Module 3 – iBGP Configuration for Training Lab Network

Objective: All the workshop lab routers are configured with required basic, interface and OSPF/IS-IS configuration according to the topology diagram below. Network level reachability testing for all twelve routers loopback interfaces, all twelve point-to-point links and two transport links are successfully done in our previous modules (Module 1&2). Participants will require to configure iBGP peering and related configuration on this module for both IPv6 and IPv4 protocol. Workshop instructor will be presenting iBGP design goal & specification for this module. Workshop team has already been build and participants have got access to their designated routers.

Prerequisites: Intermediate routing concept (OSPF/IS-IS), Huawei router CLI, Telnet/SSH software etc.

The following will be the common topology and IP address plan used for the labs.

Figure 1 – ISP Lab Topology
**Lab Notes**

This workshop is intended to be run on a real Huawei routers or eNSP (Enterprise Network Simulation Platform) with the above lab topologies set up. The routers are using both IPv4 and IPv6 supported Huawei VRP software (VRP software, Version 5.130). Participants should do their workshop module three configuration to achieve following goals.

1. After finishing the required interfaces and IGP (i.e. OSPF) configuration in module one and two we only can ping those infrastructure prefixes i.e. loopback, point-to-point interfaces and transport link interfaces. At this stage we have an IGP network baseline with 26 prefixes in all twelve infrastructure routers. Our change management system is locked for IGP until we have a new POP, region or prefixes to be added.

2. For the scalability purpose of IGP (i.e. OSPF) for ISP we will not advertise/re-distribute any external prefixes (Customer, Internet, Peering etc) into our IGP. Now the plan is when the external prefixes are collected by the perimeter routers (i.e. POP, Internet gateway or IX Peering) using either static or eBGP peering those will be announced to ISP infrastructure via iBGP. So our IGP is de-coupled from the growth of external prefixes and our network can scale in future. In MPLS network PE-CE routing we can still use any IGP class of protocol and isolation is done from the global routing table by VRF and VPN prefixes. Scalability concern is a separate discussion in MPLS network.

3. For the same purpose of iBGP we will use peer group and Route Reflector (RR). POP routers will only peer with regional core routers or RR to resolve iBGP full mesh peering requirement. As a design principle we could avoid to place RR on the same path of data and control traffic. But for the simplicity of our lab regional core routers will work as RR for each region. We will use peer group to scale our BGP configuration requirement.

4. After finishing iBGP configuration we would like to see following 12 new prefixes are learn by our infrastructure routers using iBGP.

<table>
<thead>
<tr>
<th>Customer Side P-2-P</th>
<th>Datacentre</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 =&gt; 2406:6400:10::/48</td>
<td>R2 =&gt; 2406:6400:800::/48</td>
</tr>
<tr>
<td>R3 =&gt; 2406:6400:14::/48</td>
<td>R5 =&gt; 2406:6400:a00::/48</td>
</tr>
<tr>
<td>R4 =&gt; 2406:6400:18::/48</td>
<td>R8 =&gt; 2406:6400:c00::/48</td>
</tr>
<tr>
<td>R6 =&gt; 2406:6400:1c::/48</td>
<td>R11 =&gt; 2406:6400:e00::/48</td>
</tr>
<tr>
<td>R7 =&gt; 2406:6400:20::/48</td>
<td></td>
</tr>
<tr>
<td>R9 =&gt; 2406:6400:24::/48</td>
<td></td>
</tr>
<tr>
<td>R10 =&gt; 2406:6400:28::/48</td>
<td></td>
</tr>
<tr>
<td>R12 =&gt; 2406:6400:2c::/48</td>
<td></td>
</tr>
</tbody>
</table>

5. Due to time restriction in workshop iBGP analysis and example will cover IPv6 prefixes only. You can check IPv4 prefixes for your own understanding purpose.

6. As an example here we have outlined IPv6 related configuration only. Since we are building dual stack routers, please make sure you will finish IPv4 related configuration as well. For relevant command please visit the reference section of this document.

