A Case Study in Optimizing GNU Radio's ATSC Flowgraph

Presented by Greg Scallon and Kirby Cartwright

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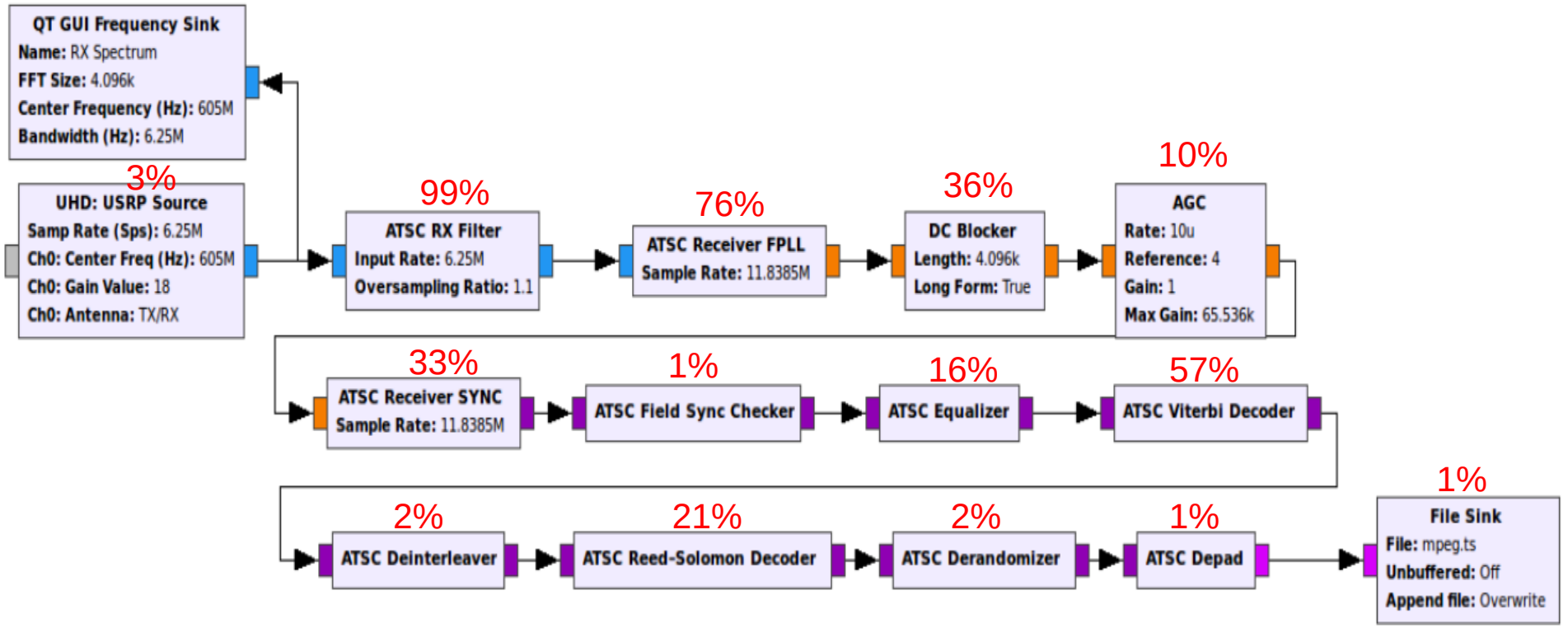
ATSC FLOWGRAPH LOADING



Architecture: Intel i7 multiple core processor Linux OS with Thread per Block Scheduler

