

# The Inevitable End of Moore's Law beyond Exascale will Result in Data and HPC Convergence and More

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The so-called "Moore's Law", by which the performance of the processors will increase exponentially by factor of 2 every 2 years or so, is slated to be ending in 10-15 year timeframe due to the lithography of VLSIs reaching its limits around that time, and combined with other physical factors. This is largely due to the transistor power becoming largely constant, and as a result, means to sustain continuous performance increase must be sought otherwise than increasing the clock rate or the number of floating point units in the chips, i.e., increase in the FLOPS. The promising new parameter in place of the transistor count is the perceived increase in the capacity and bandwidth of storage, driven by device, architectural, as well as packaging innovations: DRAM-alternative Non-Volatile Memory (NVM) devices, 3-D memory and logic stacking evolving from VIAs to direct silicone stacking, as well as next-generation terabit optics and networks. The overall effect of this is that, the trend to increase the computational intensity as advocated today will no longer result in performance increase, but rather, exploiting the memory and bandwidth capacities will instead be the right methodology. However, such shift in compute-vs-data tradeoffs would not exactly be return to the old vector days, since other physical factors such as latency will not change. As such, performance modeling to account for the evolution of such fundamental architectural change in the post-Moore era would become important, as it could lead to disruptive alterations on how the computing system, both hardware and software, would be evolving towards the future. We are now in the process of launching such innovative projects for the future of computing in Japan

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