7. After finishing required iBGP configuration our lab infrastructure routers will be ready to add customer on the POP routers and connect to Internet to allow transit for them.
Lab Exercise

1. iBGP Peering Configuration: Multi protocol BGP or MP-BGP address family configuration support both IPv6 and IPv4 as a routed protocol. We need to configure different address family related configuration from the corresponding address family mode in BGP.

Example Config on a Router:

```
system-view
To enter into a Huawei router system view.

bgp 17821
Configure BGP routing process with AS number 17821

undo default ipv4-unicast
Huawei VRP assumes that all BGP neighbours will be IPv4 unicast neighbours by default. This command will prepare the router to be multiprotocol and not only to advertise ipv4 unicast address family. Without this command running configuration shows cluttered, confusing and difficult to diagnose and troubleshoot.

group IPV6-iBGP-REG2 internal
Using peer group to scale BGP configuration requirement. Please note that regional core routers (Router 2, 5, 8, 11) might need to create one more peer group as IPV6-iBGP-TRCORE

peer IPV6-iBGP-REG2 connect-interface LoopBack 0
iBGP peering is configured with loopback address from both side but BGP open message will use outgoing interface as source by default. To resolve this source address mismatch we need to use this command on both side of peering.

peer 2406:6400::5 group IPV6-iBGP-REG2
peer 2406:6400::6 group IPV6-iBGP-REG2
Add BGP neighbors into the group

ipv6-family unicast
Switching to IPv6 address family to execute IPv6 related configuration command.

undo synchronization
BGP synchronization rule is – not installing iBGP routes into the routing table before being synchronized to the IGP. You can disable synchronization if one of the following conditions is true.
   a. Your AS does not pass traffic from one AS to another AS.
   b. All the transit routers in your AS run BGP (valid reason for our lab case).
By default, “synchronization” has been disable on Huawei routers.

peer IPV6-iBGP-REG2 enable
This command will enable the corresponding address family for this Neighbor. It is advisable to use this command in MP-BGP specially if you are using different address family i.e. IPv4, IPv6, VPNv4 etc.

peer 2406:6400::5 group IPV6-iBGP-REG2
peer 2406:6400::6 group IPV6-iBGP-REG2
quit
quit
```
2. **Network Advertisement:** This configuration will originate a prefix in BGP. Our approach will be to originate a legitimate aggregated prefix (i.e. /48) in BGP from all infrastructure routers. So BGP problem debugging and troubleshooting will be easy.

   **Example Config on a Router:**

   ```
   system-view
   bgp 17821
   ipv6-family unicast
   network 2406:6400:0010:0000:: 48
   quit
   quit
   ipv6 route-static 2406:6400:0010:0000:: 48 null 0
   quit
   ```

   Since we are using /64 end side prefix on all interfaces of a router and originating /48 atomic aggregation we need this pull-up route. If there is no specific match on this router, traffic will be directed to null 0. Otherwise BGP will not start advertising to make sure routing loop will not occur.

   ```
   quit
   save
   ```

3. **Route Reflector (RR) Configuration:** This configuration is only required to the regional core routers i.e. R2, R5, R8 and R11. Because of the iBGP full mesh peering requirement all POP routers will require peering with another regional POP routers which is a big scaling issue. Number of peering requirement is $2^n - 1$. To solve this will use all regional core routers as RR.

   **Example Config on a Core Router:**

   ```
   system-view
   bgp 17821
   ipv6-family unicast
   peer IPV6-iBGP-REG2 reflect-client
   ```

   Defining all members of IPV6-iBGP-REG2 peer group as RR client. Please note if there are any other peer group or BGP peer they will be considered as RR non-client. In our case another peer group IPV6-iBGP-REG2 and they will be RR non-client.

