OvS

Open vSwitch

December 10-11, 2019 | Westford, MA

OVS with AF_XDP
what to expect

William Tu, VMware Inc
Eelco Chaudron, Red Hat

Why AF_XDP?

A fast and flexible channel between userspace and kernel

- Another way to get better performance besides DPDK
- A more friendly way to do kernel-bypassing
  - Dynamically steering packets using XDP program
- Userspace datapath is easier to maintain than a kernel module
- Share the same datapath with OVS-DPDK

See last years af_xdp presentation: https://ovsfall2018.sched.com/event/IO7p/fast-userspace-ovs-with-afxdp

AF_XDP (Userspace) Caveat

- Device directly DMA buffer into userspace
  - OVS runs datapath in userspace (dpif-netdev)

- Difficulties when integrating features inside linux kernel
  - TCP/IP stack
  - Connection tracking using netfilter
  - TC rate limiting

Performance Comparison

- We used the ovs_perf suite for testing
- 10G ethernet, wirespeed test
- Topology: PVP and P tests [single physical port]
- OpenFlow rules, NORMAL rule (l2 forwarding)
- Packet sizes: 64, 256, 512, 1514
- Flows: 1, 100, 1000
- *No latency tests :(*

ovs_perf can be found here: https://github.com/chaudron/ovs_perf

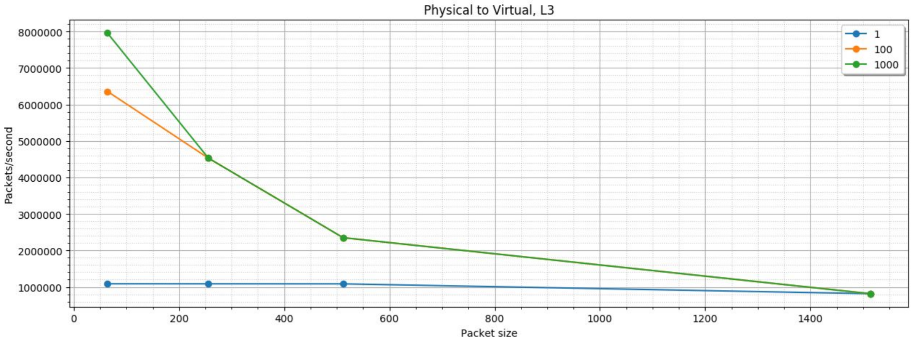
Last years presentation: https://ovsfall2018.sched.com/event/IO9n/ovs-and-pvp-testing

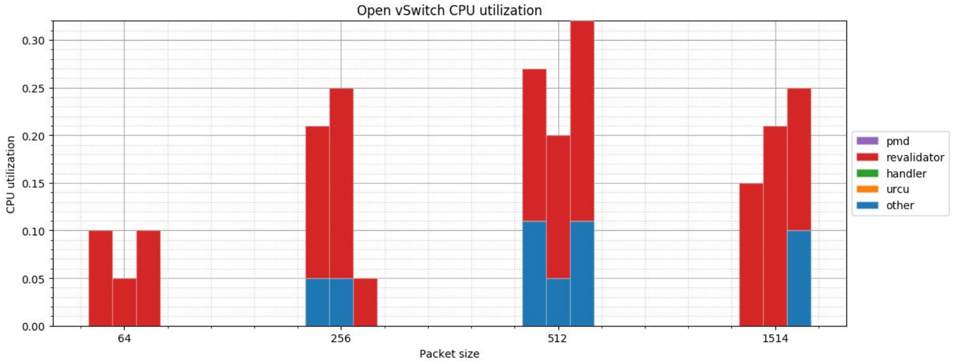
Performance Comparison, cont.

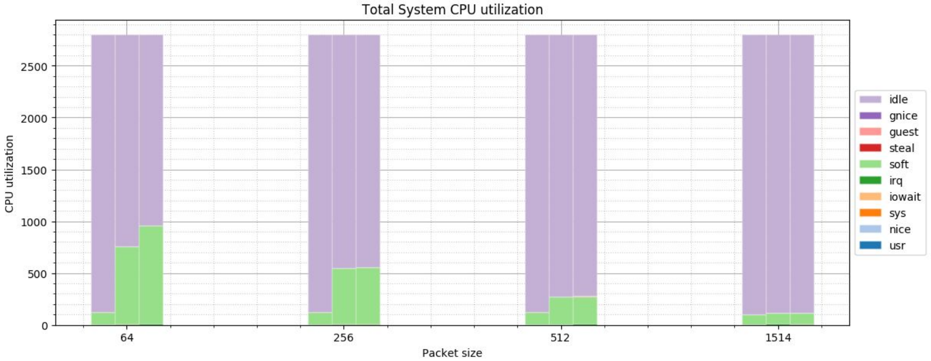
- What will we compare?
  - AF_XDP TAP vs Kernel
  - AF_XDP TAP vs AF_XDP VHOST
  - AF_XDP VHOST vs DPDK
  - Native AF_XDP vs AF_XDP DPDK PMD

