Tenant IPv6 Deployment in Kilo

Shannon McFarland – Principal Engineer - Cisco

@eyepv6

Where to get more info

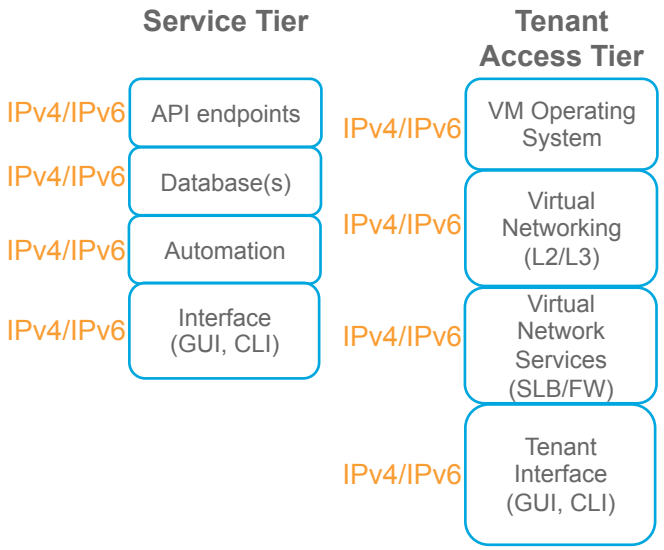
- Tenant IPv6 Deployment - http://www.debug-all.com/?p=52
- Using Heat to deploy IPv6 - http://www.debug-all.com/?p=100
- Sample Heat templates - https://github.com/shmcfarl/my-heat-templates
- Bug – Kilo LBaaS/HAproxy – VIP isn't listening on IPv6: https://bugs.launchpad.net/neutron/+bug/1403001
- Multi-Prefix http://specs.openstack.org/openstack/neutron-specs/specs/kilo/multiple-ipv6-prefixes.html
- IPv6 Prefix Delegation http://specs.openstack.org/openstack/neutron-specs/specs/liberty/ipv6-prefix-delegation.html

The Hard Stuff – IPv6 + Cloud

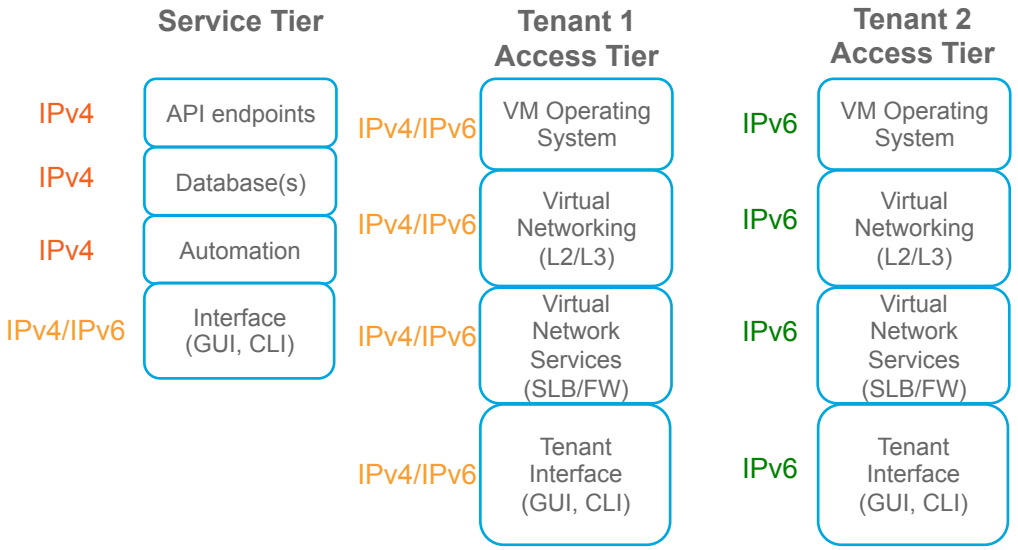
- Inside of a private cloud stack you have a lot of moving parts and they all ride on IP:
  - API endpoints
  - Provisioning, Orchestration and Management services
  - Boatload of protocols and databases and high-availability components
  - Virtual networking services <> Physical networking
- IPv6 has been available with OpenStack for awhile but it has depended on a lot of backports and custom patches to be functional
- Kilo offers the best 'out-of-box' support yet – but still needs more work
- Tenant IPv6 Address Assignment via:
  - SLAAC, Stateful DHCPv6, Stateless DHCPv6
- Two common approaches for IPv6 support:
  - Dual-Stack everything (Service Tier + Tenant Access Tier [Tenant management interface along with VM network access])
  - Conditional Dual stack (Tenant Access Tier only – API endpoints & DBs are still IPv4)

