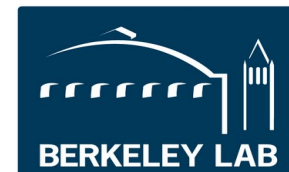


YARR with Felix-star for ITk Pixel

Documentation - [LBL wikipage](#)

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LBL Weekly Instrumentation Meeting
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TALK

View Discussion



LAST EDITED BY

Angira Rastogi

Yesterday at 11:21 PM



Quick start



There are two servers for running DAQ with FELIX board. These are [Felixcore](#) (old, will not be supported for testing at LLS sites in future) and [Felix-star](#) (new recommendation for Stage-I and Stage-II). The [Felixcore](#) version is currently more stable than [Felix-star](#) when running with YARR SW on pixel v1.1 chip or module. Hence, for first time setups and to get started quickly, running [Felixcore](#) is recommended.

Latest status of the ITkPixel DAQ with YARR software and Felixcore can be found in the presentation from ITkWeek in Sep 2023 [here](#) .

For latest status of YARR with Felix-star, you can refer to this [talk](#)  from YARR design meeting in Jan 2024.

Some other reading material can be found [here](#).

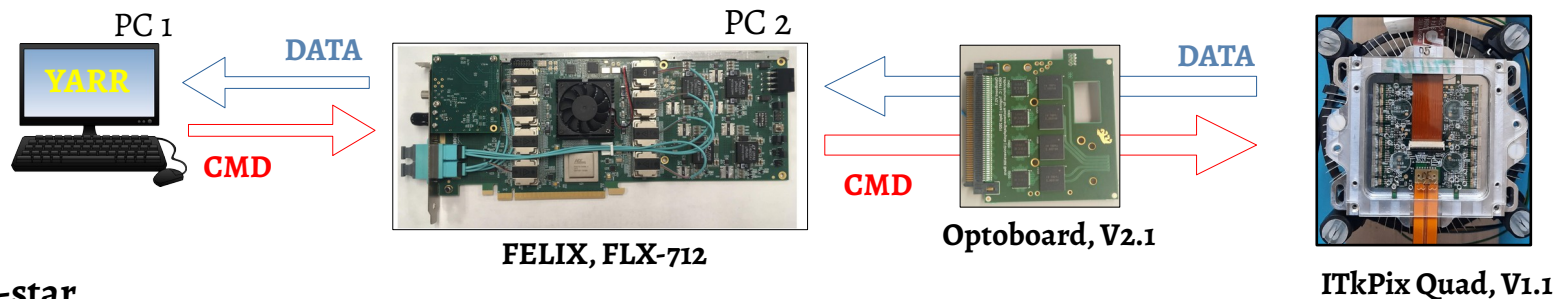
Running ITkPixel v1.1 SCC with YARR and Felixcore (Last updated on Jan 15, 2024)

- ▶ For instructions on setting up the FELIX software, firmware and driver, please look at section [Installing FELIX software, firmware and driver](#). And then, [Configure FELIX](#) and [Configure Optoboard](#).
- ▶ For instructions on installing YARR software, please follow the git repository [here](#) . An example setup instructions can also be found here on this page [Installing YARR](#). And then, [Configure ITkPixel v1.1 SCC](#).
- ▶ Setup Felixcore session in the new [felix-distribution](#)  software. In a new terminal session, run:

```
1 | export REGMAP_VERSION=0x0500
2 | source setup.sh
3 | ./x86_64-centos7-gcc11-opt/felixcore/felixcore -d 0 --data-interface lo -v -p 12350 -r 12340 -P 12330 -w 8080
```

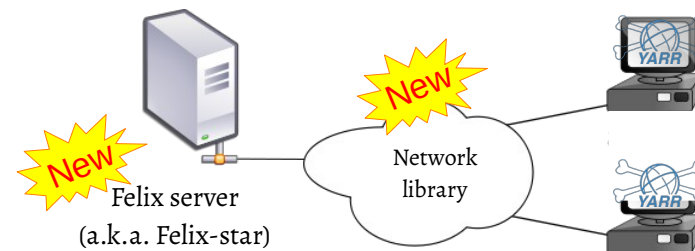
Running YARR scan

Recap: New Felix software & client interface



- **Felix-star**

- **felix-tohost**: from FLX card to network client (Readout data, DCS).
- **felix-toflx**: from network client to FLX card (TTC).
- **felix-register**: access FLX registers remotely (Monitoring)



