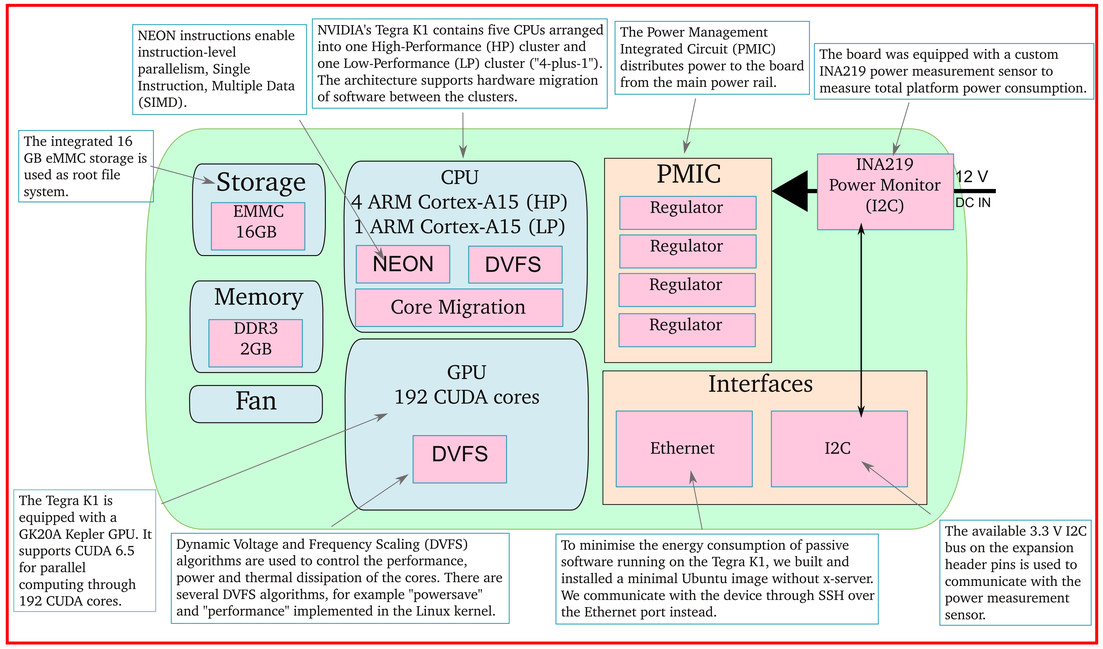
Energy and Performance Optimisation of a Simple Video Encoder on the Jetson-TK1

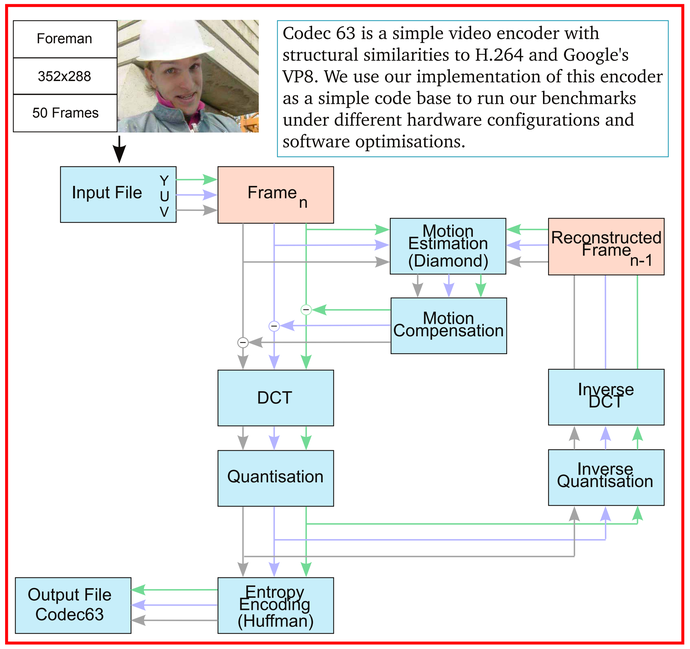
Kristoffer Robin Stokke, Håkon Kvale Stensland, Pål Halvorsen
Department of Informatics, University of Oslo, Norway
{krisrst, haakonks, paalh}@ifi.uio.no
[simula . research laboratory]

This poster analyses the energy consumption of a simple video encoder running on NVIDIA's Tegra K1 processor[1][2]. The total energy consumption of the video encoder is investigated under the influence of different hardware configurations, such as which processors (CPU clusters or GPU) are used, DVFS algorithms, and whether performance optimisations like NEON are implemented. We find that NEON instructions and multithreading generally have positive effects on energy consumption, saving between 25 to 40 % energy compared to a non-optimised, naive implementation. GPU offloading is found to be marginally better than CPU execution by an amount of 1.7 %.

