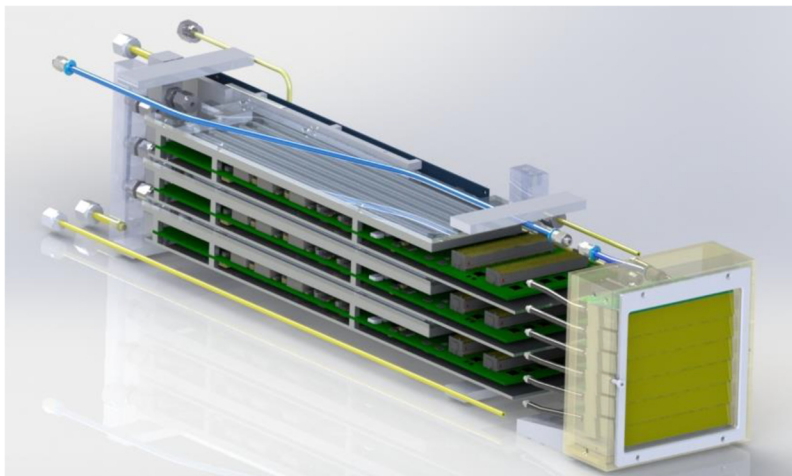




The Back-End Computer System for the Medipix Based π -MEGA X-Ray Camera

On behalf of the Beamline Software Group of LNLS

A project of Jean Polli (jean.polli@lnls.br) and the Detectors Group of LNLS

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π -MEGA

High resolution

High speed

Medipix 3RX

55 μm pixels

2,4 Mega pixels

1000 fps @ 24 bits

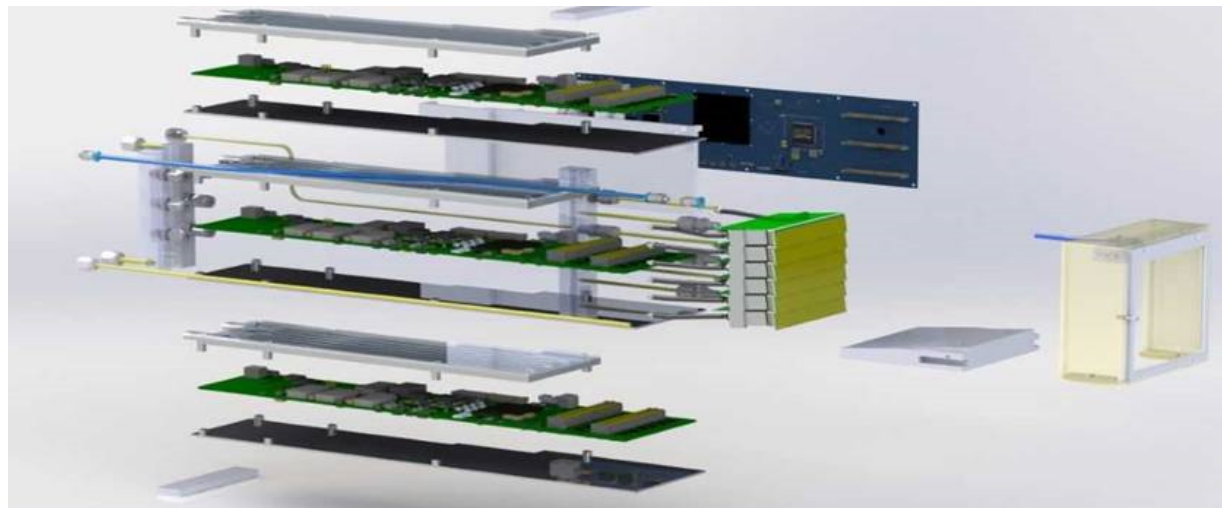
2000 fps @ 12 bits

Composable

X-Ray Camera

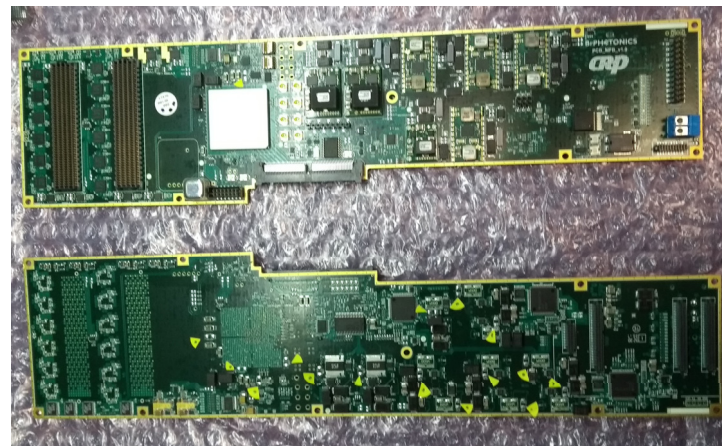
CERN – LNLS Medipix Collaboration

<http://medipix.web.cern.ch/medipix/pages/medipix3/institutes.php>



