Considerations for Benchmarking
Network Performance in
Containerized Infrastructure

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Minh-Ngoc Tran (Soongsil University), Sridhar Rao (The Linux Foundation),
Jangwon Lee, Younghan Kim (Soongsil University)
Scope

• Previous **NFV benchmarking** related RFCs
  • RFC 8172: Considerations for Benchmarking Virtual Network Functions and Their Infrastructure
  • RFC 8204: Benchmarking Virtual Switches in the Open Platform for NFV (OPNFV)

• The primary scope of this document is to fill in the gaps of these works **when applying to containerized NFV** infrastructure.

• **The consideration gaps are:**
  • Different network models/topologies configured by Container Network Interfaces (including the extended Berkeley Packet Filter model which was not mentioned in previous documents)

  • Resources configuration for containers.
Networking Models

Different with VM-based infrastructure, network in Container-based infrastructure is configured by a specific Container Network Interface (CNI) Plugin

- It inserts an interface in container network namespace and connects to the host network namespace
- Network configuration methods are different between CNI Plugins.

Different CNI Plugins create Different kinds of containerized networking model

For each model, this document discusses

- Model architecture differences
- Notable model examples
- Model repeatable environment setup guidance (newly added based on previous meeting comment)
Networking Models

Model Architecture

- **Kernel-space non Acceleration**
  - Packet processing through the switching/routing component at the host’s Kernel-space
  - Notable examples: Flannel, Calico (non-ebpf), OpenvSwitch,...

- **User-space Acceleration**
  - Packet processing bypass Kernel-space’s network stack, traverse through User-space vSwitch
  - Notable examples: OVS-DPDK, VPP user-space vSwitch

- **eBPF Acceleration**
  - Packet processing bypass Kernel via eBPF programmed path
  - Notable examples: Cilium, AFXDP plugin, OVS-DPDK/VPP vswitch with AFXDP support

- **Smart-NIC Acceleration**
  - Packet processing bypass Kernel via Smart-NIC’s features (Virtual function / offloaded eBPF)
  - Notable examples: SR-IOV, Cilium (offloaded eBPF mode)

- **Model Combination**
  - Packet processing bypass Kernel via combining SR-IOV and User-space vSwitch
Networking Models

*Repeatable Environment Setup recommendations*

- General: Use Kubernetes as container platform, Multus CNI to enable multiple network interfaces at container

- **Kernel-space non Acceleration**
  - Simply install corresponding CNI plugin yaml configuration file

- **User-space Acceleration**
  - DPDK libraries installation, binding NIC port to DPDK Poll Mode Driver
  - vSwitch vhost-user/memif ports configuration, vSwitch traffic path mapping between ports
  - Userspace CNI plugin is required to be installed and configured

- **eBPF Acceleration**
  - Install corresponding CNI (Cilium / AFXDP CNI plugin)
  - In case of vSwitch with AFXDP-ebpf support, Requires Userspace CNI and above vSwitch configurations

- **Smart-NIC Acceleration**
  - Requires DPDK libraries, SR-IOV capable NIC card and BIOS Virtual Function support feature
  - Then, created Virtual Functions should be bound to DPDK driver
  - SR-IOV CNI plugin / Cilium CNI plugin installation depends on the chosen model

- **Model Combination**
  - Follows above SR-IOV and user-space vSwitch
  - Configures North/South traffic for SR-IOV and East/West traffic for user-space vSwitch
Resources Configuration

*Compared with previous RFCs, Additional Parameters are required for container network*

- **CPU Isolation / NUMA Affinity**
  - Selected CPU Isolation level/technique
  - NUMA cores allocation to pod

- **Pod Hugepages**
  - Pod’s Hugepage size

- **Pod CPU Cores and Memory allocation**
  - Pod’s CPU cores allocation
  - Pod’s RAM allocation

- **Service Function Chaining**
  - Number of CNFs/pod
  - Selected CNI plugin
Summary

• From adoption comments, we added brief key environment setup guidance for each container networking models
• Fixed some grammatical issues.

• Additional reviews and comments are welcomed to polish the document after adoption.
Backup Slides
• Different networking models based on packet acceleration techniques
• Different networking models based on packet acceleration techniques

- **eBPF Acceleration**
  - (using AFXDP)
  - Diagram showing the flow from NIC to TREX Traffic Generator through Network Stack, Kernel, and Userspace vSwitch/AFXDP Plugin.

- **Combined Model Acceleration**
  - (SR-IOV + OVS-DPDK/VPP)
  - Diagram showing the flow from NIC to TREX Traffic Generator through Network Stack, Kernel, and Userspace vSwitch/DPDK Node Driver.