Kernel datapath results

Physical Port Loopback

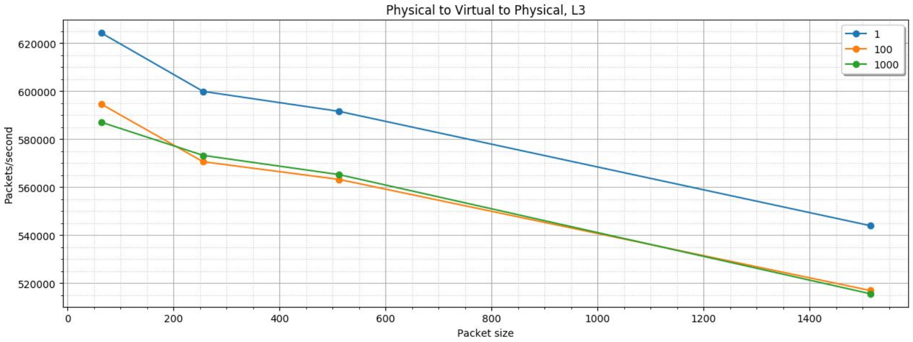


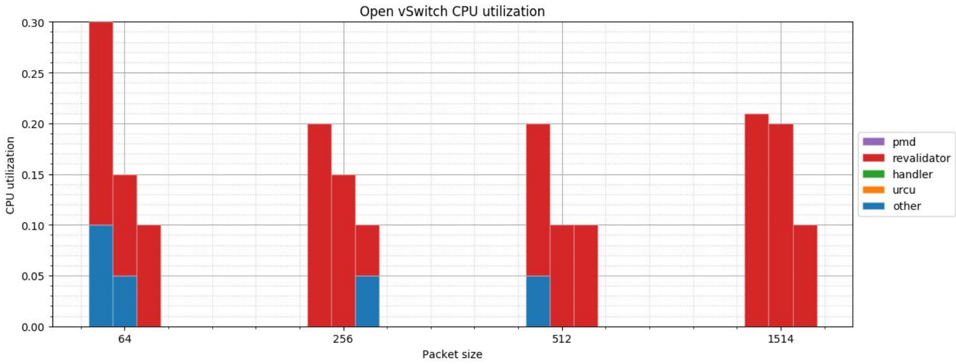


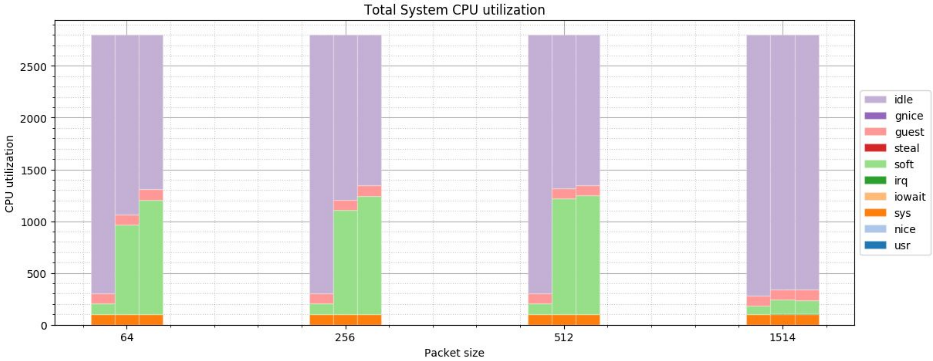


Kernel datapath results, cont.

