xtc2'
rix-drp_udpencoder[70415]: <I> Opening file '/ffb01/data/rix/rixdaq18/xtc/smalldata/rixdaq18-r0023-s002-c000.
smd.xtc2'
rix-drp_udpencoder[70415]: <I> PGPReader saw BeginRun transition @ 985133590.653839154 (0004674d32e3bd)
rix-drp_udpencoder[70415]: <I> EbReceiver saw BeginRun transition @ 985133590.653839154 (0004674d32e3bd)
rix-drp_udpencoder[70415]: <I> received key = beginstep
rix-drp_udpencoder[70415]: <I> PGPReader saw BeginStep transition @ 985133595.531025432 (0004674d77fa30)
rix-drp_udpencoder[70415]: <I> EbReceiver saw BeginStep transition @ 985133595.531025432 (0004674d77fa30)
rix-drp_udpencoder[70415]: <I> received key = enable
rix-drp_udpencoder[70415]: <I> PGPReader saw Enable transition @ 985133600.224320451 (0004674dba80e8)
rix-drp_udpencoder[70415]: <I> EbReceiver saw Enable transition @ 985133600.224320451 (0004674dba80e8)
rix-drp_udpencoder[70415]: <I> received key = disable
rix-drp_udpencoder[70415]: <I> PGPReader saw Disable transition @ 985133613.263120215 (0004674e7336db)
rix-drp_udpencoder[70415]: <I> EbReceiver saw Disable transition @ 985133613.263120215 (0004674e7336db)
rix-drp_udpencoder[70415]: <I> received key = endstep
rix-drp_udpencoder[70415]: <I> PGPReader saw EndStep transition @ 985133613.268625231 (0004674e734afa)
rix-drp_udpencoder[70415]: <I> EbReceiver saw EndStep transition @ 985133613.268625231 (0004674e734afa)
rix-drp_udpencoder[70415]: <I> received key = endrun
rix-drp_udpencoder[70415]: <I> PGPReader saw EndRun transition @ 985133613.326952707 (0004674e742027)
rix-drp_udpencoder[70415]: <I> EbReceiver saw EndRun transition @ 985133613.326952707 (0004674e742027)
rix-drp_udpencoder[70415]: <I> received key = unconfigure
rix-drp_udpencoder[70415]: <I> PGPReader saw Unconfigure transition @ 985133630.918879608 (0004674f6d5f9b)
rix-drp_udpencoder[70415]: <I> EbReceiver saw Unconfigure transition @ 985133630.918879608 (0004674f6d5f9b)
```

## Recording Experiment rixdaq18 Run 27

This was the first recording of the encoder at 120Hz.

**xtcreader output**

```
$ xtcreader -d -w 1 -f /cds/data/psdm/rix/rixdaq18/xtc/rixdaq18-r0027-s000-c000.xtc2 | grep shape | head -16

'encoderValue' (shape: 1):  23563414
'timing' (shape: 1):  505870
'scale' (shape: 1):  6667
'mode' (shape: 1):  0
'error' (shape: 1):  0
'majorVersion' (shape: 1):  1
'minorVersion' (shape: 1):  0
'microVersion' (shape: 1):  0

'encoderValue' (shape: 1):  23563404
'timing' (shape: 1):  838450
'scale' (shape: 1):  6667
'mode' (shape: 1):  0
'error' (shape: 1):  0
'majorVersion' (shape: 1):  1
'minorVersion' (shape: 1):  0
'microVersion' (shape: 1):  0
```

## Recording Experiment rixlx9720 Run 262

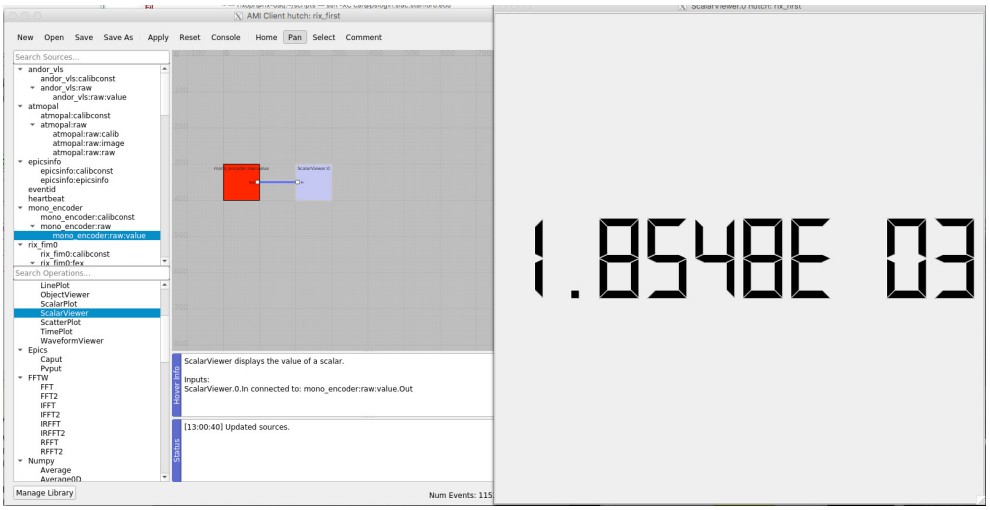
This was the first recording of the encoder using interface version 2.0.0.

**xtcreader output**

```
$ xtcreader -d -w 1 -f /cds/data/psdm/rix/rixlx9720/xtc/rixlx9720-r0262-s000-c000.xtc2 | grep shape | head -18
'encoderValue' (shape: 1):  23808197
'timing' (shape: 1):  772470
'scale' (shape: 1):  1
'scaleDenom' (shape: 1):  150
'mode' (shape: 1):  0
'error' (shape: 1):  0
'majorVersion' (shape: 1):  2
'minorVersion' (shape: 1):  0
'microVersion' (shape: 1):  0

'encoderValue' (shape: 1):  23808214
'timing' (shape: 1):  300
'scale' (shape: 1):  1
'scaleDenom' (shape: 1):  150
'mode' (shape: 1):  0
'error' (shape: 1):  0
'majorVersion' (shape: 1):  2
'minorVersion' (shape: 1):  0
'microVersion' (shape: 1):  0
```

## Viewing Encoder Value in AMI




## Run Encoder Sim on Remote Host

Earlier (2022) the sim was limited to localhost.

**Listen on drp-tst-acc01**

```
-bash-4.2$ hostname
drp-tst-acc01
-bash-4.2$ nc  -lvu 172.21.148.201 5006
Ncat: Version 7.50 ( https://nmap.org/ncat )
Ncat: Listening on 172.21.148.201:5006
Ncat: Connection from 172.21.148.110.
sim_updencodersim_updencodersim_updencodersim_updencodersim_updencoder
```

**Send from daq-tst-dev03**

```
(ps-4.5.26) -bash-4.2$ hostname
daq-tst-dev03.pcdsn
(ps-4.5.26) -bash-4.2$ sim_udpencoder -r 0 -a 172.21.148.201 | head -4
 Version          PulseID        TimeStamp  Markers  BeamReq          BsaInit         BsaActiv          BsaAvgD
        BsaDone
   10000       374b0fc41f    3e4f023b73138    10040        0                0                0                0
             0
   10000       374b0fc420    3e4f023b7356d    10040        0                0                0                0
             0
   10000       374b0fc421    3e4f023b739a2    10040        0                0                0                0
             0
```