NFV Testing

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Agenda

- NFV Testing with Open Source Projects
- Role of CI
- Performance Testing
Intro to OPNFV
Orchestration and Management

Virtual Network Functions

Compute Virtualization
Storage Virtualization
Network Virtualization

Compute
Storage
Network

Infrastructure

Integration
Testing
New Features

Continuous Integration / Continuous Deployment
Documentation
Security
OPNFV – testing and integration project

Additions

Enhancements
OPNFV – testing and integration project

PLATFORM

SDN

COMPONENTS

FEATURES

SFC
BPGPVPN
IPv6
Hugepages

Fault management
OPNFV – testing and integration project

- OSS/BSS
- NFV orchestration
- NFV apps
- Cloud Management
- Infrastructure
- Virtualization
- Compute
- Storage
- Network
NFV Testing with Open Source Projects
Test Ecosystem in OPNFV

OPNFV Testing Community

- Database Test Results
- Functest
- NFVI, VM, NANO-APIS & Functions
- Test Dashboards
- Database Analytics & Dashboards
- Database Test Cases & Results
- Scenario Status Webpage
- TestAPI

Functional Testing

- NFVI KPIs & VNF KPIs
- Yardstick
- Performance Testing
- Vperf
- Storperf
- qtip
- Bottlenecks
- Performance as a Service
- Staging Manager & Test Analysis

Pharos LF & Community Lab Infrastructure

- Dev Resources
- CI Integration Resources
- CI Test Resources

Test Tiers

- In Service
- Stress
- VNF
- Performance
- Components
- Features
- Smoke Test
- Health Check
Types of testing

- **Functional**
  - Infrastructure
  - Features
  - Components
  - VNF
  - MANO
  - ...

- **Performance**
  - Network
  - Storage
  - Compute
  - Virtual layer
  - Traffic gen.
  - ...

- **Stress**
  - Network
  - Storage
  - Compute
  - ...

- **Security**
  - Upgradability
  - Backup&Restore
  - ...
  - ...
  - ...

[OPNFV logo]
The concept of scenarios

scenario X

scenario Y

scenario Z

SFC
The role of CI
Continuous Integration
Infrastructure – Distributed Pharos Labs
Pharos Architecture
Role of CI

4/3/2017 LF Infra Collab
CI workflow

1. Patch
2. Gerrit Code Review
   - Verified +1/-1
3. Patchset Verification
4. Poll changes
5. new changes?
   - yes: Clone repo, Build
   - no: Patch
6. Build Server
7. Build
8. Google Cloud Storage
9. Upload ISO
10. Push Image
11. Docker Hub
Working with upstream communities

- contribute
- pull from master, deploy, test
- and/or
- verify patchset, post feedback
NFV Performance Testing

1. Meanings
2. Approaches
3. Tools
4. Examples
5. Ambitions

“When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind.” … Lord Kelvin
Meanings of NFV Performance Testing

How do vendor A & B compare?

• Can the platform deliver required networking performance?
• Evaluating switching, acceleration technology, hardware platform, NFVI, VNF, full solution?

What Tools and Methods are needed?

• We have relied on trusted proprietary tools
• Traditional network performance methodologies are useful but not sufficient

NFV => general purpose compute elements in a heterogeneous compute environment

• Benchmarking virtual network functions is different to physical functions
• System configurations are complex and few deployments are the same (test infrastructures also differ)

Performance Testing Tools and Methods are not just for Developers and Test-Experts
Approaches to NFV Performance Testing

System Under Test, Workloads and Stimuli
- VNF / NFVI
- Pre-deployment / In-service
- Topology / SW versions / configurations
- Data Plane vs Control Plane + Data Plane
- Component / sub-system / platform / network service
- Traffic profiles, Workloads
- Deployment automation vs control

Test Objectives
- How many Sessions?
- How Quick is Recovery?

Test Methods and Metrics
- Throughput, back2back, frame-loss
- Packet and Frame Delay Distribution
- Scalability according to number of flows, active ports, etc.
- Stream Type with realistic profiles / flows: L2, L3, L4
- Control and Data Path Coupling
- CPU and Memory Consumption
- “Soak” tests capture transient changes in performance

COVERAGE | SPEED | ACCURACY | RELIABILITY | SCALABILITY
--- | --- | --- | --- | ---
Activation
Operation
De-activation

IETF NFV Benchmarking Internet Drafts
- Data Centre Benchmarking Methodology (draft-ietf-bmwg-dcbench-methodology-02)
- Data Centre Benchmarking Terminology (draft-ietf-bmwg-dcbench-terminology-05)
- Benchmarking Methodology for SDN Controller Performance (draft-ietf-bmwg-sdn-controller-benchmark-method-meth-01)
- Terminology for Benchmarking SDN Controller Performance (draft-ietf-bmwg-sdn-controller-benchmark-term-01)
- Benchmarking VNFs and Their Infrastructure (draft-ietf-bmwg-virtual-net-02)
- Considerations for Benchmarking High Availability of NFVI (draft-kim-bmwg-ha-nfvi-01)
- Benchmarking Methodology for EVPN (draft-kishjac-bmwg-evpntest-00)
- VNF Benchmarking Methodology (draft-cosa-bmwg-vnfbench-00)
- Benchmarking Virtual Switches in OPNFV (draft-vsperf-bmwg-vswitch-opnfv-02)

