BMWG – Containerized Infrastructure Benchmarking

IETF 114 Hackathon

July 23-24, 2022

Remote

Hackathon Plan

- Our draft main goal is to figure out container networking performance impacts by various resource options.
  - Draft:
    Considerations for Benchmarking Network Performance in Containerized Infrastructures
    https://tools.ietf.org/html/draft-dcn-bmwg-containerized-infra
  - Two main features
    - Verify container network performance with **various network acceleration models**
    - Verify performance impacts depending on **different configuration settings**

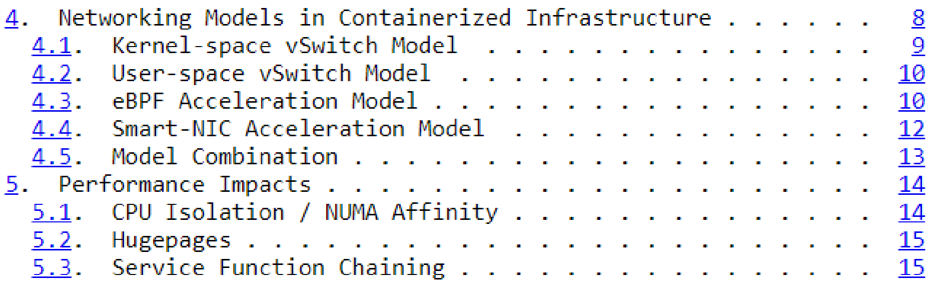
Hackathon Plan

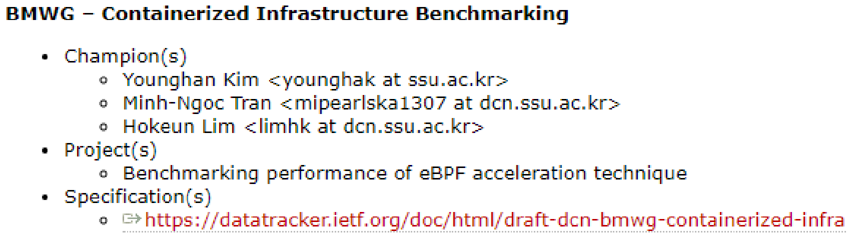
What we have done so far in Hackathon

1. **Models**
   - ✓ Kernel-space
   - ✓ User-space (OVS DPDK, VPP)
   - ✓ SmartNIC (SRIOV)
   - ✓ Combined (SRIOV-VPP)
2. **Configuration**
   - ✓ NUMA (CNF, vSwitch, NIC)
   - ✓ Hugepages
   - ✓ Service chains (multiple pods)

In this hackathon

- ➢ eBPF Acceleration Model





BMWG – Containerized Infrastructure Benchmarking

- Champion(s)
  - Younghan Kim <younghak at ssu.ac.kr>
  - Minh-Ngoc Tran <mipearlska1307 at dcn.ssu.ac.kr>
  - Hokeun Lim <limhk at dcn.ssu.ac.kr>
- Project(s)
  - Benchmarking performance of eBPF acceleration technique
- Specification(s)
  - https://datatracker.ietf.org/doc/html/draft-dcn-bmwg-containerized-infra

What got done

- Using AF-XDP and OVS-DPDK vSwitch

NIC ↔ Userspace

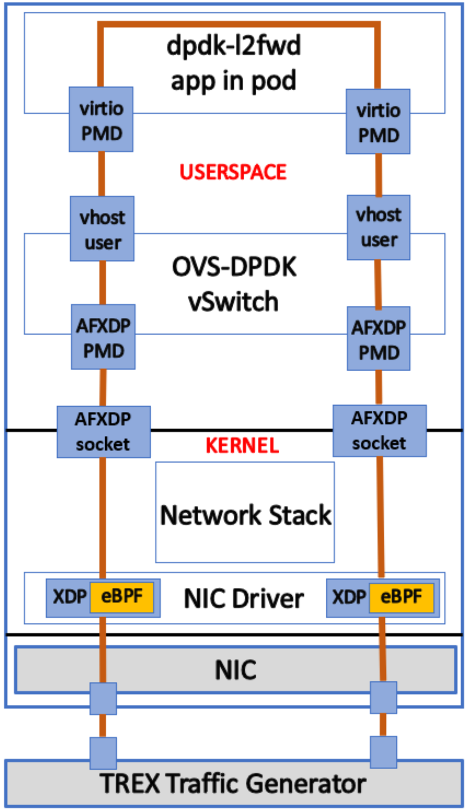
AF-XDP

- The new socket type available from Linux Kernel > 4.18
- Allows attached eBPF program in XDP hook at kernel NIC driver (native XDP mode) to **transmit packet to userspace bypassing kernel network stack**

