Accelerated Open vSwitch

Use Case
Open vSwitch (OVS) is a fully fledged flow based implementation of a virtual switch which is widely adopted in virtualization environments such as Xen and KVM, as well as being used as a platform in Software Defined Networks (SDNs). OVS maintains a flow table which is typically hosted in the Linux kernel datapath and identifies flows based on any combination of several L2-L4 fields. For highly virtualized servers in data centers, enables end servers to participate in the SDN by serving as the on/off ramp to the SDN infrastructure.

In this new architecture, compute resources typically reserved for host applications such as web servers, databases, authentication, and security are now also being used for networking tasks inside the server. These tasks include, but are not limited to:

- Flow table management
- Tunnel encap/decap
- Cryptography
- Metering/QoS
- Recursive table lookups
- L2/L3/L4 field manip
- Statistics

Combining this workload with the traffic characteristics observed in today’s data centers, end servers are not able to scale vertically to 10-, 40, and 100GbE data rates. Data center traffic is made up of large numbers of short-lived flows. This drives high concurrent flow counts and high connection setup rates, which consequently lowers the networking and application performance of end servers.

Kernel Packet Flow in Open vSwitch
The kernel component of OVS performs the majority of the fast path datapath operation.

The Netronome Solution
Netronome’s Flow Processors and Software accelerate the network inside the server. The combined solution allows for full OVS offload onto the NFP, where the NFP is purpose built for this workload and simultaneously relieves the host CPU from the equivalent processing. This partitioning of workloads enables OVS-based applications and security services to scale to 10-100GbE data rates while seamlessly staying under OVS control, making it fully compatible with SDNs in today’s data centers. The solution also supports Intel’s DPDK Poll Mode Driver (PMD), allowing for an accelerated datapath to x86 over PCIe and simplified integration with data center applications and services.

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<td>Autonomous Flow State Table</td>
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System Architecture
For OVS acceleration, this solution makes use of a heterogeneous processing architecture where application and control tasks are handled by a general purpose CPU and datapath flow forwarding is handled by the NFP. By offloading the datapath forwarding tasks to the NFP, the host system CPU resources are left fully available for business application and network/security services. All match and action fields used in OVS 1.11 today are supported on the accelerated datapath and the OVS control software operates identically to that of the non-accelerated, open-source version.

NFP Parallel Processing
General purpose CPUs were never designed for the unique demands of network traffic because they are not able to efficiently hide memory latencies found in networking applications. Parallel processing and multithreading are how the NFP family of processors achieve their high performance in hostile networking environments, making it the ideal location to host flow forwarding applications such as OVS.

Benchmarks
The NFP provides over 200 cores and 1000 threads, making the highly parallelized system ideal for processing millions of flows. As a result, the system scales to 200Gbps of flow forwarding and over 15M connections/second without performance degradation. 1Gbps applications and now scale to 10Gbps and 100Gbps without hitting networking bottlenecks in software-only implementations.

Summary
Combining Netronome’s NFP with x86 processors allows OVS instantiations to scale beyond single Gigabit rates to 100G within a COTS server platform. This solution lends itself to several deployment modes and use cases, including highly virtualized end servers, SDN security applications and data center gateways.