Cloud Stack – IP Version Options

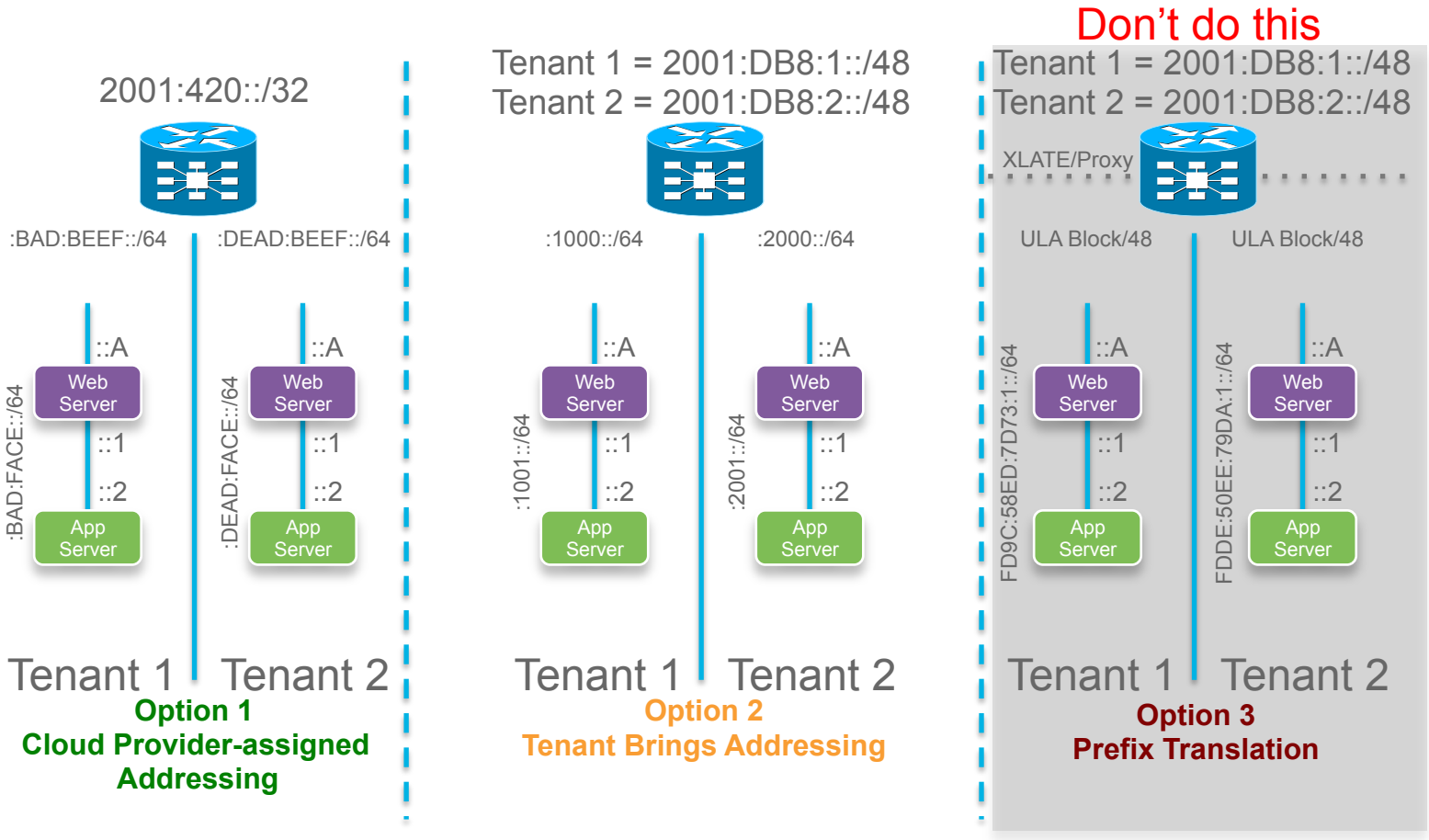
Dual-Stack Everything



Conditional Dual-Stack

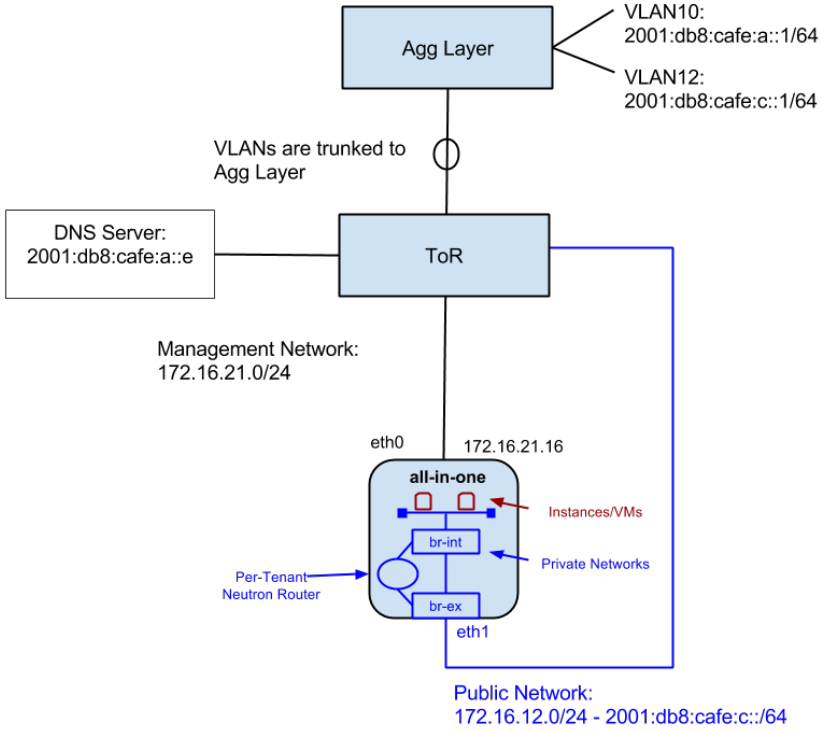


Tenant IPv6 Address Options



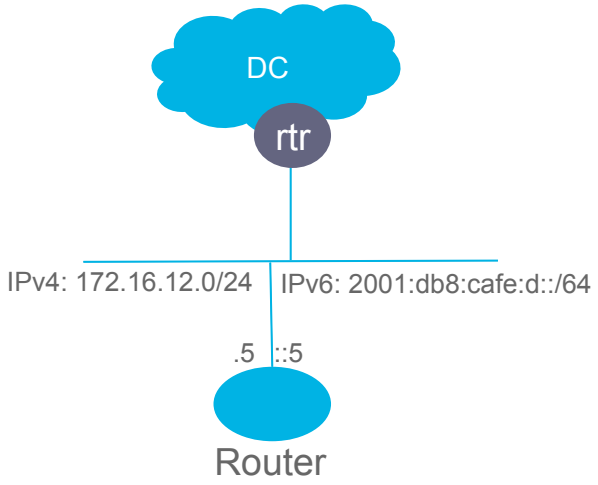
Reference

IPv6 in OpenStack – Example Topology



Create the Public Network/Subnet

```
neutron net-create public --router:external

neutron subnet-create --name public-subnet --allocation-pool start=172.16.12.5,
end=172.16.12.254 public 172.16.12.0/24

neutron subnet-create --ip-version=6 --name=public-v6-subnet --allocation-pool start=2001:db8:cafe:d::5,
end=2001:db8:cafe:d:ffff:ffff:ffff:fffe --disable-dhcp public 2001:db8:cafe:d::/64
```

