Tango Integration of Modern 2D Detectors

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Outline

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Background

- Motivation
  - Provide detector with high sensitivity, high resolution,high frame rate and large area

- New detector development
  - LAMBDA 2D detector
  - Developed by DESY.
  - Based on the Medipix3 readout chip
  - Single Module:1536 x 512 pixels
  - Support both 12 and 24 bit image modes
  - Maximum frame rate:2000 frames/second with 12 bit mode

Large Area Medipix Based Detector Array

(LAMBDA)

  - Other detectors (e.g. AGIPD) are under development as well

Challenges

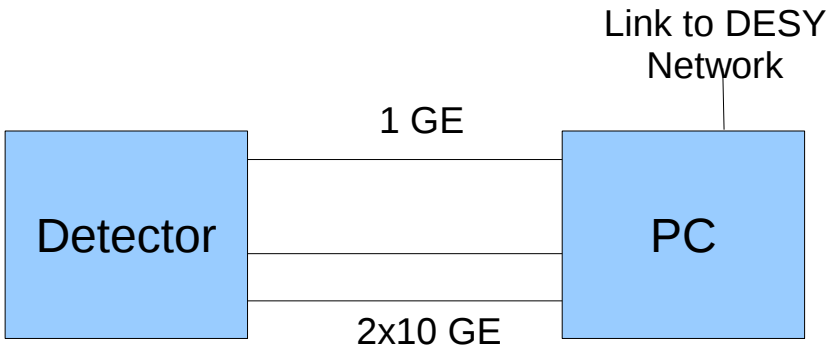
- Large amounts of data from LAMBDA
  - Data transmission via UDP protocol
  - Each raw image: ~1.2 MBytes
  - With maximum frame rate: 2.4 GBytes/s
  - How do we receive reliably such amounts of data?

- Multiple modules compatibility
  - LAMBDA: full size module (1536 x 512 Pixels) half size module (768 x 512 Pixels) three modules system
  - Other high speed detector (e.g. AGIPD) with same data transmission protocol
  - How do we generalize the software and make it reusable?

Hardware

- Detector PC
  - Dell PowerEdge R620 Server
  - Intel(R) Xeon(R) CPU E5-2667 0 @ 2.90GHz X 12 cores
  - RAM: 256 GBytes
  - Hard disk: 4 TBytes
  - 6 X 10 GE NICs
  - 2 X 1 GE NICs

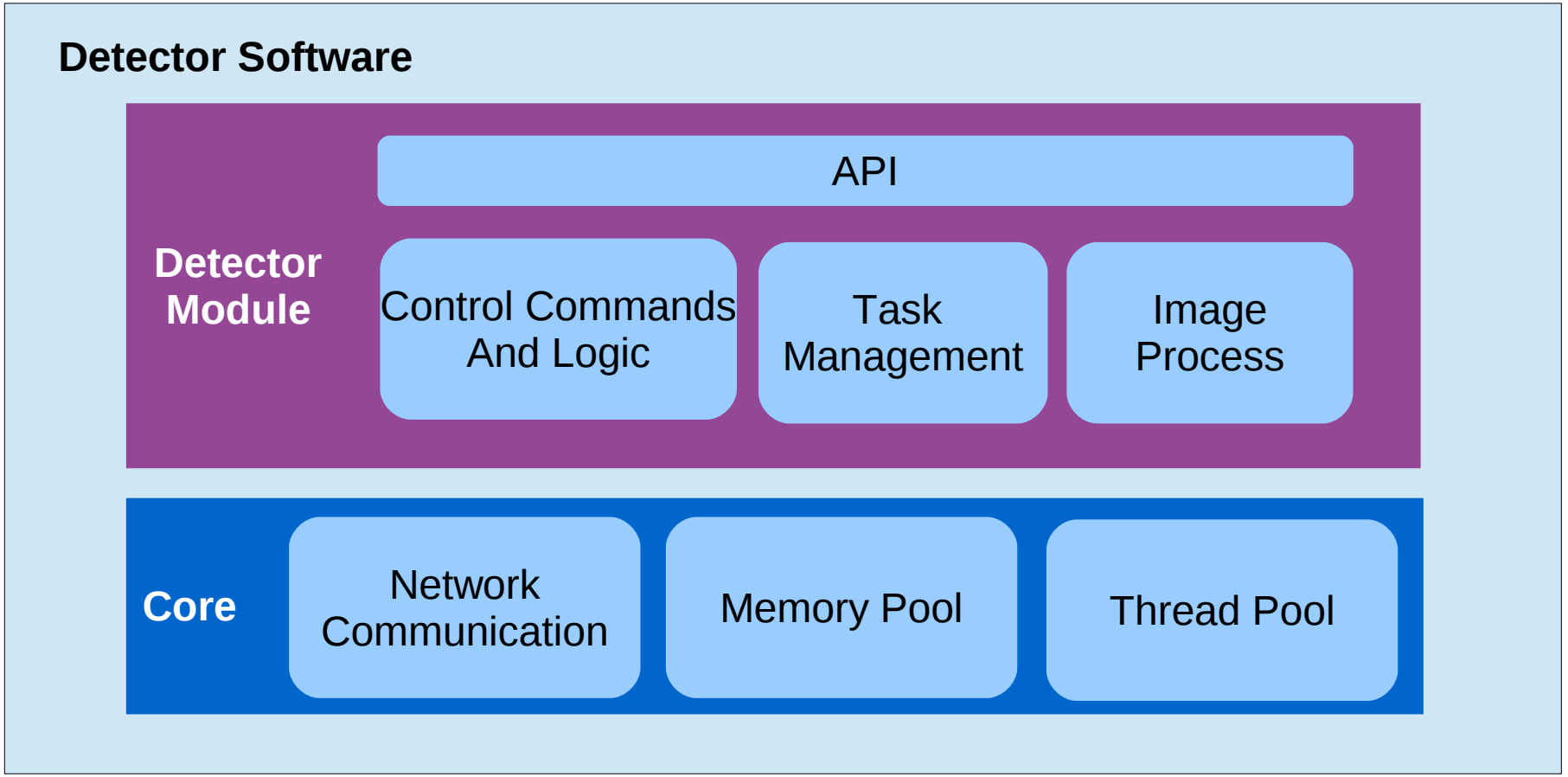
- LAMBDA system Overview
  - 1 GE TCP link, slow control
  - 10 GE UDP link, data transmission



