

# Massively-Parallel Packet Processing with GPUs to Accelerate Software Routers

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As programmability and extensibility have become the key factors of network equipment, software routers running on commodity servers are gaining momentum. However, the performance of current software routers is limited to 1–10 Gbps, which is not enough to handle fast growing internet traffic. The bottleneck lies in CPU because it takes all the burden of I/O, packet processing, and control plane operations (e.g. BGP protocol daemon).

In order to tackle the performance problem of software routers, we offload packet processing to graphics processing units (GPUs). Over the last decade, the GPU has become programmable and flexible enough to handle general workloads beyond graphics rendering. The peak performance of GPUs now reaches to 1 TFLOPS, which is roughly 10 times faster than current general-purpose CPUs. We believe that GPU is a cheap, ubiquitous, flexible, and scalable alternative to ASIC, FPGA, or network processors.

The processing power of GPUs comes from its hundreds of cores. The key insight of our work is that such a massive array of cores matches the inherent parallelism in stateless packet processing. To exploit parallelism, we process multiple packets in parallel. The following figure compares the throughput of IPv6 routing table lookup (longest prefix matching) done by CPU and GPU. Its promising result confirms that GPU acceleration for core packet processing functions with enough parallelism can significantly boost the performance of software routers.

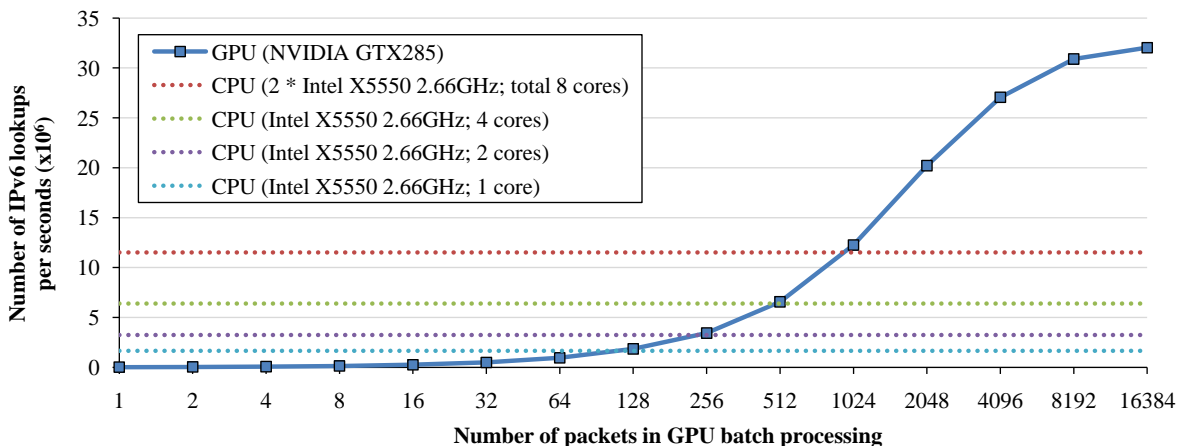


Figure 1: Throughput comparison of IPv6 routing table lookup with GPU and CPU

We introduce PacketShader, a software router framework for general packet processing with GPU acceleration. Maximizing synergy with our highly optimized packet I/O engine, PacketShader exhibits an extremely high level of performance that has not been achievable with CPU-only software routers. It can route 64-byte IPv4 packets at 38 Gbps on a single x86 machine. On top of PacketShader, we are building IPv4 and IPv6 routing, OpenFlow switch, and IPsec gateway.

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