Graduate School of Science and Technology Master's Thesis Abstract

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Abstract

As we transition from 5G to 6G network development, achieving a highly flexible network with computational ubiquity becomes essential to support emerging technologies like cloud-edge-continuum, edge-AI, and telco cloud. However, the current network and computing infrastructure are too complex and fragmented. They are driven by super-specialized ASIC/FPGA-based, highly performant designs that compromise system flexibility and agility. To achieve system flexibility, the use of multi-core general-purpose processors has become popular through network function virtualization (NFV). We started our research by extensively studying the NFV landscape, with a focus on cloud deployment. We have identified containerized networking functions (CNF) with state-of-the-art userspace I/O acceleration (DPDK) and virtual network I/O architecture (vhost-user) as key candidate technologies supporting this transition. Despite its appeal, CNF suffers from under-studied performance issues due to the curse of layered architecture. Therefore, in the second half of our study, we measured the historically overlooked jitter and latency issues of CNFs across various CPU configurations. Our study found that when dynamic frequency and CPU power optimization were disabled, CNFs experienced a 13% decrease in jitter but a 13-20% increase in latency at low traffic of 100 kpps across different packet sizes. When traffic rates were high, CNFs didn't perform as well as their bare-metal counterparts. We found that the bottleneck was the virtual network I/O architecture. The insights gained will assist network practitioners in making informed decisions when designing network applications with predictable jitter/latency.