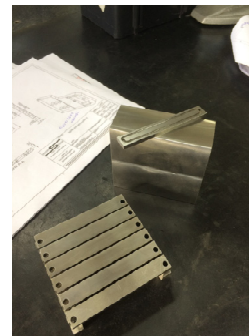
Features:

- Fast Readout (up to 2000 continuous fps)
- Background-free Hybrid technology
- 55 μm square pixel size
- Modularity (2,36 MPixel / module)
- Gap-minimizing (No dead area)
- Easy maintenance and replacement



Status:

- First prototypes under construction.
- Firmware under development.



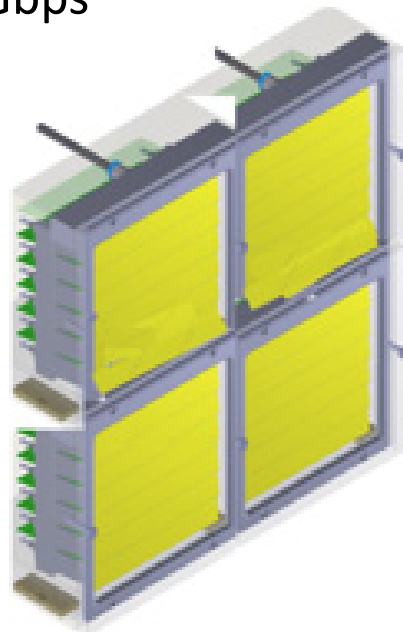
π -M Ξ GA back-end

Machines that will receive, pre-process images and send result to storage.

- One π -M Ξ GA = 2,4 MPixel x 24 bit x 1000 fps => 56.6 Gbps
- Composable
 - 2x2 array (9 MPixel) => **226,5 Gbps**