PVP test, using single port

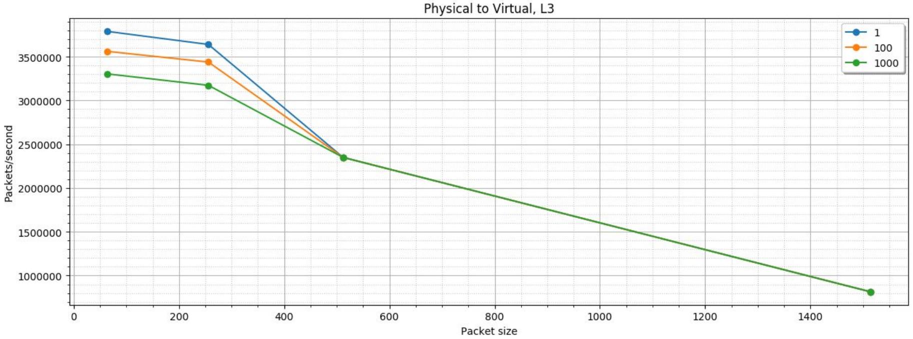


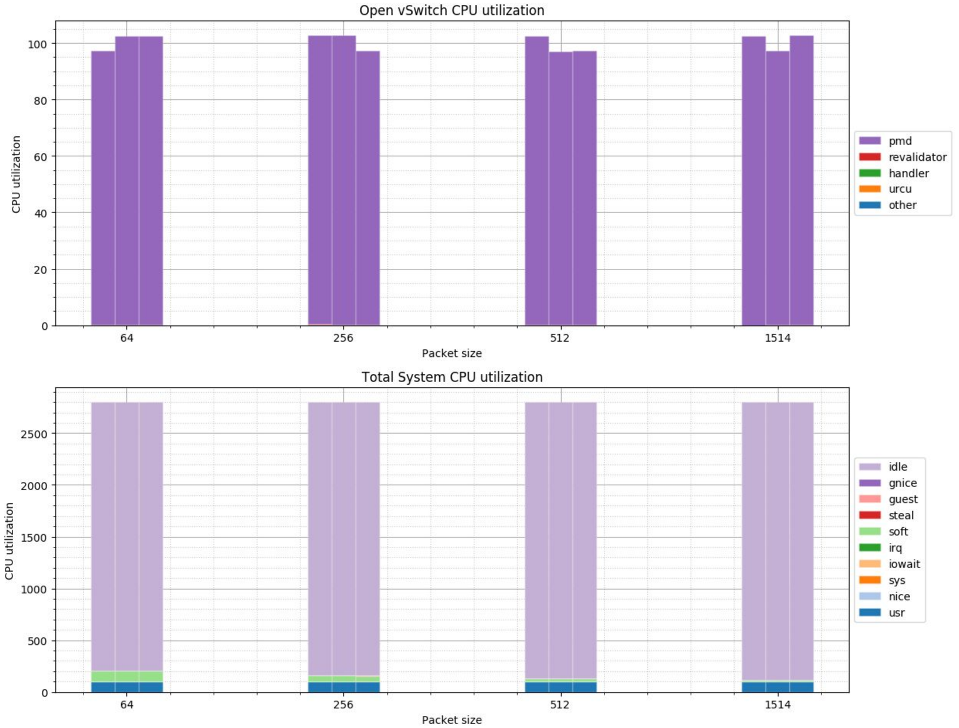




AF_XDP userspace datapath results

Physical Port Loopback

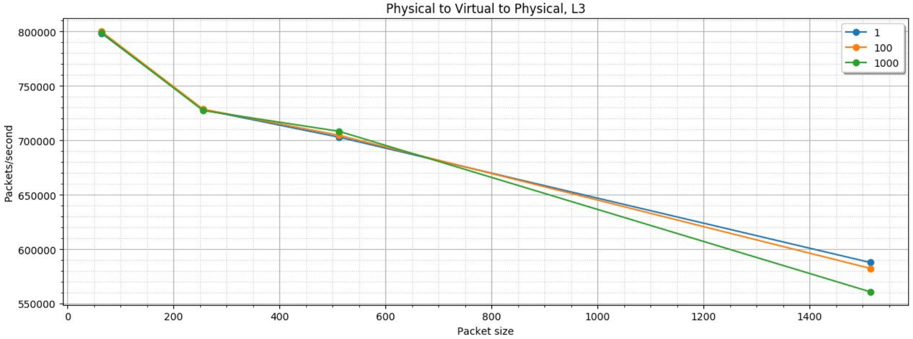


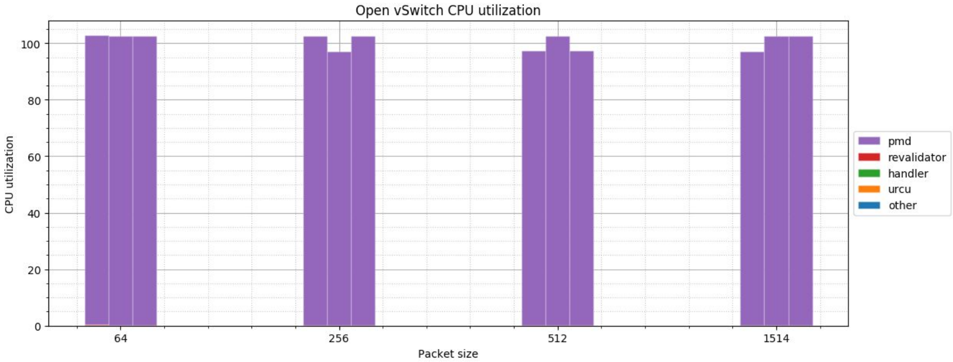


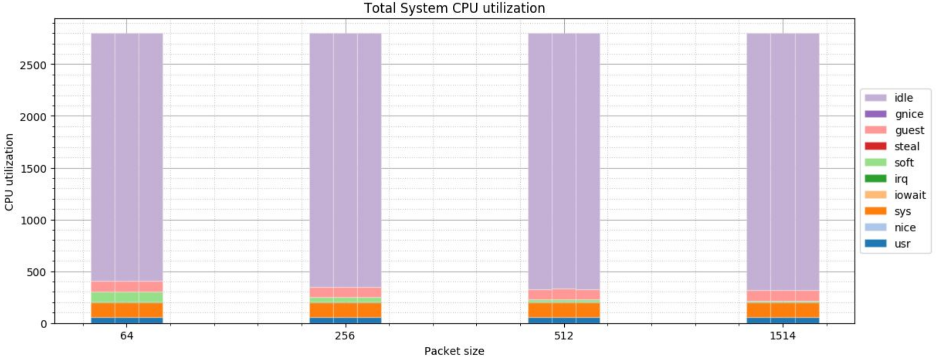
NOTE: All native AF_XDP tests were run with use-need-wakeup = true

AF_XDP userspace datapath results, cont.