   ```
   quit
   quit
   save
   ```
4. Verify iBGP Configuration:

**Example IPv6 protocol verification on a Router:**

After iBGP Peering Config:
display bgp ipv6 peer [To check bgp peering status]
display bgp ipv6 routing-table [To check detail bgp table]
display ipv6 routing-table protocol bgp [To check the routing table prefixes learned by BGP ]

After prefix announcement:
display bgp ipv6 routing-table peer [router 1.....router12 loopback] advertised-routes [To check prefixes advertised to iBGP peers]
display bgp ipv6 routing-table peer [router 1.....router12 loopback] received-routes [To check prefixes received from iBGP peers]
display ipv6 routing-table [R2, R5, R8, R11 datacenter & R1, R3, R4, R6, R7, R9, R10, R12 CS WAN Link prefix] [To check prefixes in routing table]

After RR configuration on regional core routers. Verification need to be done from all infrastructure routers to see the outcome:
display bgp ipv6 peer
display bgp ipv6 routing-table
display ipv6 routing-table protocol bgp
display bgp ipv6 routing-table peer [router 1.....router12 loopback] advertised-routes
display bgp ipv6 routing-table peer [router 1.....router12 loopback] received-routes
display ipv6 routing-table [R2, R5, R8, R11 datacenter & R1, R3, R4, R6, R7, R9, R10, R12 CS WAN Link prefix]

**Example IPv4 protocol verification on a Router:**

After iBGP Peering Config:
display bgp peer [To check bgp peering status]
display bgp routing-table [To check detail bgp table]
display ip routing-table protocol bgp [To check the routing table prefixes learned by BGP ]

After prefix announcement:
display bgp routing-table peer [router 1.....router12 loopback] advertised-routes [To check prefixes advertised to iBGP peers]
display bgp routing-table peer [router 1.....router12 loopback] received-routes [To check prefixes received from iBGP peers]
display ip routing-table [R2, R5, R8, R11 datacenter & R1, R3, R4, R6, R7, R9, R10, R12 CS WAN Link prefix] [To check prefixes in routing table]

After RR configuration on regional core routers. Verification need to be done from all infrastructure routers to see the outcome:
display bgp peer
display bgp routing-table
display ip routing-table protocol bgp
display bgp routing-table peer [router 1.....router12 loopback] advertised-routes
display bgp routing-table peer [router 1.....router12 loopback] received-routes
display ip routing-table [R2, R5, R8, R11 datacenter & R1, R3, R4, R6, R7, R9, R10, R12 CS WAN Link prefix]

END OF MODULE THREE......

Next pages for reference template used on different routers....
iBGP configuration for training ISP network Region1:

IPv4 iBGP Conf Router1:

system-view
bgp 17821
group IPv4-iBGP-REG1 internal
peer IPv4-iBGP-REG1 connect-interface LoopBack 0
peer 172.16.15.2 group IPv4-iBGP-REG1
peer 172.16.15.3 group IPv4-iBGP-REG1
ipv4-family unicast
peer IPv4-iBGP-REG1 enable
peer 172.16.15.2 group IPv4-iBGP-REG1
peer 172.16.15.3 group IPv4-iBGP-REG1
quit
quit
quit
save

IPv6 iBGP Conf Router1:

system-view
bgp 17821
undo default ipv4-unicast
group IPv6-iBGP-REG1 internal
peer IPv6-iBGP-REG1 connect-interface LoopBack 0
peer 2406:6400::2 group IPv6-iBGP-REG1
Wednesday, June 08, 2016

IPv6 iBGP Conf Router2:

peer 2406:6400::3 group IPV6-iBGP-REG1
ipv6-family unicast
peer IPV6-iBGP-REG1 enable
peer 2406:6400::2 group IPV6-iBGP-REG1
peer 2406:6400::3 group IPV6-iBGP-REG1
quit
quit
quit
save