Jetson-TK1



The Workload: Codec 63



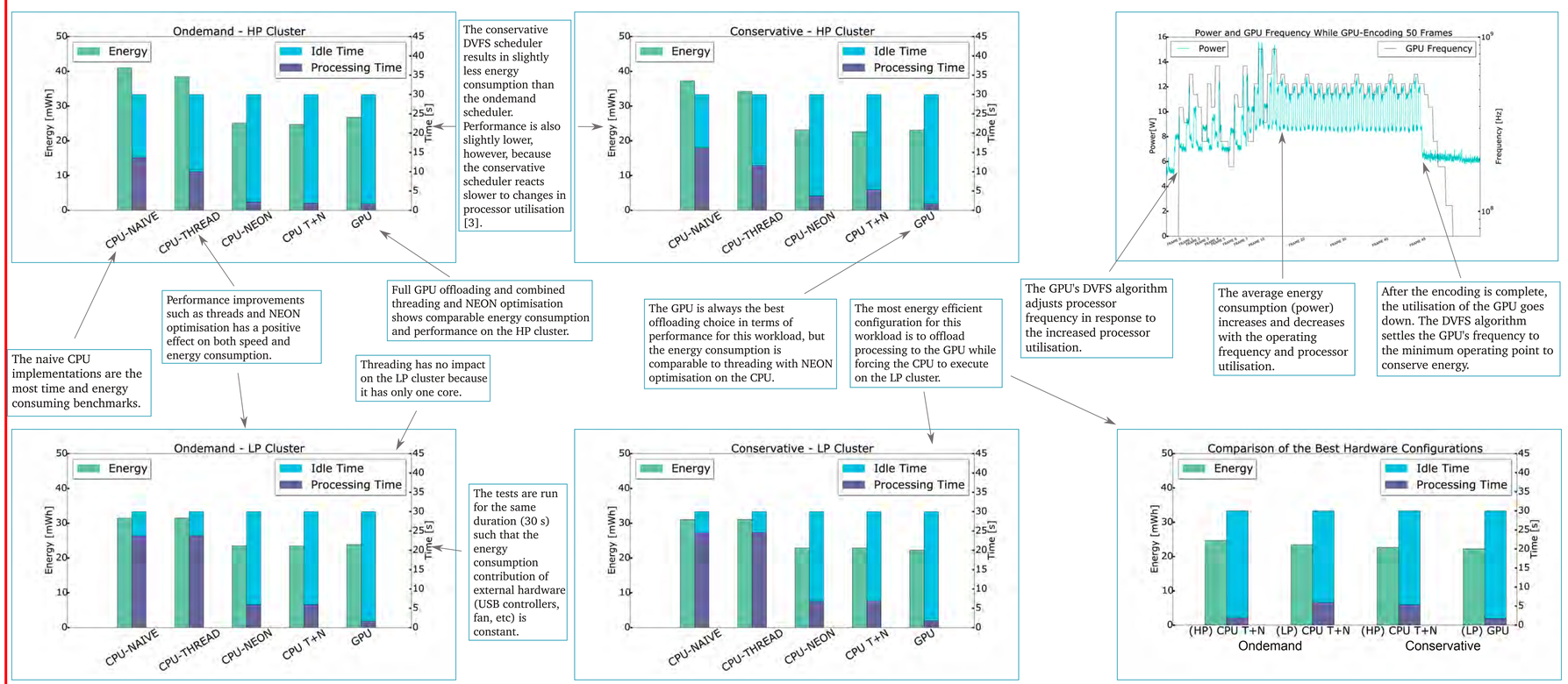
Benchmark Configurations

CPU - Naive	Single threaded.
CPU - Threaded	Multithreaded (3, one thread per frame type, Y, U and V).
CPU - NEON	Single threaded, but with NEON optimisation.
CPU - Threaded,NEON	Multithreaded (3) with NEON optimisation.
GPU	GPU offloading using CUDA.

Hardware Configurations

Processor	Cluster	DVFS Algorithm
CPU	High Performance	Ondemand
		Conservative
	Low Performance	Ondemand
		Conservative
GPU	N/A	Auto

Experimental Results



Concluding Remarks

NVIDIA's Tegra K1 processor provides the programmer with a wide range of tools for performance optimisation, for example multithreading, NEON, and GPU offloading. From the experimental results we see that these affect energy consumption in a positive way. The best hardware configuration is to offload the workload to the GPU, while forcing the CPU to operate in the LP cluster.

We have not shown the "performance" or "power" CPU DVFS algorithms here because they are easily outperformed by the "ondemand" and "conservative" algorithms. We see that the "conservative" algorithm causes slightly lower energy consumption, but also higher runtime. This is because it reacts slower to changes in processor utilisation.

Energy consumption is an important topic in a mobile world. The Jetson-TK1 takes great steps to provide the developer with a feature rich computing platform with interesting power saving opportunities that are yet to be explored fully.

References

[1] "Variable SMP (4+PLUS-1) - A Multi-Core CPU Architecture for Low Power and High Performance"
http://www.nvidia.com/content/PDF/tegra_white_papers/Variable-SMP-A-Multi-Core-CPU-Architecture-for-Low-Power-and-High-Performance.pdf

[2] "NVIDIA Tegra K1 - A new Era in Mobile Computing"
http://www.nvidia.com/content/PDF/tegra_white_papers/Tegra-K1-whitepaper-v1.0.pdf

[3] V. Pallipadi and A. Starikovskiy. The ondemand governor. In Proc. of the Linux Symposium, volume 2, pages 215–230. sn, 2006.

[4] K.R. Stokke, H.K. Stensland, C. Griwodz, P. Halvorsen. Energy Efficient Video Encoding Using the Tegra K1 Mobile Processor. In Proc. of the ACM Multimedia Systems Conference, 2015.