PVP: kernel tap, vhost_net





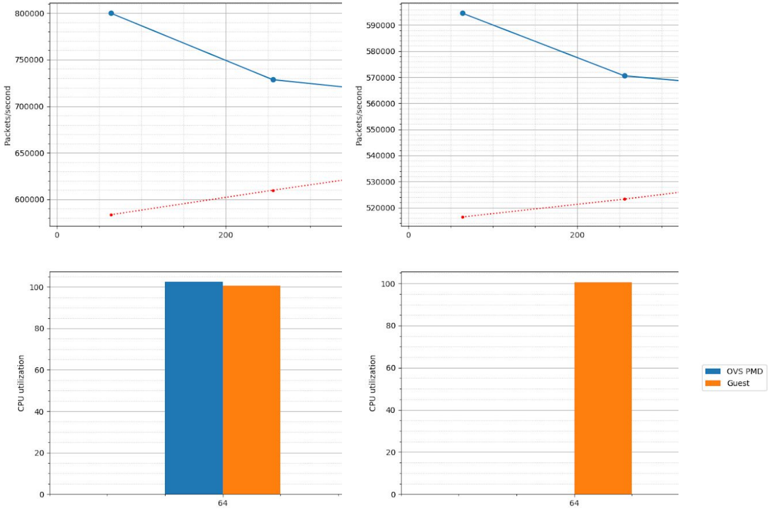


AF_XDP userspace datapath vs Kernel datapath

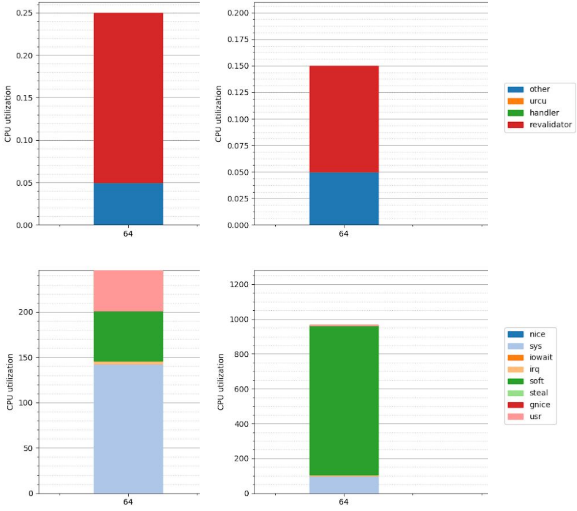
- So for the comparison we pick one test
  - Use the PVP tests, as it represents a real life scenario
  - Use 64 byte packets as this does not fill the pipe
  - Use 100 streams

AF_XDP userspace datapath vs Kernel datapath

AF_XDP Kernel



AF_XDP Kernel



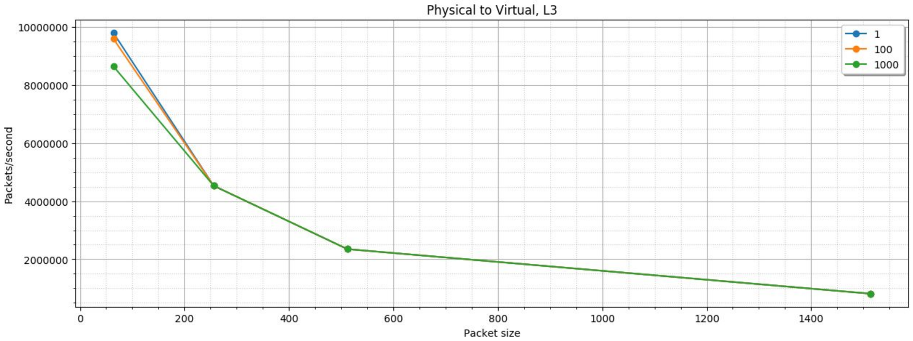
AF_XDP userspace datapath vs Kernel, conclusion

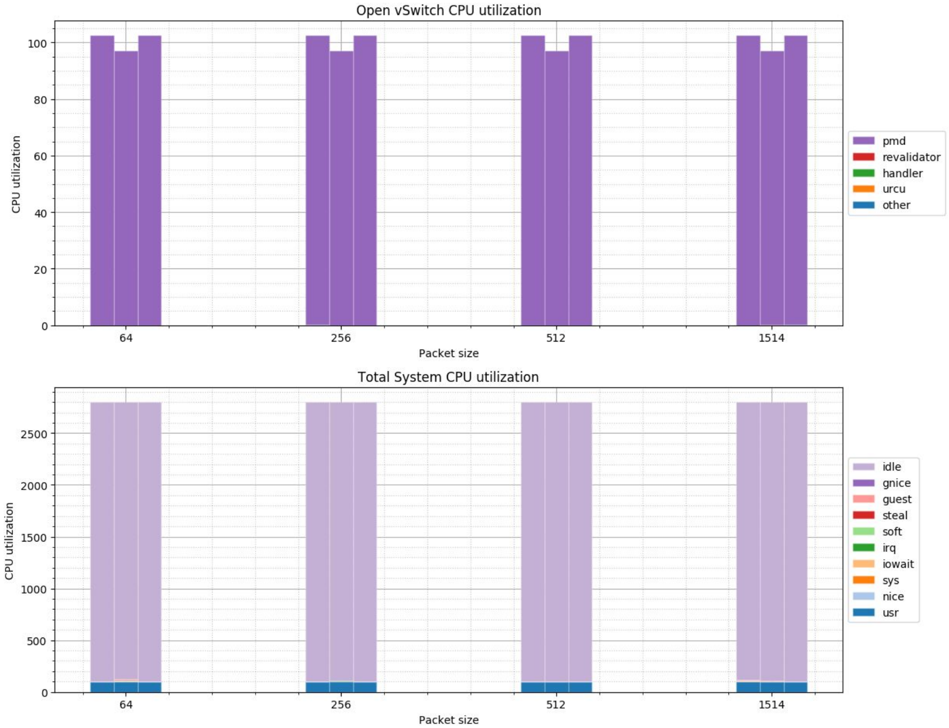
- Pros
  - Use less CPU power
  - More throughput
  - No kernel module dependencies

- Cons
  - Missing kernel datapath features, see datapath feature table: https://docs.openvswitch.org/en/latest/faq/releases/
  - It also has no “QoS - Policing support”
  - Traffic from a “kernel” interface uses *slow* path (same as DPDK)

