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GERMAN NETWORK OPERATORS GROUP

Running a Platform for CNFs in 2023

The Good, the Bad and the Ugly

Marcel Fest | DT Technik GmbH | November 15, 2023

CNFs non K8s ready

2023-11-15

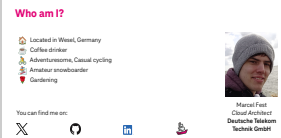
1. Hey and welcome to my story about being one of the Admins running a Kubernetes platofrm for Cloud Native Network Functions in 2023

Who am I?

- 🏠 Located in Wesel, Germany
- ☕ Coffee drinker
- 🚴 Adventuresome, Casual cycling
- 🏂 Amateur snowboarder
- 🌹 Gardening

Marcel Fest
Cloud Architect
Deutsche Telekom Technik GmbH

You can find me on:



1. I am Marcel located in Wesel Germany
2. drink Coffee
3. do casual cycling
4. do snowboarding
5. additionally I am getting better with the hedge skimmer in my backyard

The Mission

1. Reliable Kubernetes Clusters with well defined API Contract for internal customers

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2. Telco Grade Network Integration for Cloud Native Network Functions (CNFs)
3. Contribute to Upstream OpenSource projects to provide enhancements for our niche use-cases

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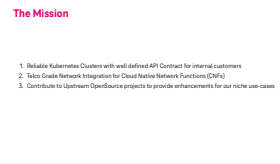

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01
The Narrative

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Running NF on Kubernetes in a Telco

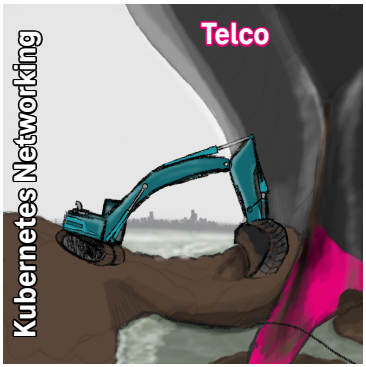


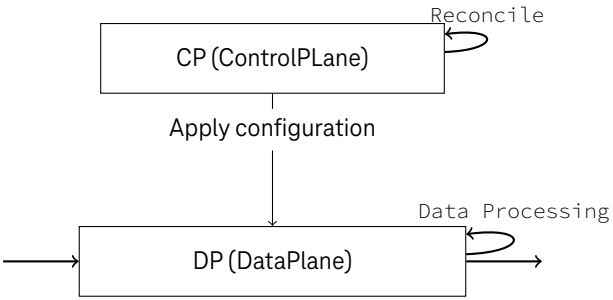
Figure 1: Hosting a NF (Network Function) on vanilla Kubernetes! [1]

Running NF on Kubernetes in a Telco

Figure 1: Hosting a NF (Network Function) on vanilla Kubernetes! [1]

1. Its like constantly digging and searching for solutions
2. For migration to happen we need to first increase complexity and get opportunities
3. Lets come to the why it is like it is

What is a CNF or VNF or PNF? Really what's an NF



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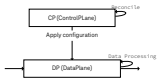


1. simple NF consists of two parts
2. CP is separate from DP
3. DP is handling the forwarding
4. DP always non-blocking and gets configured by CP
5. NFs implement LoadBalancers, DDOS appliances, directory services and more

History Lesson about NFs

- Everything started with **PNF**'s
  - normally it is a proprietary hardware chassis or black-box with labeled network ports
  - support and maintenance was done by the vendor and the updatecycle was around once/twice a year
- Than **VNF**s came around
  - These network functions are deployed in a VM (Virtual Machine)
  - First approach to consolidate on commodity hardware
  - The main NFVI (Network Function and Virtualization Infrastructure) is OpenStack
- The newest incarnation of a network function is the **CNF**
  - These network functions are deployed as a Container with 12-factors
  - Second approach to consolidate on commodity hardware
  - The main *NFCO (Network Function and Container Orchestrator)* is Kubernetes

1. PNF: proprietary hardware black-box
2. PNF: fully vendor support (hardware, software integration)
3. VNF: VMs
4. VNF: consolidation of different fucntions on the same Platform
5. VNF: OpenStack as NFVI normally provided by a consultancy company
6. CNF: Containerized network functions
7. CNF: Kubernetes as Orchestrator
8. **short *break*** hydronate

Lets hydronate and drink some VRF!

