VPN test specification

Scope

The VPN test area evaluates the ability of the system under test to support VPN networking for virtual workloads. The tests in this test area will evaluate establishing VPN networks, publishing and communication between endpoints using BGP and tear down of the networks.

References

This test area evaluates the ability of the system to perform selected actions defined in the following specifications. Details of specific features evaluated are described in the test descriptions.

- RFC 4364 - BGP/MPLS IP Virtual Private Networks
  - https://tools.ietf.org/html/rfc4364
- RFC 4659 - BGP-MPLS IP Virtual Private Network
  - https://tools.ietf.org/html/rfc4659
- RFC 2547 - BGP/MPLS VPNs
  - https://tools.ietf.org/html/rfc2547

Definitions and abbreviations

The following terms and abbreviations are used in conjunction with this test area

- BGP - Border gateway protocol
- eRT - Export route target
- IETF - Internet Engineering Task Force
- iRT - Import route target
- NFVi - Network functions virtualization infrastructure
- Tenant - An isolated set of virtualized infrastructures
- VM - Virtual machine
- VPN - Virtual private network
- VLAN - Virtual local area network

System Under Test (SUT)

The system under test is assumed to be the NFVi and VIM in operation on a Pharos compliant infrastructure.

Test Area Structure

The test area is structured as four sequential tests with inherent dependencies between each test in the test area. The test area evaluates the ability of the SUT to establish connectivity between Virtual Machines using an appropriate route target configuration, reconfigure the route targets to remove connectivity between the VMs, then reestablish connectivity by re-association.

Test Descriptions

Test Case 1 - VPN provides connectivity between Neutron subnets

Short name

opnfv.sdnvpn.subnet_connectivity

Use case specification

This test evaluates the use case where an NFVi tenant uses a BGPVPN to provide connectivity between VMs on different Neutron networks and subnets that reside on different hosts.

Test preconditions

2 compute nodes are available, denoted Node1 and Node2 in the following.

Basic test flow execution description and pass/fail criteria

Methodology for verifying connectivity

Connectivity between VMs is tested by sending ICMP ping packets between selected VMs. The target IPs are passed to the VMs sending pings by means of a custom user data script. Whether or not a ping was successful is determined by checking the console output of the source VMs.

Test execution

- Create Neutron network N1 and subnet SN1 with IP range 10.10.10.0/24
- Create Neutron network N2 and subnet SN2 with IP range 10.10.11.0/24
- Create VM1 on Node1 with a port in network N1
- Create VM2 on Node1 with a port in network N1
- Create VM3 on Node2 with a port in network N1
- Create VM4 on Node1 with a port in network N2
- Create VM5 on Node2 with a port in network N2
- Create VPN1 with eRT<>iRT
- Create network association between network N1 and VPN1
- VM1 sends ICMP packets to VM2 using `ping`
- **Test assertion 1:** Ping from VM1 to VM2 succeeds: `ping` exits with return code 0
- VM1 sends ICMP packets to VM3 using `ping`
- **Test assertion 2:** Ping from VM1 to VM3 succeeds: `ping` exits with return code 0
- VM1 sends ICMP packets to VM4 using `ping`
- **Test assertion 3:** Ping from VM1 to VM4 fails: `ping` exits with a non-zero return code
- Create network association between network N2 and VPN1
- VM4 sends ICMP packets to VM5 using `ping`
- **Test assertion 4:** Ping from VM4 to VM5 succeeds: `ping` exits with return code 0
- Configure iRT=eRT in VPN1
- VM1 sends ICMP packets to VM4 using `ping`
- **Test assertion 5:** Ping from VM1 to VM4 succeeds: `ping` exits with return code 0
- VM1 sends ICMP packets to VM5 using `ping`
- **Test assertion 6:** Ping from VM1 to VM5 succeeds: `ping` exits with return code 0

Pass / fail criteria

This test evaluates the capability of the NFVi and VIM to provide routed IP connectivity between VMs by means of BGP/MPLS VPNs. Specifically, the test verifies that:

- VMs in the same Neutron subnet have IP connectivity regardless of BGP/MPLS VPNs (test assertion 1, 2, 4)
- VMs in different Neutron subnets do not have IP connectivity by default - in this case without associating VPNs with the same import and export route targets to the Neutron networks (test assertion 3)
- VMs in different Neutron subnets have routed IP connectivity after associating both networks with BGP/MPLS VPNs which have been configured with the same import and export route targets (test assertion 5, 6). Hence, adjusting the ingress and egress route targets enables as well as prohibits routing.

In order to pass this test, all test assertions listed in the test execution above need to pass.