Required algorithms are complex

- Main reference: tomographic reconstruction
 - Requires GPU to be fast



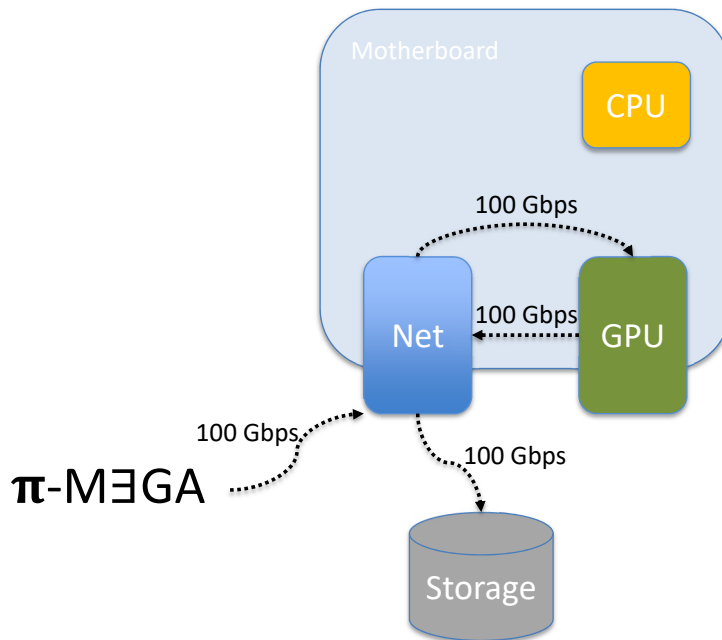
Single π -M Ξ GA design

1 x π -M Ξ GA

1 x 100 Gbps network link

1 x GPU

Idealized Dataflow



RDMA: Remote Direct Memory Access

Low overhead, high performance network protocol

Application programs card, card does the rest

Packet sending

receiving

interpreting

dispatching

} Done by network card

“0 CPU usage” == < 5% CPU usage

Well supported (from Infiniband)

RDMA implementations

- Infiniband
 - Infiniband over Ethernet, our choice
- RoCE
 - Modified compatible TCP over Ethernet
- iWARP
 - Intel
- Soft RoCE
 - Software based RoCE, no acceleration, but Ethernet compatible, linux 4.8

Multiple π -M Ξ GA back-end

NVLink based back end

IBM S822LC HPC (OpenPOWER)

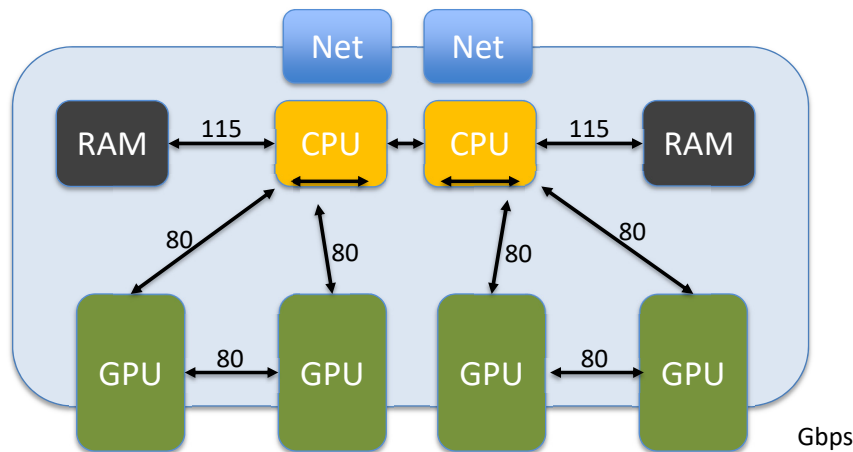
4 pi-megas

2 100 Gbps PCIe network cards

4 NVLink GPUs

Shared GPU data

GPU access to 2 network cards



Back-end:

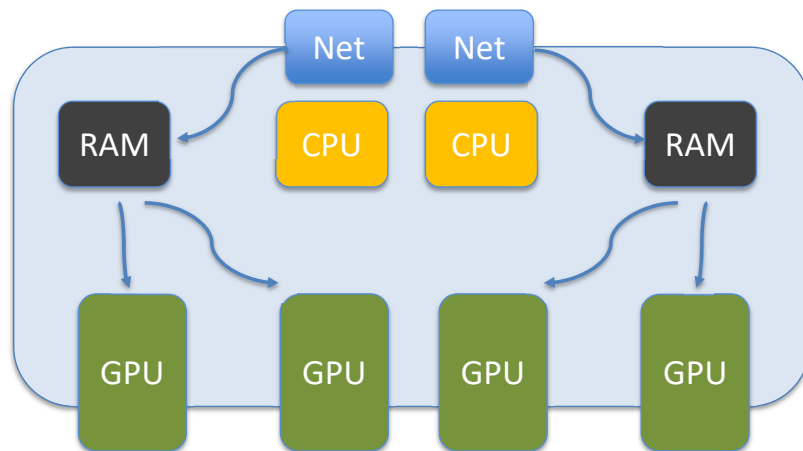
IBM NVLink cluster @ NY, USA

Result: 78 Gbps!

Everything working simultaneously

Benchmarks with 256 GiB, ~28 seconds

Still missing storage integration



rdmacp

Benchmark software available! →

LNLS SOL group github
<https://github.com/lnls-sol>

Questions?

Software Group

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End.

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