Software Architecure

> Architecture

- Divided into core and module dependent parts



Software Core

- Network communication
  - Based on Linux socket API
  - Data receiving and sending methods are implemented
- Memory pool
  - Based on boost fast pool allocator
  - Support different data types by using generic programming technology
  - FIFO circular buffer without overwriting
- Thread pool
  - Based on boost thread implementation
  - Used to support variable tasks (e.g. data receiving, image decoding)

Detector Module

- Module dependent control
  - Detector control commands are implemented (e.g. setting shutter time)
  - Basic control logics are implemented (e.g. start acquisition)
- Task management
  - Create tasks for parallel computing (e.g. UDP listener, image decoding)
  - Created tasks are pushed to thread pool
- Image process
  - Provide image process related method (e.g. decoding image, distortion correction)
- API for further integration
  - Interface for developing user applications (e.g. tango server)

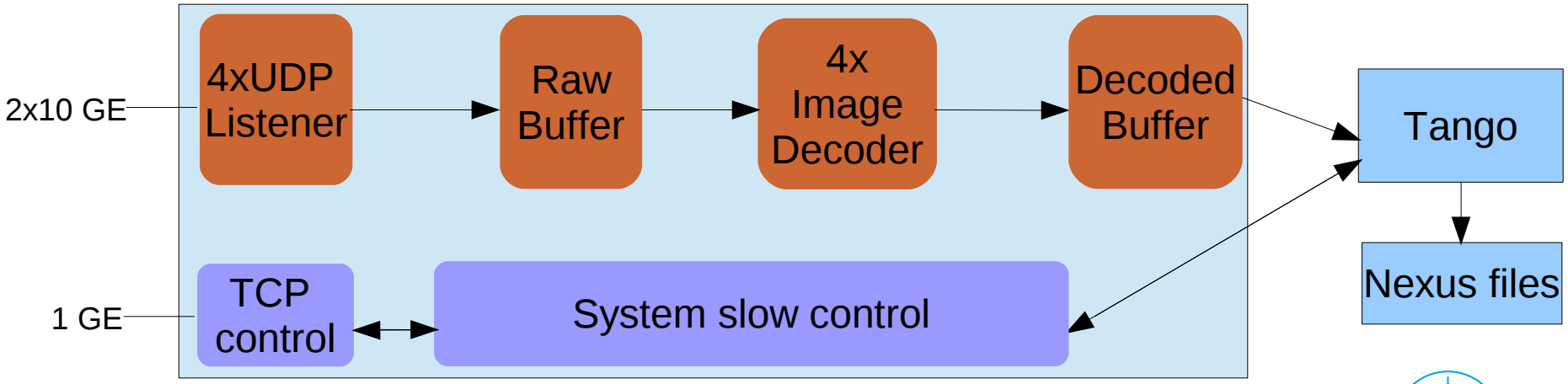
Tango Integration

> Tango server implementation

- Based on the interface of detector software, tango attributes are created
- Based on PNI library, data are saved to local disk with Nexus format

> LAMBDA system workflow

- 4 x UDP listeners;4 x Image Decoders
- Parallel running: UDP receiving data, image decoding, saving data to disk
- Maximum images to take: 150,000 images (75 seconds)



PNI library:https://github.com/pni-libraries

Summary and Outlook

- Successfully integrated into tango control system at PETRA3 in DESY
- Works reliably with high speed(2000 fps) data acquisition mode
- Bottleneck on data compression, local file saving slowly
- The core part of the software is reused in AGIPD
- With this software, integration to LIMA is possible
- Increase compression speed with parallel running HDF5 external filter
- In future, with help of the GPFS file system from IBM. The data will be saved to DESY central storage rather than local disk
- Three module LAMBDA system is being developed and will be integrated into tango

Thank you