IPv4 iBGP Conf Router2:

system-view
bgp 17821
group IPV4-iBGP-REG1 internal
peer IPV4-iBGP-REG1 connect-interface LoopBack 0
peer 172.16.15.1 group IPV4-iBGP-REG1
peer 172.16.15.3 group IPV4-iBGP-REG1
peer IPV4-iBGP-TRCORE internal
peer IPV4-iBGP-TRCORE connect-interface LoopBack 0
peer 172.16.15.5 group IPV4-iBGP-TRCORE
peer 172.16.15.8 group IPV4-iBGP-TRCORE
peer 172.16.15.11 group IPV4-iBGP-TRCORE
ipv4-family unicast
peer IPV4-iBGP-REG1 enable
peer 172.16.15.1 group IPV4-iBGP-REG1
peer 172.16.15.3 group IPV4-iBGP-REG1
peer IPV4-iBGP-TRCORE enable
peer 172.16.15.5 group IPV4-iBGP-TRCORE
peer 172.16.15.8 group IPV4-iBGP-TRCORE
peer 172.16.15.11 group IPV4-iBGP-TRCORE
quit
quit
quit
save

IPv6 iBGP Conf Router2:

system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG1 internal
peer IPV6-iBGP-REG1 connect-interface LoopBack 0
peer 2406:6400::1 group IPV6-iBGP-REG1
peer 2406:6400::3 group IPV6-iBGP-REG1
peer IPV6-iBGP-TRCORE internal
peer IPV6-iBGP-TRCORE connect-interface LoopBack 0
peer 2406:6400::5 group IPV6-iBGP-TRCORE
peer 2406:6400::8 group IPV6-iBGP-TRCORE
peer 2406:6400::11 group IPV6-iBGP-TRCORE
ipv6-family unicast
peer IPV6-iBGP-REG1 enable
peer 2406:6400::1 group IPV6-iBGP-REG1
peer 2406:6400::3 group IPV6-iBGP-REG1
peer IPV6-iBGP-TRCORE enable
peer 2406:6400::5 group IPV6-iBGP-TRCORE
peer 2406:6400::8 group IPV6-iBGP-TRCORE
peer 2406:6400::11 group IPV6-iBGP-TRCORE
quit
quit
IPv4 iBGP Conf Router3:

```conf
system-view
bgp 17821
group IPV4-iBGP-REG1 internal
peer IPV4-iBGP-REG1 connect-interface LoopBack 0
peer 172.16.15.1 group IPV4-iBGP-REG1
peer 172.16.15.2 group IPV4-iBGP-REG1
ipv4-family unicast
peer IPV4-iBGP-REG1 enable
peer 172.16.15.1 group IPV4-iBGP-REG1
peer 172.16.15.2 group IPV4-iBGP-REG1
quit
quit
quit
save
```

IPv6 iBGP Conf Router3:

```conf
system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG1 internal
peer IPV6-iBGP-REG1 connect-interface LoopBack 0
peer 2406:6400::1 group IPV6-iBGP-REG1
peer 2406:6400::2 group IPV6-iBGP-REG1
ipv6-family unicast
peer IPV6-iBGP-REG1 enable
peer 2406:6400::1 group IPV6-iBGP-REG1
peer 2406:6400::2 group IPV6-iBGP-REG1
quit
quit
quit
save
```
Prefix Announcement/Advertisement from Region 1:

IPv4 Prefix Announcement on Router1:

    system-view
    bgp 17821
    ipv4-family unicast
    network 172.16.11.0 255.255.255.224
    quit
    quit
    ip route-static 172.16.11.0 255.255.255.224 null 0 permanent
    quit
    save

IPv6 Prefix Announcement on Router1:

    system-view
    bgp 17821
    ipv6-family unicast
    network 2406:6400:0010:0000:: 48
    quit
    quit
    ipv6 route-static 2406:6400:0010:0000:: 48 null 0
    quit
    save

IPv4 Prefix Announcement on Router2:

    system-view
    bgp 17821
    ipv4-family unicast
network 172.16.0.0 255.255.255.0
quit
quit
ip route-static 172.16.0.0 255.255.255.0 null 0  permanent
quit
save

IPv6 Prefix Announcement on Router2:

system-view
bgp 17821
ipv6-family unicast
network 2406:6400:0800:0000:: 48
quit
quit
ipv6 route-static 2406:6400:0800:0000:: 48 null 0
quit
save

IPv4 Prefix Announcement on Router3:

system-view
bgp 17821
ipv4-family unicast
network 172.16.11.32 255.255.255.224
quit
quit
ip route-static 172.16.11.32 255.255.255.224 null 0  permanent
quit
save

IPv6 Prefix Announcement on Router3:

system-view
bgp 17821
ipv6-family unicast
network 2406:6400:0014:0000:: 48
quit
quit
ipv6 route-static 2406:6400:0014:0000:: 48 null 0
quit
save
Route Reflector (RR) Conf Training ISP Network Region 1 (One RR per region):

IPv4 RR Configuration on Router1 (One RR Server per region):

No configuration required

Wait for R2 to finish configuration then perform following verification to analyse network effect.