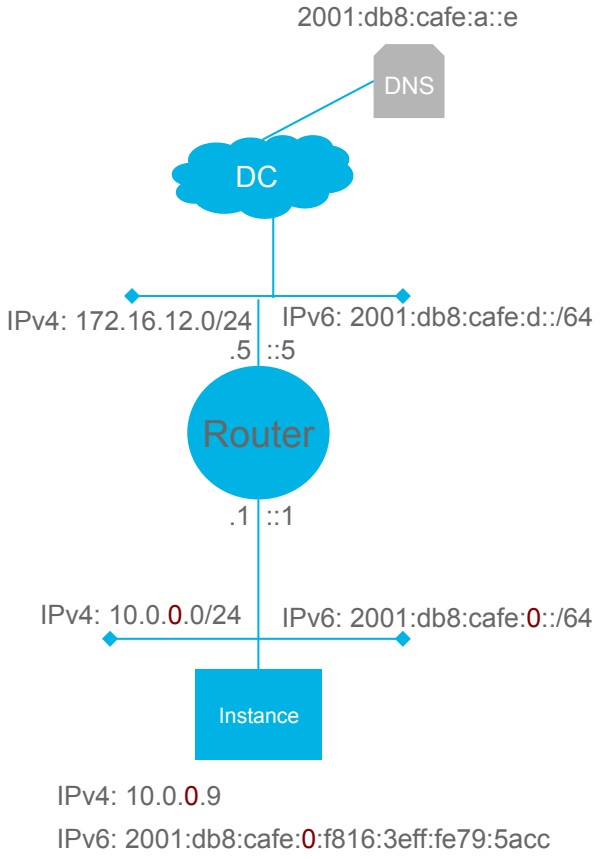


IPv6 Address Assignment Modes - Kilo

- StateLess Address AutoConfiguration – SLAAC:
  - The first-hop L3 device (router/L3 switch – RADVD in the case of OpenStack) provides addressing to client
  - RADVD advertises 64-bit prefix – Client self-derives last 64-bit (Interface ID)
  - No domain info provided
- Stateless DHCPv6:
  - SLAAC + DHCPv6 for domain info
  - L3 device still provides addressing but a ‘real’ DHCPv6 service provides DNS/Domain name options
- Stateful DHCPv6
  - All of the common DHCP concepts you already know and love

SLAAC Mode

```
neutron net-create private

neutron subnet-create --ip-version=6 --name=private_v6_subnet --ipv6-address-mode=slaac
--ipv6-ra-mode=slaac private 2001:db8:cafe::/64
+-------------------+-------------------------------------------------------------------------------+
| Field             | Value                                                                         |
+-------------------+-------------------------------------------------------------------------------+
| allocation_pools  | {"start": "2001:db8:cafe::2", "end": "2001:db8:cafe:0:ffff:ffff:ffff:fffe"} |
| cidr              | 2001:db8:cafe::/64                                                            |
| dns_nameservers   |                                                                               |
| enable_dhcp       | True                                                                          |
| gateway_ip        | 2001:db8:cafe::1                                                              |
| host_routes       |                                                                               |
| id                | 42cc3dbc-938b-4ad6-b12e-59aef7618477                                          |
| ip_version        | 6                                                                             |
| ipv6_address_mode | slaac                                                                         |
| ipv6_ra_mode      | slaac                                                                         |
| name              | private_v6_subnet                                                             |
| network_id        | 7166ce15-c581-4195-9479-ad2283193d06                                          |
| subnetpool_id     |                                                                               |
| tenant_id         | f057804eb39b4618b40e06196e16265b                                              |
+-------------------+-------------------------------------------------------------------------------+
```



