4. (Extra) Part of your weekly reading included a paper titled “MPI on Millions of Cores.” Given that this paper was published in 2010 (12 years ago), can you comment on what changes have occurred since 2010 that could positively and/or negatively impact our ability to fully exploit parallelism on millions of cores? Many of the papers today discuss exascale computing. Select a recent paper on exascale-computing and compare/contrast the barriers identified in the two papers that impact our ability to achieve these milestones.

Improvements in system management software, job scheduler, and the storage system can have a positive impact on the parallelism on millions of cores. Manually scheduling multiple nodes in a cluster is not only time-consuming but also error-prone. With dedicated cluster management software, multiple nodes and resources can be pre-provisioned and configured together in a repeatable and deterministic manner, improving efficiency. Traditional job schedulers are adequate for small to medium sized clusters, but as the cluster size increases, the load on the file servers can curtail performance. At larger scales, parallel and distributed file systems can be used to solve this problem. The improved communication protocoal also reduces the overhead. Last but not least, for storage system, horizontal scaling and parallel file systems help scale to large clusters, while the expanded cache size significantly reduces latency.

I choose the paper https://ieeexplore.ieee.org/abstract/document/9408861. The paper first analyzes different traditional low-power techniques and NTC techniques, followed by NDP techniques such as in-memory computing and network computing, and finally analyzes a low-overhead network model for a new process and cache coherent technology supported chip. The purpose of this paper is to look forward to the new architecture in exascale computing. In particular, NDP is a major step forward in terms of communication on millions of cores. Increasing cache level, as mentioned above, can reduce the data movement quantity but can’t solve the problem at its root. In network computing effectively solves the problems of collective communication and PTP bottleneck. According to Huang, there’s an idea of mapping the computing kernel to the memory netwok, which will play a role in the data-flow mode through NDP, so called Active-Routing. This ideal utilizes large-scale memory level parallelism and network concurrency and make a significant optimization on aggregation operations along a dynamically constructed active routing tree.