IPv6 RR Configuration Router1 (One RR Server per region):

No configuration required

Wait for R2 to finish configuration then perform following verification to analyse network effect.

IPv4 RR Configuration on Router2 (One RR Server per region):

```
system-view
bgp 17821
ipv4-family unicast
peer IPV4-iBGP-REG1 reflect-client
quit
quit
quit
save
```

IPv6 RR Configuration Router2 (One RR Server per region):

```
system-view
bgp 17821
ipv6-family unicast
peer IPV6-iBGP-REG1 reflect-client
```
IPv4 RR Configuration on Router3 (One RR Server per region):

No configuration required

Wait for R2 to finish configuration then perform following verification to analyse network effect.

IPv6 RR Configuration Router3 (One RR Server per region):

No configuration required

Wait for R2 to finish configuration then perform following verification to analyse network effect.
iBGP configuration for training ISP network Region2:

IPv4 iBGP Conf Router4:

```
system-view
bgp 17821
group IPV4-iBGP-REG2 internal
peer IPV4-iBGP-REG2 connect-interface LoopBack 0
peer 172.16.15.5 group IPV4-iBGP-REG2
peer 172.16.15.6 group IPV4-iBGP-REG2
ipv4-family unicast
peer IPV4-iBGP-REG2 enable
peer 172.16.15.5 group IPV4-iBGP-REG2
peer 172.16.15.6 group IPV4-iBGP-REG2
quit
quit
quit
save
```

IPv6 iBGP Conf Router4:

```
system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG2 internal
peer IPV6-iBGP-REG2 connect-interface LoopBack 0
peer 2406:6400::5 group IPV6-iBGP-REG2
peer 2406:6400::6 group IPV6-iBGP-REG2
ipv6-family unicast
peer IPV6-iBGP-REG2 enable
peer 2406:6400::5 group IPV6-iBGP-REG2
peer 2406:6400::6 group IPV6-iBGP-REG2
quit
```
IPv4 iBGP Conf Router5:

system-view
bgp 17821
group IPV4-iBGP-REG2 internal
peer IPV4-iBGP-REG2 connect-interface LoopBack 0
peer 172.16.15.4 group IPV4-iBGP-REG2
peer 172.16.15.6 group IPV4-iBGP-REG2
group IPV4-iBGP-TRCORE internal
peer IPV4-iBGP-TRCORE connect-interface LoopBack 0
peer 172.16.15.2 group IPV4-iBGP-TRCORE
peer 172.16.15.8 group IPV4-iBGP-TRCORE
peer 172.16.15.11 group IPV4-iBGP-TRCORE
ipv4-family unicast
peer IPV4-iBGP-REG2 enable
peer 172.16.15.4 group IPV4-iBGP-REG2
peer 172.16.15.6 group IPV4-iBGP-REG2
peer IPV4-iBGP-TRCORE enable
peer 172.16.15.2 group IPV4-iBGP-TRCORE
peer 172.16.15.8 group IPV4-iBGP-TRCORE
peer 172.16.15.11 group IPV4-iBGP-TRCORE
quit
quit
quit
save