DPDK userspace datapath results

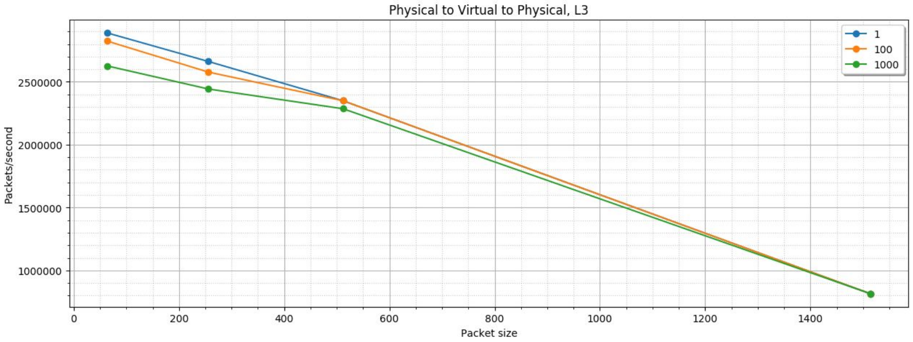
Physical Port Loopback

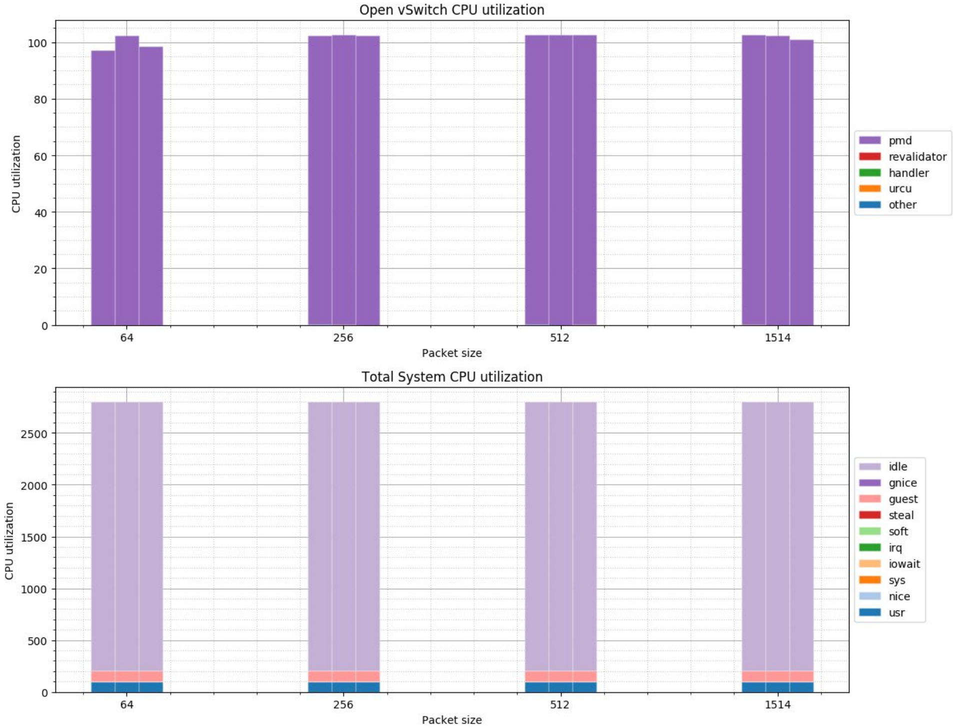




DPDK userspace datapath results, cont.

