Cloud-Native NFV & Performance Benchmarks

The Big Picture

Presented by

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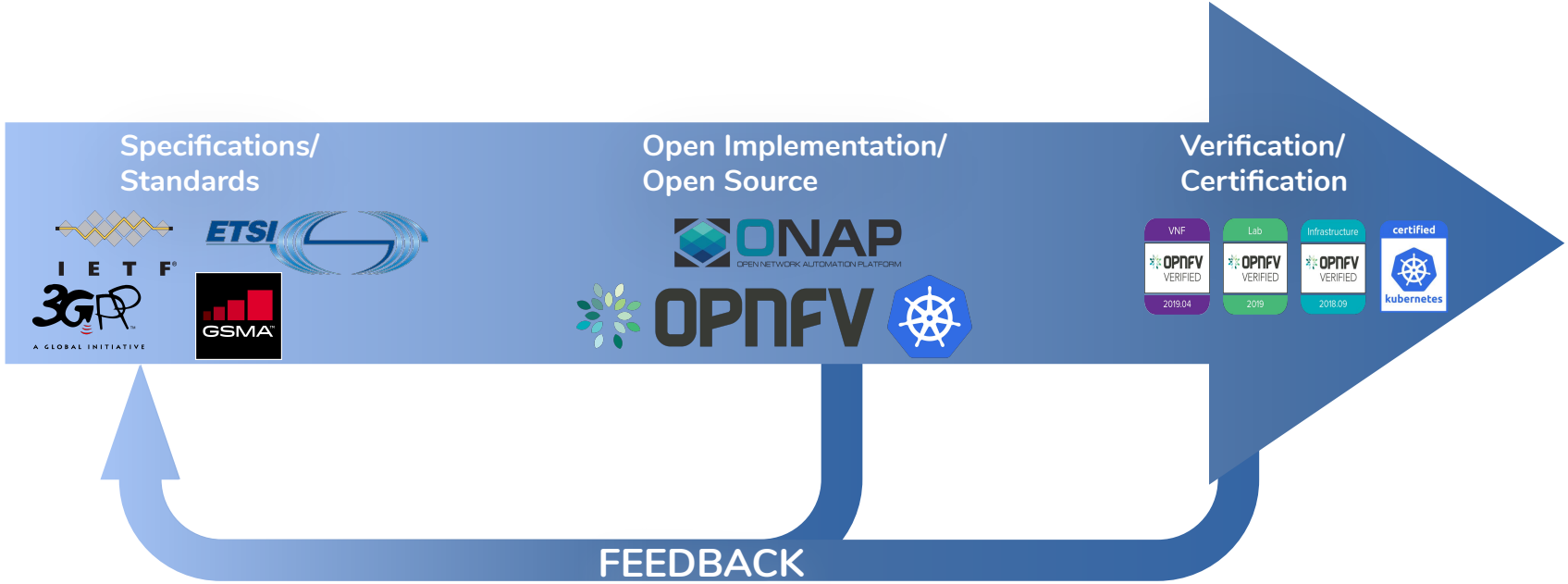
Standards and Open Communities Collaborating



References:
Kubernetes Certification | LF Networking OVP

The Transition from VM to Cloud-Native

Doing the new networking the ~~old~~ **new** way.

"NFV was training wheels, Cloud Native is real deal"

References:

https://www.youtube.com/watch?v=B6wn3iK01qo

Workload: Container as a computing unit

- Packaging, easy for distributions
- Fine-grained Modular Testing
- Portability
- Lighter than VM... less compute footprint...
- Security? Isolation....

Container Security: Isolation as a solution

Two approaches...

- UniKernel
- Micro-VM

kata containers

Firecracker

Nabla Containers

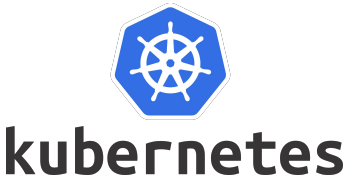
unik

gVisor

References:
unit42.paloatnetworks.com/making-containers-more-isolated

Managing Workloads: Orchestration

Kubernetes is unofficially de facto standard



Features:

LCM, self-healing, auto-scaling, scheduling, ...

Current challenges:

Resource affinity and awareness for workloads

References:

New Features for K8s/Containers

- CPU Manager
- Hugepage Manager
- Device Plugin Manager(SR-IOV, GPU, FPGA, P4 switches)
- Node Feature Discovery
- Topology Manager
- .....many more....

References:

Modeling CNFs

What is CNF?

Check TUG white paper on CNF....

How can we model it?

Possible tools.. Extended TOSCA, Helm, K8s Custom Resources/Operators..... ?

Note: Considerations for higher network orchestration layer(NFVO).....

Building a fast data-path

Multiple Options:

- VPP (User-mode, DPDK, no kernel dependencies, Native Nic drivers, Linux API,)
- eBPF+XDP (Bypass Kernel networking stack but still in kernel-mode)
- SR-IOV (Single Root- I/O Virtualization)
- .....

What is the best option?