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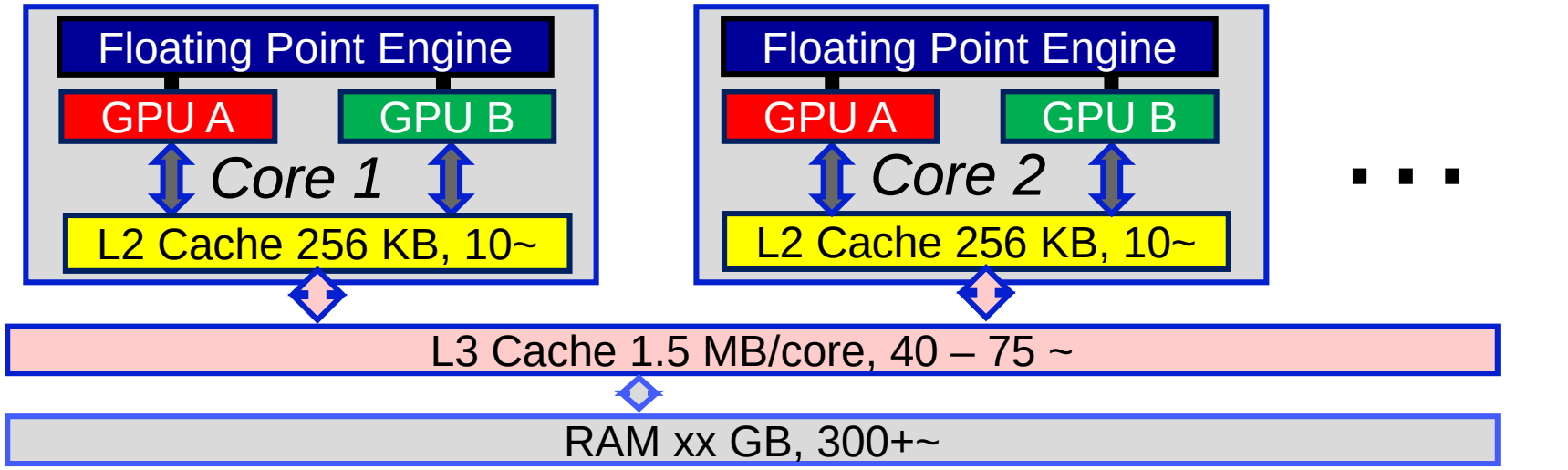
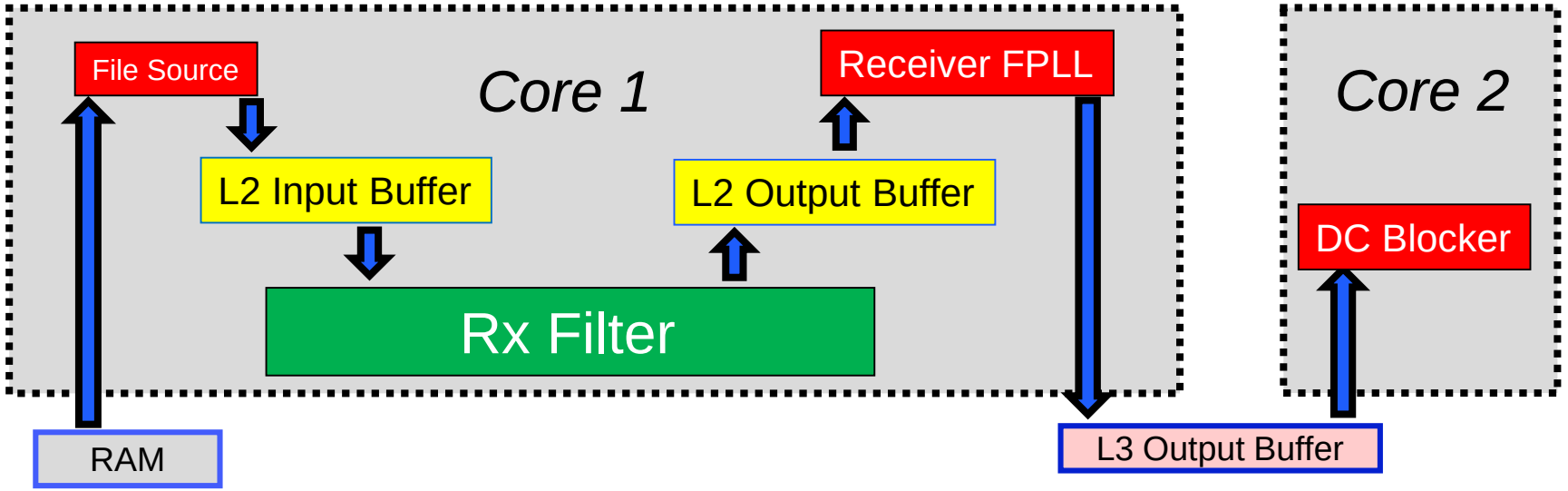
L2 SIBLING COMMUNICATION