Userspace ↔ Container

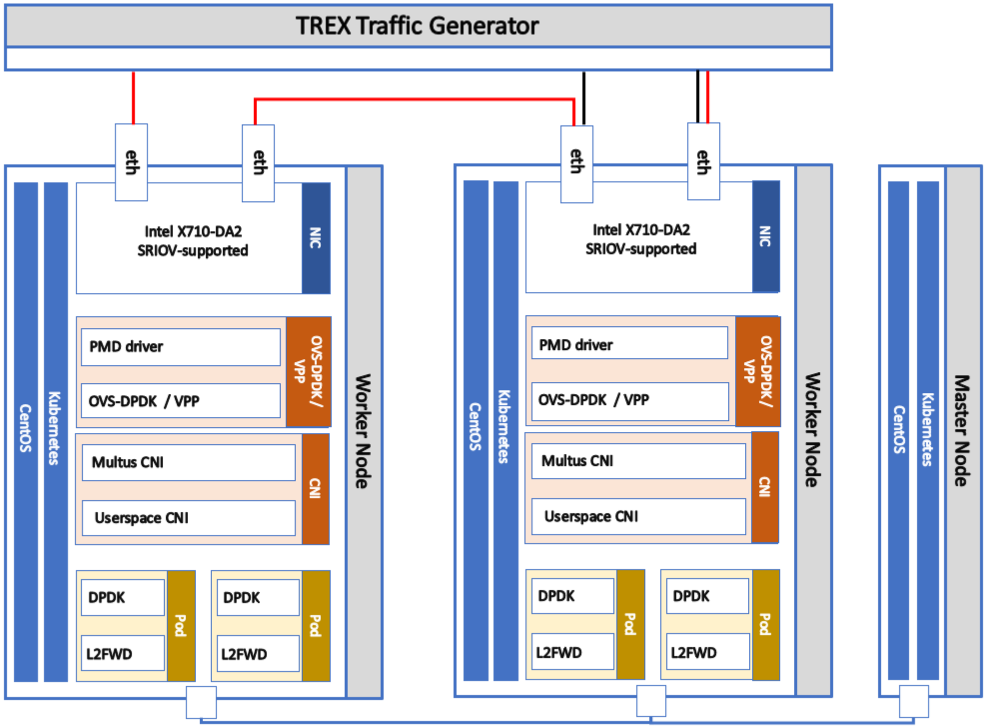
OVS-DPDK AF-XDP supported version

- An optional built version of OVS-DPDK vSwitch that support AF-XDP
- **Can create AF-XDP Poll Mode Driver (PMD) ports that continuously poll packets from AF-XDP sockets**
- Vhostuser ports and Virtio PMDs at application are used to transmit packets between container and host



What got done

- Benchmarking Testbed – same with previous hackathons



- eBPF Supported NIC: Intel X710
- AF-XDP supported kernel: Ubuntu 22.04 (kernel v5.15)
- Pod multi-interfaces: Multus
- vSwtich supported CNI: Userspace CNI

What got done

- Benchmarking Configuration
- **Hardware – Worker Node**

CPU	Intel(R) Xeon(R) Gold 5220R CPU @ 2.20GHz 48 CPU cores * 2 NUMA nodes
Memory	256GB: 32GB x 4DIMMs x 2 NUMA nodes @ 2400MHz
NIC	Intel Corporation Ethernet Network Adapter X71-40Gbps
Microcode	0x5003102
Intel NIC Device ID	0x1572
Intel NIC Firmware version	6.01 0x800035cf 1.1747.0
BIOS setting	CPU Power and Performance Policy <Performance> CPU C-state Disabled CPU P-state Disabled Intel(R) Hyper-Threading Tech Enabled Turbo Boost Disabled

- **Traffic Generator : T-Rex (v2.92)**

Name	T-Rex
Version	2.92
Benchmark method	T-Rex Non Drop Rate application (accepted percentage of drop rate is less than 0.1%)

