5. Green500 vs Top500 & Green500 November 2024 vs June 2013

Green500 vs Top500 November 2024:

There are few similarities between the supercomputers in the Top500, which are graded on HPL score, and the Green500, which is ranked based on HPL benchmark per Watt of electrical power consumed. The most obvious differences are visible in the scale of each top 10, as the Green500’s maximum number of cores is below 400,000, while the Top500 doesn’t have a member of the top 10 below 1 million cores. The majority of the Green500’s systems were developed in Europe as well, exibiting the continent’s priorities of energy efficiency, whereas most of the best performing supercomputers are from the United States.

A difference in architecture is the Nvidia GH200 superchip, which is the choice of half the Green500, and only present in one Top500 system. This superchip contains a Grace CPU and Hopper GPU, and includes NVLink-C2C, which provides 900GB/s of bandwidth between cores and greater networks. This is much more efficient performance than the common interconnect PCle, and reduces power loss that takes place in traditional interconnect. The GH200 also uses 72 cores, greater than any amount present on the CPU list of the Top500. This makes computation more compact, as potential bottlenecks in work stealing could occur with limited cores. Combined with the overall smaller size of the systems implementing this chip, the greater core number allows a smaller size while maintaining a high-level compute.

Another optimization of this superchip is the CPU’s access to 480 GB of DDR5 memory. These optimizations to speed lead to losses in computation, as, for example, AMD’s MI300A accelerator unit performances better in FP32 and FP64 computation by significant amounts of teraFLOPS.

Additionally, top systems in the Green500 utilize improved the previously mentioned CPU & GPU integration. The top 3 systems of the Green500 use the Nvidia GH200, and 4th uses AMD’s MI300A accelerator unit, with 4 GPU nodes assigned to a multi-core CPU.

Green500 November 2024 vs June 2013:

The amount of power, in kW, consumed by the systems in November 2024’s list varies from below 50 to greater than 1,000, where none of the June 2013 systems reach over 200 kW. Additionally, the performance of systems from November 2024 is much greater than the previously developed systems of June 2013. November 2024’s 10th spot has a 62.803 GFlops/watt energy efficiency, whereas June 2013’s 1st spot has a performance in the megaflops, at 3208.8 MFlops/watt. The two most common processors in the June 2013 list were Intel’s Xeon E5-2670, and Power BQC. Neither of these CPUs exceed 16 cores, while all November 2024 CPU’s are at 24 cores or greater. This development has enabled improved energy efficiency, as CPUs with greater amounts of cores are able to perform more intensive computation, and due to the compactness of the processor, can do so in a way that doesn’t present energy inefficiency. The interconnect speed was also significantly slower, cache size is less, and the DDR3 memory doesn’t perform as well as the newer DDR4 and DDR5 implemented on many chips in the November 2024 list.

Additionally, while some of the June 2013 list seem to lack a GPU altogether, the Nvidia K20 GPU that is used by the top 2 performs significantly worse than the GH200’s H100. The K20 contains 2,496 CUDA cores with a processor clock of 706 MHz, and the H100 has 14,592 CUDA cores with a clock of 2.5 GHz. Its memory is 5GB of DDR, compared to the 80GB of HBM3, a newer high-bandwidth memory which sees is very valuable for GPUs. Its FP64 of 3.95 TFlops compared to the H100’s 60 TFlops demonstrates pure performance superiority.