SLAAC Mode Info

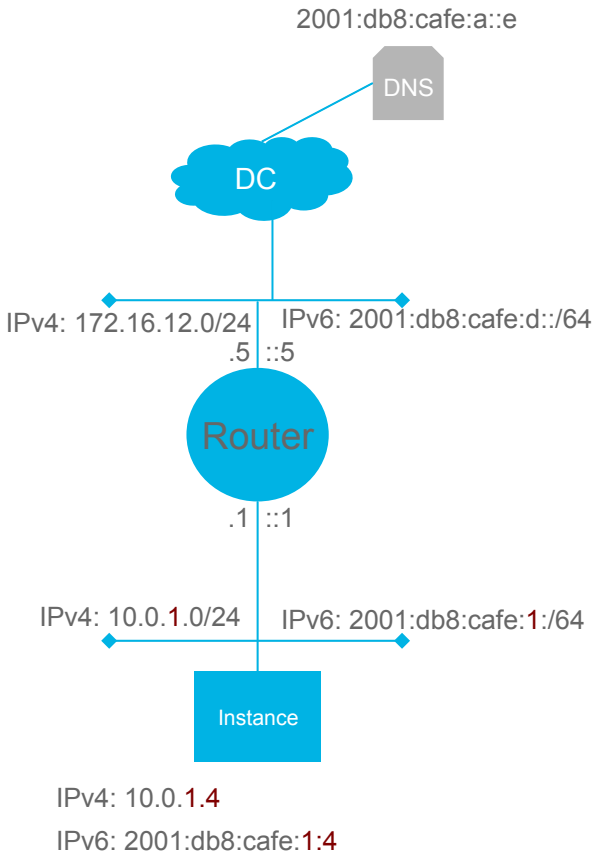
- OpenStack will not inject the IPv6 DNS entry from the subnet dns_nameservers entry
- Options
  - Manually setting the IPv6 DNS server entry in the resolv.conf file allows for correct IPv6-based name resolution
  - Bake DNS settings into your image
  - Cloud-init to inject the DNS configuration
- You do get A and AAAA records back over IPv4 transport
- Basically, it works as it should

SLAAC Mode – Sniffer Capture

```
15:08:01.520353 IP6 (hlim 255, next-header ICMPv6 (58) payload length: 16) fe80::f816:3eff:fe79:5acc > ff02::2: [icmp6 sum ok] ICMP6, router
solicitation, length 16
         source link-address option (1), length 8 (1): fa:16:3e:79:5a:cc
           0x0000:  fa16 3e79 5acc


15:08:01.520667 IP6 (hlim 255, next-header ICMPv6 (58) payload length: 56) fe80::f816:3eff:fec3:17b4 > ff02::1: [icmp6 sum ok] ICMP6, router
advertisement, length 56
       hop limit 64, Flags [none], pref medium, router lifetime 30s, reachable time 0s, retrans time 0s
         prefix info option (3), length 32 (4): 2001:db8:cafe::/64, Flags [onlink, auto], valid time 86400s, pref. time 14400s
           0x0000:  40c0 0001 5180 0000 3840 0000 0000 2001
           0x0010:  0db8 cafe 0000 0000 0000 0000 0000
         source link-address option (1), length 8 (1): fa:16:3e:c3:17:b4
           0x0000:  fa16 3ec3 17b4
15:08:02.256004 IP6 (hlim 1, next-header Options (0) payload length: 36) fe80::f816:3eff:fe79:5acc > ff02::16: HBH (rtalert: 0x0000) (padn) [icmp6 sum
ok] ICMP6, multicast listener report v2, 1 group record(s) [gaddr ff02::1:ff79:5acc is_ex { }]
15:08:02.484047 IP6 (hlim 255, next-header ICMPv6 (58) payload length: 24) :: > ff02::1:ff79:5acc: [icmp6 sum ok] ICMP6, neighbor solicitation, length
24, who has 2001:db8:cafe:0:f816:3eff:fe79:5acc
```

