REMOTE HANDS-ON session

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WP6 - CERN

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INTRODUCTION

All the tests have been done using the following setup

- **readout -> v1.4.4-X**
- **CRU FW -> 3.7.0**
- **CRORC FW -> dev**

INSTALL the O2 software

follow this link

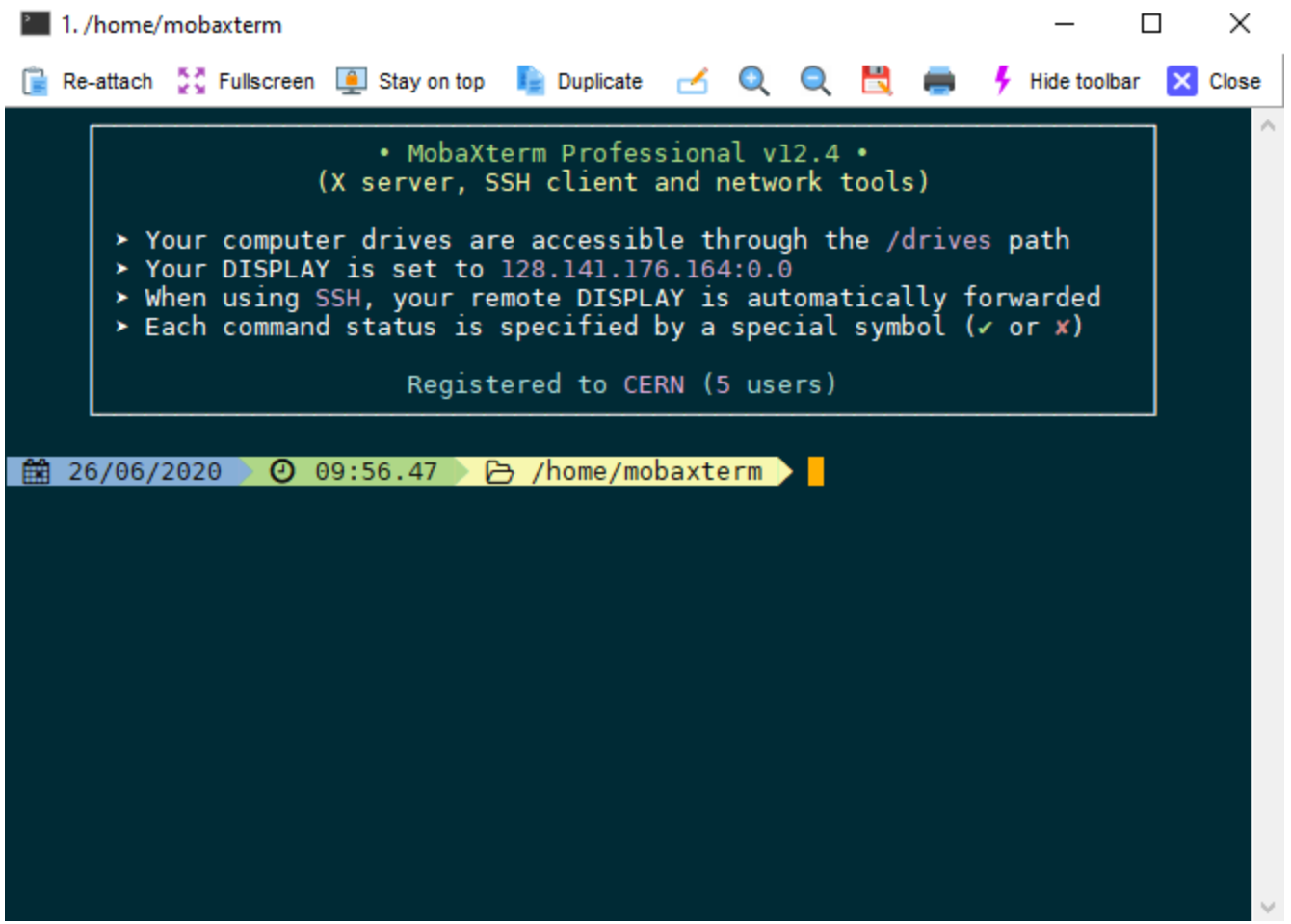
CMD summary:

```
ssh root@<test-machine>
bash <(curl -s https://cernbox.cern.ch/index.php/s/kNMAmYaN9l6RaKD/download)
o2-flp-setup install
o2-flp-setup checkout flp-suite-vX.Y.Z
export ANSIBLE_LOG_PATH=/root/flp-suite-deployment.log
# single machine setup
o2-flp-setup deploy --head <test-machine> --flps <test-machine>
reboot
```

INSTALL a different ROC or readout software version

```
yum clean all
yum search readout
yum install -y  alisw-Readout+v1.4.4-4-1-1.el7.x86_64

ls /opt/alisw/el7/Readout
v1.4.4-4

aliswmod enter Readout
aliswmod list

# or you can specify the version you want to load

aliswmod enter Readout/v1.4.4-4
aliswmod list
```

example


1. /home/mobaxterm
Re-attach
Fullscreen
Stay on top
Duplicate
Hide toolbar
Close
• MobaXterm Professional v12.4 •
(X server, SSH client and network tools)
➤ Your computer drives are accessible through the /drives path
➤ Your DISPLAY is set to 128.141.176.164:0.0
➤ When using SSH, your remote DISPLAY is automatically forwarded
➤ Each command status is specified by a special symbol (✔ or ✘)
Registered to CERN (5 users)
26/06/2020
09:56.47
/home/mobaxterm

DETECT THE CRUs IN THE SYSTEM

lspci | grep -i altera

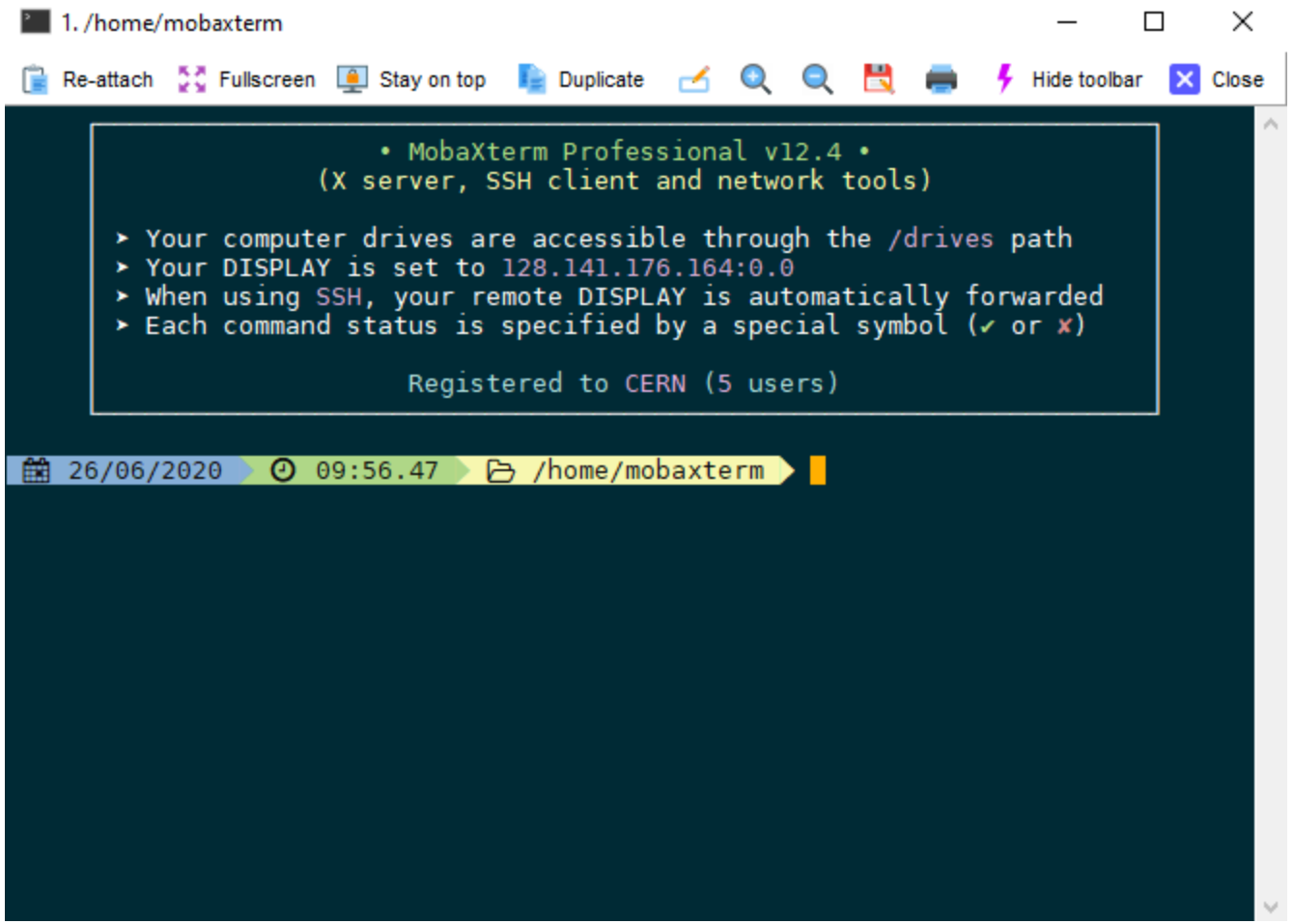
```
lspci | grep -i altera
3b:00.0 RAM memory: Altera Corporation Device e001
3c:00.0 RAM memory: Altera Corporation Device e001
af:00.0 RAM memory: Altera Corporation Device e001
b0:00.0 RAM memory: Altera Corporation Device e001
```

DETECT THE CRORCs IN THE SYSTEM

lspci | grep -i cern

```
lspci | grep -i cern
af:00.0 Multimedia video controller: CERN/ECP/EDU Device 0033 (rev 07)
```

example


1. /home/mobaxterm
Re-attach
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• MobaXterm Professional v12.4 •
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➤ Your DISPLAY is set to 128.141.176.164:0.0
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➤ Each command status is specified by a special symbol (✔ or ✘)
Registered to CERN (5 users)
26/06/2020
09:56.47
/home/mobaxterm

List the cards installed

- Addressing
  - PCI Address
  - Sequence Number
  - Serial, Endpoint ID
    - From EEPROM
    - Pre-production CRUs
    - Production CRUs
- Compatibility
  - Firmware version
    - tag (supported)
    - commit (unsupported)

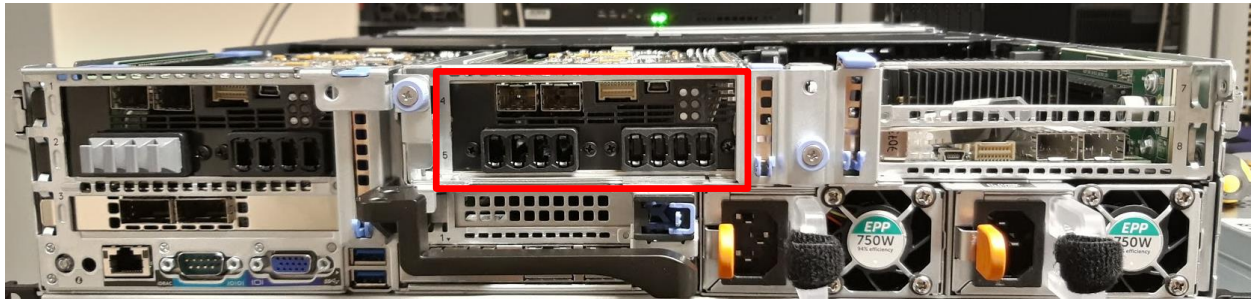
```
roc-list-cards
================================================================================
  #   Type   PCI Addr   Serial   Endpoint   NUMA  FW Version   UL Version
--------------------------------------------------------------------------------
  0   CRU    af:00.0    0559     0          1     75e22511     75e22511
  1   CRU    3b:00.0    0023     0          0     v3.7.0       f8cecade
  2   CRU    3c:00.0    0023     1          0     v3.7.0       f8cecade
  3   CRU    b0:00.0    0559     1          1     75e22511     75e22511
================================================================================
```

How to address the card

- Addressing
  - PCI Address
  - Sequence Number
  - Serial:Endpoint ID

```
roc-list-cards
=================================================================================
  #   Type   PCI Addr   Serial    Endpoint   NUMA   FW Version    UL Version
---------------------------------------------------------------------------------
  0   CRU    af:00.0    0559      0          1      75e22511      75e22511
  1   CRU    3b:00.0    0023      0          0      v3.7.0        f8cecade
  2   CRU    3c:00.0    0023      1          0      v3.7.0        f8cecade
  3   CRU    b0:00.0    0559      1          1      75e22511      75e22511
=================================================================================
```

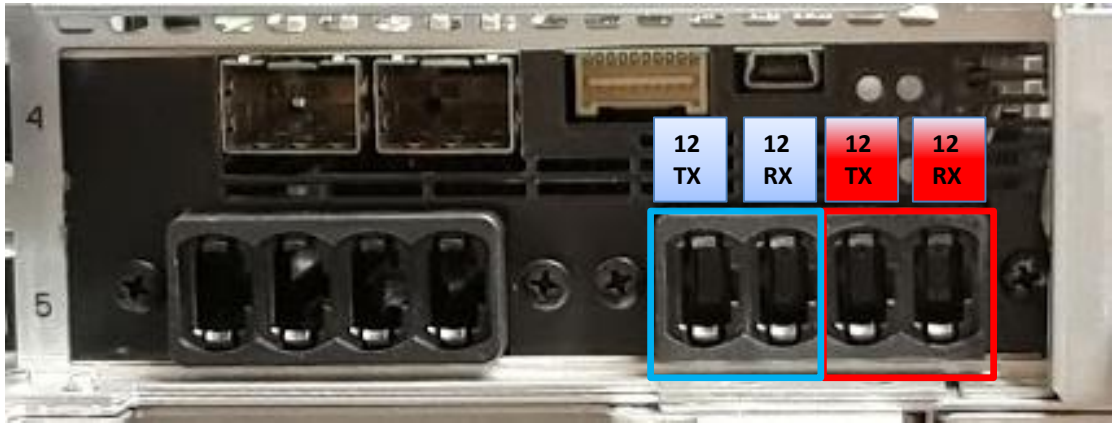
CRU – END POINTS




```
lspci | grep -i altera
3b:00.0 RAM memory: Altera Corporation Device e001 (EP0)
3c:00.0 RAM memory: Altera Corporation Device e001 (EP1)
```

```
roc-list-cards
=================================================================================
  #    Type    PCI Addr    Serial    Endpoint    NUMA   FW Version    UL Version
---------------------------------------------------------------------------------
  0    CRU     3b:00.0     0023      0           0      v3.7.0        f8cecade
  1    CRU     3c:00.0     0023      1           0      v3.7.0        f8cecade
=================================================================================
```