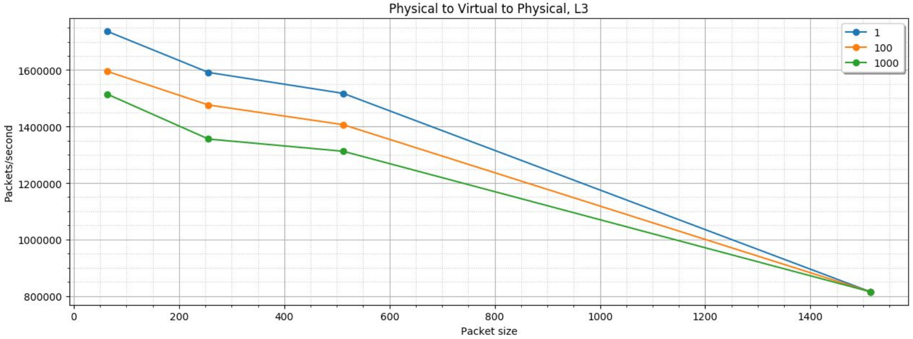
PVP: dpdk vhostuser

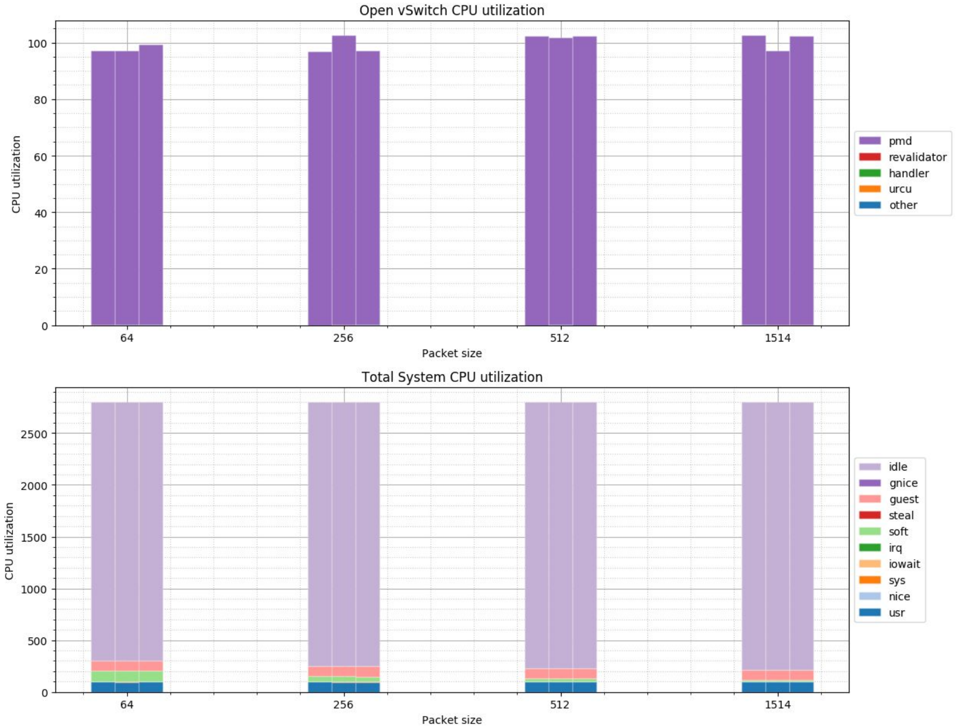




AF_XDP userspace datapath results + DPDK vhost

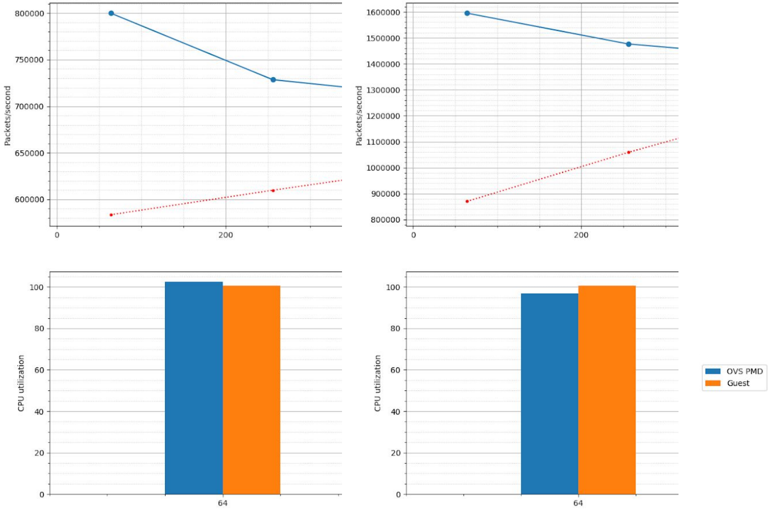
PVP: dpdk vhostuser



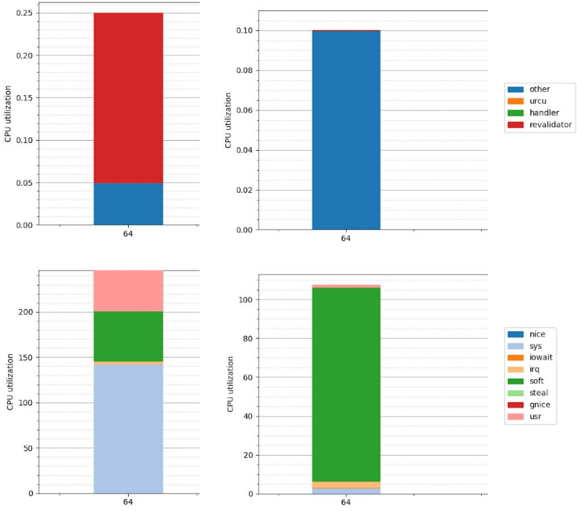


AF_XDP TAP vs AF_XDP VHOST

AF_XDP AF_XDP VHOST



AF_XDP AF_XDP VHOST



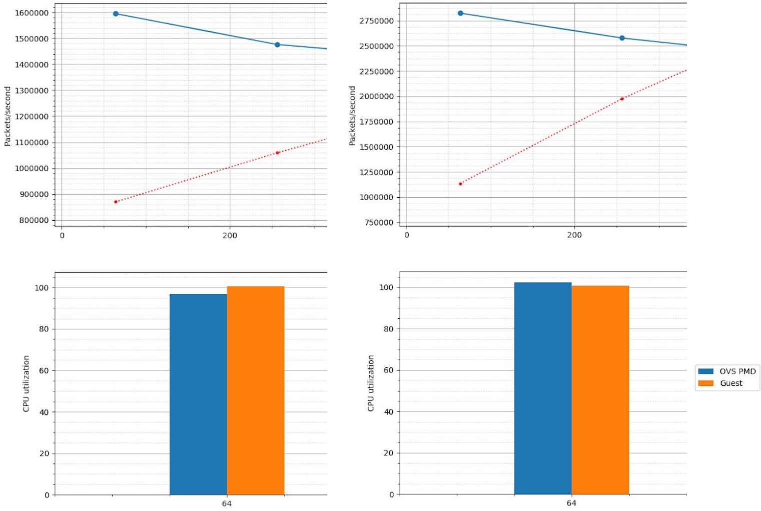
AF_XDP TAP vs AF_XDP VHOST, conclusion

- Pros
  - VHOST Use less CPU power (Qemu & TAP)
  - Throughput roughly doubles
  - Constant CPU usage (even if you add more interfaces)

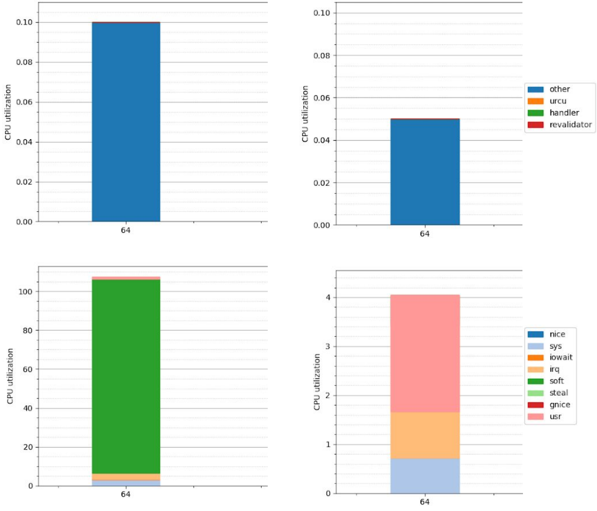
- Cons
  - Need to setup DPDK also
  - Separate memory pool for DPDK (hughe pages)