Stateful DHCPv6 Mode

```
neutron net-create private-dhcpv6

neutron subnet-create --ip-version=6 --name=private_dhcpv6_subnet --ipv6-address-mode=dhcpv6-stateful
--ipv6-ra-mode=dhcpv6-stateful private-dhcpv6 2001:db8:cafe:1::/64 --dns-nameserver 2001:db8:cafe:a::e
+-------------------+-------------------------------------------------------------------------------------+
| Field             | Value                                                                               |
+-------------------+-------------------------------------------------------------------------------------+
| allocation_pools  | {"start": "2001:db8:cafe:1::2", "end": "2001:db8:cafe:1:ffff:ffff:ffff:fffe"} |
| cidr              | 2001:db8:cafe:1::/64                                                                |
| dns_nameservers   | 2001:db8:cafe:a::e                                                                  |
| enable_dhcp       | True                                                                                |
| gateway_ip        | 2001:db8:cafe:1::1                                                                  |
| host_routes       |                                                                                     |
| id                | 545ea206-9d14-4dca-8bae-7940719bdab5                                                |
| ip_version        | 6                                                                                   |
| ipv6_address_mode | dhcpv6-stateful                                                                     |
| ipv6_ra_mode      | dhcpv6-stateful                                                                     |
| name              | private_dhcpv6_subnet                                                               |
| network_id        | 55ed8333-2876-400a-92c1-ef49bc10aa2b                                                |
| subnetpool_id     |                                                                                     |
| tenant_id         | f057804eb39b4618b40e06196e16265b                                                    |
+-------------------+-------------------------------------------------------------------------------------+
```



DHCPv6 Stateful Mode Info

- Enable client for DHCPv6:

Ubuntu

```
/etc/network/interfaces
auto eth0
iface eth0 inet dhcp
iface eth0 inet6 dhcp
```

CentOS/RHEL/Fedora

```
/etc/sysconfig/network-scripts/ifcfg-xxxx
IPV6INIT="yes"
DHCPV6C="yes"
```

- Then you get addressing and options:

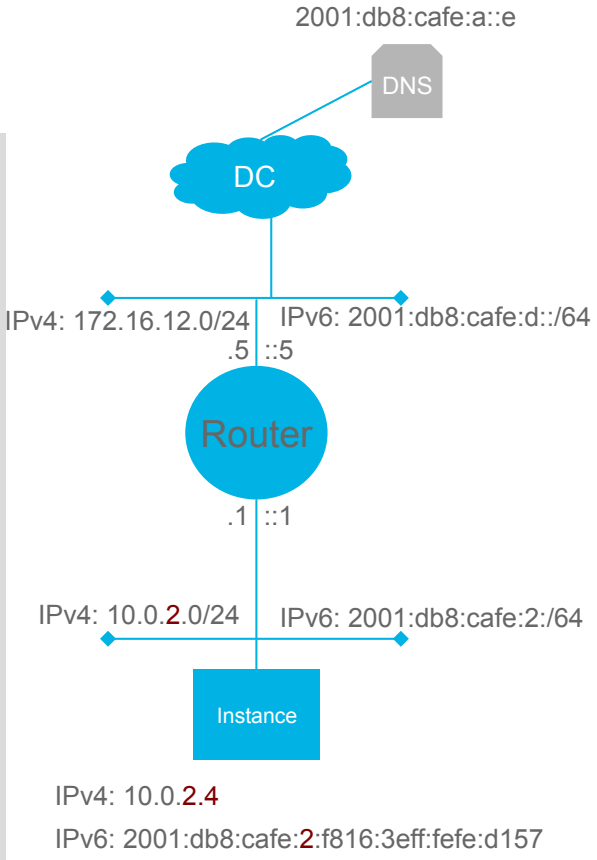
```
ubuntu@dhcpv6-1:~$ more /etc/resolv.conf
# Dynamic resolv.conf(5) file for glibc resolver(3) generated by resolvconf(8)
#     DO NOT EDIT THIS FILE BY HAND -- YOUR CHANGES WILL BE OVERWRITTEN
nameserver 172.16.10.14
nameserver 2001:db8:cafe:a::e
search openstacklocal
```