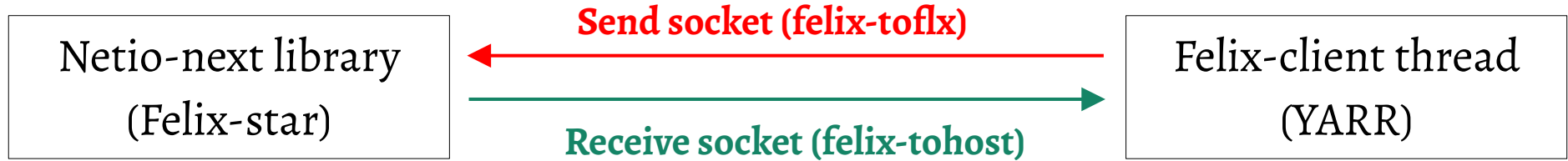
- **Network technology**

- **RDMA-over-converged-Ethernet** provided by **netio-next library**. Requires capable hardware e.g. NVIDIA Connect-X (Mellanox) cards.
- TCP/IP with loopback interface (without Mellanox card) in place but with lower performance.



- **Felix-client interface**

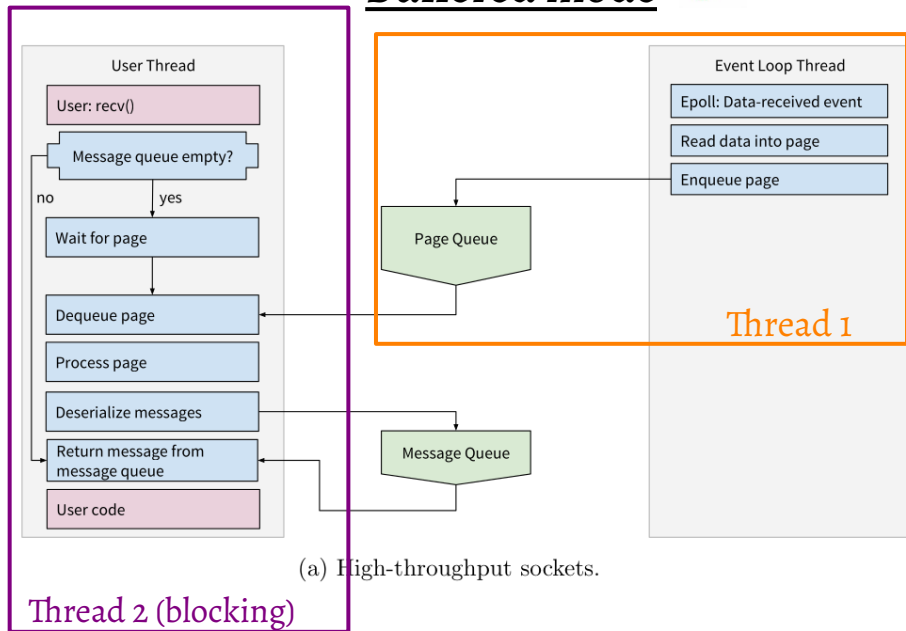
FELIX API for client applications, hides the complexity of netio-next library.