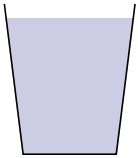
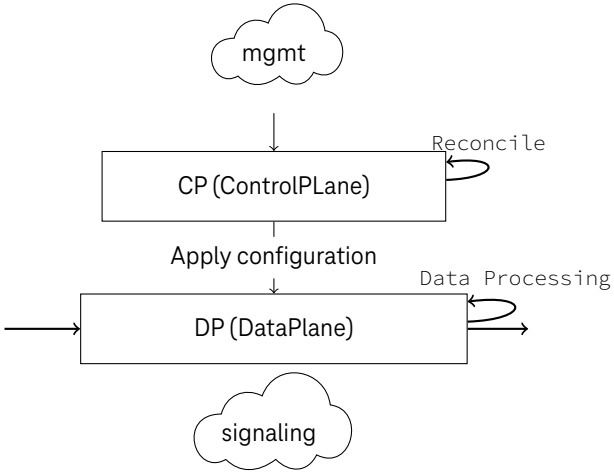
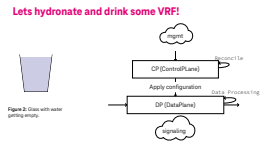


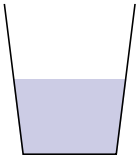
Figure 2: Glass with water getting empty.





1. Lets wire the NF into a Telco
2. NFs normally are wired into a lot of VRFs (Virtual Routing and Forwardings Domains)
3. fancy orchestrators just support **one** the *default* VRF (Virtual Routing and Forwarding)
4. so we need a solution for this *problem*

Lets hydronate and drink some VRF!



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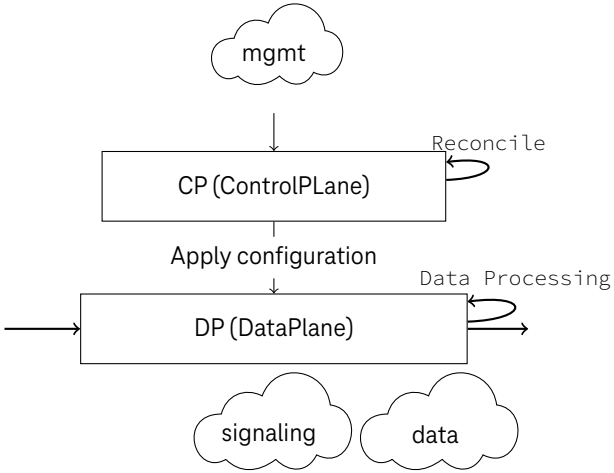

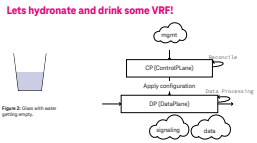

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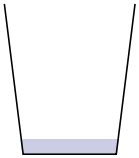

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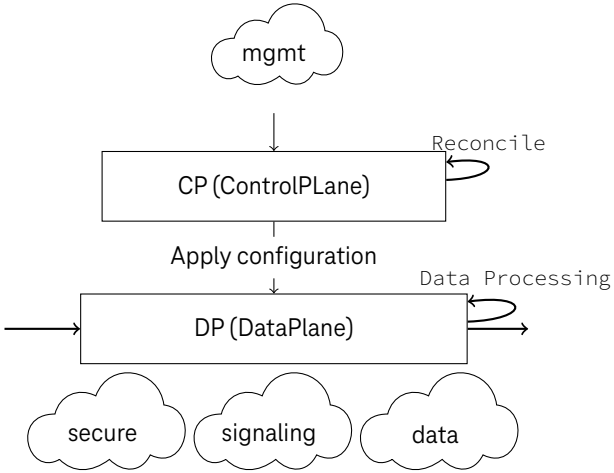