CRU – END POINTS




```
lspci | grep -i altera
3b:00.0 RAM memory: Altera Corporation Device e001 (EP0)
3c:00.0 RAM memory: Altera Corporation Device e001 (EP1)
```

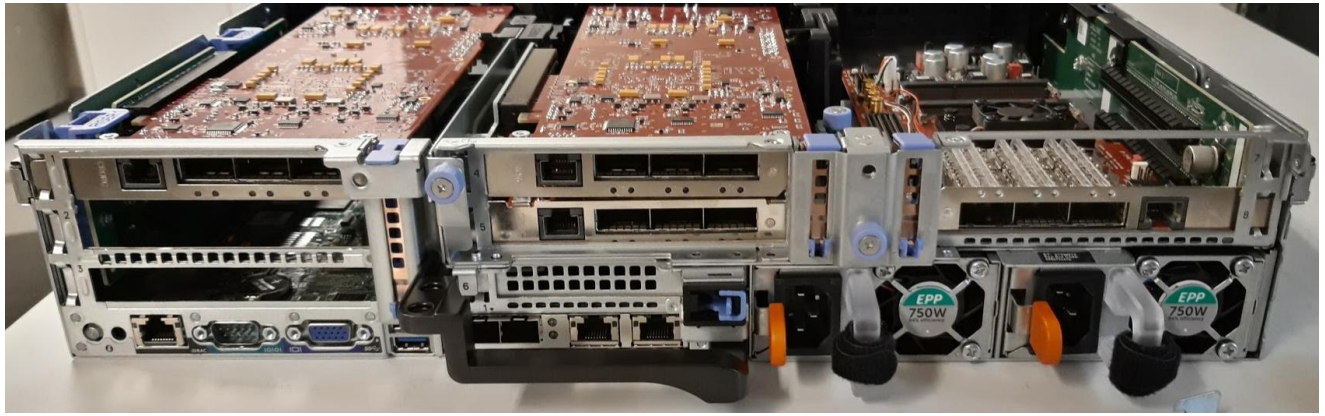
```
roc-list-cards
=================================================================================
  #    Type    PCI Addr    Serial    Endpoint    NUMA   FW Version    UL Version
---------------------------------------------------------------------------------
  0    CRU     3b:00.0     0023      0           0      v3.7.0        f8cecade
  1    CRU     3c:00.0     0023      1           0      v3.7.0        f8cecade
=================================================================================
```

List the cards installed

- Addressing
  - PCI Address
  - Sequence Number
  - Serial, Endpoint ID
- Compatibility
  - Firmware version
    - tag (supported)
    - commit (unsupported)

```
roc-list-cards
================================================================================
  #   Type   PCI Addr   Serial   Endpoint   NUMA  FW Version   UL Version
--------------------------------------------------------------------------------
  0   CRORC  03:00.0    1234     0          0     ca9395a      n/a
================================================================================
```

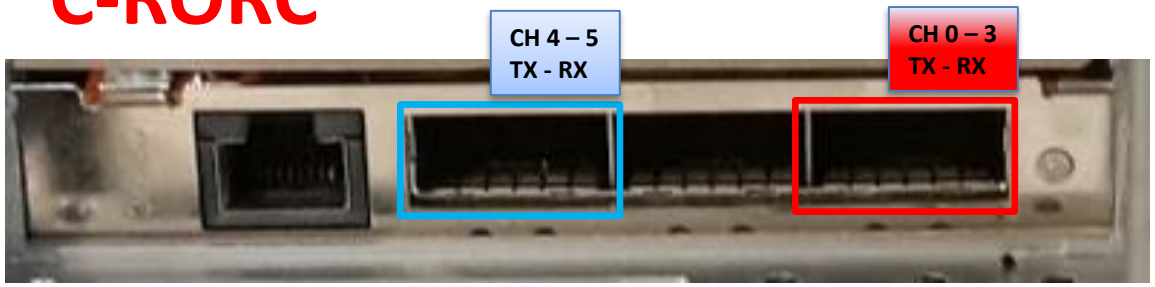
C-RORC




```
lspci | grep -i cern
af:00.0 Multimedia video controller: CERN/ECP/EDU Device 0033 (rev 07)
```

```
 roc-list-cards
================================================================================
  #    Type    PCI Addr    Serial    Endpoint    NUMA  FW Version    UL Version
--------------------------------------------------------------------------------
  0    CRORC   03:00.0     1234      0           0     ca9395a       n/a
================================================================================
```

C-RORC




```
lspci | grep -i cern
af:00.0 Multimedia video controller: CERN/ECP/EDU Device 0033 (rev 07)
```

```
 roc-list-cards
================================================================================
  #    Type    PCI Addr    Serial    Endpoint    NUMA  FW Version    UL Version
--------------------------------------------------------------------------------
  0    CRORC   03:00.0     1234      0           0     ca9395a       n/a
================================================================================
```

Check the status of the card (CARD not configured)

```
roc-status --i=#0
----------------------------
Local clock | Fixed offset
User Logic Disabled
----------------------------
```

Link ID	GBT Mode Tx/Rx	Loopback	GBT MUX	Datapath Mode	Datapath	RX freq(MHz)	TX freq(MHz)	Status	Optical power(uW)
0	GBT/GBT	None	TTC:CTP	Continuous	Disabled	172.01	158.03	DOWN	0.0
1	GBT/GBT	None	TTC:CTP	Continuous	Disabled	177.93	186.38	DOWN	0.0
2	GBT/GBT	None	TTC:CTP	Continuous	Disabled	167.47	158.03	DOWN	0.0
3	GBT/GBT	None	TTC:CTP	Continuous	Disabled	185.69	186.38	DOWN	0.0
4	GBT/GBT	None	TTC:CTP	Continuous	Disabled	169.14	158.03	DOWN	0.0
5	GBT/GBT	None	TTC:CTP	Continuous	Disabled	173.04	186.38	DOWN	0.0
6	GBT/GBT	None	TTC:CTP	Continuous	Disabled	168.10	158.03	DOWN	0.0
7	GBT/GBT	None	TTC:CTP	Continuous	Disabled	190.24	186.38	DOWN	0.0
8	GBT/GBT	None	TTC:CTP	Continuous	Disabled	70.55	158.03	DOWN	0.0
9	GBT/GBT	None	TTC:CTP	Continuous	Disabled	181.59	186.38	DOWN	0.0
10	GBT/GBT	None	TTC:CTP	Continuous	Disabled	104.61	158.03	DOWN	0.0
11	GBT/GBT	None	TTC:CTP	Continuous	Disabled	165.47	186.38	DOWN	0.0

Configure the card

- Configure the CRU:
  - continuous mode
  - packet mode
  - dynamic offset
  - CRUID
  - linkmask
  - loopback
  - downstream (CRU -> FEE)
  - …

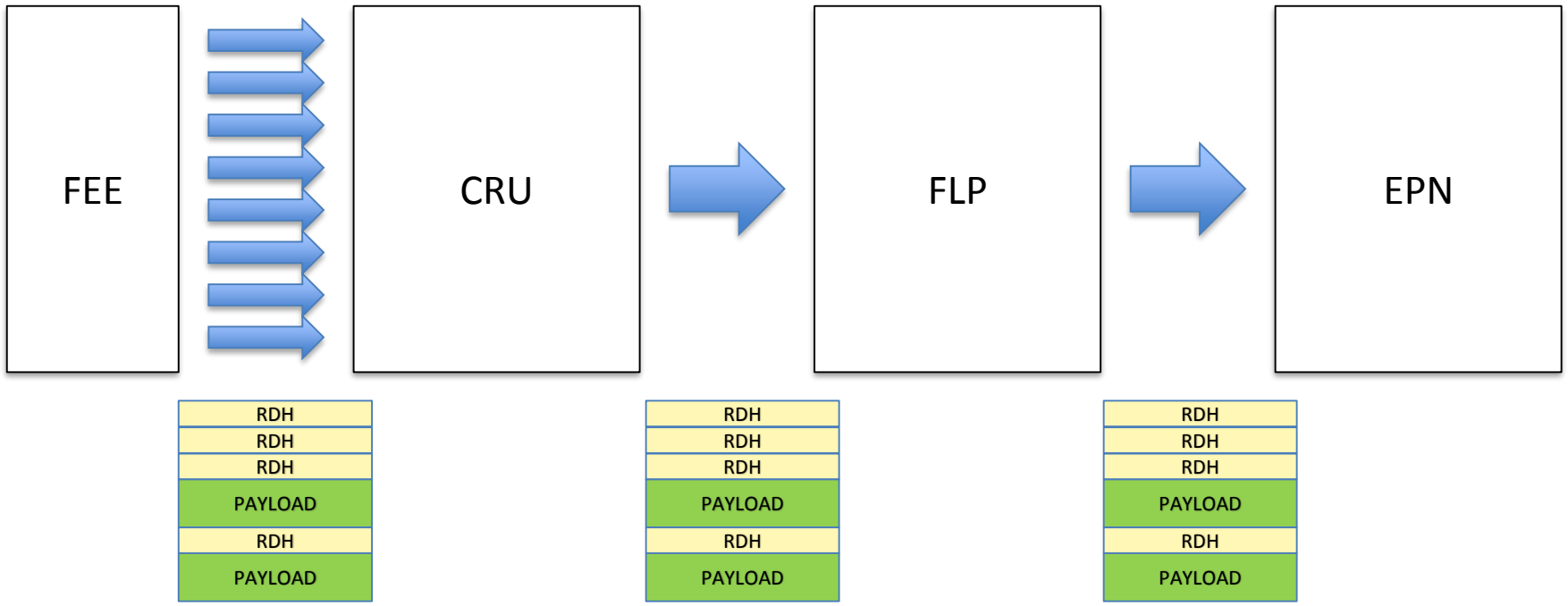
```
roc-config -h
Program options invalid: Unknown option '-h'

#### Config
Configure the ReadoutCard(s)

Allowed options:
  --help                        Produce help message
  --verbose                     Verbose output
  --version                     Display RORC library version
  --allow-rejection             Flag to allow HBF rejection
  --clock arg (=LOCAL)          Clock [LOCAL, TTC]
  --crorc-id arg (=0x0)         12-bit CRORC ID
  --cru-id arg (=0x0)           12-bit CRU ID
  --datapathmode arg (=PACKET)  DatapathMode [PACKET, CONTINUOUS]
  --downstreamdata arg (=CTP)   DownstreamData [CTP, PATTERN, MIDTRG]
  --gbtmode arg (=GBT)          GBT MODE [GBT, WB]
  --gbtmux arg (=TTC)           GBT MUX [TTC, DDG, SWT]
  --links arg (=0)              Links to enable
  --config-uri arg              Configuration URI ('ini://[path]', 'json://[path]' or 'consul://[host][:port][/path]'
  --loopback                    Flag to enable link loopback for DDG
  --pon-upstream                Flag to enable use of the PON upstream
  --dyn-offset                  Flag to enable the dynamic offset
  --onu-address arg (=0)        ONU address for PON upstream
  --config-all                  Flag to configure all cards with default parameters on startup
  --force-config                Flag to force configuration and not check if the configuration is already present
  --bypass-fw-check             Flag to force configuration, bypassing the firmware checker
  --trigger-window-size arg     The size of the trigger window in GBT words
  --tf-length arg               Sets the length of the Time Frame
  --no-tf-detection             Flag to enable the Time Frame Detection
  --gen-cfg-file arg            If set generates a configuration file from the command line options. [DOES NOT CONFIGURE]
  --no-gbt                      Flag to switch off GBT
  --user-logic                  Flag to enable the User Logic link
  --id arg                      Card ID: PCI Address, Serial ID, or sequence number, as reported by `roc-list-cards`

Example:
  roc-config --config-uri ini:///home/flp/roc.cfg
roc-config --id 42:00.0 --links 0-23 --clock local --datapathmode packet --loopback --gbtmux ttc #CRU
roc-config --id #0 --crorc-id 0x42 --dyn-offset --tf-length 255 #CRORC
```

TELL ME YOUR FEE

running modes

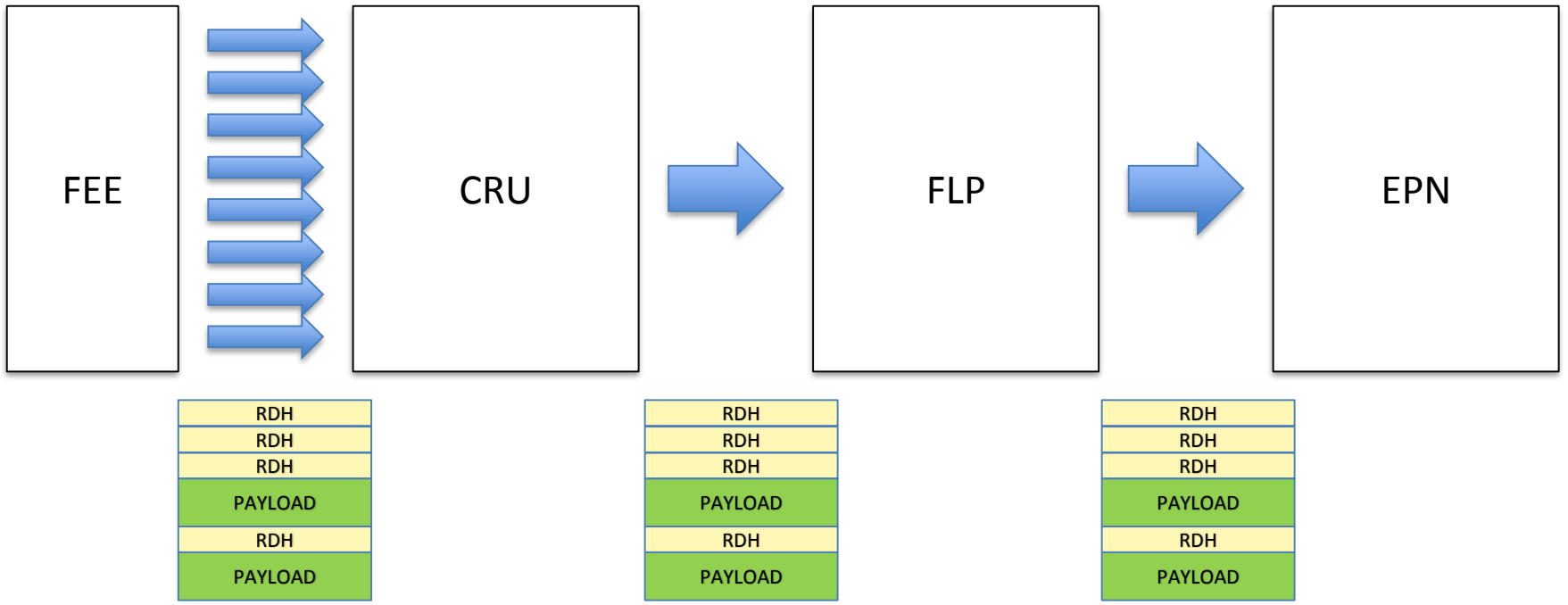
FEE TYPE	READOUT MODE	
PACKET	CONTINUOS (SOC)	TRIGGERED (SOT)
STREAMING (NO UL)	CONTINUOS (SOC)	TRIGGERED (SOT)
STREAMING (UL)	CONTINUOS (SOC)	TRIGGERED (SOT)
DDL	CONTINUOS (SOC)	TRIGGERED (SOT)