ETSI NFV Test Specifications
- NFV Pre-deployment Testing (Spec) (http://www.etsi.org/technologies-clusters/technologies/nfv)
- NFV Interoperability Testing Methodology (Spec)
- Use cases & recommendations for VNF Snapshot (Spec)
- Path-implementations among NS Endpoints & VNFs (https://docbox.etsi.org/isg/nfv/open/drafts/)
- Capture of VNF data and VNF/VNFC snapshots
- DevOps and CI/CD - test procedures and metrics
- Interop test guidelines VNF, MANO, VIM-NFVI
- Key performance NFVI metrics at different layers

OPNFV
NFV Performance Testing Tools

Test Infrastructure
- https://wiki.opnfv.org/display/pharos
- https://wiki.opnfv.org/display/pharos/Community+Labs
- Video Tutorial: Introduction to Pharos

Test Frameworks
- Network Service Performance (MANO)
- VNF Characterization (Control + Data Plane)
- NFVI Performance (Data Plane)
- Components and Sub-system Performance
- Staging Manager and Bottleneck Analysis
- Analytics (post-process test results from CI/CD pipeline)
- Integrated statistics / events monitoring

Traffic Generators
- Vary in measurement capability and suitability
- Vary in complexity and cost

<table>
<thead>
<tr>
<th>Traffic Generator</th>
<th>Type</th>
<th>SW/HW</th>
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<tbody>
<tr>
<td>IXIA (physical and virtual)</td>
<td>Proprietary</td>
<td>SW/HW</td>
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<tr>
<td>Spirent (physical and virtual)</td>
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<td>SW</td>
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<tr>
<td>LAN Tornado RFC 2544</td>
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<td>Seagull</td>
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<tr>
<td>PROX</td>
<td>Open Source</td>
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</tbody>
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NFV Test Tools - VSPERF

Modular test framework, combining traffic generation, virtual switches, VNFs, and network configuration test cases


Test-cases: configure and program vSwitch, deploy and terminate VNFs, execute a traffic generator, modify a VSPERF configuration, execute external commands, etc. http://docs.opnfv.org/en/latest/submodules/vswitchperf/docs/testing/user/userguide/teststeps.html


Results
- OPNFV community lab resources https://wiki.opnfv.org/display/pharos/VSPERF+in+Intel+Pharos+Lab+-+Pod+12
- Scenario example http://docs.opnfv.org/en/latest/submodules/vswitchperf/docs/testing/developer/results/scenario.html
- Visualization (proto): http://testresults.opnfv.org/proto/index-vspfer.html
NFV Test Tools - Yardstick

**Yardstick is used in for verifying the OPNFV infrastructure KPIs and some OPNFV features**

- Test configurations in YAML … parsed and converted into an internal model … converted into a Heat template and deployed
- Scenario runners execute commands in VMs with SSH
- Output written as json records to a file or influxdb, results shown with Grafana

Test Cases: [http://docs.opnfv.org/en/latest/submodules/yardstick/docs/testing/user/userguide/15-list-of-tcs.html](http://docs.opnfv.org/en/latest/submodules/yardstick/docs/testing/user/userguide/15-list-of-tcs.html)

Metrics: [http://docs.opnfv.org/en/latest/submodules/yardstick/docs/testing/user/userguide/02-methodology.html#metrics](http://docs.opnfv.org/en/latest/submodules/yardstick/docs/testing/user/userguide/02-methodology.html#metrics)

Results: [http://testresults.opnfv.org/grafana/](http://testresults.opnfv.org/grafana/)
Test Example - TCP VM Performance
Test Example – vSwitch Flow Rules

• OpenStack deployed with Fuel/Apex uses single logical tenant network (two tenant networks possible with DevStack/Kolla)

• Two OVS bridges by default. Br-prv is outward facing bridge. Br-int is inner bridge where VMs are logically connected

• VLAN segmentation means additional modify VLAN ID required to and from VMs

• OVS flow rules are created by OpenStack Neutron

• OVS flow action NORMAL - FDB table updated per packet
Test Example - Traffic Flow Comparison

Colorado deployment with OVS normal mode (MAC learning) comparing throughput when UDP traffic has varying source MAC address and varying UDP ports

Varying source MAC

Varying UDP port
NFV Platform Performance Testing

Developer Testing
- Stand-alone
- Previous
- Master
- Future?

Testing Artifacts
- Test Tools
- Test Cases
- Test Data
- Performance Reference Scenarios
- Configurations
- Performance Ranges

Release Testing
- Test
- Integrate
- Deploy

User Testing
- Vendor Platform Tests
- OPNFV Test Suites

“NFV Performance Standards”

Analytic

Good Data + Good Explanations -> Good Configurations -> Good Performance
NFV Testing - Conclusions

NFV is more challenging than Cloud Computing …

• Just working is not good enough

Test areas in evolution are …

• Advancing CI and integration test toolchains
• Integrating test capabilities with upstream communities
• Performance Testing automation
You’re Invited! Free Beer, Basketball, and Networking

- Open Source Community Reception
- Tonight from 6:00 – 10:00 PM
- Levi’s Stadium, Yahoo! Fantasy Football Lounge (a short walk)
- Sponsored by Serro, Juniper, and Inocybe
- Meet community members from OPNFV, OpenDaylight, OpenStack, Fd.io and ONAP. Light food and drinks will be provided.
- We’ll also be showing the NCAA Men’s Basketball Final Game!
- RSVP Required via OPNFV website here:
  - https://www.opnfv.org/event/open-networking-summit