But more importantly what is right approach data-plane in kernel space or User Space?

References:

VPP: Vector Packet Processing

- High performance, packet-processing stack that can run on commodity CPUs.
- Plugin based architecture
- Processes vector of packets
- Runs as an user space application.

References:
[Img]: fd.io/vppproject/vpptech

Multi-Interface Pods

Options: Multus, Danm, ...

Use Cases:

- Control plane, data plane separation
- Connecting workloads to different network

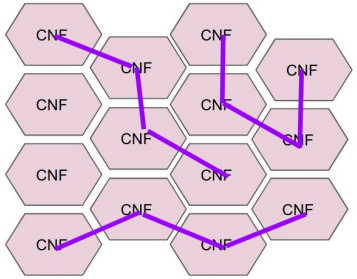
Service Function Chaining

CNF SFC:

- CNF snake
- CNF pipeline

SFC implementation:

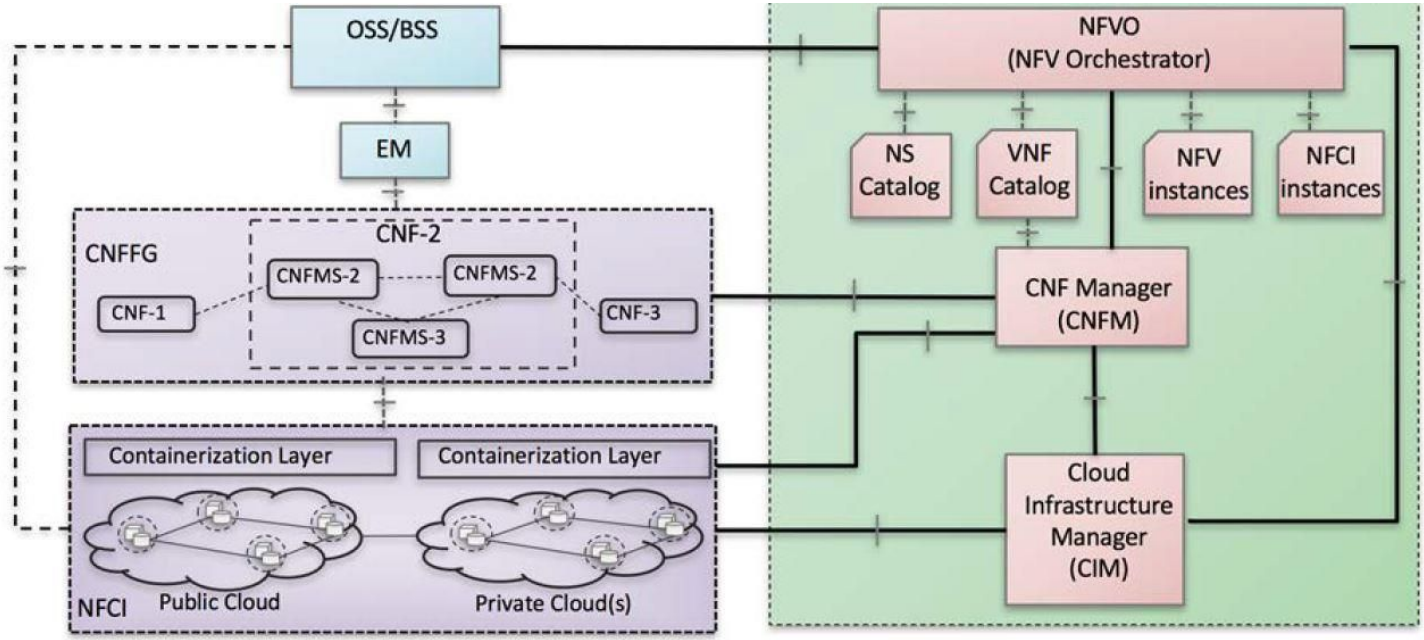
- SDN
- Wiring logic in dataplane(Ligato Framework)
- Service Mesh(NSM)
- A lot more to see...



src: cisco/resources

References:

The Big Picture: Bringing things together



Proposed ETSI MANO Reference Architecture Augmentation for Cloud Native NFV

References:

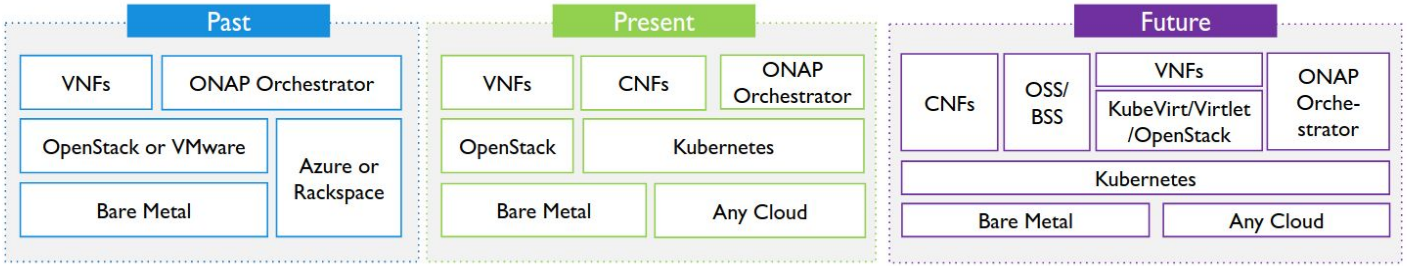
[Img]: 2017 SCTE-ISBE and NCTA

Required Values for CIM(Cloud Infrastructure Manager)