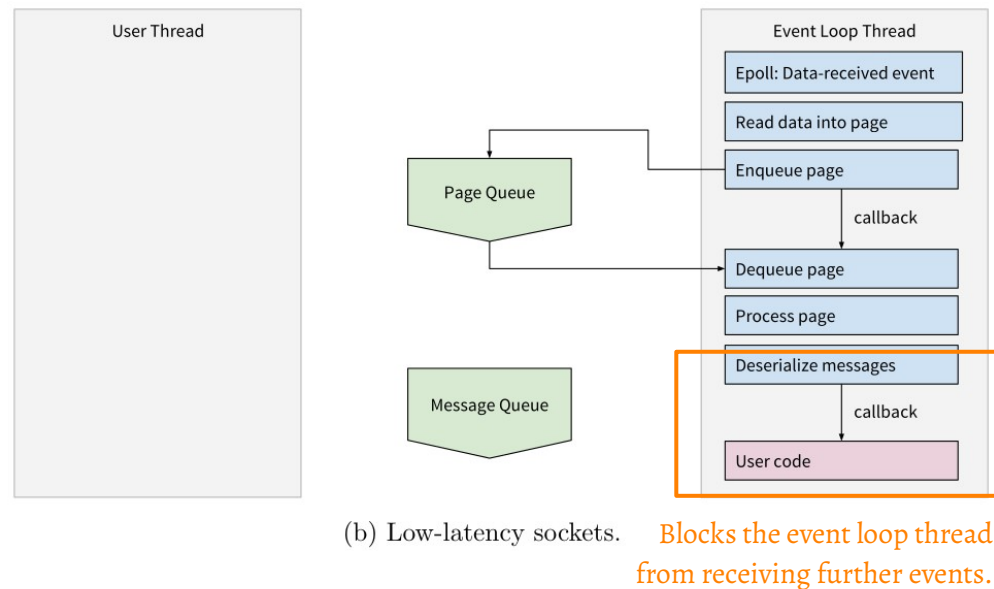
Receive socket (Felix-tohost) – Ideal configuration

Image courtesy: [ATL-DAQ-PROC-2017-010](#)

Buffered mode

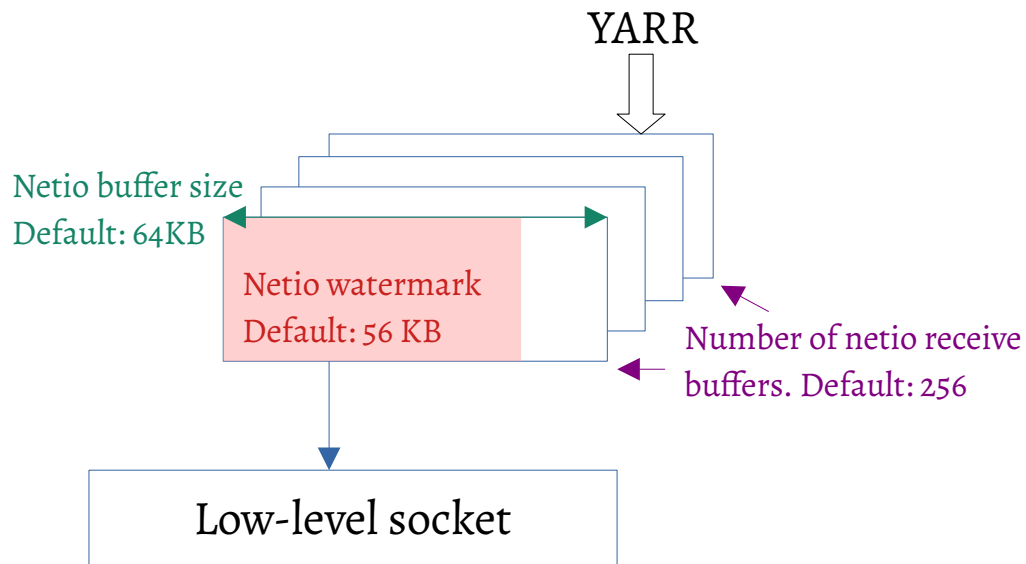


Unbuffered mode



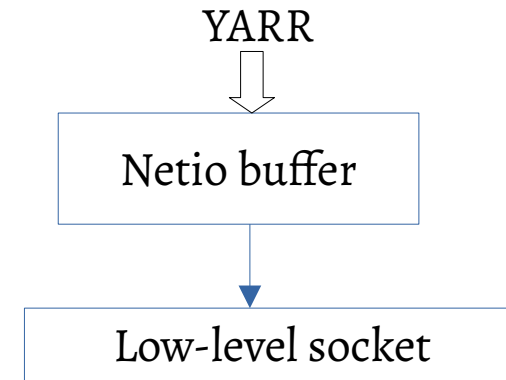
- Central event loop thread to handle I/O events (connection requests, transmission completions, timeouts etc.)
- User thread runs the application code to parse the buffer and extract the message.