CASE 1 : FEE PACKET MODE (SOT)



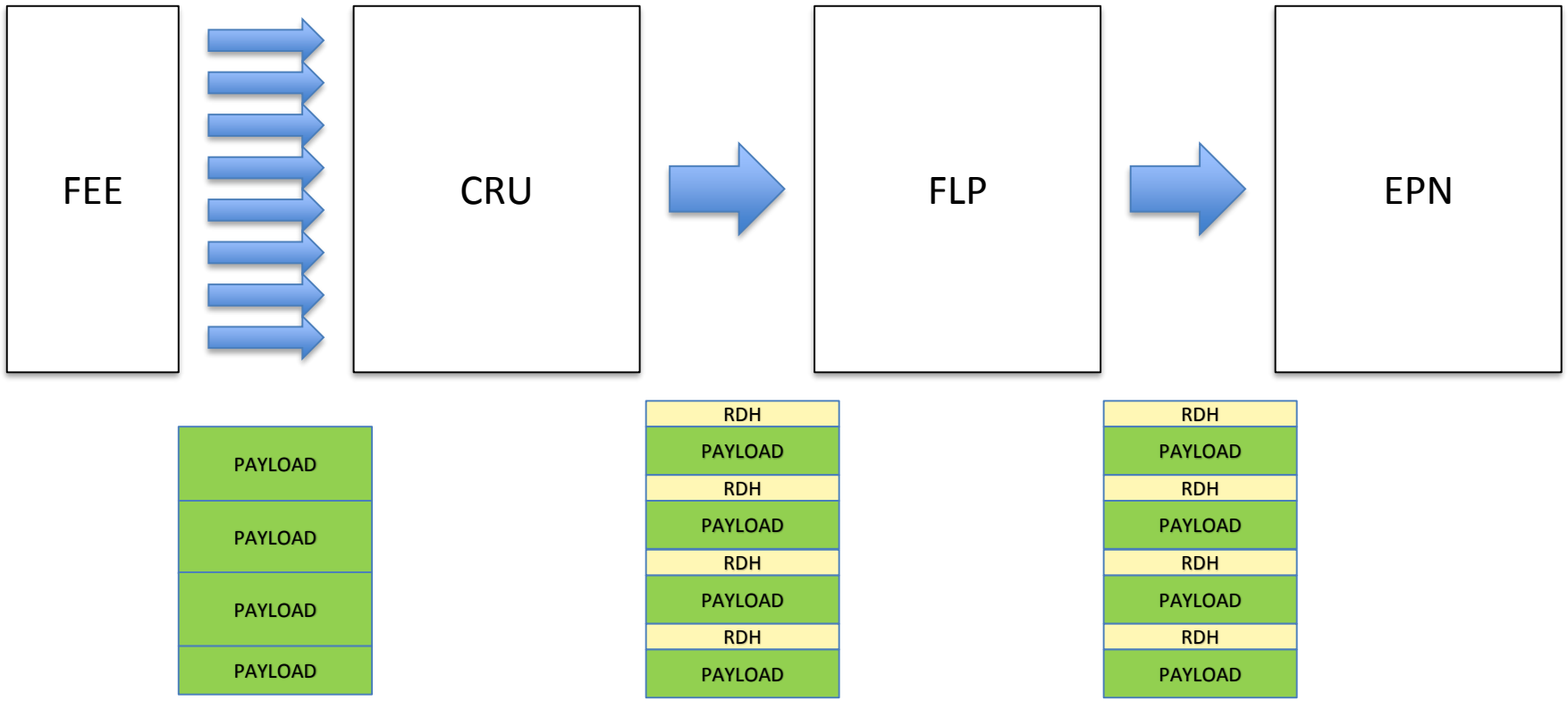
The FEE receives SOT (Start of Trigger) and generates RDH for every HB trigger.
All the HB frames are empty, PAYLOAD (green block) is added only when there is a PHY trigger in the HB frame.

CASE 2 : FEE PACKET MODE (SOC)



The FEE receives SOC (Start of Continuous) and generates RDH for every HB trigger.
The FEE is in charge to autotrigger itself, PAYLOAD is generated for every AUTOTRIGGER created in the FEE.
In this case it is not mandatory to receive PHY trigger from the LTU, but still possible.

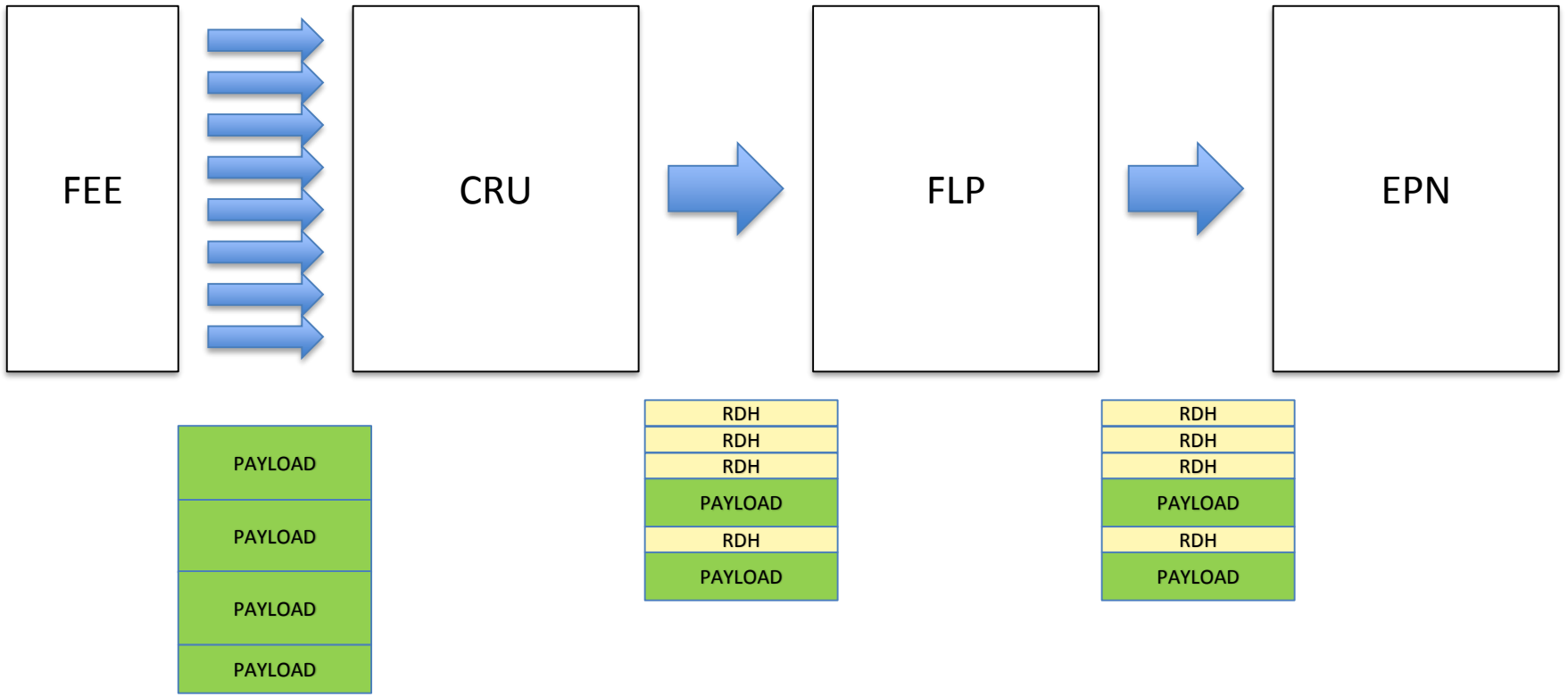
CASE 3 : FEE STREAMING MODE – NO UL (SOC)



The FEE generates a continuous stream of data.
The CRU chops the data for every HB trigger and generates HB FRAME consisting of several blocks (RDH + PAYLOAD).

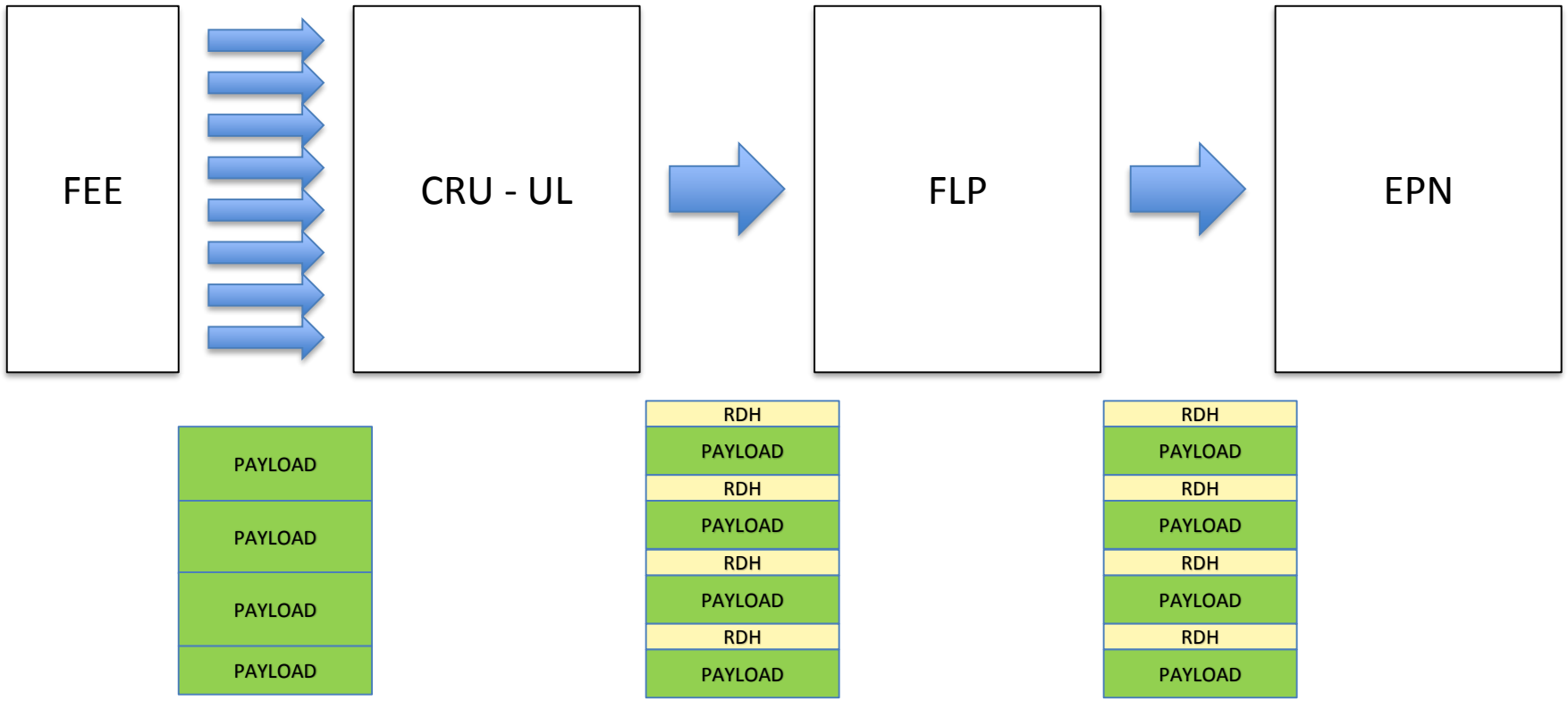
NOTE : this type of run generates a lot of data, impossible to digest. 1 GBT link -> 6 Gb/s

CASE 4 : FEE STREAMING MODE – NO UL (SOT)



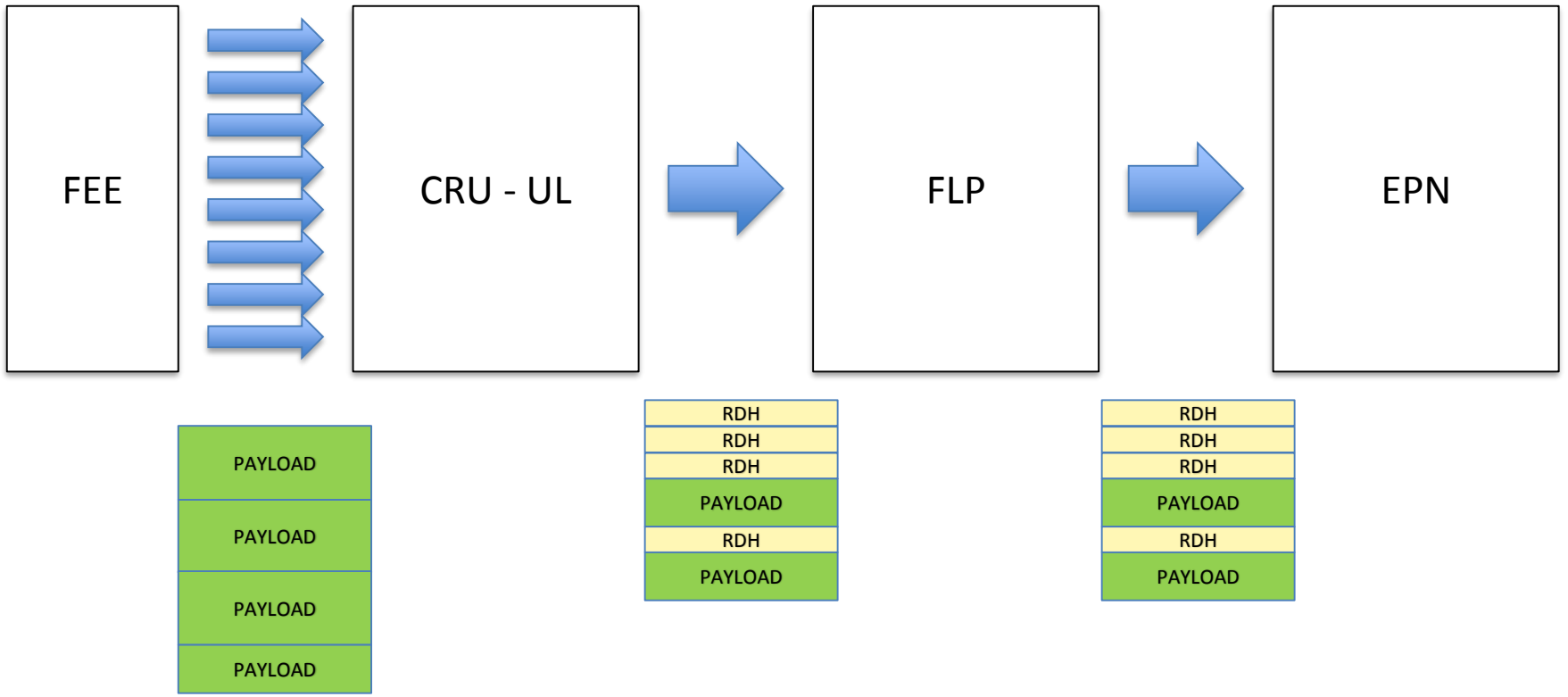
The FEE generates a continuous stream of data.
The CRU generates empty HB frame for every HB trigger.
PAYLOAD is added only when PHY trigger is detected.
REQUIREMENTS from TPC : 1 HB frame @ 10 Hz.