- Automation(Ansible, Terraform,)
- Interoperability with PNFs(Device Plugin Manager, CRDs)
- Observability(Prometheus, Cortex,)
- Extensibility(Plugin based Architecture)
- Platform Agnostic
- Cloud Native(immutable infra, declarative apis and microservices)

References:

Running VNFs on Kubernetes



- kubeVirt

References:
Telecom User Group slides

Benchmarking & CNFs

If it is fast then it sells!

CNF Testing Goals

- Compliance - *check against existing standards*
- Validation - *check against cloud platforms (for LCM, Health, etc..)*
- **Performance - *Performance tests and Profiling***
- Interoperability - *Integration and interoperability (for different hardware, cloud infra, interfaces, etc..)*

Performance Testing and Profiling

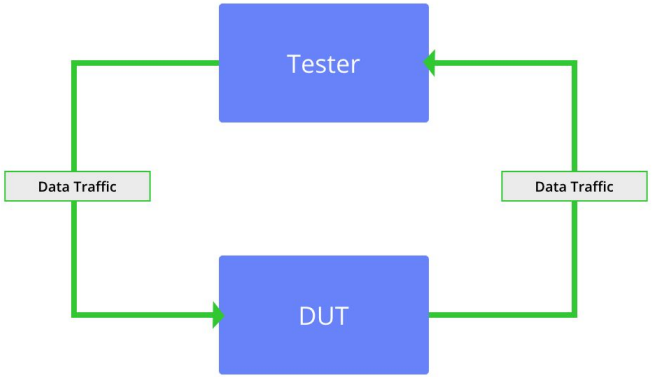
- Gold CNF
- Silver CNF
- Bronze CNF
- Not-so-good-CNF

References:

Telecom User Group slides

Some Basics: Test Setup

RFC 2544

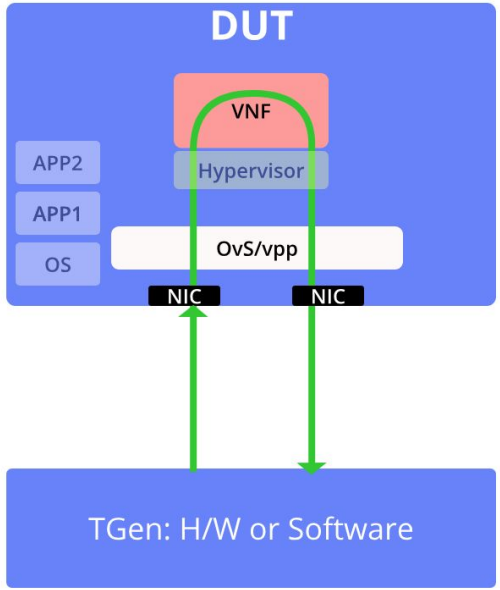


References:

IETF-BMWG RFC-2544

RFC 8172 for VNFs

- **Benchmarking: Same as before**
- Continued Emphasis on Black-Box Benchmarks
- Recording all configuration parameters(both Hw/Sw)
- Attention to Shared Resources
- Space for new Benchmarks and Related Metrics



References:
IETF-BMWG RFC-8172

Consideration for Benchmarking network performance in Containerized Infrastructure

BMWG Draft-03(work-in-progress)

- **Includes RFC 8172 for VNFs**
- Network Model used
  - Kernel Space Network Model (OvS, eBPF, Flannel, Calico,..)
  - User Space Network Model (VPP+OvS+DPDK, SR-IOV, ..)
- Support for new resources for Containers like
  - Rx/Tx Multiple Queue
  - NUMA
  - Hugepages
  - .....

References:

BMWG Draft: Containers Network Infra

Consideration for Benchmarking network performance in Containerized Infrastructure

BMWG Draft-03(work-in-progress)

- Traffic scenarios like
  - Container2Container
  - BMP2BMP
  - BMP2VMP and
  - VMP2VMP

- BMP - Bare Metal Pod
- VMP - Virtual Machine Pod

References:
BMWG Draft: Containers Network Infra

Assessment of Benchmark Coverage now 4x3

	SPEED	ACCURACY	RELIABILITY	SCALE
Activation	Speed of Activation benchmarks	Accuracy of Activation benchmarks	Reliability of Activation benchmarks	Scale of Activation benchmarks
Operation	Speed of Operation benchmarks	Accuracy of Operation benchmarks	Reliability of Operation benchmarks	Scalability of Operation benchmarks
De-activation	Speed of Deactivation benchmarks	Accuracy of Deactivation benchmarks	Reliability of Deactivation benchmarks	Scalability of Deactivation benchmarks

But what are benchmarks?