Buffered mode



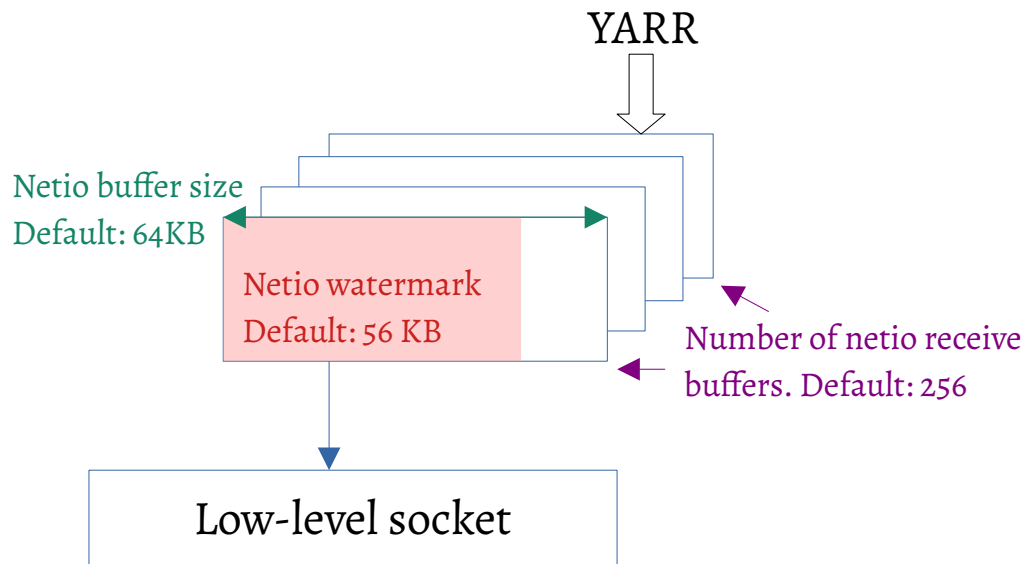
- Messages not sent out immediately, only when the buffer reaches watermark size or timeout. Timeout currently hardcoded in felix-client library [FLXUSERS-659](#)
- Hence, network interface receives large packets at reduced rate.
- Risk of **increasing average transmission latency** of any specific message.

Unbuffered mode



- Message buffer is directly passed to the underlying low-level socket.
- Hence, no netio watermark or timeout parameter.
- Many small packets with large overhead.
- Can **exhaust the buffers**.

Buffered mode



- Sending chip configuration in larger-size packets, governed by netio-watermark. (Not time-critical).
- Sending triggers immediately without any transmission latencies (using “flush” functionality for netio buffers). This is especially important for SW-triggers or time-based scans.

Running digital scan with FW-trigger in buffered mode (toflx and tohost)

Case 1 (ideal)

- Send chip configuration (flush = false)
- Send trigger commands (flush = true)

Failing pixels in two mask stages (0 or 50 hits out of 100).

Case 2

- Send chip configuration, **aggregating packets in YARR (up to 1024 bytes)**. (flush = false).
- **Calling IsCmdEmpty with flush=true to clear netio buffers**. Returns “FelixClientResourceNotAvailableException”. [FLXUSERS-658](#)
- Send trigger commands (flush = true)

Only one mask stage failing (78 hits out of 100).

Case 3

- Send chip configuration, aggregating packets in YARR (up to 1024 bytes). (flush = true). Same error [FLXUSERS-658](#).
- Calling IsCmdEmpty with flush=true to clear netio buffers. Returns “FelixClientResourceNotAvailableException” [FLXUSERS-658](#).
- Send trigger commands (flush = true)

Successful scan (6.8 s, configuration 1.8 s).