CASE 5 : FEE STREAMING MODE – UL (SOC)



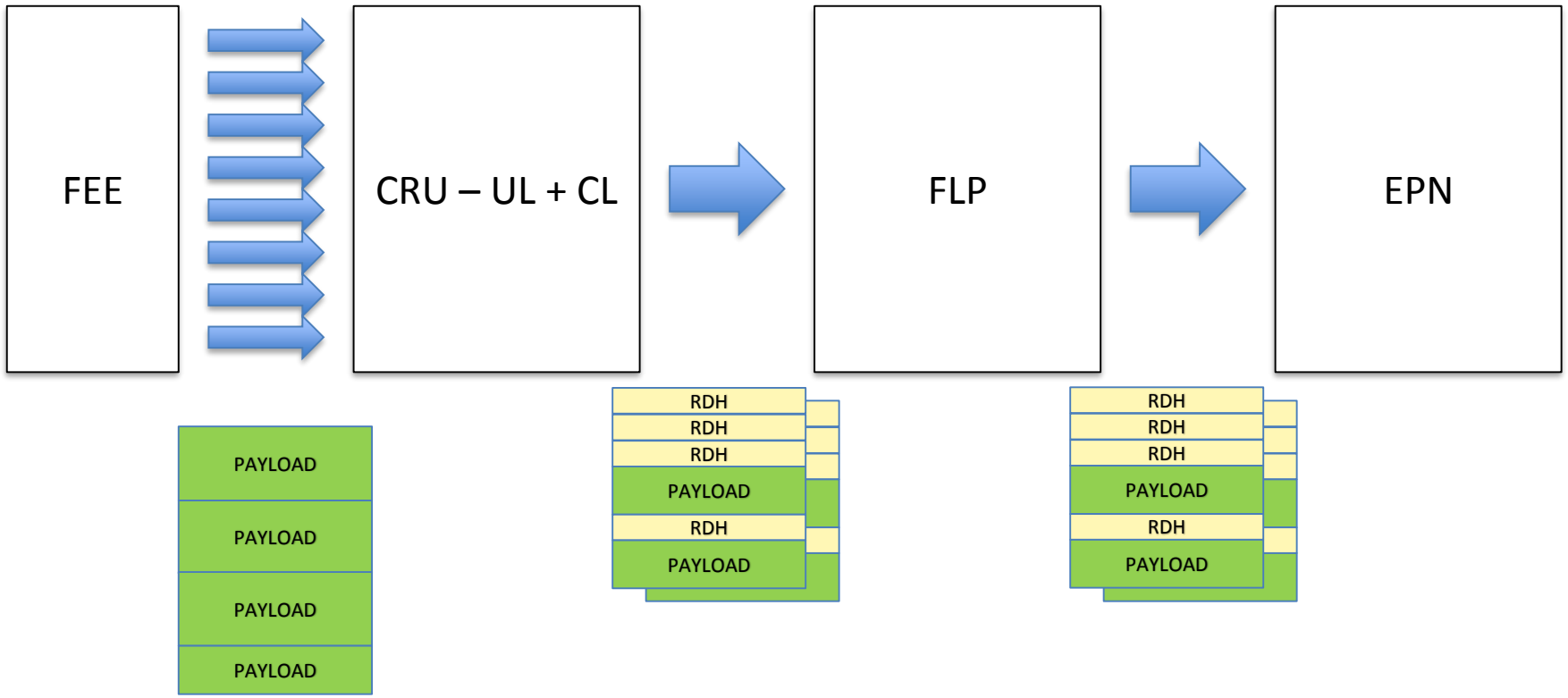
The FEE generates a continuous stream of data.
The CRU-UL processes data and generates HB frame with PAYLOAD.
The content of the payload is completely under control of the UL.
STANDARD RUNNING MODE.

CASE 6 : FEE STREAMING MODE – UL (SOT)



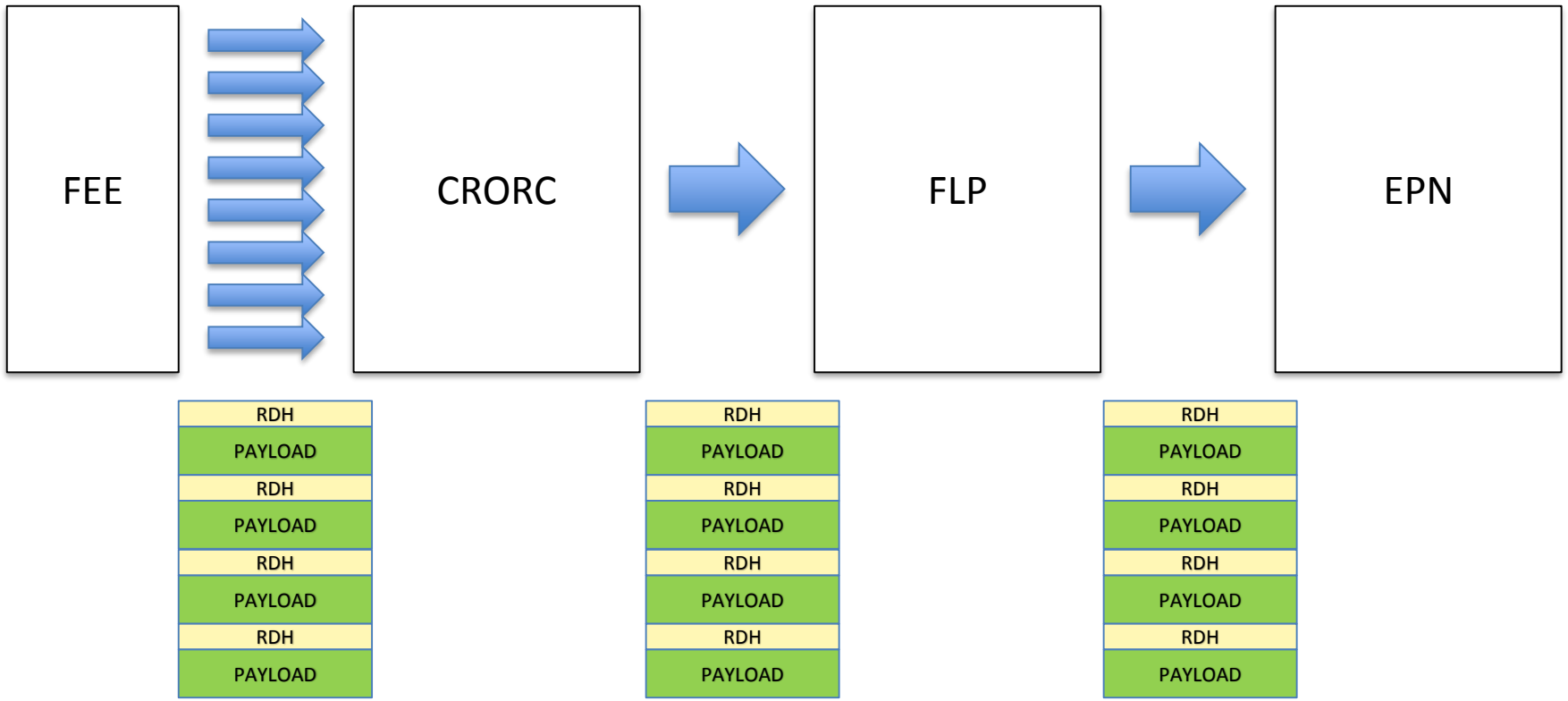
The FEE generates a continuous stream of data.
The CRU-UL processes data and generates empty HB frames. PAYLOAD is added when a PHY trigger is detected.
The content of the payload is completely under control of the UL.
STANDARD RUNNING MODE.

CASE 7 : FEE STREAMING MODE – UL + CL (Common Logic)



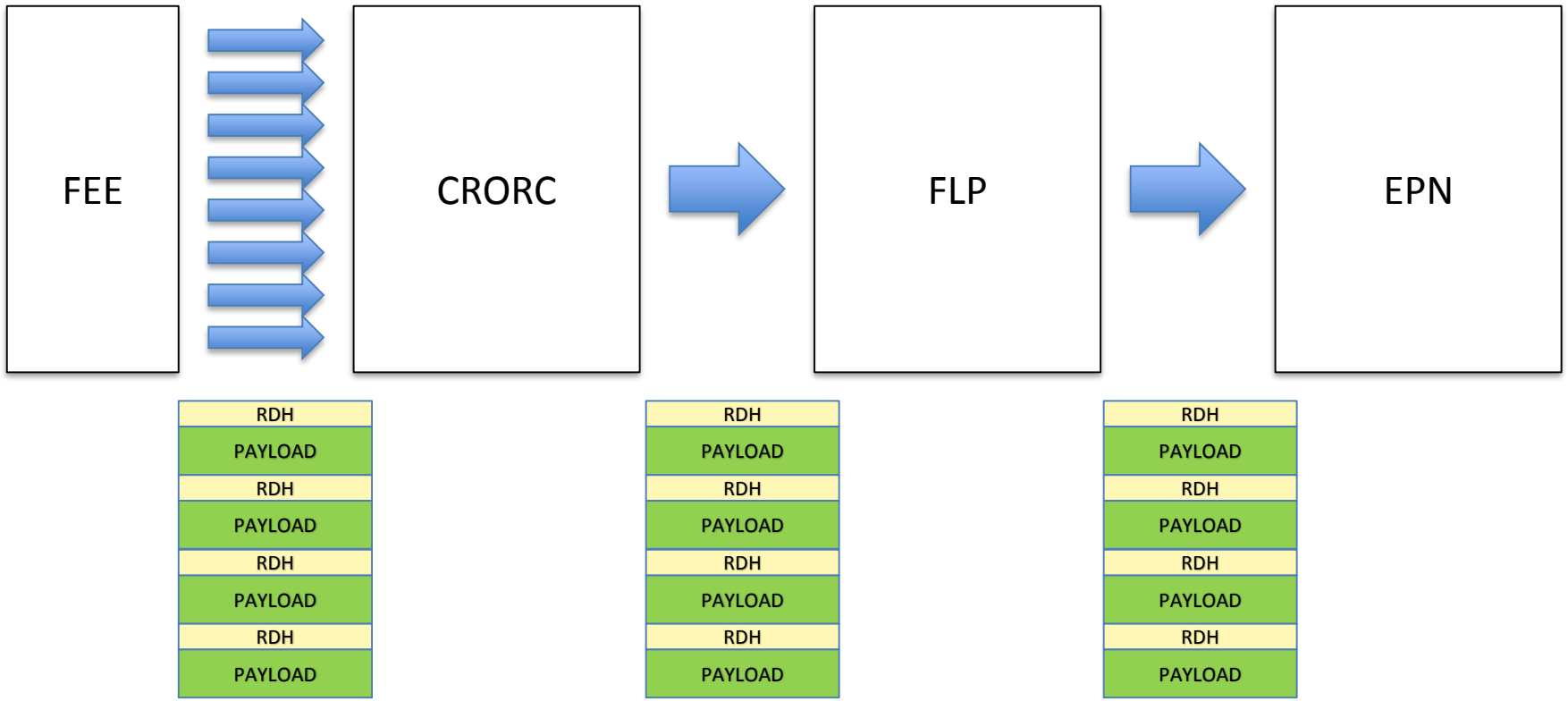
The FEE generates a continuous stream of data.
The CRU-UL processes data and generates HB frames.
The CRU at the same time chops the data and generates HB frames.
NOTE: this mode could be used to collect data from both UL and CL and compare the results.
The throughput is very high, so it can be used only in SOT mode and for debugging.

CASE 8 : FEE PACKET MODE (SOT) - CRORC



The FEE receives SOT (Start of Trigger) and generates RDH for every PHYS trigger.

CASE 9 : FEE PACKET MODE (SOC) - CRORC



The FEE receives SOC (Start of Continuous) and generates RDH for every PHYS trigger.
In this case it is not mandatory to receive PHY trigger from the LTU, but still possible.

Can a FEE-DDL autotrigger itself?

Configure the CRU streaming mode, local clock

```
roc-config --id=#0 --clock=local --links=0-3  --data=continuous --loop --gbtmux=swt  --bypass --dyn -allow

clock  -> local (no LTU)
links  -> 0-3 (4 links)
data   -> continuous (CRU chops the data based on HB trigger)
loop   -> data will not reach the FEE but it is fw back to the CRU
gbtmux -> SWT, CRU -> FEE SWT stream
bypass -> if you use a firmware not yet supported
dyn    -> dynamic offset (no fixed 8KB offset)
allow  -> HB rejected won't reach the DMA
```

MANDATORY

Configure the CRU streaming mode, LTU clock

```
roc-config --id=#0 --clock=ttc --links=0-3  --data=continuous --loop --gbtmux=swt  --bypass --dyn --pon --onu 1 --force;

clock  -> ttc (LTU)
links  -> 0-3 (4 links)
data   -> continuous (CRU chops the data based on HB trigger)
loop   -> data will not reach the FEE but it is fw back to the CRU
gbtmux -> SWT, CRU -> FEE SWT stream
bypass -> if you use a firmware not yet supported
dyn    -> dynamic offset (no fixed 8KB offset)
pon    -> enable PON upstream (CRU -> LTU)
onu    -> CRU-ONU address (needed for pon upstream)
force  -> force the clock configuration (if the clock source didn't change it is skipped otherwise)
```

MANDATORY

Configure the CRU packet mode

```
roc-config --id=#0 --clock=ttc --links=0-3  --data=packet --gbtmux=ttc  --dyn --pon --onu 1;

clock  -> ttc (LTU)
links  -> 0-3 (4 links)
data   -> packet (FEE generates GBT packet)
gbtmux -> TTC (trigger info), CRU -> FEE SWT stream
dyn    -> dynamic offset (no fixed 8KB offset)
pon    -> enable PON upstream (CRU -> LTU)
onu    -> CRU-ONU address (needed for pon upstream)
```