RFC 2544 + More RFCs based on network functions,

For example: Switch: 2889, 2285,... ,(new RFC 8204 for vSwitches)

References:

Benchmarking Automation

For

- Performance focused CI/CD of CNFs
- On demand tests for some target environment
- Automated & precise analytics of results for CNF profiling

Future Considerations

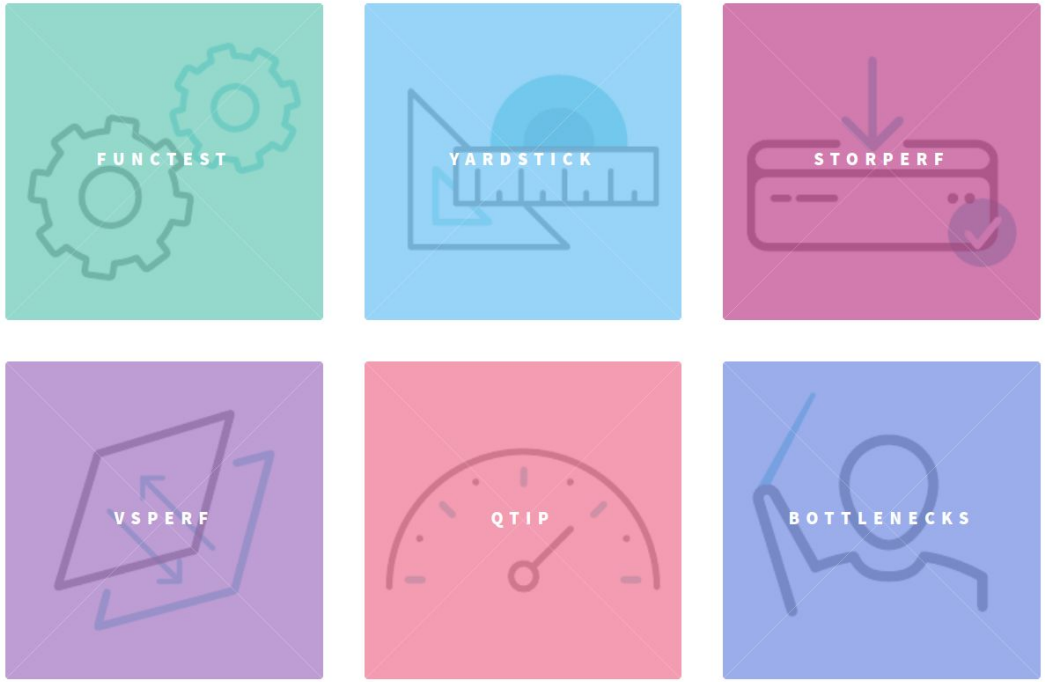
- Benchmarks for Scaling up CNFs
- Benchmarks SFC performance
- Measuring impact of Service Density
- Performance impact on migrating CNFs
- Considering preprovisioned CNFs
- Power Consumption(Average power consumption, dynamic power consumption with varying load)
- KPIs
- .....
- ....

References:

Community Works

The Open World!