AF_XDP vs DPDK userspace datapath

AF_XDP VHOST DPDK



AF_XDP VHOST DPDK



AF_XDP vs DPDK userspace datapath, conclusion

- Pros
  - Less CPU power needed (can use irq pinning / multiqueue)
  - Throughput increase of roughly 1.6x

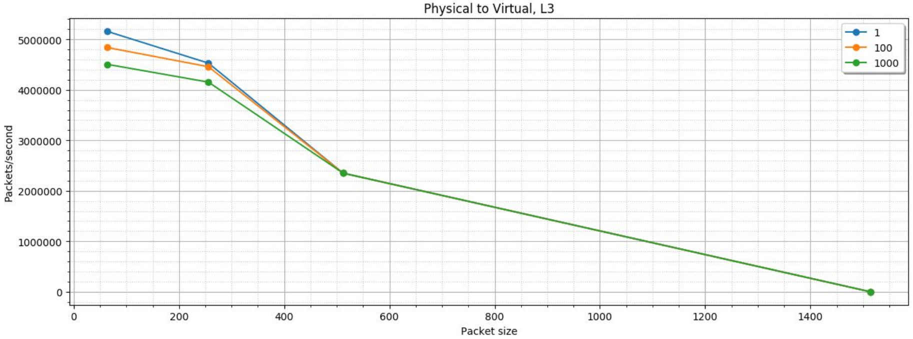
- Cons
  - Need to setup DPDK
  - PMD network driver problems
  - Can’t use XDP program steering

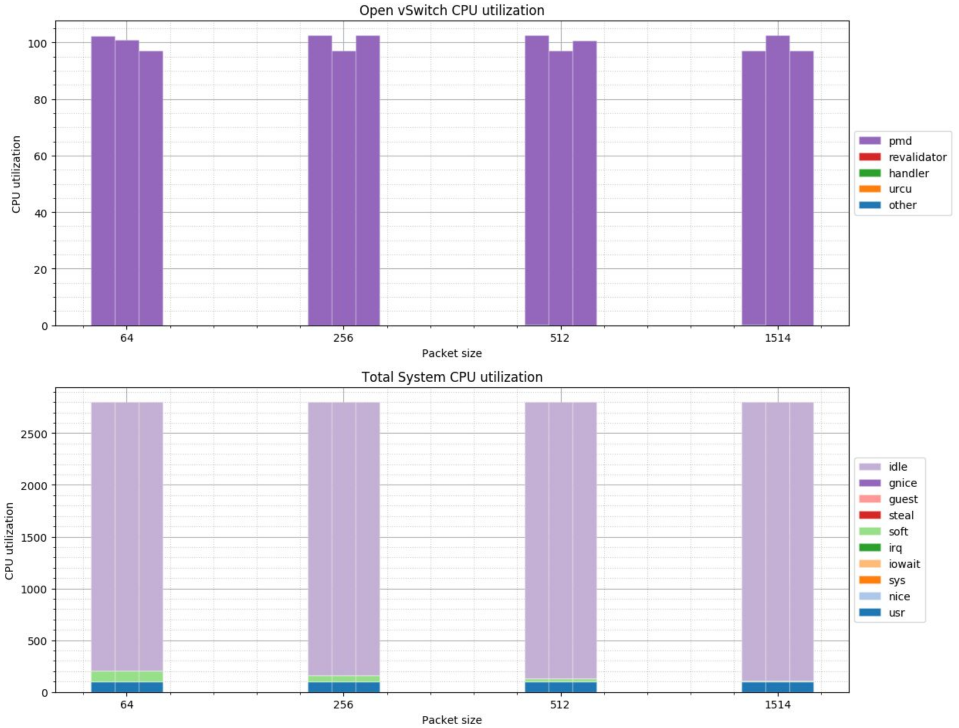
OVS with AF_XDP DPDK PMD

- DPDK has a native AF_XDP PMD
- Allow you to use existing DPDK environment
- If enhanced it could allow for packet steering