Configure the CRU config file

```
roc-config --i=#1 --config-uri ini:///home/flp/roc.cfg
Configuring with config uri
```

https://github.com/AliceO2Group/ReadoutCard/blob/master/cru_template.cfg

```
[cru]
# [true | false]
allowRejection=false

# [ttc | local]
clock=ttc

# 12-bit CRU ID [0xdac]
cruId=0xB

# [packet | continuous]
datapathMode=packet

# [true | false]
loopback=false

# [GBT | WB]
gbtMode=GBT

# [CTP | PATTERN | MIDTRG]
downstreamData=CTP

# [true | false]
ponUpstream=true

onuAddress=0xB

# [true | false]
dynamicOffset=true

# [<4096]
triggerWindowSize=1000

# [true | false]
gbtEnabled=true

# [true | false]
userLogicEnabled=false

[links]
# [true | false]
enabled=true

# [TTC | DDG | SWT]
gbtMux=SWT
```

Check the status of the card (CARD not configured)

```
roc-status --i=#0
----------------------------
Local clock | Fixed offset
User Logic Disabled
----------------------------
```

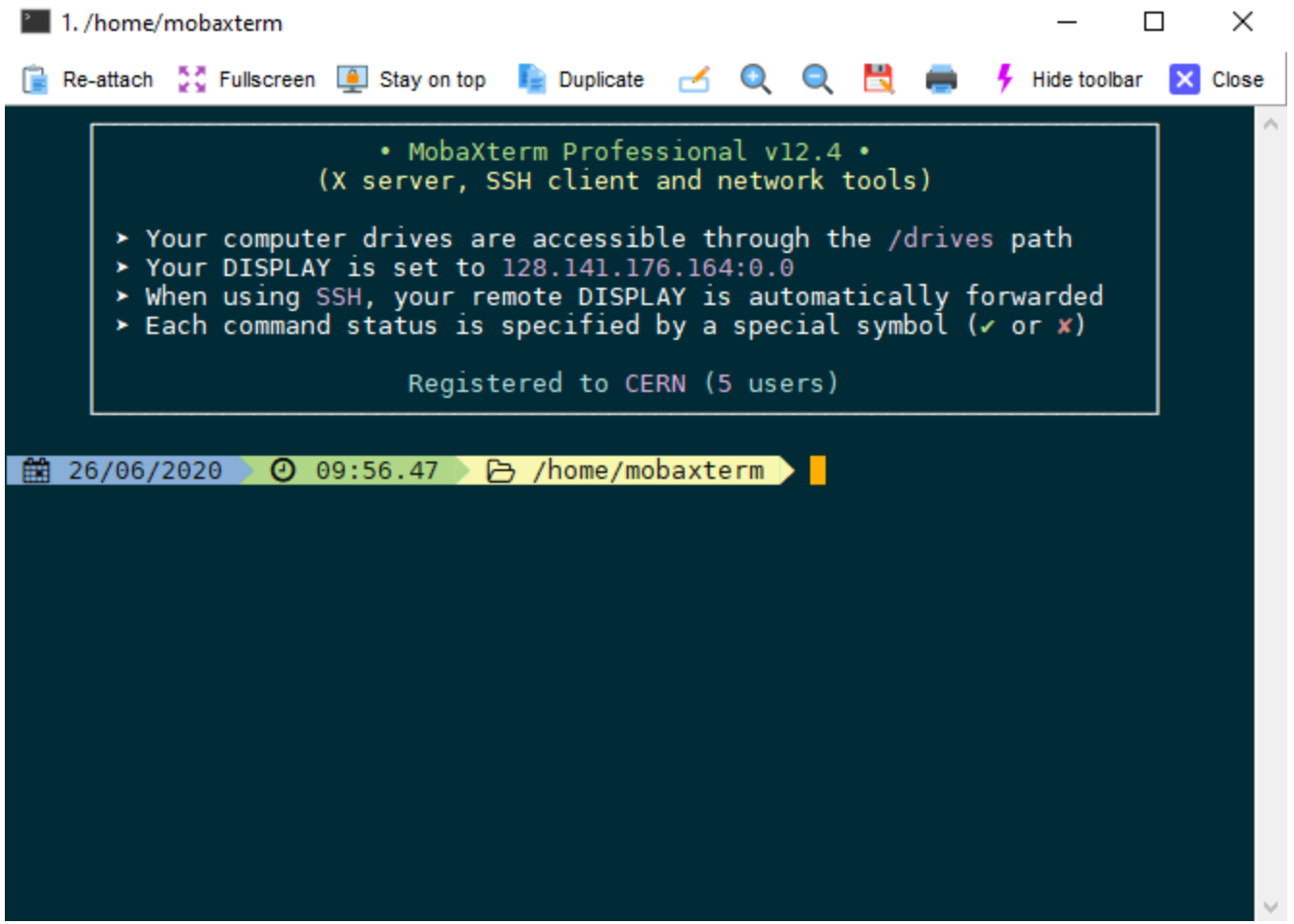
Link ID	GBT Mode Tx/Rx	Loopback	GBT MUX	Datapath Mode	Datapath	RX freq(MHz)	TX freq(MHz)	Status	Optical power(uW)
0	GBT/GBT	None	TTC:CTP	Continuous	Disabled	172.01	158.03	DOWN	0.0
1	GBT/GBT	None	TTC:CTP	Continuous	Disabled	177.93	186.38	DOWN	0.0
2	GBT/GBT	None	TTC:CTP	Continuous	Disabled	167.47	158.03	DOWN	0.0
3	GBT/GBT	None	TTC:CTP	Continuous	Disabled	185.69	186.38	DOWN	0.0
4	GBT/GBT	None	TTC:CTP	Continuous	Disabled	169.14	158.03	DOWN	0.0
5	GBT/GBT	None	TTC:CTP	Continuous	Disabled	173.04	186.38	DOWN	0.0
6	GBT/GBT	None	TTC:CTP	Continuous	Disabled	168.10	158.03	DOWN	0.0
7	GBT/GBT	None	TTC:CTP	Continuous	Disabled	190.24	186.38	DOWN	0.0
8	GBT/GBT	None	TTC:CTP	Continuous	Disabled	70.55	158.03	DOWN	0.0
9	GBT/GBT	None	TTC:CTP	Continuous	Disabled	181.59	186.38	DOWN	0.0
10	GBT/GBT	None	TTC:CTP	Continuous	Disabled	104.61	158.03	DOWN	0.0
11	GBT/GBT	None	TTC:CTP	Continuous	Disabled	165.47	186.38	DOWN	0.0

Check the status of the card (CARD)

```
roc-status --i=#0
----------------------------
Local clock | Dynamic offset
User Logic Disabled
----------------------------
```

Link ID	GBT Mode Tx/Rx	Loopback	GBT MUX	Datapath Mode	Datapath	RX freq(MHz)	TX freq(MHz)	Status	Optical power(uW)
0	GBT/GBT	Enabled	SWT	Continuous	Enabled	240.47	240.47	UP (was DOWN)	0.0
1	GBT/GBT	Enabled	SWT	Continuous	Enabled	240.47	240.47	UP (was DOWN)	0.0
2	GBT/GBT	Enabled	SWT	Continuous	Enabled	240.47	240.47	UP (was DOWN)	0.0
3	GBT/GBT	Enabled	SWT	Continuous	Enabled	240.47	240.47	UP (was DOWN)	0.0
4	GBT/GBT	None	TTC:CTP	Continuous	Disabled	239.97	240.47	DOWN	0.0
5	GBT/GBT	None	TTC:CTP	Continuous	Disabled	227.32	240.47	DOWN	0.0
6	GBT/GBT	None	TTC:CTP	Continuous	Disabled	195.87	240.47	DOWN	0.0
7	GBT/GBT	None	TTC:CTP	Continuous	Disabled	198.62	240.47	DOWN	0.0
8	GBT/GBT	None	TTC:CTP	Continuous	Disabled	260.64	240.47	DOWN	0.0
9	GBT/GBT	None	TTC:CTP	Continuous	Disabled	240.59	240.47	DOWN	0.0
10	GBT/GBT	None	TTC:CTP	Continuous	Disabled	240.06	240.47	DOWN	0.0
11	GBT/GBT	None	TTC:CTP	Continuous	Disabled	237.00	240.47	DOWN	0.0

example


1. /home/mobaxterm
Re-attach
Fullscreen
Stay on top
Duplicate
Hide toolbar
Close
• MobaXterm Professional v12.4 •
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List the cards installed

- Addressing
  - PCI Address
  - Sequence Number
  - Serial, Endpoint ID
- Compatibility
  - Firmware version
    - tag (supported)
    - commit (unsupported)

```
roc-list-cards
================================================================================
  #    Type    PCI Addr    Serial    Endpoint    NUMA  FW Version    UL Version
--------------------------------------------------------------------------------
  0    CRORC   af:00.0     2345      0           1     f90be8e       n/a
================================================================================
```

Check the status of the CRORC (NOT configured)

```
roc-status --i=#0
----------------------------
QSFP Disabled
Fixed offset
----------------------------
Time Frame Detection Disabled
Time Frame Length: 0
----------------------------
=========================================
  Link ID   Status   Optical power(uW)
-----------------------------------------
  0         DOWN     0.0
  1         DOWN     0.0
  2         DOWN     0.0
  3         DOWN     0.0
  4         DOWN     0.0
  5         DOWN     0.0
=========================================
```

Configure the card (CRU)

- Configure the CRU:
  - continuous mode
  - packet mode
  - dynamic offset
  - CRUID
  - linkmask
  - loopback
  - downstream (CRU -> FEE)
  - …

```
roc-config -h
Program options invalid: Unknown option '-h'

#### Config
Configure the ReadoutCard(s)

Allowed options:
  --help                        Produce help message
  --verbose                     Verbose output
  --version                     Display RORC library version
  --allow-rejection             Flag to allow HBF rejection
  --clock arg (=LOCAL)          Clock [LOCAL, TTC]
  --crorc-id arg (=0x0)         12-bit CRORC ID
  --cru-id arg (=0x0)           12-bit CRU ID
  --datapathmode arg (=PACKET)  DatapathMode [PACKET, CONTINUOUS]
  --downstreamdata arg (=CTP)   DownstreamData [CTP, PATTERN, MIDTRG]
  --gbtmode arg (=GBT)          GBT MODE [GBT, WB]
  --gbtmux arg (=TTC)           GBT MUX [TTC, DDG, SWT]
  --links arg (=0)              Links to enable
  --config-uri arg              Configuration URI ('ini://[path]', 'json://[path]' or 'consul://[host][:port][/path]'
  --loopback                    Flag to enable link loopback for DDG
  --pon-upstream                Flag to enable use of the PON upstream
  --dyn-offset                  Flag to enable the dynamic offset
  --onu-address arg (=0)        ONU address for PON upstream
  --config-all                  Flag to configure all cards with default parameters on startup
  --force-config                Flag to force configuration and not check if the configuration is already present
  --bypass-fw-check             Flag to force configuration, bypassing the firmware checker
  --trigger-window-size arg     The size of the trigger window in GBT words
  --tf-length arg               Sets the length of the Time Frame
  --no-tf-detection             Flag to enable the Time Frame Detection
  --gen-cfg-file arg            If set generates a configuration file from the command line options. [DOES NOT CONFIGURE]
  --no-gbt                      Flag to switch off GBT
  --user-logic                  Flag to enable the User Logic link
  --id arg                      Card ID: PCI Address, Serial ID, or sequence number, as reported by `roc-list-cards`

Example:
  roc-config --config-uri ini:///home/flp/roc.cfg
roc-config --id 42:00.0 --links 0-23 --clock local --datapathmode packet --loopback --gbtmux ttc #CRU
roc-config --id #0 --crorc-id 0x42 --dyn-offset --tf-length 255 #CRORC
```

Configure the CRORC

```
roc-config --i=#0 --crorc-id=0x42 --dyn --tf-length=256 -bypass

crorc-id  -> ID of the CRORC
dyn       -> dynamic offset (no fixed 8KB offset)
tf-length -> length of Time Frame in ORBIT
bypass    -> configure unsupported firmware
```

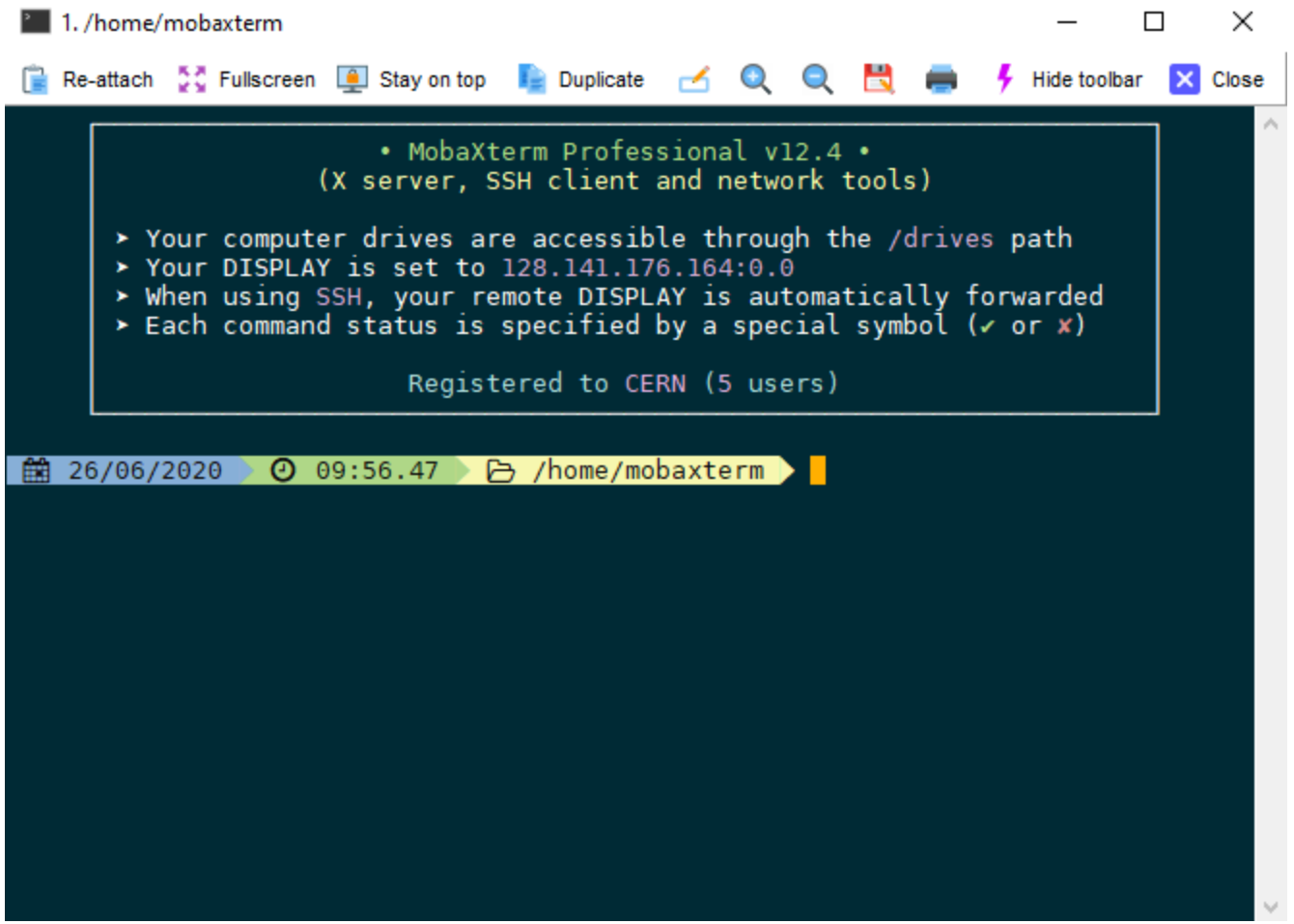
Check the status of the CRORC (NOT configured)

```
roc-status --i=#0
----------------------------
QSFP Disabled
Fixed offset
----------------------------
Time Frame Detection Disabled
Time Frame Length: 0
----------------------------
=========================================
  Link ID   Status   Optical power(uW)
-----------------------------------------
  0         DOWN     0.0
  1         DOWN     0.0
  2         DOWN     0.0
  3         DOWN     0.0
  4         DOWN     0.0
  5         DOWN     0.0
=========================================
```