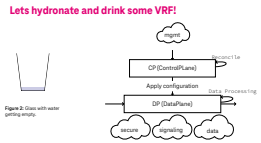

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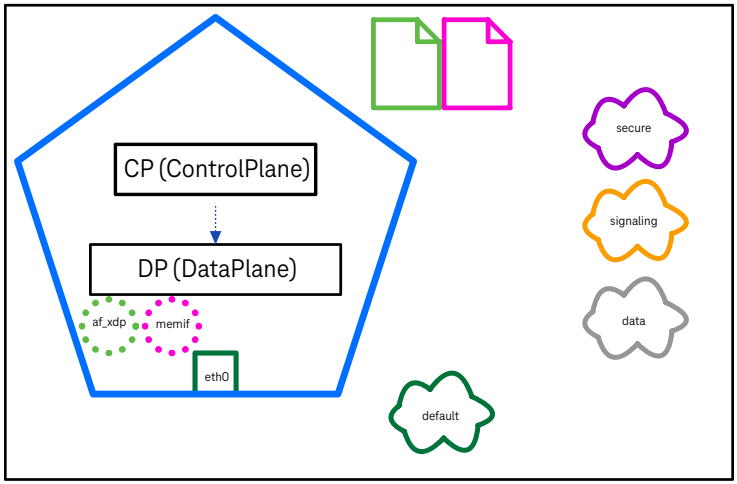
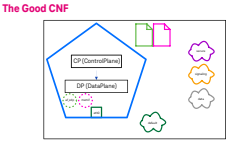
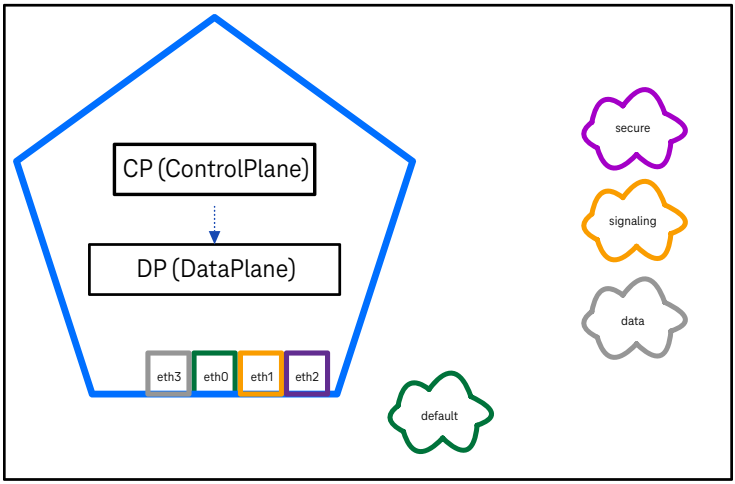
The Good CNF

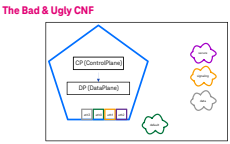




1. the black rectangle represents the linux host
2. the blue pentagon is a running pod/container on the orchestrator
3. in it we have a exemplary network function with the connectivity needs from earlier
4. **eth0** should be connected to the CNI of the K8s cluster (directly routed)
5. **eth0** should be used for all casual connectivity and supports all kubernetes features
6. **eth0** is handled by the platform provided networking stack
7. **memif or af_xdp** should be used for the fast-datapath to bypass the kernel
8. **vrfs** are connected without the application knowing about them
9. **memif or af_xdp** need to have either own routing daemon or leverage a standardized process to handle dynamic routing updates

The Bad & Ugly CNF





1. **eth0** connected to standard kubernetes cni with direct L3 routing as in the earlier example
2. additional complexity added by adding more interfaces **eth1, eth2 and eth3**
3. additional components needed for these additional interfaces (firewalling, cnis, ...)
4. every peace of software handling the complexity needs to also run on the same kubernetes cluster
5. network complexity rises as we need to provide additional l2 domains for every additional interface which is non **L3**
6. manual configuration on vendor site for routing is required when dealing with the requested L2 domains

02
Conclusion

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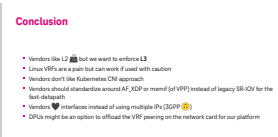
- Vendors like L2 📠 but we want to enforce **L3**
- Linux VRFs are a pain but can work if used with caution
- Vendors don't like Kubernetes CNI approach
- Vendors should standardize around AF_XDP or memif (of VPP) instead of legacy SR-IOV for the fast-datapath
- Vendors 🖤 interfaces instead of using multiple IPs (3GPP 🙃)
- DPUs might be an option to offload the VRF peering on the network card for our platform



1. Vendors L2 is heavily used instead of Kubernetes L3
2. Linux VRFs (the pain)
3. Kubernetes CNI is extended by additional CNIs to support 3GPPs **standards** they say
4. Vendors use SR-IOV build formerly for hypervisors as passthrough and not AF_XDP or memif which are more fitting to a CNF platform
5. DPUs could abstract the host based routing for VRFs into an linux kernel on network card

END

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1. Want to know more?
2. Just head over to the talk of my colleague Christopher
3. He will go into details of the underlying network stack at 14:30 today

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Two years of BGP-EVPN to the host

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