AF_XDP DPDK PMD results

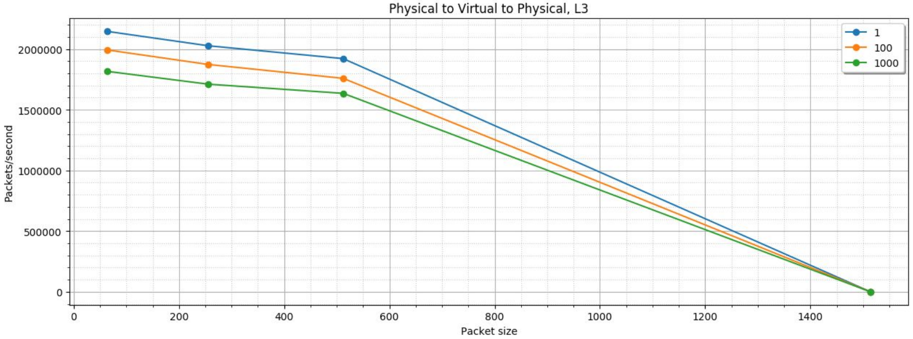
Physical Port Loopback

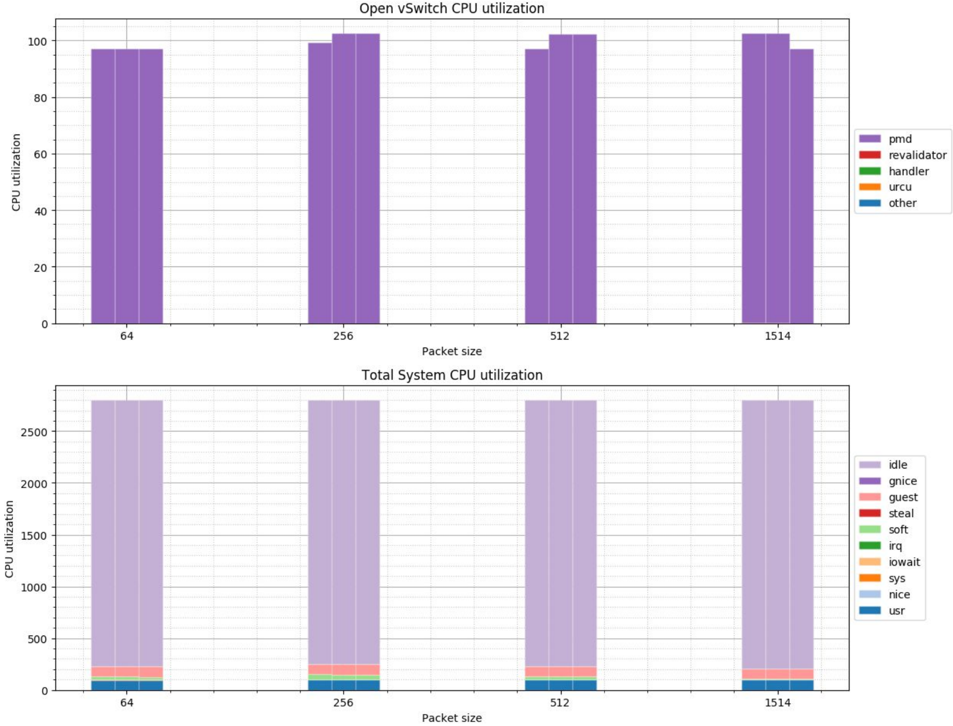




AF_XDP DPDK PMD results, cont

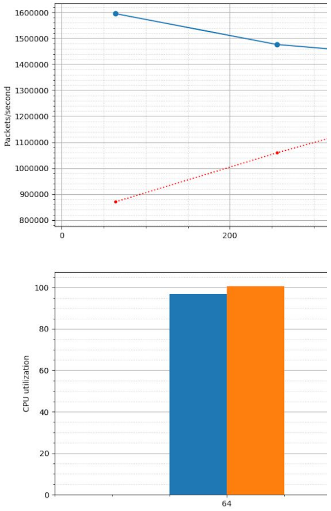
PVP: dpdk vhostuser



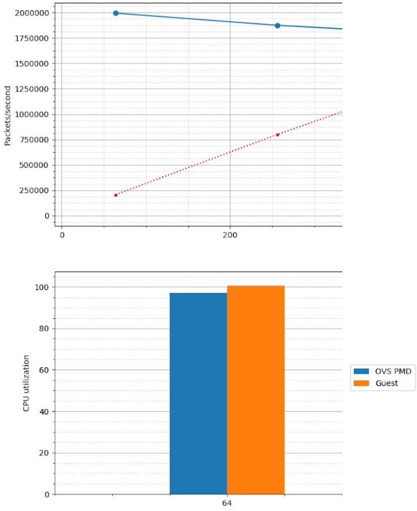


Native AF_XDP vs AF_XDP DPDK PMD datapath

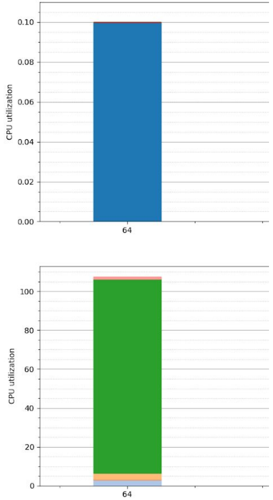
AF_XDP VHOST



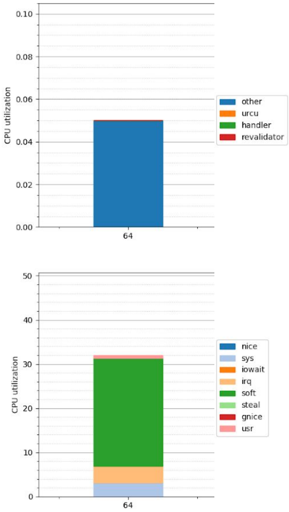
AF_XDP PMD



AF_XDP VHOST



AF_XDP PMD



Native AF_XDP vs AF_XDP PMD datapath, cont.

- Pros
  - Throughput increase
    (due to mbuf reuse vs copy in native AF_XDP)
  - QoS - Policing support
- Cons
  - Need to setup DPDK
  - No XDP packet steering (yet)

Future Items

- Shared umem between ports to avoid memcpy [OVS]
  - This is why the AF_XDP PMD performs better
- Native zero copy support for veth/tap interfaces [Kernel]
- VHOST library to avoid including/using DPDK [OVS]
- Egress QoS support for AF_XDP interfaces [OVS]

Future Items, cont.

- CI testing of AF_XDP [OVS]

- Load custom XDP programs [OVS]
  - Patch is currently on the maillinglist: netdev-afxdp: Enable loading XDP program

- Allow more finegrane driver loading [OVS]
  - skb mode, or driver mode with or without zero-copy
  - Patch is currently on the maillinglist: netdev-afxdp: Best-effort configuration of XDP mode

Conclusion

- Stuff we did not do
  - Compare latency
  - Compare multiqueue support
- AF_XDP sits between kernel and DPDK
  - From throughput and CPU usage perspective
  - Missing some kernel feature (and DPDK QoS - Policing support)
- AF_XDP requires kernel support
  - But if the kernel support AF_XDP there is no kernel module dependency