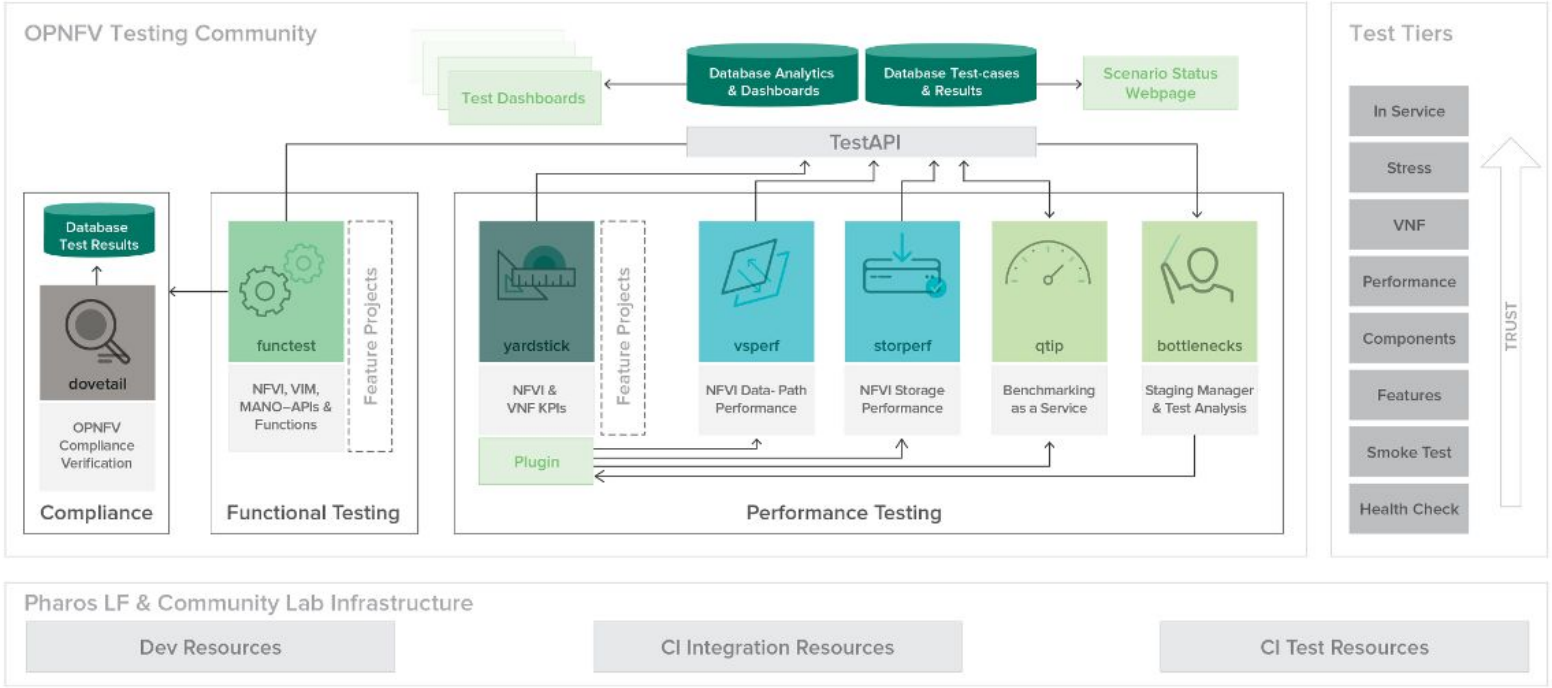
OPNFV: Testing community



References:

[Img]: OPNFV Testing Report website

OPNFV: Testing community



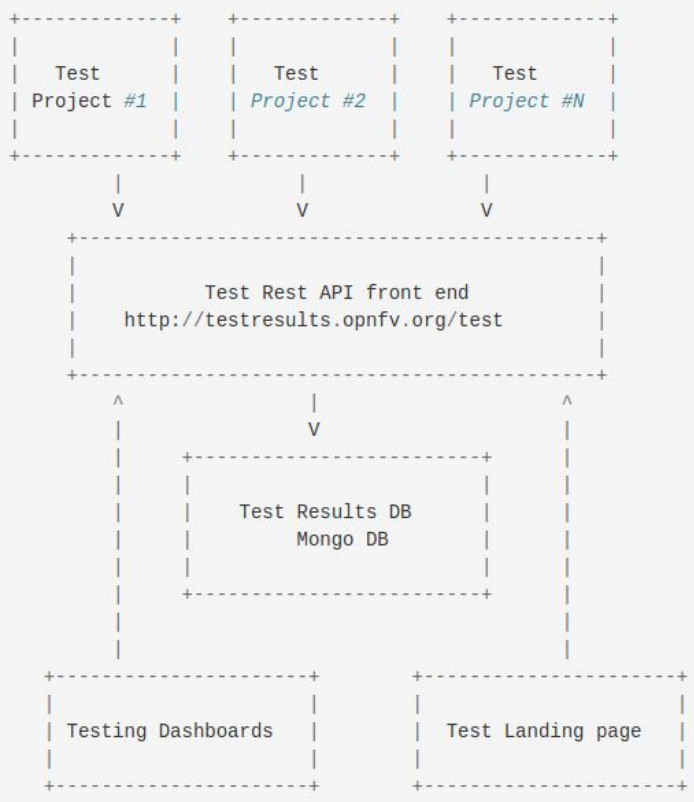
References:

[Img]: OPNFV Testing Catalog

OPNFV: Open Verification Program (OVP)