- **Software**

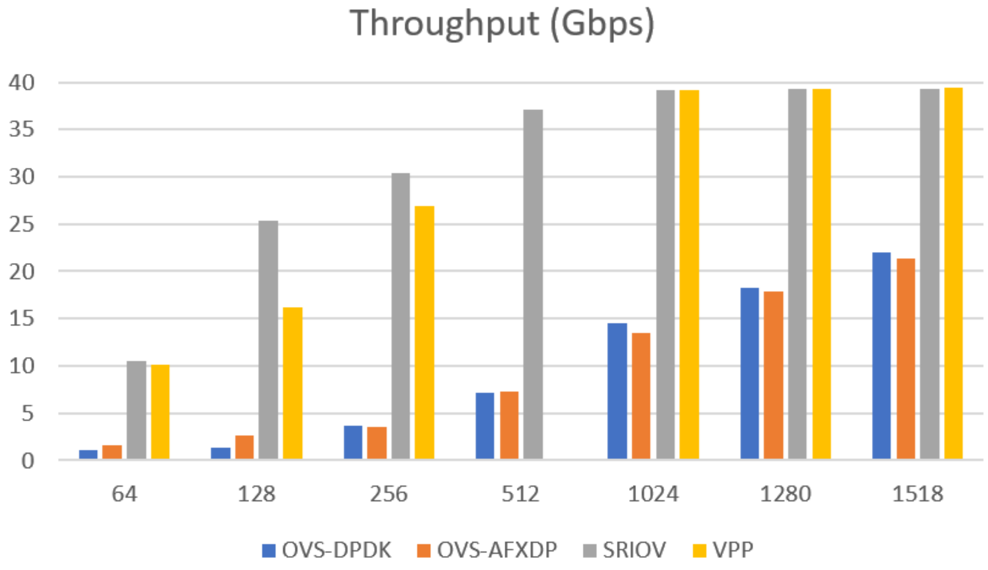
Operating System	Ubuntu 22.04
Linux Kernel Version	5.15
GCC version	gcc version 4.8.5 20150623 (Red Hat 4.8.5-44)
DPDK version	21.11.1
Hugepages	1Gi

What we learned

- Benchmarking Performance Results vs OVS-DPDK, SRIOV, VPP (Single Pod)
  - OVS-AFXDP catches up with the performance of OVS-DPDK
  - But significantly lower behinds SRIOV and VPP

  - The reason might be at the limitation of vhostuser-virtioPMD path between container and vSwitch
  - VPP uses memif PMD (shared memory packet interface) which is a better performance method

→ This result might not show true performance of AF-XDP-eBPF acceleration model
→ Using AF_XDP with VPP vSwitch and memif interfaces might significantly improve the performance



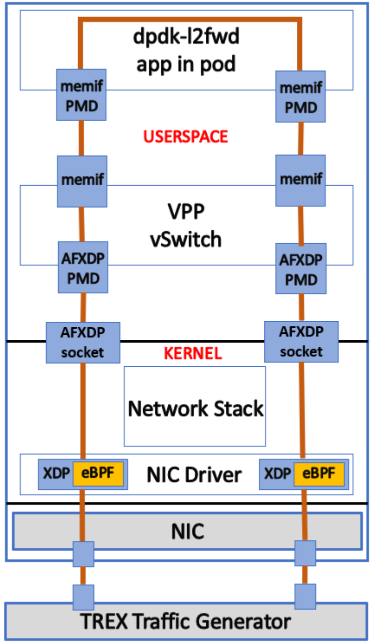
Future Works

- Performance comparison with other XDP-eBPF acceleration model variations
  - **VPP-AF-XDP**
  - **Cloud Native Data Plane (CNDP):** A new cloud native userspace framework developed by Intel (first release April 2022) which utilizes AF-XDP and VPP
  - **Cililum**: eBPF based CNI

Differences at packet transmission routes between XDP socket and container

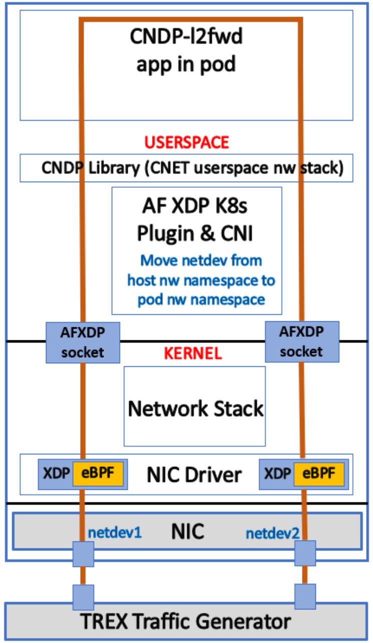
Differences at East-West (E-W) traffic handling