- Case 1 is ideal but **doesn't work**.
- Case 2 is **non-ideal** since we should not need to buffer messages from YARR. Instead, use the netio-watermark feature. However, that **doesn't work** as expected.
- Case 3 is also **non-ideal** since flushing the buffers all the time is in reality the “unbuffered mode”.

Running digital scan with FW-trigger in unbuffered mode (toflx) and buffered mode (tohost)

Case 1

- Send chip configuration (flush = false)
- Send trigger commands (flush = true)

“FelixClientResourceNotAvailableException”. FLXUSERS-658

Adding try-catch block with a wait time of 500ms gets rid of the error. Successful scan (6.7 s, configuration time 28 s).

Case 2

- Send chip configuration, **aggregating packets in YARR (up to 1024 bytes)**. (flush = false).
- **IsCmdEmpty clears the YARR buffers.**
- Send trigger commands (flush = true)

First mask stage failing (78 hits out of 100).

Case 3

- Send chip configuration, aggregating packets in YARR (up to 1024 bytes). **(flush = true)**. Same error **FLXUSERS-658**. Adding try-catch.
- IsCmdEmpty clears the YARR buffers.
- Send trigger commands (flush = true)

Successful scan (6.7 s, configuration 0.7 s).

YARR branch (WIP) - [MR!704](#)

- Case 1 takes a **long time to configure the chip**. Cannot control the size of outgoing packets with netio-watermark.
- Case 2 can be a workaround for case 1, but **doesn't work** as expected.
- Case 3: why does **“flush” setting changes the behavior in the unbuffered** mode? Makes the configuration much faster and also fixes the missing data.

Running digital scan with FW-trigger in buffered mode (toflx and tohost).

Removing the Mellanox network card (disable RDMA), current recommendation for Stage-I setup.

- Using TCP/IP in loopback mode.
- Sending chip configuration (flush = true) and trigger commands (flush = true).
- Aggregating command packets in YARR.

} Same configuration
as for RDMA.

Scan successful and very stable.

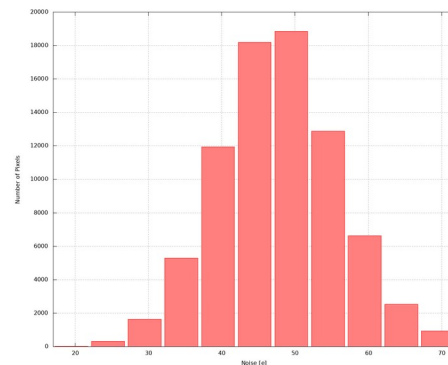
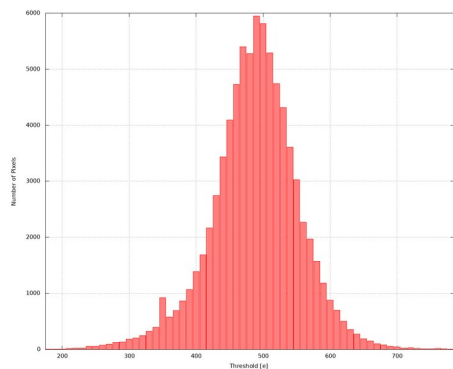
YARR branch (WIP) - [MR !721](#)

ITkPix SCC v1.1	FelixCore (TCP/IP)	Felix-star (RDMA)	Felix-star (TCP/IP, loopback)
Digital scan (FW-based trigger frequency = 5KHz, trigger multiplier = 16, injections = 100)	Scan time: 39.198 s Analysis: 740 ms Configuration: 620 ms Processing: 0 ms	Scan time: 5.079 s Analysis: 762 ms Configuration: 770 ms Processing: 0 ms	Scan time: 5.506 s Analysis: 669 ms Configuration: 236 ms Processing: 0 ms

ITkPix SCC v1.1	FelixCore (TCP/IP)	Felix-star (RDMA)	Felix-star (TCP/IP, loopback)
Digital scan (SW-based trigger frequency = 5KHz, trigger multiplier = 16, injections = 100)	Scan time: 175.066 s Analysis: 760 ms Configuration: 797 ms Processing: 0 ms	Scan time: 5.079 s Analysis: 762 ms Configuration: 770 ms Processing: 0 ms	Scan time: 8.659 s Analysis: 713 ms Configuration: 241 ms Processing: 0 ms

Current baseline – II for sites using YARR with FELIX (Felix-star) with network card for RDMA or in the loopback mode with TCP/IP.