References:
LF Networking OVP

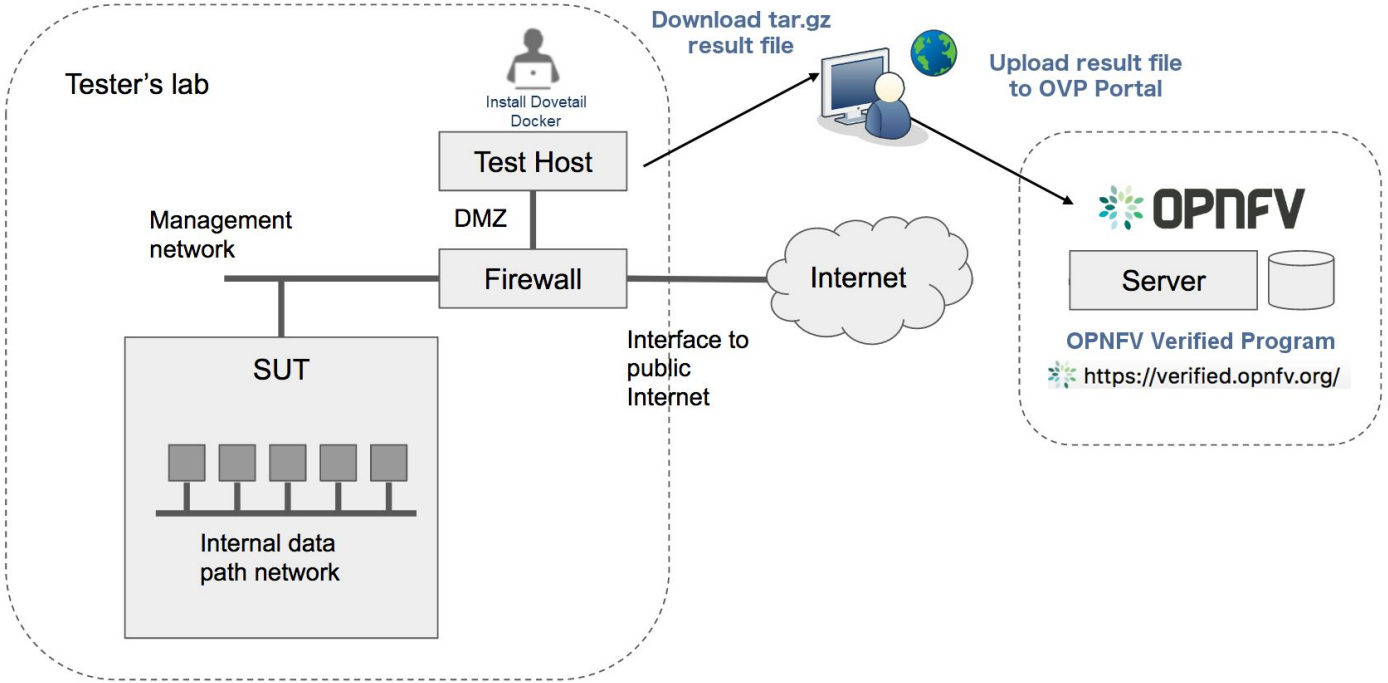
OPNFV Test API: Test community



References:

[Img]: OPNFV testing doc

OPNFV Dovetail: Making things easy



References:

[Img]: Dovetail testing user guide

OPNFV 2.0

Recently, the OPNFV 2.0 sub-committee was created with task to generate new contents, roadmap and actions for the OPNFV 2.0 transformation.

Work In Progress
@
https://wiki.opnfv.org/display/DEV/Working+Progress+Page

(Expecting to be highly affected by CNTT works.....Let's see...)

References:

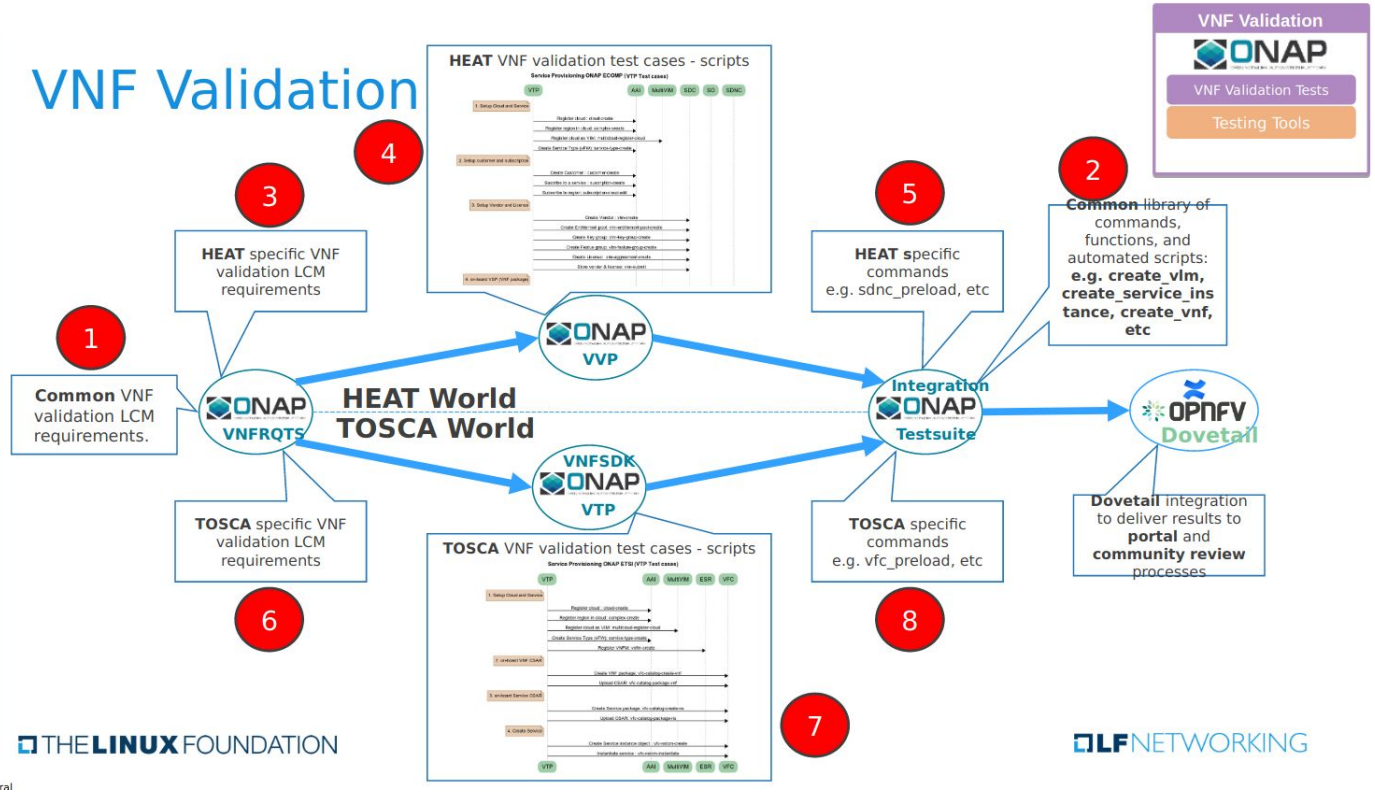
Introducing X-testing

- Developed in OPNFV Functest project
- Allow the developer to work only on the test suites without diving into CI/CD integration
- Simplify test integration in a complete LFN-based CI/CD toolchain (e.g. Jenkins, Testing Containers, Test API and dashboard)
- Allow a proper design and verify multiple components in the same CI/CD toolchain (OpenStack, Kubernetes, ONAP, etc.)

References:

[ONS2019]: From Infra to E2E Testing

ONAP: VNF Verification



References:

[OPNFV Plugfest 2020]: OVP Introduction

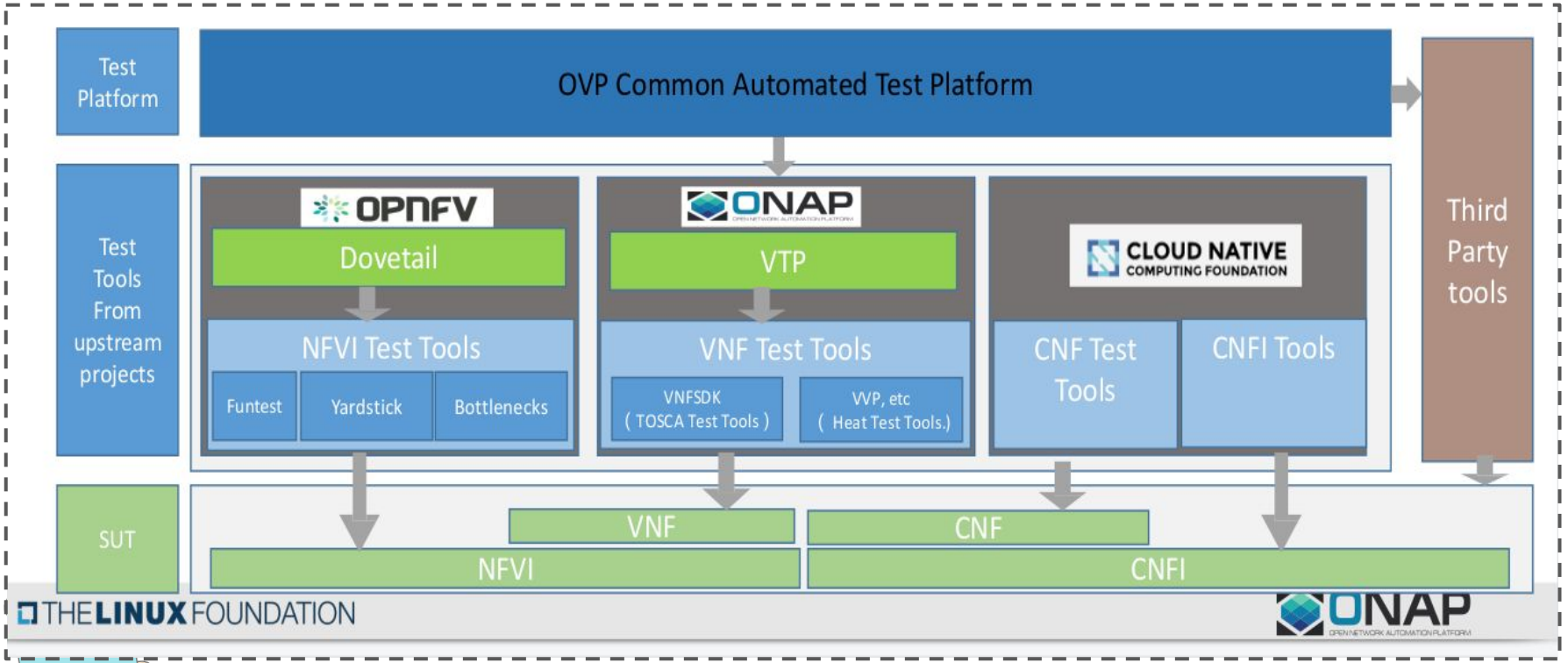
CNCF: TUG, TestBed, ...

- Telecom User Group(TUG)
  - Whitepaper 1: [Cloud Native Thinking for Telecommunications]
  - Whitepaper 2: (W.I.P.)
  - **Proposal for CNF conformance project**(Coming Soon to Sandbox proj.)