Post conditions

All VMs, networks, subnets and VPNs created during the test have been deleted.

Test Case 2 - VPNs ensure traffic separation between tenants

Short Name

opnfv.sdnvpn.tenant_separation

Use case specification

This test evaluates if VPNs provide separation of traffic such that overlapping IP ranges can be used.

Test preconditions

2 compute nodes are available, denoted Node1 and Node2 in the following.

Basic test flow execution description and pass/fail criteria

Methodology for verifying connectivity

Connectivity between VMs is tested by establishing an SSH connection. Moreover, the command “hostname” is executed at the remote VM in order to retrieve the hostname of the remote VM. The retrieved hostname is furthermore compared against an expected value. This is used to verify tenant traffic separation, i.e., despite overlapping IPs, a connection is made to the correct VM as determined by means of the hostname of the target VM.

Test execution

- Create Neutron network N1
- Create subnet SN1a of network N1 with IP range 10.10.10.0/24
- Create subnet SN1b of network N1 with IP range 10.10.11.0/24
- Create Neutron network N2
- Create subnet SN2a of network N2 with IP range 10.10.10.0/24
- Create subnet SN2b of network N2 with IP range 10.10.11.0/24
- Create VM1 on Node1 with a port in network N1 and IP 10.10.10.11.
- Create VM2 on Node1 with a port in network N1 and IP 10.10.10.12.
- Create VM3 on Node2 with a port in network N1 and IP 10.10.11.13.
- Create VM4 on Node1 with a port in network N2 and IP 10.10.10.12.
- Create VM5 on Node2 with a port in network N2 and IP 10.10.11.13.
- Create VPN1 with iRT=eRT=RT1
- Create network association between network N1 and VPN1
- VM1 attempts to execute the command `hostname` on the VM with IP 10.10.10.12 via SSH.

- **Test assertion 1:** VM1 can successfully connect to the VM with IP 10.10.10.12. via SSH and execute the remote command `hostname`. The retrieved hostname equals the hostname of VM2.
- VM1 attempts to execute the command `hostname` on the VM with IP 10.10.11.13 via SSH.
- **Test assertion 2:** VM1 can successfully connect to the VM with IP 10.10.11.13 via SSH and execute the remote command `hostname`. The retrieved hostname equals the hostname of VM3.
- Create VPN2 with iRT=eRT=RT2
- Create network association between network N2 and VPN2
- VM4 attempts to execute the command `hostname` on the VM with IP 10.10.11.13 via SSH.
- **Test assertion 3:** VM4 can successfully connect to the VM with IP 10.10.11.13 via SSH and execute the remote command `hostname`. The retrieved hostname equals the hostname of VM5.
- VM4 attempts to execute the command `hostname` on the VM with IP 10.10.11.11 via SSH.
- **Test assertion 4:** VM4 cannot connect to the VM with IP 10.10.11.11 via SSH.

Pass / fail criteria

This test evaluates the capability of the NFVi and VIM to provide routed IP connectivity between VMs by means of BGP/MPLS VPNs. Specifically, the test verifies that:

- VMs in the same Neutron subnet (still) have IP connectivity between each other when a BGP/MPLS VPN is associated with the network (test assertion 1).
- VMs in different Neutron subnets have routed IP connectivity between each other when BGP/MPLS VPNs with the same import and expert route targets are associated with both networks (assertion 2).
- VMs in different Neutron networks and BGP/MPLS VPNs with different import and export route targets can have overlapping IP ranges. The BGP/MPLS VPNs provide traffic separation (assertion 3 and 4).

In order to pass this test, all test assertions listed in the test execution above need to pass.

Post conditions

All VMs, networks, subnets and VPNs created during the test have been deleted.

Test Case 4 - VPN provides connectivity between subnets using router association

Short Name

opnfv.sdnvpn.router_association

Use case specification

This test evaluates if a VPN provides connectivity between two subnets by utilizing two different VPN association mechanisms: a router association and a network association.

Specifically, the test network topology comprises two networks N1 and N2 with corresponding subnets. Additionally, network N1 is connected to a router R1. This test verifies that a VPN V1 provides connectivity between both networks when applying a router association to router R1 and a network association to network N2.

Test preconditions

2 compute nodes are available, denoted Node1 and Node2 in the following.

Basic test flow execution description and pass/fail criteria

Methodology for verifying connectivity

Connectivity between VMs is tested by sending ICMP ping packets between selected VMs. The target IPs are passed to the VMs sending pings by means of a custom user data script. Whether or not a ping was successful is determined by checking the console output of the source VMs.

