Characterising radio telescope software with the Workload Characterisation Framework

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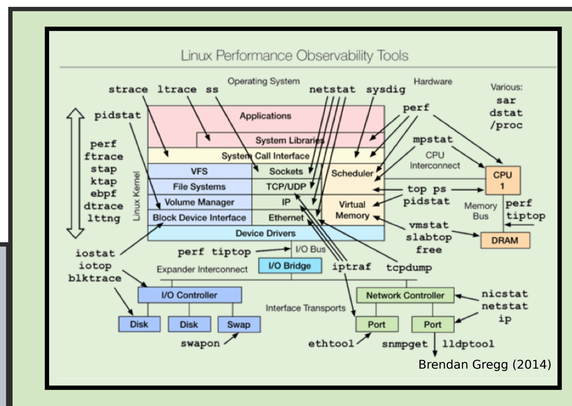
Reading time (s)

Introduction

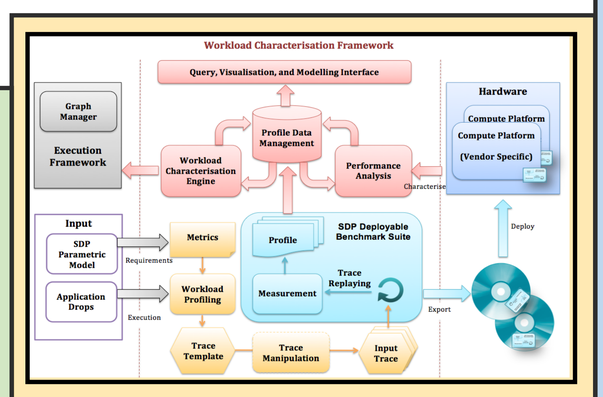
Scientific projects are growing more complex and with wider collaborations. Standards need to be defined to ensure that results of investigations can be reproduced, while facilitating development and mitigating issues. This is especially true for the analysis of software. The ability to uniformly characterise and compare software that is being used, during production and development, is very important for a broad range of activities, including planning and costing.

O/S profiling and monitoring



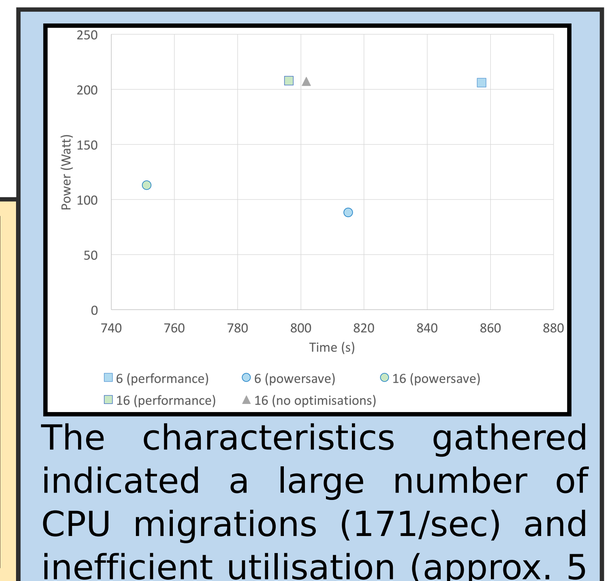
As can be seen in the image, the Linux kernel provides many probe points for system resource monitoring and application characterisation. The multitude of probes, tools and methods of which each has their own complexity when interacting with the system, makes it hard to obtain numbers that are reproducible with different hardware and software.

The framework



The Workload Characterisation Framework (WFC) is developed as part of the SKA Science DataProcessor (SDP) element. The goal of this framework is to support future operations, planning and R&D efforts. The Figure above shows the components from which the WFC will consist. It aims to provide a uniform method to characterise workloads in atelescope, with provenance making it suited for other use cases as well.

LOFAR example with WCFfcute

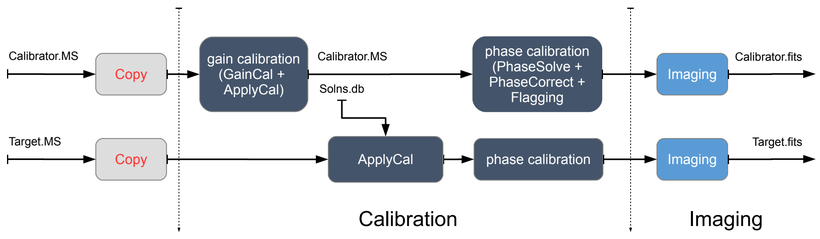


The characteristics gathered indicated a large number of CPU migrations (171/sec) and inefficient utilisation (approx. 5 CPU cores). After modification, the pipeline had a reduction in migrations that lead to greater efficiency. Limiting the computation to 6 CPU's (instead of 16) only resulted in an additional 6.48% in runtime. Tuning the hardware to be more power efficient with only 6 CPU cores, rather than in performance mode (fixed freq. HPC setting) resulted in up to 57.49% power reduction, while only being 1.64% longer in runtime.