Future Works



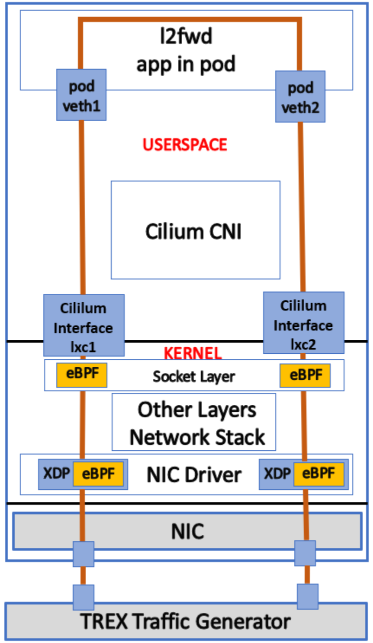
VPP-AFXDP

Use vSwitch pmd and memif



CNDP

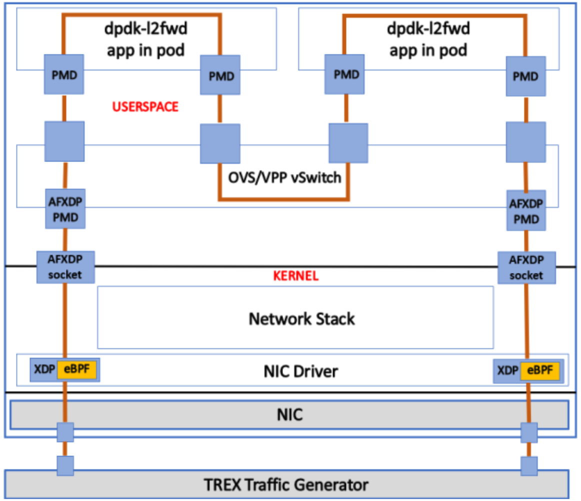
Create afxdp socket at pod namespace



Cilium

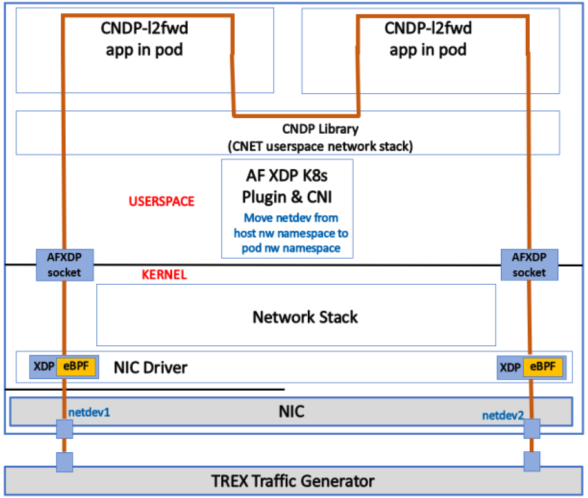
Normal xdp at NIC driver and Socket Layer, CNI veth pair with pod

Future Works



OVS/VPP-AFXDP

E-W using vSwitch

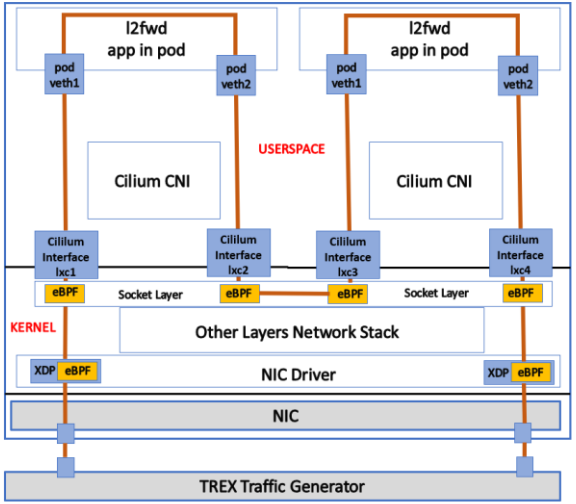


CNDP

E-W using their own

CNET userspace network stack

(Assumption: not yet described by official docs)



Cilium

E-W using eBPF at NW Socket Layer

Wrap Up

Team members:

Younghan Kim (SSU)

Minh Ngoc Tran(SSU)

Thanh Nguyen Nguyen (SSU)

Jangwon Lee (SSU)

Hokeun Lim (SSU)

Git repo:

https://github.com/SSU-DCN/bmwg-container-networking

Remote Hackathon from Seoul

Internet Infra System Technology Research Center – Soongsil University (IISTRC- SSU)