Check the status of the CRORC (configured)

```
roc-status --i=#0
----------------------------
QSFP Enabled
Dynamic offset
----------------------------
Time Frame Detection Enabled
Time Frame Length: 256
----------------------------
=========================================
  Link ID   Status   Optical power(uW)
-----------------------------------------
  0         UP       549.6
  1         DOWN     0.0
  2         DOWN     0.0
  3         UP       552.6
  4         DOWN     0.0
  5         DOWN     0.0
=========================================
```

example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SELF-TEST

CRORC (part of the code will be integrated in O2)

```
# START DMA
roc-bench-dma --i=#0 --data=diu/siu  --dma-channel=0 --bypass

# ENABLE DDG
roc-reg-write --id=#0 --channel=0 --address=0x20 --value=0x80010000;

# START TRG
source ctp.sh 0x100 0xff
```

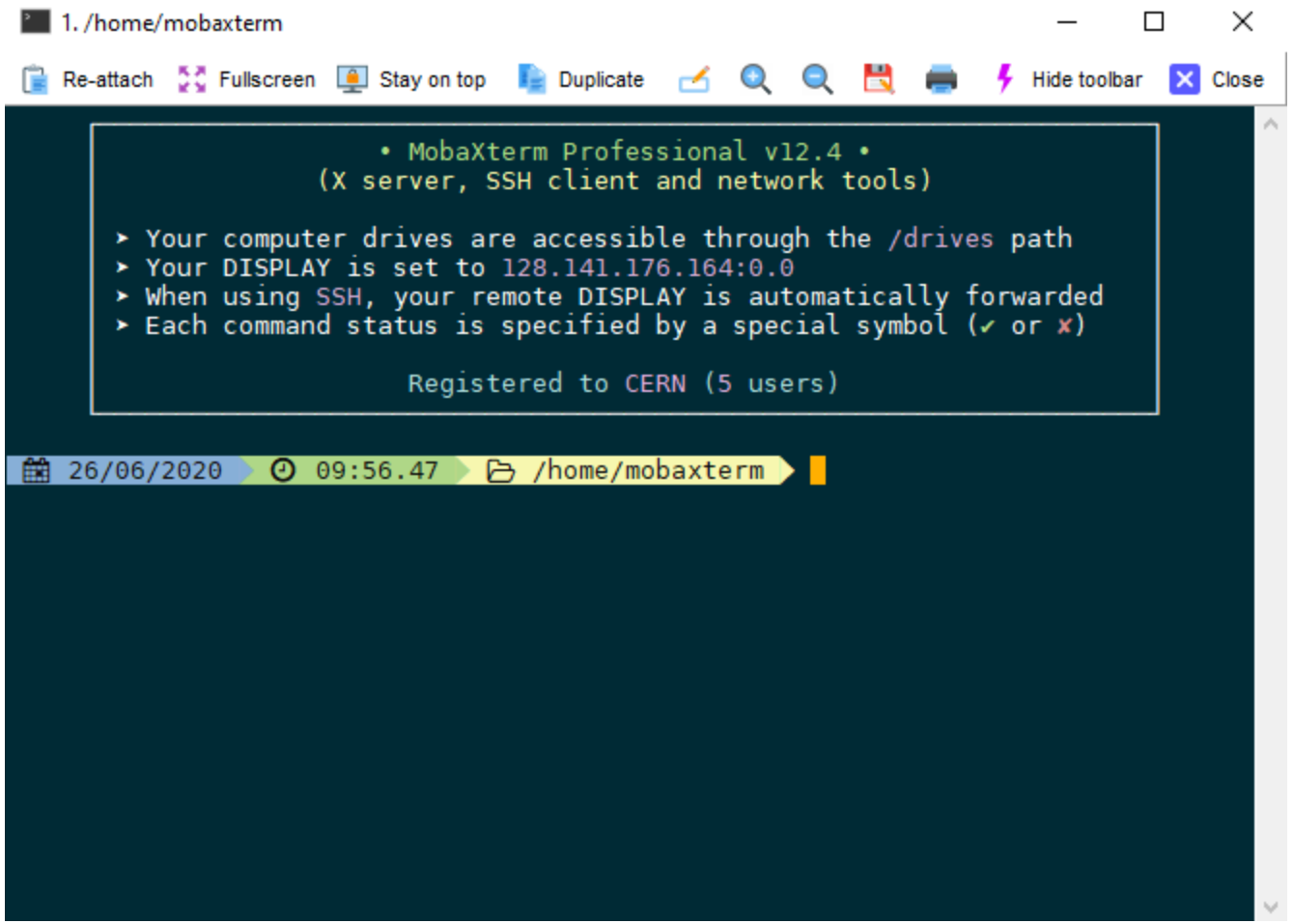
CRU

```
# configure the CRU CONT mode LOOPBACK
roc-config --id=#0 --clock=local --links=0-1  --data=continuous --loop --dyn

# START DMA
roc-bench-dma --i=#0 --data=ddg

# START TRG
roc-ctp-emulator --id=#0 --trigger-mode=continuous
```

example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COLLECT DATA FROM FEE

It is important to understand what type of FEE you have.

- C-RORC : FEE – DDL
- CRU must be configured accordingly to your FEE:
  - packet
  - continuous
  - continuous + UL
- **do not use LOOPBACK**
- **remove the error check with --no-err or use the --fast (only RDH checks)**

- CRU can run without LTU, the C-RORC no.

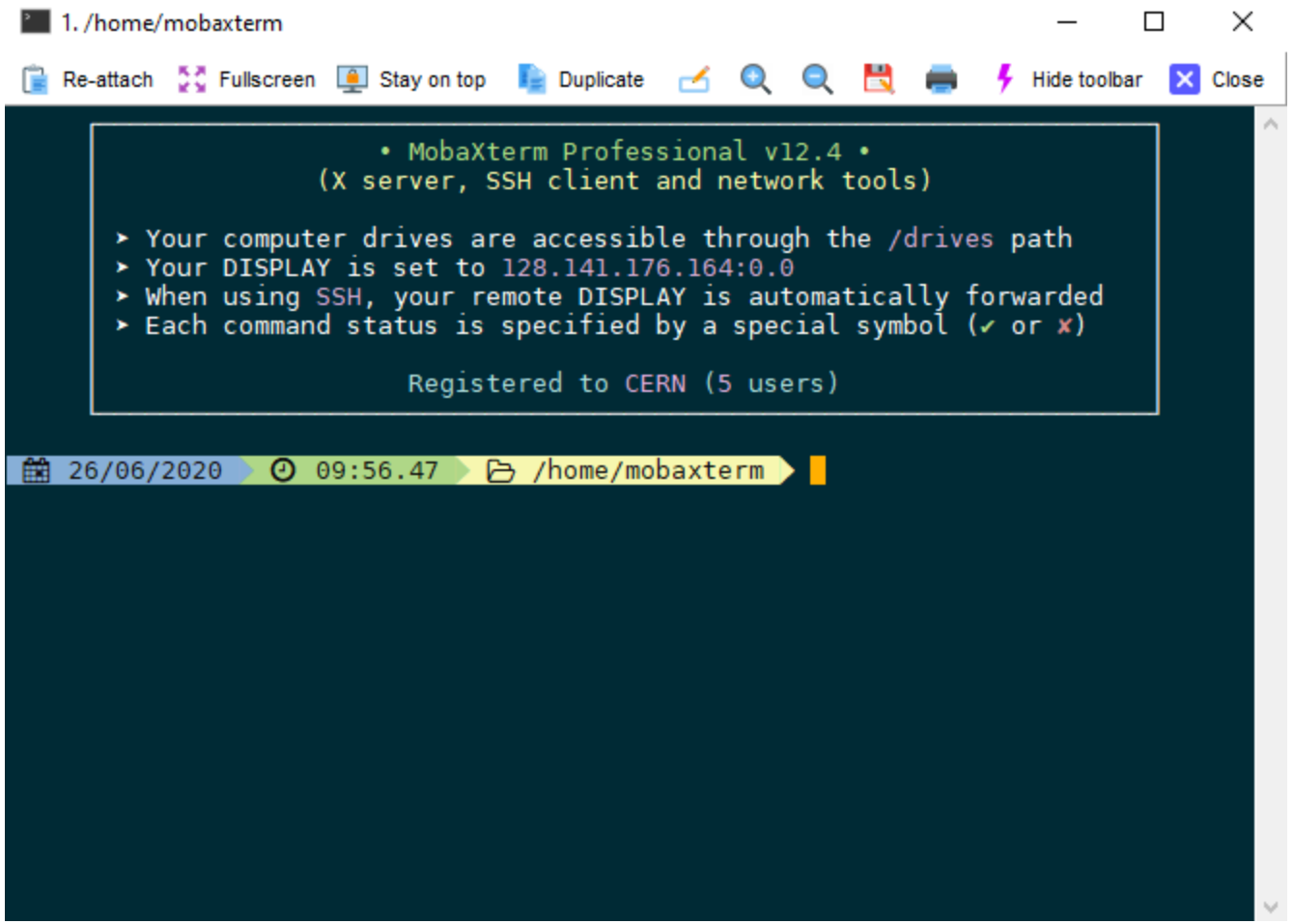
CRU - FEE

```
# configure the CRU CONT mode LOOPBACK
roc-config --id=#0 --clock=local --links=0-1  --data=continuous --dyn

# START DMA
roc-bench-dma --i=#0 --data=fee --no-er
# START DMA (check RDH)
roc-bench-dma --i=#0 --data=fee --fast


# START TRG
roc-ctp-emulator --id=#0 --trigger-mode=continuous
```

CRORC - FEE

```
# START DMA
roc-bench-dma --i=#0 --data=fee  --dma-channel=0 --bypass --no-er
# START DMA (check RDH)
roc-bench-dma --i=#0 --data=fee  --dma-channel=0 --bypass --fast
```

example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roc-bench-dma

It is a debugging tool not a data taking software.

It should be used only for simple data taking.
It can’t read data from multiple endpoints, you need to start two instances at the same time.
It has been developed to test the CRU and perform fast data taking, it is not well suited to store data on the disk with high performance.
It doesn’t communicate with the other software components of the data flow.

readout – check the size of the hugepage allocated

```
hugeadm --pool-list
      Size  Minimum  Current  Maximum  Default
   2097152      128      128      128        *
1073741824        8        8        8
```

In this case we have 8 GB of hugepages.
4 GB NUMA 0
4 GB NUMA 1

```
cat /etc/flp.d/readoutcard/hugepages-1GiB.conf
8
```

(this value can be modified … reboot)

readout config file

readout works for both CRU and C-RORC

Readout requires at least 2 parameters to function properly:
- memory bank
- equipment

A memory bank must be assigned to one equipment only.

The main difference between CRU and C-RORC is:
- CRU equipment is one endpoint that consists of 12 links
- CRORC equipment is one DMA ch that consists of 1 link

In the CRU there is 1 DMA CH for endpoint (1 EP - 1 DMA CH => 12 links)
In the C-RORC there is 1 DMA CH for each DDL link (MAX 6)

readout – config file – memory BANKs (CRU)

```
[bank-1]
type=MemoryMappedFile
size=4G

[bank-2]
type=MemoryMappedFile
size=4G

[equipment-cru-1]
equipmentType=rorc
cardId=#1
dataSource=Fee
memoryBankName=bank-1
memoryPoolPageSize=4M
memoryPoolNumberOfPages=1000
rdhUseFirstInPageEnabled=1
```

```
[equipment-cru-2]
equipmentType=rorc
cardId=#2
dataSource=Fee
memoryBankName=bank-2
memoryPoolPageSize=4M
memoryPoolNumberOfPages=1000
rdhUseFirstInPageEnabled=1

[consumer-stats]
consumerType=stats
consoleUpdate=1
monitoringUpdatePeriod=1
monitoringEnabled=0
```

```
# record data to file (disabled)
[consumer-rec]
enabled=0
consumerType=fileRecorder
fileName=/home/data/data.raw
```

readout – config file – EQUIPMENTs (CRU)

```
[bank-1]
type=MemoryMappedFile
size=4G

[bank-2]
type=MemoryMappedFile
size=4G

[equipment-cru-1]
equipmentType=rorc
cardId=#1
dataSource=Fee
memoryBankName=bank-1
memoryPoolPageSize=4M
memoryPoolNumberOfPages=1000
rdhUseFirstInPageEnabled=1
```

```
[equipment-cru-2]
equipmentType=rorc
cardId=#2
dataSource=Fee
memoryBankName=bank-2
memoryPoolPageSize=4M
memoryPoolNumberOfPages=1000
rdhUseFirstInPageEnabled=1

[consumer-stats]
consumerType=stats
consoleUpdate=1
monitoringUpdatePeriod=1
monitoringEnabled=0
```

```
# record data to file (disabled)
[consumer-rec]
enabled=0
consumerType=fileRecorder
fileName=/home/data/data.raw
```

readout – config file – MISC OPTIONS (CRU)

```
[bank-1]
type=MemoryMappedFile
size=4G

[bank-2]
type=MemoryMappedFile
size=4G

[equipment-cru-1]
equipmentType=rorc
cardId=#1
dataSource=Fee
memoryBankName=bank-1
memoryPoolPageSize=4M
memoryPoolNumberOfPages=1000
rdhUseFirstInPageEnabled=1
```

```
[equipment-cru-2]
equipmentType=rorc
cardId=#2
dataSource=Fee
memoryBankName=bank-2
memoryPoolPageSize=4M
memoryPoolNumberOfPages=1000
rdhUseFirstInPageEnabled=1

[consumer-stats]
consumerType=stats
consoleUpdate=1
monitoringUpdatePeriod=1
monitoringEnabled=0
```

```
# record data to file (disabled)
[consumer-rec]
enabled=0
consumerType=fileRecorder
fileName=/home/data/data.raw
```

https://github.com/AliceO2Group/Readout/blob/master/doc/configurationParameters.md

readout – config file (C-RORC)