DHCPv6 Stateful Mode – Sniffer Capture

```
14:56:02.671930 IP6 (hlim 255, next-header ICMPv6 (58) payload length: 24) fe80::f816:3eff:fe77:e5a0 > ff02::1: [icmp6 sum ok] ICMP6, router advertisement, length 24
        hop limit 64, Flags [managed], pref medium, router lifetime 30s, reachable time 0s, retrans time 0s
          source link-address option (1), length 8 (1): fa:16:3e:77:e5:a0
            0x0000:  fa16 3e77 e5a0


14:56:08.042878 IP6 (hlim 1, next-header UDP (17) payload length: 64) fe80::f816:3eff:fe22:386b.546 > ff02::1:2.547: [udp sum ok] dhcp6 solicit (xid=85680b (client-ID hwaddr/time type 1 time 482446373 fa163e22386b) (option-request DNS-server DNS-search-list Client-FQDN SNTP-servers) (elapsed-time 101) (IA_NA IAID:1042430059 T1:3600 T2:5400))


14:56:08.143267 IP6 (class 0xc0, hlim 64, next-header UDP (17) payload length: 175) fe80::f816:3eff:fe06:176f.547 > fe80::f816:3eff:fe22:386b.546: [udp sum ok] dhcp6 advertise (xid=85680b (client-ID hwaddr/time type 1 time 482446373 fa163e22386b) (server-ID hwaddr type 1 fa163e06176f) (IA_NA IAID:1042430059 T1:43200 T2:75600 (IA_ADDR 2001:db8:cafe:1::4 pltime:86400 vltime:86400)) (status-code success) (preference 255) (DNS-search-list openstacklocal.) (DNS-server 2001:db8:cafe:a::e) (Client-FQDN))


14:56:08.143719 IP6 (hlim 1, next-header UDP (17) payload length: 106) fe80::f816:3eff:fe22:386b.546 > ff02::1:2.547: [udp sum ok] dhcp6 request (xid=9cb172 (client-ID hwaddr/time type 1 time 482446373 fa163e22386b) (server-ID hwaddr type 1 fa163e06176f) (option-request DNS-server DNS-search-list Client-FQDN SNTP-servers) (elapsed-time 0) (IA_NA IAID:1042430059 T1:3600 T2:5400 (IA_ADDR 2001:db8:cafe:1::4 pltime:7200 vltime:7500)))


14:56:08.143897 IP6 (class 0xc0, hlim 64, next-header UDP (17) payload length: 186) fe80::f816:3eff:fe06:176f.547 > fe80::f816:3eff:fe22:386b.546: [udp sum ok] dhcp6 reply (xid=9cb172 (client-ID hwaddr/time type 1 time 482446373 fa163e22386b) (server-ID hwaddr type 1 fa163e06176f) (IA_NA IAID: 1042430059 T1:3600 T2:6300 (IA_ADDR 2001:db8:cafe:1::4 pltime:7200 vltime:7500)) (status-code success) (DNS-search-list openstacklocal.) (DNS-server 2001:db8:cafe:a::e) (Client-FQDN))
```