Test execution

- Create a network N1, a subnet SN1 with IP range 10.10.10.0/24 and a connected router R1
- Create a network N2, a subnet SN2 with IP range 10.10.11.0/24
- Create VM1 on Node1 with a port in network N1
- Create VM2 on Node1 with a port in network N1
- Create VM3 on Node2 with a port in network N1
- Create VM4 on Node1 with a port in network N2
- Create VM5 on Node2 with a port in network N2
- Create VPN1 with eRT<>iRT so that connected subnets should not reach each other
- Create route association between router R1 and VPN1
- VM1 sends ICMP packets to VM2 using `ping`
- **Test assertion 1:** Ping from VM1 to VM2 succeeds: `ping` exits with return code 0
- VM1 sends ICMP packets to VM3 using `ping`
- **Test assertion 2:** Ping from VM1 to VM3 succeeds: `ping` exits with return code 0
- VM1 sends ICMP packets to VM4 using `ping`
- **Test assertion 3:** Ping from VM1 to VM4 fails: `ping` exits with a non-zero return code
- Create network association between network N2 and VPN1
- VM4 sends ICMP packets to VM5 using `ping`
- **Test assertion 4:** Ping from VM4 to VM5 succeeds: `ping` exits with return code 0
- Change VPN1 so that iRT=eRT
- VM1 sends ICMP packets to VM4 using `ping`
- **Test assertion 5:** Ping from VM1 to VM4 succeeds: `ping` exits with return code 0
- VM1 sends ICMP packets to VM5 using `ping`
- **Test assertion 6:** Ping from VM1 to VM5 succeeds: `ping` exits with return code 0

Pass / fail criteria

This test evaluates the capability of the NFVi and VIM to provide routed IP connectivity between VMs by means of BGP/MPLS VPNs. Specifically, the test verifies that:

- VMs in the same Neutron subnet have IP connectivity regardless of the import and export route target configuration of BGP/MPLS VPNs (test assertion 1, 2, 4)
- VMs in different Neutron subnets do not have IP connectivity by default - in this case without associating VPNs with the same import and export route targets to the Neutron networks or connected Neutron routers (test assertion 3).
- VMs in two different Neutron subnets have routed IP connectivity after associating the first network and a router connected to the second network with BGP/MPLS VPNs which have been configured with the same import and export route targets (test assertion 5, 6). Hence, adjusting the ingress and egress route targets enables as well as prohibits routing.
- Network and router associations are equivalent methods for binding Neutron networks to VPN.

In order to pass this test, all test assertions listed in the test execution above need to pass.

Post conditions

All VMs, networks, subnets and VPNs created during the test have been deleted.

Test Case 8 - Verify interworking of router and network associations with floating IP functionality

Short Name

opnfv.sdnvpn.router_association_floating_ip

Use case specification

This test evaluates if both the router association and network association mechanisms interwork with floating IP functionality.

Specifically, the test network topology comprises two networks N1 and N2 with corresponding subnets. Additionally, network N1 is connected to a router R1. This test verifies that i) a VPN V1 provides connectivity between both networks when applying a router association to router R1 and a network association to network N2 and ii) a VM in network N1 is reachable externally by means of a floating IP.

Test preconditions

At least one compute node is available.

Basic test flow execution description and pass/fail criteria

Methodology for verifying connectivity

Connectivity between VMs is tested by sending ICMP ping packets between selected VMs. The target IPs are passed to the VMs sending pings by means of a custom user data script. Whether or not a ping was successful is determined by checking the console output of the source VMs.

Test execution

- Create a network N1, a subnet SN1 with IP range 10.10.10.0/24 and a connected router R1
- Create a network N2 with IP range 10.10.20.0/24
- Create VM1 with a port in network N1
- Create VM2 with a port in network N2
- Create VPN1
- Create a router association between router R1 and VPN1
- Create a network association between network N2 and VPN1
- VM1 sends ICMP packets to VM2 using `ping`
- **Test assertion 1:** Ping from VM1 to VM2 succeeds: `ping` exits with return code 0
- Assign a floating IP to VM1
- **Test assertion 2:** Ping the floating IP of VM1 from the host running the test framework

Pass / fail criteria

This test evaluates the capability of the NFVi and VIM to provide routed IP connectivity between VMs by means of BGP/MPLS VPNs. Specifically, the test verifies that:

- VMs in the same Neutron subnet have IP connectivity regardless of the import and export route target configuration of BGP/MPLS VPNs (test assertion 1)
- VMs connected to a network which has been associated with a BGP/MPLS VPN are reachable through floating IPs.

In order to pass this test, all test assertions listed in the test execution above need to pass.

Post conditions

All VMs, networks, subnets and VPNs created during the test have been deleted.