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Adapting a SDR environment to GPU architectures

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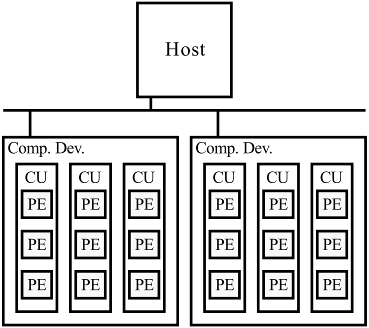
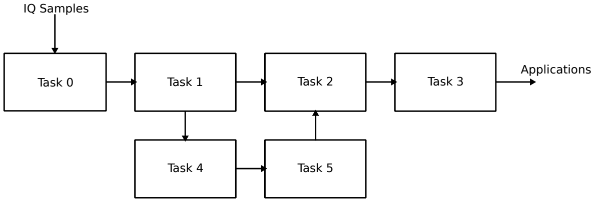
OpenCL architecture



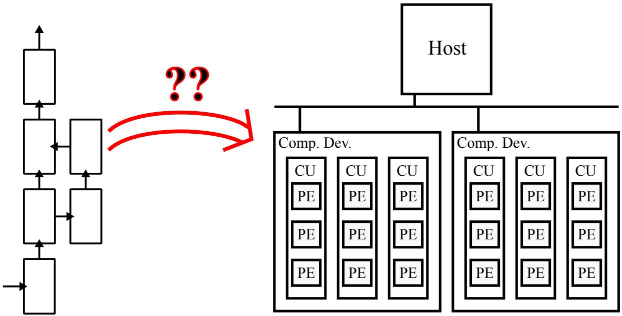
- Centralized management on host
- SIMD architecture: same kernels applied on large vectors

GNURadio

- SDR framework
- Provides:
  - a large set of SDR basic operations
  - runtime management of the operations
  - I/O integration (Ettus Research, audio, . . .)



Aim



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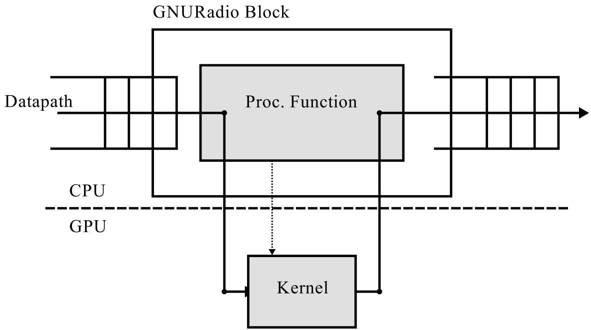
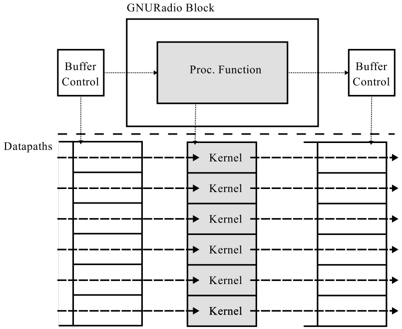
Straightforward approach



- Use GPU as a single very efficient CPU
- Per-block optimization
- Efficient for some operations on very large data set

Mapping to GPU : parallelism



- Use each PE as a small CPU
- Apply an optimized sequential operation on each data set
- Lauch operation on multiple data sets
- Efficient for streaming applications, requires more memory

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Test platform and method

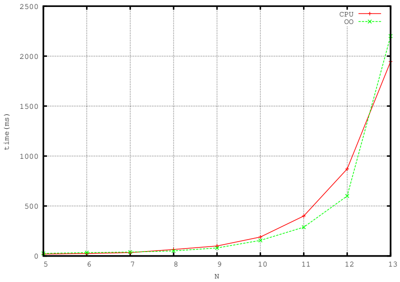
Test platform

- Intel Core i5 760 CPU (4 cores, 2.8GHz, 8MB cache)
- 4GB DDR3 memory
- Linux 2.6.36 kernel
- NVidia GTS 450 GPU, Asus DirectCU Card, 1GB DDR5 memory

Method

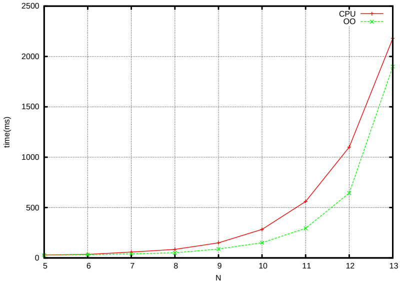
- 3 single operations:
  - FFT
  - IIR
  - Mapping
- Sequences of operations

FFT



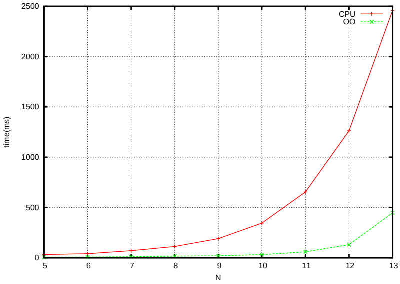
- Straightforward solution inefficient on considered vector sizes
- Small gain for GPU solution
- Data transfer reduces performance
- GPU monitoring :
  - 10% for straightforward solution
  - 98% for parallel solution

IIR



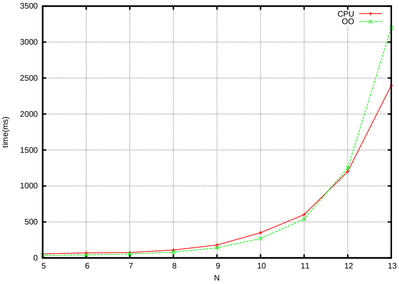
- No optimized algorithm for straightforward solution
- ∼ 50% gain for GPU solution
- High block size requires more memory

Demapping



- No need for high processing power
  → GPU core is sufficient
- Very efficient on GPU, even for large data set

Multitasking



- No multitasking on GPU: sequential execution
- Issue on buffer management reduces performance
- 20% gain for 4 tasks for size 1024

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Conclusion and perspectives

Contributions

- Study of two possible solutions for GPU integration
  - an existing solution, with disappointing results
  - a new solution for streaming application, with promising performance

Perspectives

- Resolve the buffer management issue
- Experiment in a real radio application