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TUNING BUFFER SIZE

Larger buffer sizes increase procedure efficiency

- Economy of scale amortizes overhead

Buffers too large overflow L2 cache memory

- Increases access overhead

Experiments with different buffer sizes shows effect :

Default Buffer size	Throughput Impact	
64 KB	0	*reference*
56 KB	-11.1%	
48 KB	3.8%	
40 KB	3.5%	
32 KB	2.9%	

Exploiting L2 allocation improves performance by more than 21%

- Baseline tuning doesn't change any ATSC application code or structures

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UPGRADE to NEWER LINUX OS RELEASE

Throughput differences between Linux versions

Ubuntu OS release version:		4.4.0	4.11.2
Baseline configuration	*reference*	0%	12.6%
Allocate for L2 communication		23.2%	25.4%
Net improvement		23.2%	11.3%

Latest Linux offsets 46% of the L2 allocation savings

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COMPARING INTEL and AMD CHIPS

New AMD Ryzen 7 processors rival Intel i7 chips

Characteristics	Intel i7 6950X	AMD Ryzen 7 1700
Default Clock speed (GHz.)	3.0	3.0
L1 Cache (instruction, data) KB per thread	32, 32	64, 32
L2 Cache KB per core	256	512
Number of cores each with Hyper-Thread	10	8
L3 Cache MB shared across all cores	25	16
Max DDR4 RAM GB shared by all cores	128	64
Memory Channels	4	2

Larger L1 & L2 Cache promises more performance

- For executing the ATSC using L2 cache communication

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INTRODUCING: KIRBY CARTWRIGHT

Using the AMD Chip for ATSC

Experience getting the ATSC application to run on a Ryzen 7 processor (and the Intel I7)

Problems and solutions

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ISSUES REHOSTING to a RYZEN CHIP

AMD Ryzen chips are New

- Lack full support for both processor and different motherboards (Gigabyte ga-ab350 gaming)

Finally found a source patch for Ubuntu 4.11.2 allowing Linux to boot on the Ryzen chip

- Not sure if core allocation and threading is completely supported
- Kudos to Canonical and Ubuntu support and the Internet community for the support!

As of 5/23/17, there is no direct VOLKS library support for Ryzen

- Some overlap with Intel CPUs but not all specialized floating point instructions are supported - see me at the booth for details

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ISSUES REHOSTING to a RYZEN CHIP

- On the other hand - there are great Linux run-time analysis & performance tools; e.g., top and htop. They apply directly to the AMD and Intel i7 processors, cores, and threads

- On the third hand there are no runtime cache analysis and monitoring tools. *Does anybody in the radio audience know of any?*

- By the way - If you have tweaked a GRC application to run optimally on one machine - That's all you have done. *You will need different tweaking on a different machine.*

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RUNNING GNU ATSC on a RYZEN CHIP

The 14 ATSC blocks now load and run on the Ryzen CPU

- Once the Ubuntu kernel booted ...

Default performance is 4% slower on the AMD Ryzen

- As compared to the particular Intel configuration options previously identified

The larger L2 Cache promises more performance

- For executing the ATSC flow graph using L2 cache for inter-block communications

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RYZEN BUFFER SIZE TUNING

- Experimentally tuning the ATSC buffer sizes for the ATSC Flowgraph running on the Ryzen 1700 chip

Buffer Size (KB)	Performance Time	
56K	372s	
64K	361s	
128K	363s	
152K	355s	
256K	358s	

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CHANGES THAT IMPROVED PERFORMANCE

Allocate critical blocks to fixed hyper-threads

- Increases throughput of the critical Rx Filter block
- Allocate L2 Cache Communications for faster access
- Allow Turbo Boost to focus on critical Rx Filter block

Experimentally tune default buffer size allocation

- Find the buffer size which gives the best performance

Upgrade to the latest Linux OS version release

- Apply the latest OS system optimizations & improvements

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Questions?

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