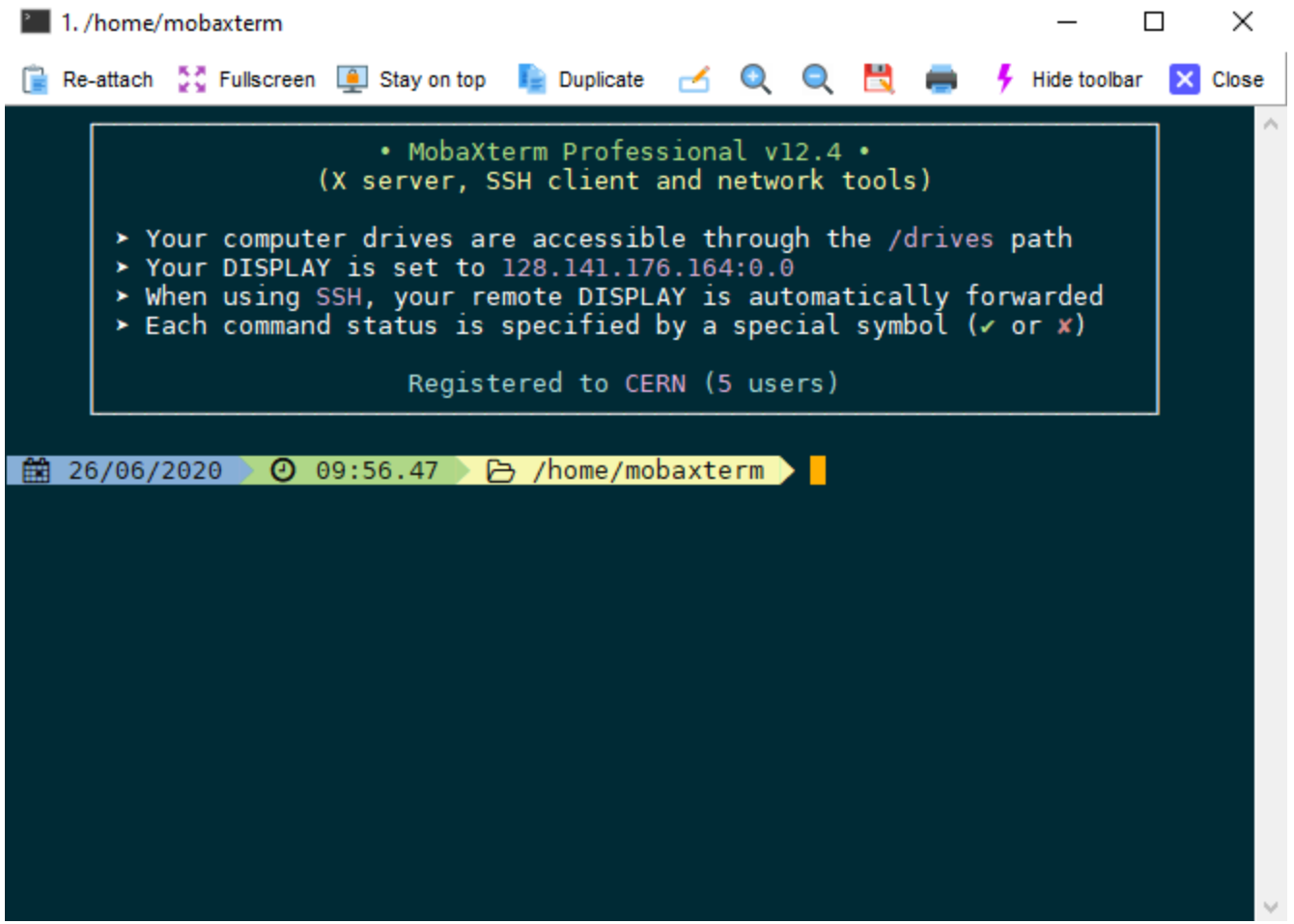
```
[consumer-stats]
consumerType=stats
enabled=1
monitoringEnabled=0
monitoringUpdatePeriod=1
consoleUpdate=1

# recording to file
[consumer-rec]
consumerType=fileRecorder
enabled=1
fileName=/tmp/data.raw
```

```
[bank-1]
type=MemoryMappedFile
size=4G
numaNode=0

[equipment-roc-1]
enabled=1
equipmentType=rorc
cardId=03:00.0
channel=0
dataSource=Siu
memoryBankName=bank-1
memoryPoolNumberOfPages=2048
memoryPoolPageSize=1048576
firmwareCheckEnabled=0
rdhCheckEnabled=1
```

```
[bank-2]
type=MemoryMappedFile
size=4G
numaNode=0

[equipment-roc-2]
enabled=0
equipmentType=rorc
cardId=3:00.0
channel=1
dataSource=Siu
memoryBankName=bank-2
memoryPoolNumberOfPages=2048
memoryPoolPageSize=1048576
firmwareCheckEnabled=0
rdhCheckEnabled=0
```

https://github.com/AliceO2Group/Readout/blob/master/doc/configurationParameters.md

example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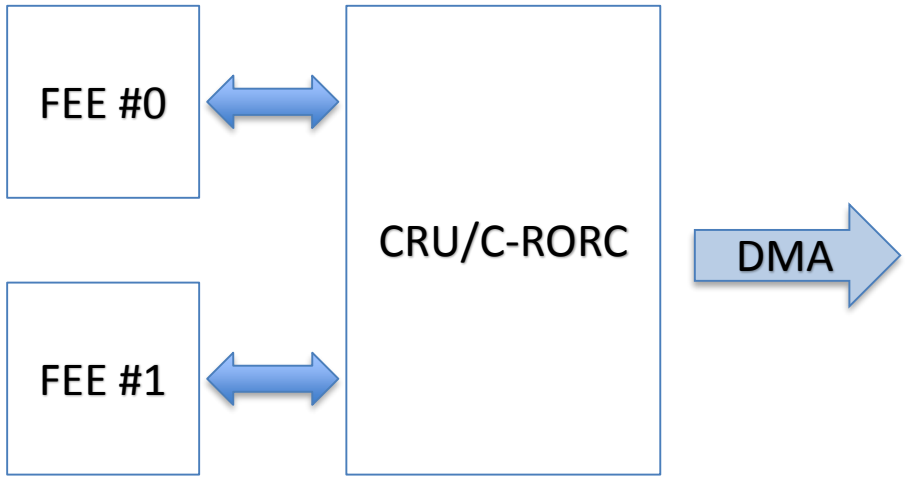
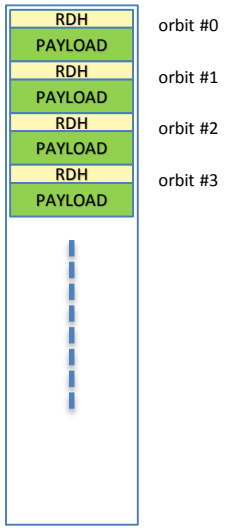
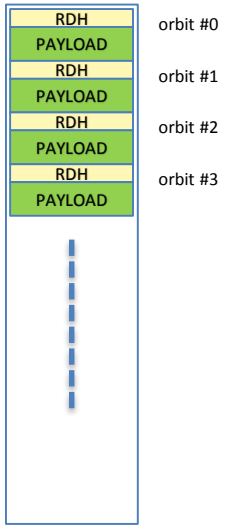
DATA FORMAT





Link ID 0



Link ID 1

Memory in the FLP is organized in buffers called SUPERPAGE.
A SUPERPAGE usually is 1, 2 or 4 MB size.
Every readout links (GBT or DDL) has a dedicated SUPERPAGE. Data inside the same SUPERPAGE is not mixed between links.

A SUBTIME FRAME consists of 1 or more SUPERPAGES produced by all the links.

Example:
2 readout links
DATA of one SUB TIME FRAME fit in a single SUPERPAGE.

The SUB TIME FRAME consists of 2 SUPERPAGEs, 1 for each readout link.

EVENT STRUCTURE (C-RORC) => FILE

```
 0) 0x     4006 NEW BLOCK
 1) 0x        0
 2) 0x   400048
 3) 0x 1230000 EP ID: 0 Link ID: 0
 4) 0x        0
 5) 0x        2 ORBIT 2
 6) 0x        0
 7) 0x        0
 8) 0x      883 TTYPE 883
 9) 0x        0 PAGES COUNTER 0
10) 0x        0
11) 0x        0
12) 0x        0
13) 0x        0
14) 0x        0
15) 0x        0 END RDH
16) 0x        0
17) 0x        0
```

RDH V6
SOT

```
 0) 0x     4006 NEW BLOCK
 1) 0x        0
 2) 0x1C441C48
 3) 0x 1230100 EP ID: 0 Link ID: 0
 4) 0x        8 BC 8
 5) 0x        2 ORBIT 2
 6) 0x        0
 7) 0x        0
 8) 0x80000010 TTYPE 80000010
 9) 0x        0 PAGES COUNTER 0
10) 0x        0
11) 0x        0
12) 0x        0
13) 0x        0
14) 0x        0
15) 0x        0 END RDH
```

RDH V6
PHYS

```
16) 0x        0
17) 0x        1
18) 0x        2
19) 0x        3
20) 0x        4
21) 0x        5
22) 0x        6
```

PAYLOAD

=>

END
SPAGE
LINK #0
START
SPAGE
LINK #3

```
3) 0x 123FB00 EP ID: 0 Link ID: 0 EV SIZE: 3200
3) 0x 123FC00 EP ID: 0 Link ID: 0 EV SIZE: 2304
3) 0x 123FD00 EP ID: 0 Link ID: 0 EV SIZE: 7808
3) 0x 123FE00 EP ID: 0 Link ID: 0 EV SIZE: 3264
3) 0x 123FF00 EP ID: 0 Link ID: 0 EV SIZE: 7488
3) 0x 1230000 EP ID: 0 Link ID: 0 EV SIZE: 4736
3) 0x 1230100 EP ID: 0 Link ID: 0 EV SIZE: 1856
3) 0x 1230200 EP ID: 0 Link ID: 0 EV SIZE: 1152
3) 0x 1230300 EP ID: 0 Link ID: 0 EV SIZE: 3320
3) 0x 1230400 EP ID: 0 Link ID: 0 EV SIZE: 3072
3) 0x 1230500 EP ID: 0 Link ID: 0 EV SIZE: 8128
3) 0x 1230600 EP ID: 0 Link ID: 0 EV SIZE: 5120
3) 0x 1230700 EP ID: 0 Link ID: 0 EV SIZE: 2496
3) 0x 1230800 EP ID: 0 Link ID: 0 EV SIZE: 8064
3) 0x 1230900 EP ID: 0 Link ID: 0 EV SIZE: 7040
3) 0x 1230003 EP ID: 0 Link ID: 3 EV SIZE: 3200
3) 0x 1230103 EP ID: 0 Link ID: 3 EV SIZE: 6016
3) 0x 1230203 EP ID: 0 Link ID: 3 EV SIZE: 1472
3) 0x 1230303 EP ID: 0 Link ID: 3 EV SIZE: 6080
3) 0x 1230403 EP ID: 0 Link ID: 3 EV SIZE: 6080
3) 0x 1230503 EP ID: 0 Link ID: 3 EV SIZE: 7544
3) 0x 1230603 EP ID: 0 Link ID: 3 EV SIZE: 4736
3) 0x 1230703 EP ID: 0 Link ID: 3 EV SIZE: 6528
3) 0x 1230803 EP ID: 0 Link ID: 3 EV SIZE: 2816
3) 0x 1230903 EP ID: 0 Link ID: 3 EV SIZE: 1920
3) 0x 1230A03 EP ID: 0 Link ID: 3 EV SIZE: 7808
3) 0x 1230B03 EP ID: 0 Link ID: 3 EV SIZE: 1088
3) 0x 1230C03 EP ID: 0 Link ID: 3 EV SIZE: 4416
3) 0x 1230D03 EP ID: 0 Link ID: 3 EV SIZE: 1920
3) 0x 1230E03 EP ID: 0 Link ID: 3 EV SIZE: 1216
3) 0x 1230F03 EP ID: 0 Link ID: 3 EV SIZE: 1792
3) 0x 1231003 EP ID: 0 Link ID: 3 EV SIZE: 7104
3) 0x 1231103 EP ID: 0 Link ID: 3 EV SIZE: 6016
3) 0x 1231203 EP ID: 0 Link ID: 3 EV SIZE: 2368
3) 0x 1231303 EP ID: 0 Link ID: 3 EV SIZE: 2752
```

Data is stored in the file
one SPAGE after the other.

EVENT STRUCTURE (CRU) => FILE

```
 0) 0x     4006 NEW BLOCK
 1) 0x        0
 2) 0x20002000
 3) 0x        0 EP ID: 0 Link ID: 0
 4) 0x        0
 5) 0x        2 ORBIT 2
 6) 0x        0
 7) 0x        0
 8) 0x     6A03 TTYPE 6A03
 9) 0x        0 PAGES COUNTER 0
10) 0x        0
11) 0x        0
12) 0x        0
13) 0x        0
14) 0x        0
15) 0x        0 END RDH
16) 0x        0
17) 0x        0
18) 0x        0
19) 0x        0
20) 0x        0
21) 0x        0
22) 0x        0
23) 0x        0
24) 0x        0
25) 0x        0
26) 0x        0
27) 0x        0
28) 0x        0
```

RDH V6
SOT

PAYLOAD

=>

END
SPAGE
LINK #0
START
SPAGE
LINK #3

```
3) 0x        0 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      100 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      200 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      300 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      400 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      500 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      600 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      700 EP ID: 0 Link ID: 0 EV SIZE: 192
3) 0x      800 EP ID: 0 Link ID: 0 EV SIZE: 64
3) 0x      900 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      A00 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      B00 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      C00 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      D00 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x      E00 EP ID: 0 Link ID: 0 EV SIZE: 8192
3) 0x        0 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      100 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      200 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      300 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      400 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      500 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      600 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      700 EP ID: 0 Link ID: 3 EV SIZE: 192
3) 0x      800 EP ID: 0 Link ID: 3 EV SIZE: 64
3) 0x      900 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      A00 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      B00 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      C00 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      D00 EP ID: 0 Link ID: 3 EV SIZE: 8192
3) 0x      E00 EP ID: 0 Link ID: 3 EV SIZE: 8192
```

Data is stored in the file
one SPAGE after the other.