ITkPix SCC v1.1	FelixCore (TCP/IP) FW-trigger	FelixCore (TCP/IP) SW-trigger	Felix-star (TCP/IP, loopback) FW-trigger	Felix-star (TCP/IP, loopback) SW-trigger
Threshold scan	Scan time: 1733.258 s Analysis: 787 ms Configuration: 696 ms Processing: 0 ms	Scan time: 2020.552 s Analysis: 791 ms Configuration: 745 ms Processing: 0 ms	Scan time: 190.583 s Analysis: 772 ms Configuration: 240 ms Processing: 0 ms	Scan time: 273.982 s Analysis: 615 ms Configuration: 237 ms Processing: 0 ms

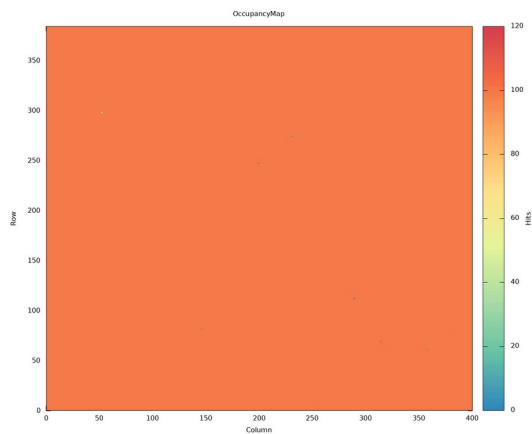


```
[ StdAnalysis ]: [0][0x16276][0] Threshold Mean = 487.8425954849906 +- 66.26427172622094
[ StdAnalysis ]: [0][0x16276][0] Noise Mean = 47.50202274357343 +- 9.384491453273608
[ StdAnalysis ]: [0][0x16276][0] Number of failed fits = 3162
```

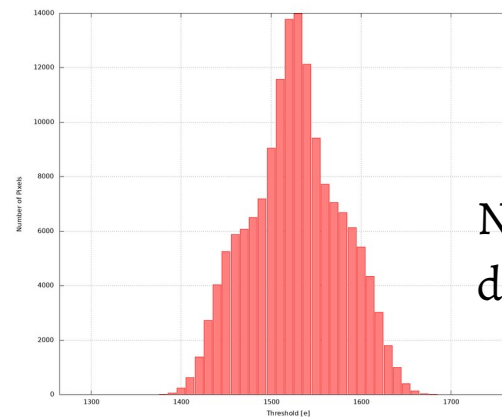
Current baseline – II for sites using YARR with FELIX (Felix-star) with network card for RDMA or in the loopback mode with TCP/IP.

YARR + Felix-star performance

ITkPix SCC v1.1	FelixCore (TCP/IP) FW-trigger	FelixCore (TCP/IP) SW-trigger	Felix-star (TCP/IP, loopback) FW-trigger	Felix-star (TCP/IP, loopback) SW-trigger
Analog scan (Trigger frequency = 5KHz, trigger multiplier = 16, injections = 100)	Scan time: 43.065 s Analysis: 729 ms Configuration: 703 ms Processing: 0 ms	Scan time: 168.273 s Analysis: 490 ms Configuration: 745 ms Processing: 0 ms	Scan time: 5.540 s Analysis: 801 ms Configuration: 238 ms Processing: 0 ms	Scan time: 9.142 s Analysis: 500 ms Configuration: 238 ms Processing: 0 ms



Failing pixels = 15
 (After retuning the
 chip to 1500 e)



New threshold
 distribution

Current baseline – II for sites using YARR with FELIX (Felix-star) with network card for RDMA or in the loopback mode with TCP/IP.