Stateless DHCPv6 Mode

```
neutron net-create private-dhcpv6-stateless

neutron subnet-create --ip-version=6 --name=private_dhcpv6_stateless_subnet
--ipv6-address-mode=dhcpv6-stateless --ipv6-ra-mode=dhcpv6-stateless private-dhcpv6-stateless
2001:db8:cafe:2::/64 --dns-nameserver 2001:db8:cafe:a::e
+-------------------+-------------------------------------------------------------------------------------+
| Field             | Value                                                                               |
+-------------------+-------------------------------------------------------------------------------------+
| allocation_pools  | {"start": "2001:db8:cafe:2::2", "end": "2001:db8:cafe:2:ffff:ffff:ffff:fffe"} |
| cidr              | 2001:db8:cafe:2::/64                                                                |
| dns_nameservers   | 2001:db8:cafe:a::e                                                                  |
| enable_dhcp       | True                                                                                |
| gateway_ip        | 2001:db8:cafe:2::1                                                                  |
| host_routes       |                                                                                     |
| id                | e63e72d5-493a-4a49-8f7d-8846c2bc7a8f                                                |
| ip_version        | 6                                                                                   |
| ipv6_address_mode | dhcpv6-stateless                                                                    |
| ipv6_ra_mode      | dhcpv6-stateless                                                                    |
| name              | private_dhcpv6_stateless_subnet                                                     |
| network_id        | 27618d5e-318c-46a4-b6a2-a155beed9643                                                |
| subnetpool_id     |                                                                                     |
| tenant_id         | f057804eb39b4618b40e06196e16265b                                                    |
+-------------------+-------------------------------------------------------------------------------------+
```



DHCPv6 Stateless Mode Info

- Enable client for DHCPv6 Stateless:

Ubuntu

```
/etc/network/interfaces
auto eth0
iface eth0 inet dhcp
iface eth0 inet6 auto
dhcp 1
```

CentOS/RHEL/Fedora

```
/etc/sysconfig/network-scripts/ifcfg-xxxx
IPV6INIT="yes"
DHCPV6C="yes”
DHCPV6C_OPTIONS="-S"
```

- Then you get addressing and options:

```
ubuntu@dhcpv6-stateless-4:~$ more /etc/resolv.conf
# Dynamic resolv.conf(5) file for glibc resolver(3) generated by resolvconf(8)
#     DO NOT EDIT THIS FILE BY HAND -- YOUR CHANGES WILL BE OVERWRITTEN
nameserver 172.16.10.14
nameserver 2001:db8:cafe:a::e
search openstacklocal
```

DHCPv6 Stateless Mode – Sniffer Capture

```
15:43:23.911172 IP6 (hlim 255, next-header ICMPv6 (58) payload length: 56) fe80::f816:3eff:fec1:bc52 > ff02::1: [icmp6 sum ok] ICMP6, router
advertisement, length 56
       hop limit 64, Flags [other stateful], pref medium, router lifetime 30s, reachable time 0s, retrans time 0s
         prefix info option (3), length 32 (4): 2001:db8:cafe:2::/64, Flags [onlink, auto], valid time 86400s, pref. time 14400s
           0x0000:  40c0 0001 5180 0000 3840 0000 0000 2001
           0x0010:  0db8 cafe 0002 0000 0000 0000 0000
         source link-address option (1), length 8 (1): fa:16:3e:c1:bc:52
           0x0000:  fa16 3ec1 bc52
15:43:25.353331 IP6 (hlim 1, next-header UDP (17) payload length: 44) fe80::f816:3eff:fefe:d157.546 > ff02::1:2.547: [udp sum ok] dhcp6 inf-req
(xid=d2dbc8 (client-ID hwaddr type 1 fa163efed157) (option-request DNS-server DNS-search-list Client-FQDN SNTP-servers) (elapsed-time 94))
15:43:25.353578 IP6 (class 0xc0, hlim 64, next-header UDP (17) payload length: 88) fe80::f816:3eff:fe2d:a6de.547 > fe80::f816:3eff:fefe:d157.546: [udp
sum ok] dhcp6 reply (xid=d2dbc8 (client-ID hwaddr type 1 fa163efed157) (server-ID hwaddr type 1 fa163e2da6de) (DNS-search-list openstacklocal.) (DNS-
server 2001:db8:cafe:a::e) (lifetime 86400))
```