standardisation — reproducibility — verification

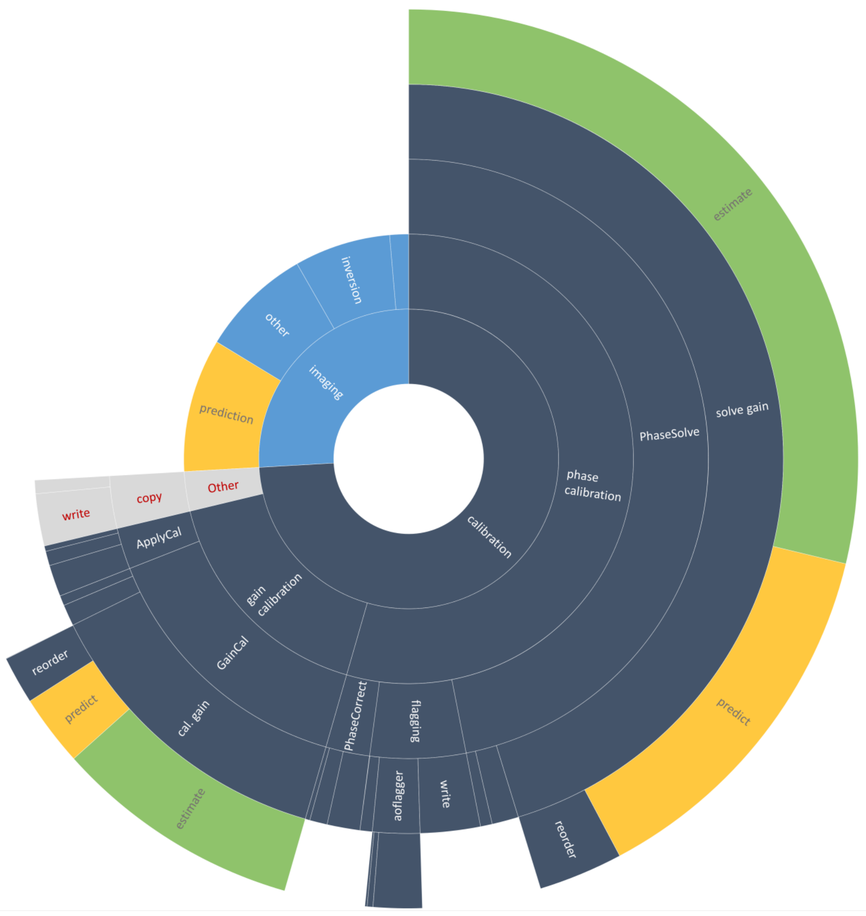
The LOFAR use case

The ASTRON R&D group is amongst early adopters of the WFC. By doing this, the developers of the WFC will get feedback from the LOFAR team. WFC is intended to be extensible and as an illustration, we show a possible extention here.



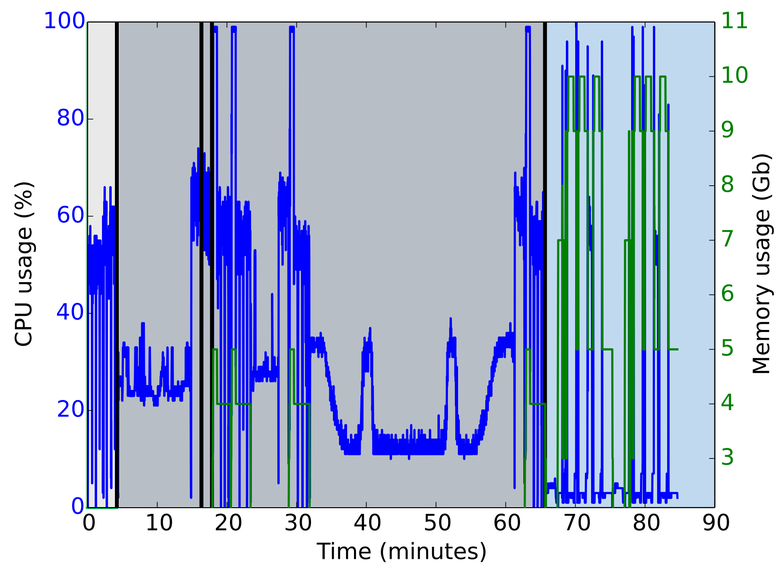
Graphical representation of the pipeline used for this demo. The pipeline consists of generating an image based on a target and calibrator observation. For this demonstration, we execute on a single LOFAR subband, averaged by a factor 32. The colours in the image match the colours in the results shown later.

Extention



A hierarchical overview of the timings obtained by characterising the pipeline. The most time consuming steps — predict and estimate — are emphasised.

Using the framework



Complementary to the timings in the diagram, the WFC can be used to characterise the resource utilisation at run time. Here it is shown at what time the bottle necks occur, and whether the system is fully being effeciently utilised. Together, such plots can be used to decide on what parts of the pipeline to focus R&D efforts.

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