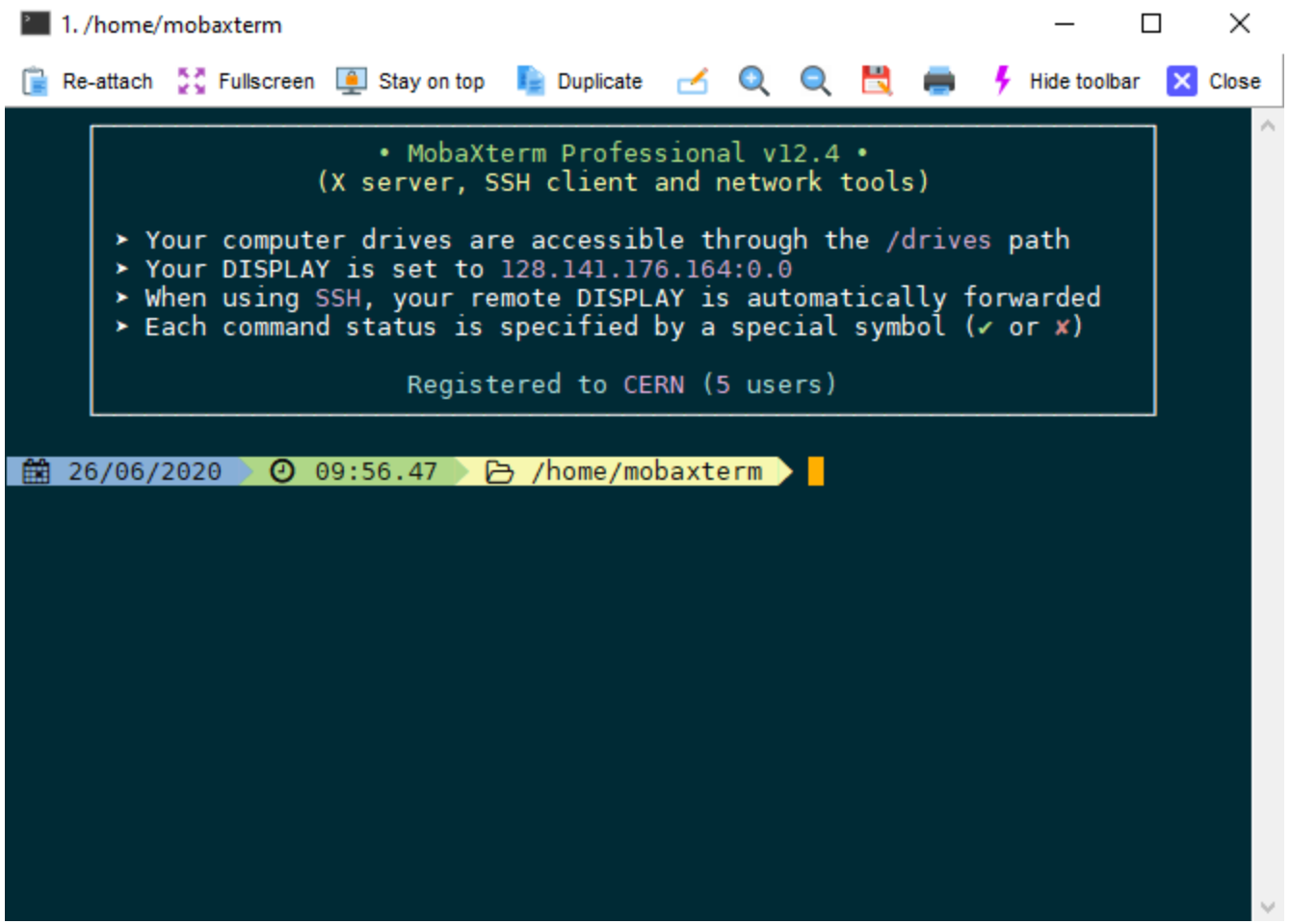
CRU – check the run status

```
roc-pkt-monitor --i=#1
=========================================================
  Link ID    Accepted        Rejected        Forced
---------------------------------------------------------
  0          1150216         0               0
  1          0               0               0
  2          0               0               0
  3          0               0               0
  4          0               0               0
  5          0               0               0
  6          0               0               0
  7          0               0               0
  8          0               0               0
  9          0               0               0
  10         0               0               0
  11         0               0               0
=========================================================
  ULL ID     Accepted        Rejected        Forced
---------------------------------------------------------
  15         0               0               0
=========================================================
  Wrapper    Dropped           Total Packets per second
---------------------------------------------------------
  0          0                 101456
=========================================================
```

C-RORC – check the run status (to be integrated)

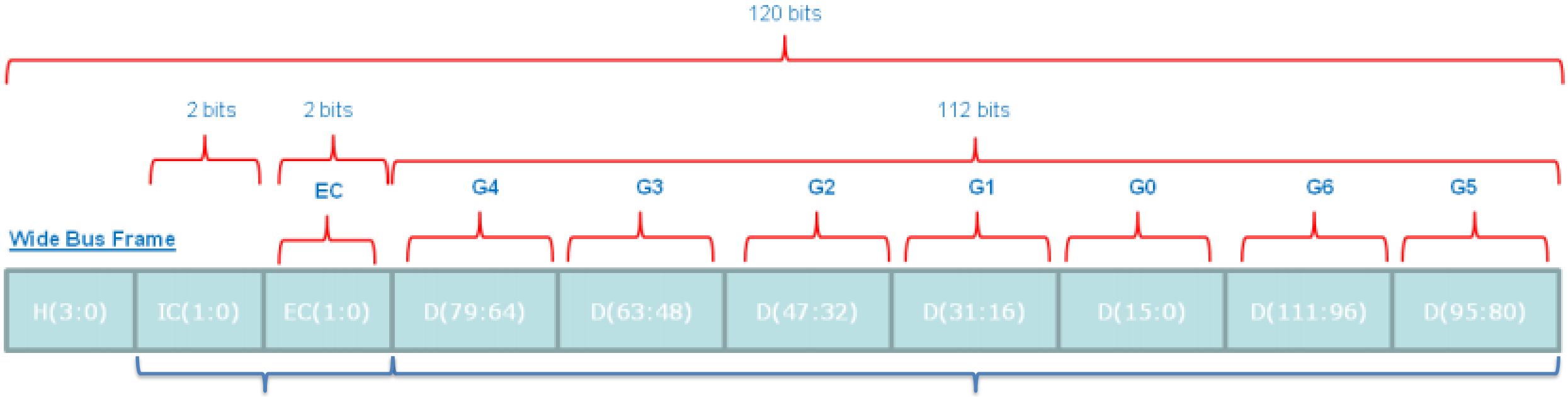
```
# CH 0
# ACQ RATE
roc-reg-read --i=#0 --ch=0 --add=0x50
# PACKET RECEIVED
roc-reg-read --i=#0 --ch=0 --add=0x54
# TRG RECEIVED
roc-reg-read --i=#0 --ch=0 --add=0x58


# CH 1
# ACQ RATE
roc-reg-read --i=#0 --ch=1 --add=0x50
# PACKET RECEIVED
roc-reg-read --i=#0 --ch=1 --add=0x54
# TRG RECEIVED
roc-reg-read --i=#0 --ch=3 --add=0x58
```

example


1. /home/mobaxterm
Re-attach
Fullscreen
Stay on top
Duplicate
Hide toolbar
Close
• MobaXterm Professional v12.4 •
(X server, SSH client and network tools)
➤ Your computer drives are accessible through the /drives path
➤ Your DISPLAY is set to 128.141.176.164:0.0
➤ When using SSH, your remote DISPLAY is automatically forwarded
➤ Each command status is specified by a special symbol (✔ or ✘)
Registered to CERN (5 users)
26/06/2020
09:56.47
/home/mobaxterm

SC - CRU

SC



4 bit IC/EC
(SCA -> EC)

80 bit of payload
(used by SWT)

```
roc-config --gbtmux=swt
```

FW update

UPDATE FIRMWARE (C-RORC) ~10 mins

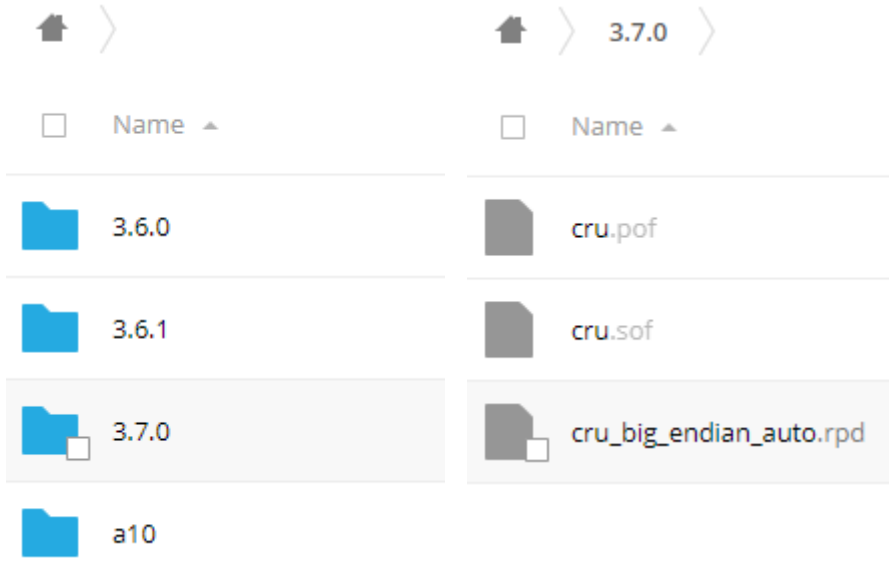
https://cernbox.cern.ch/index.php/s/m7027XJi5eW8UGh

```
roc-flash -h
Program options invalid: Unknown option '-h'

#### Flash
Programs the card's flash memory

Allowed options:
  --help                Produce help message
  --verbose             Verbose output
  --version             Display RORC library version
  --id arg              Card ID: PCI Address, Serial ID, or
sequence number, as reported by `roc-list-cards`
  --file arg            Path of firmware file to flash
  --serial arg          Serial number to flash

Example:
  roc-flash --id=12345 --file=/dir/my_file
```

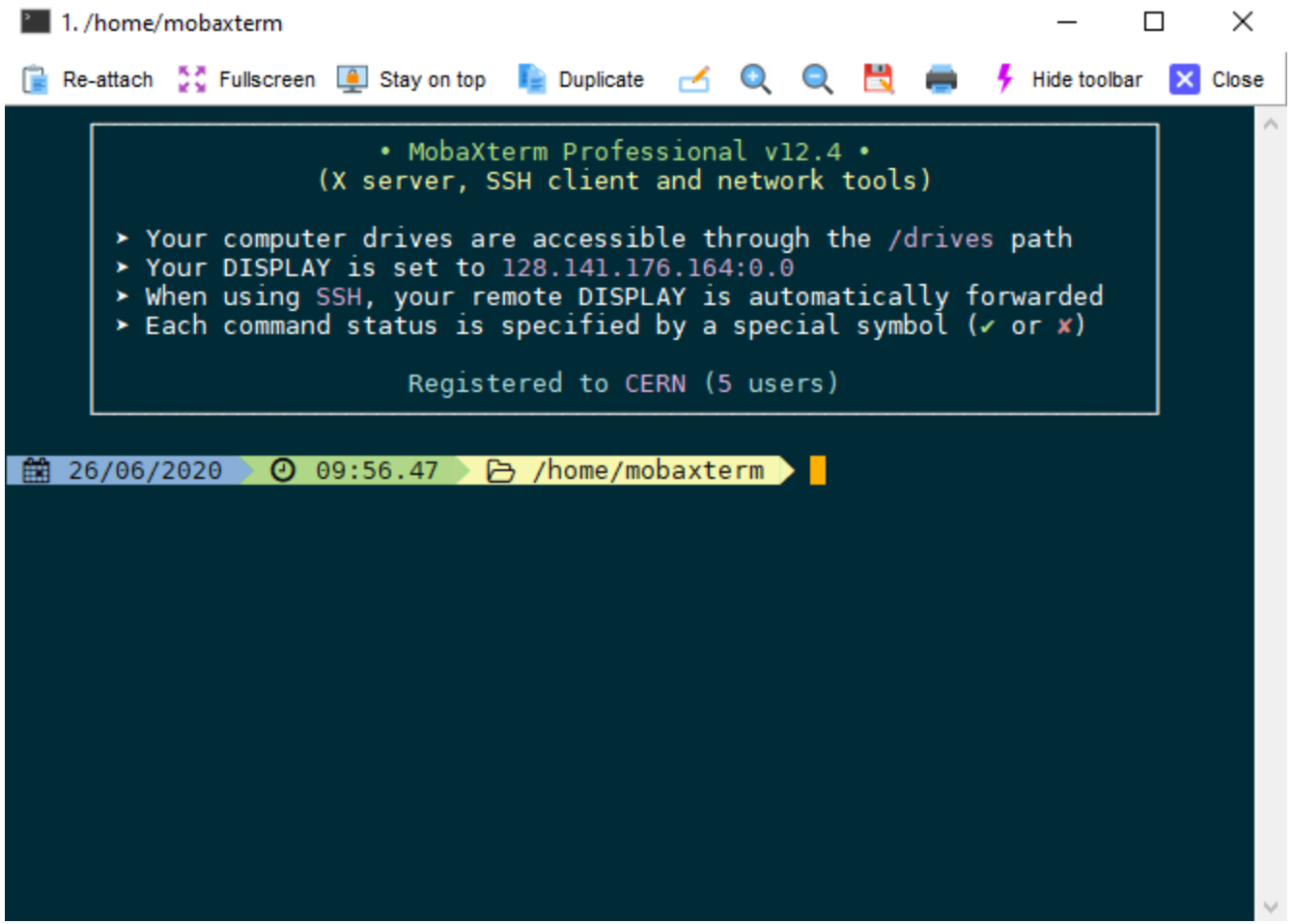
UPDATE FIRMWARE (CRU) – after FW 3.5.2

https://cernbox.cern.ch/index.php/s/AL0sxJz3U5Ctnfb

```
/root/intelFPGA_pro/17.1/qprogrammer/bin/quartus_pgm --cable=1 --mode=JTAG --operation="p;cru.sof"

echo 1 > /sys/bus/pci/devices/0000\:02\:00.0/remove
echo 1 > /sys/bus/pci/rescan
```



example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Registered to CERN (5 users)
26/06/2020
09:56.47
/home/mobaxterm

Links

RDH v6
https://gitlab.cern.ch/AliceO2Group/wp6-doc.git

DATA FORMAT
https://gitlab.cern.ch/AliceO2Group/wp6-doc/-/blob/master/detector/DATAFORMAT.md#rdh-v6-32-bit-format

UTILITIES usage
https://gitlab.cern.ch/AliceO2Group/wp6-doc/-/tree/master/sw

CRU DOC
https://gitlab.cern.ch/alice-cru/cru-fw/-/blob/master/README.md

TRG
https://www.overleaf.com/read/dchwzqqfbtyn

READOUT
https://github.com/AliceO2Group/Readout/tree/master/doc

ROC
https://github.com/AliceO2Group/ReadoutCard/blob/master/README.md

MISC SW
https://gitlab.cern.ch/alice-cru/cru-dbg-sw.git
https://gitlab.cern.ch/AliceO2Group/crorc-run3-sw.git