- **CNF-Testbed**
  - An initiative to create a repeatable, apples-to-apples testbed to evaluate how CNF architectures compare to VNF ones.
  - To help facilitate the transition in the NFV world from VNFs to CNFs
  - Teleco focused

References:

Possible Future of OVP



References:

[Img]: OVP Automation Augment(OPNFV Plugfest 2020)

CNTT: RM, RA, RI, RC

Reference Model
RM

Reference Architecture
RA1

Ch03:
Target State

Ch04:
Lab Req

Ch05:
Installer Req

Ch07:
Integration

Ch06:
Ops

RI 1 *(Reference Implementation)*

Community
Installers
OPNFV
Airship
Installer

Labs/Servers

Ch03:
TC Req

Ch05:
Test Cases
& Traceability

Ch02:
Framework
Req

Ch04:
Integration

Ch03:
TC Req

Ch05:
Test Cases
& Traceability

Ch02:
Framework
Req

Ch04:
Integration

RC 1 *(Reference Conformance)*

NFVI Testing

VNF Testing

OPNFV *Xtesting* OPNFV

Functional:
Functest

Performance

Functional

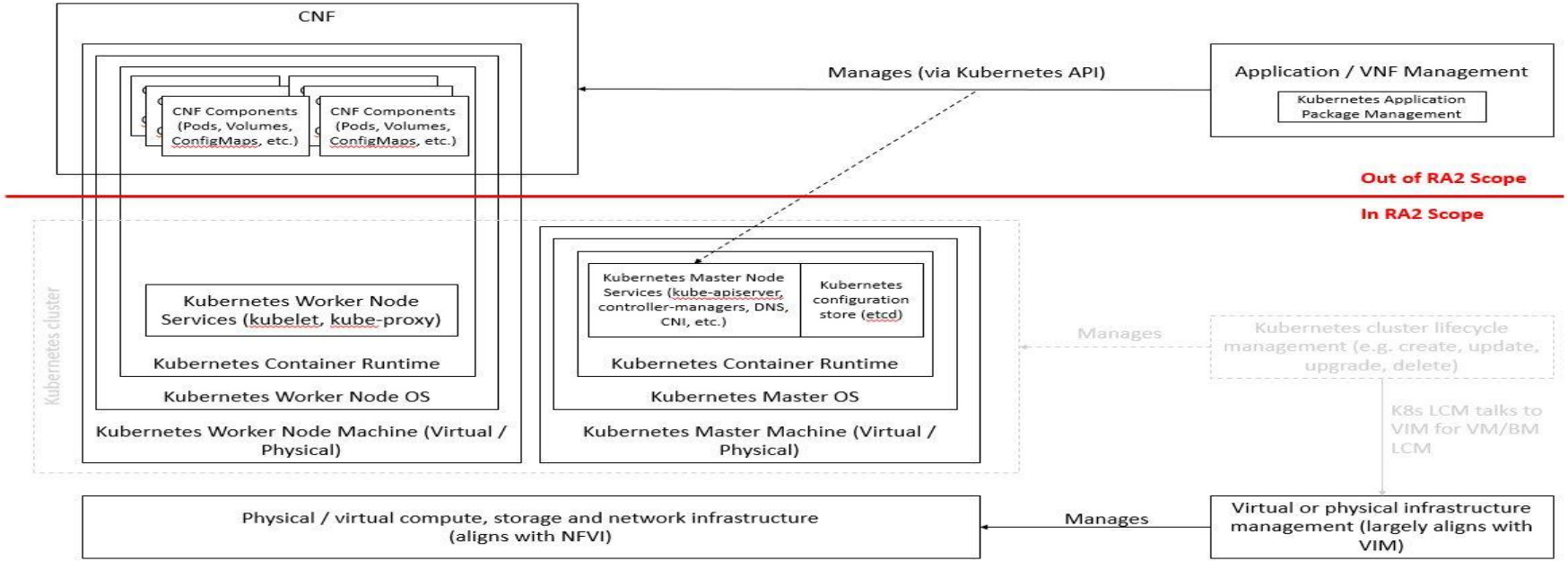
Performance

OPNFV *Dovetail(WWW Portal)* OPNFV

Infrastructure
OPNFV VERIFIED
2018.09

VNF
OPNFV VERIFIED
2019.04

CNTT



References:

https://github.com/cntt-n/CNTT/issues/449

IETF BMWG

- RFC 8172: [Considerations for benchmarking Virtual Network Functions and their Infrastructure]
- RFC 8204: [Benchmarking Virtual Switches in Open Platform for NFV]
- Draft(WIP): [Consideration for Benchmarking Network Performance in Containerized infrastructures]
- Draft(WIP): [Methodology for VNF benchmarking Automation]

References:
IETF BMWG Docs

ETSI NFV TST

GS NFV-TST 001
GS NFV-TST 002

⋮

GS NFV-TST 009

References:

The Open World!

Thank you

/vipratos

/parthyadav3105