Pushing the boundaries for Cloud-native Network Functions

PTP Live demo, up to Kubernetes

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NFV is at every hop of Mobile networks
Deployment overview 1/3

Service Assurance Framework 1.0 (TP) Running on OpenShift cluster 3.11
vRAN: why do we need PTP?

- **Connection to multiple antennas**
  - (+) Higher throughput
  - (-) Risk of interferences
    - Timing spec for radio fronthaul
      - CDMA2000: $\pm 3\mu s < \text{phase} < \pm 10\mu s$
      - LTE: $\pm 1.5\mu s < \text{phase} < \pm 5\mu s$
      - 5G: $\pm 130\text{ns}$

- **GNSS receivers for each compute node?**
  - Satellites not visible
    - High buildings “shadow”
    - In-buildings
    - Underground
  - Expensive
Deployment overview 2/3

PTP Grand Master Clock
NTP Time Server

NTP

undercloud
controllers
misc...

Central Site

Switch
Boundary Clock (BC)

PTP + switch latency

VNF
/dev/ptp0
RT-Compute

Red Hat
Deployment overview 3/3
Enabling vRAN use case

- **Generic NFV characteristics**
  - Mix virtio + SRIOV VF
  - Device role tagging

```
(overcloud)$ nova boot --nic net-id=$UPLINK_ID,tag=uplink
               --nic port-id=$RADIO_PORT_ID,tag=radio
```

```
(vm)$ jq '.devices[]|"\(.address) \(.mac) \(.tags[0])" meta_data.json
"0000:00:04.0 fa:16:3e:fa:89:0f uplink"
"0000:00:06.0 fa:16:3e:6f:dd:e8 radio"
```

- **vRAN Specific**
  - PTP
  - FPGA (PCI passthrough)
  - Real time
Generates Device Plugining CRDs from OpenStack nova tags

```bash
cat << EOF > sriovdp.yml
apiVersion: v1
kind: ConfigMap
metadata:
  name: sriov-nodes-config
  namespace: kube-system
data:
  fallback-config: |
  
    {"resourceList": [
      {
        "resourceName": "radio_net",
        "rootDevices": ["$RADIO_PCI"],
        "sriovMode": false,
        "deviceType": "vfio"
      },
      {
        "resourceName": "uplink_net",
        "rootDevices": ["$UPLINK_PCI"],
        "sriovMode": false,
        "deviceType": "vfio"
      }
    ]}
EOF
```
Simpler catch-all test

This is not a benchmark!

Make sure that the VM is not the bottleneck
=> Use DPDK testpmd to forward packets

Check expected Mpps and Latency
=> zero packet drop expected

Single flow, 64 Bytes frames
Demo
Managing A Broad Ecosystem Of Workloads

Operator-backed services allow for a SaaS experience on your own infrastructure

An Operator is both a method and runtime for the packaging, deployment and lifecycle management of a Kubernetes application.
Multus Enables Multiple Networks & New Functionality to Existing Networking

The Multus CNI “meta plugin” for Kubernetes enables one to create multiple network interfaces per pod, and assign a CNI plugin to each interface created.

1. Create pod annotation(s) to call out a list of intended network attachments...
2. ...each pointing to CNI network configurations packed inside CRD objects

OpenShift 3.x Capability...
- Kubernetes
- OpenShift SDN CNI
- Pod
  - eth0

OpenShift 4.1 Capability...
- Kubernetes
- CNI “meta plugin” (Multus)
- OpenShift SDN CNI
- Pod
  - eth0
  - net0

CRDs
- default
- plugin#2
Several optional Kubernetes CNI Plug-Ins are added or enhanced in OCP 4.2 to grow capability.

Existing CNI Plug-Ins
- openshift-sdn
- ovn-kubernetes
- host device
- IPAM(dhcp)
- MACVLAN

New CNI Plug-Ins:
- IPVLAN
- Bridge with VLAN
- Static IPAM
High-performance Networking

SR-IOV Solution:

- Tech Preview since Jun 2019
- Fully Supported Dec 2019
- CNI Plug-In
- Device Plug-In
- RDMA / RoCE Support
- DPDK Mode for SR-IOV VFs
- Admission Controller
- Operator

Initially tested NICs (details):
- Intel XXV710-DA2
- Mellanox CX-4/5
Enabling Cloud Native CNFs: Current and Roadmap

- IPv6 single-stack in OCP 3.9
- Network Plumbing K8s working group
- Multus spec draft 1.0
- Hugepages support

4.1 CURRENT

3.x

- CNI Plugin: Bridge with VLAN mode
- SCTP support
- SR-IOV DPDK mode\(^1\)
- SR-IOV Network Operator\(^1\)
- SR-IOV RDMA mode\(^1\)
- SR-IOV Admission Controller\(^1\)
- Installer-Provisioned OpenStack Infrastructure
- Proxy support
- Disconnected installs

End Of 2019 TARGETED

4.2 COMMITTED

- IPv6 full single stack support
- CNI Plugin: Userspace Interface
- OVS offload SR-IOV part
- SR-IOV support for vSphere

Q3CY2020 TBD

- IPv6 full dual stack support
- Multi-NIC host support
- Full Network QoS
- GPUDirect SR-IOV part
- Bond CNI
- Node Feature Discovery (NFD)
- Infiniband

Q2CY2020 TBD

- Multus Multi-Network support
- SR-IOV CNI Plugin\(^1\)
- SR-IOV Device Plugin\(^1\)
- CNI Plugin: MACVLAN
- CNI Plugin: IPAM(DHCP)
- CNI Plugin: Host device
- CPU Manager (CPU pinning)
- SR-IOV GA
- Topology Manager (NUMA Awareness)
- PTP support
- High-Performance Multicast
- IP & MAC Address Mgmt in Multus
- SR-IOV VF Security and QoS Flags
- SR-IOV RDMA mode
- Userspace pod interface & API\(^1\)
- IPv6 single & dual stack on 2ndary interfaces
- DNS Forwarding

\(^1\)Tech Preview
\(^2\)With 3rd-party vendor SDN
Thank you

linkedin.com/company/red-hat
youtube.com/user/RedHatVideos
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twitter.com/RedHat