IPv6 iBGP Conf Router5:

system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG2 internal
peer IPV6-iBGP-REG2 connect-interface LoopBack 0
peer 2406:6400::4 group IPV6-iBGP-REG2
peer 2406:6400::6 group IPV6-iBGP-REG2
group IPV6-iBGP-TRCORE internal
peer IPV6-iBGP-TRCORE connect-interface LoopBack 0
peer 2406:6400::2 group IPV6-iBGP-TRCORE
peer 2406:6400::8 group IPV6-iBGP-TRCORE
peer 2406:6400::11 group IPV6-iBGP-TRCORE
ipv6-family unicast
peer IPV6-iBGP-REG2 enable
peer 2406:6400::4 group IPV6-iBGP-REG2
peer 2406:6400::6 group IPV6-iBGP-REG2
peer IPV6-iBGP-TRCORE enable
peer 2406:6400::2 group IPV6-iBGP-TRCORE
peer 2406:6400::8 group IPV6-iBGP-TRCORE
peer 2406:6400::11 group IPV6-iBGP-TRCORE
quit
quit
quit
save

IPv4 iBGP Conf Router6:
system-view
bgp 17821
group IPV4-iBGP-REG2 internal
peer IPV4-iBGP-REG2 connect-interface LoopBack 0
peer 172.16.15.4 group IPV4-iBGP-REG2
peer 172.16.15.5 group IPV4-iBGP-REG2
ipv4-family unicast
peer IPV4-iBGP-REG2 enable
peer 172.16.15.4 group IPV4-iBGP-REG2
peer 172.16.15.5 group IPV4-iBGP-REG2
quit
quit
quit
save

IPv6 iBGP Conf Router6:

system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG2 internal
peer IPV6-iBGP-REG2 connect-interface LoopBack 0
peer 2406:6400::4 group IPV6-iBGP-REG2
peer 2406:6400::5 group IPV6-iBGP-REG2
ipv6-family unicast
peer IPV6-iBGP-REG2 enable
peer 2406:6400::4 group IPV6-iBGP-REG2
peer 2406:6400::5 group IPV6-iBGP-REG2
quit
quit
quit
save
Prefix Announcement/Advertisement from Region 2:

IPv4 Prefix Announcement on Router4:

```
system-view
bgp 17821
ipv4-family unicast
network 172.16.11.64 255.255.255.224
quit
quit
ip route-static 172.16.11.64 255.255.255.224 null 0 permanent
quit
save
```

IPv6 Prefix Announcement on Router4:

```
system-view
bgp 17821
ipv6-family unicast
network 2406:6400:0018:0000:: 48
quit
quit
ipv6 route-static 2406:6400:0018:0000:: 48 null 0
quit
save
```

IPv4 Prefix Announcement on Router5:

```
system-view
bgp 17821
```
ipv4-family unicast
network 172.16.2.0 255.255.255.0
quit
quit
ip route-static 172.16.2.0 255.255.255.0 null 0 permanent
quit
save

IPv6 Prefix Announcement on Router5:

system-view
bgp 17821
ipv6-family unicast
network 2406:6400:0A00:0000:: 48
quit
quit
ipv6 route-static 2406:6400:0A00:0000:: 48 null 0
quit
save

IPv4 Prefix Announcement on Router6:

system-view
bgp 17821
ipv4-family unicast
network 172.16.11.96 255.255.255.224
quit
quit
ip route-static 172.16.11.96 255.255.255.224 null 0 permanent
quit
save

IPv6 Prefix Announcement on Router6:

system-view
bgp 17821
ipv6-family unicast
network 2406:6400:001C:0000:: 48
quit
quit
ipv6 route-static 2406:6400:001C:0000:: 48 null 0
quit
save
IPv4 RR Configuration on Router4 (One RR Server per region):

No configuration required

Wait for R5 to finish configuration then perform following verification to analyse network effect.

IPv6 RR Configuration Router4 (One RR Server per region):

No configuration required

Wait for R5 to finish configuration then perform following verification to analyse network effect.

IPv4 RR Configuration on Router5 (One RR Server per region):

```plaintext
system-view
bgp 17821
ipv4-family unicast
peer IPV4-iBGP-REG2 reflect-client
quit
quit
quit
save
```

IPv6 RR Configuration Router5 (One RR Server per region):

```plaintext
system-view
bgp 17821
ipv6-family unicast
peer IPV6-iBGP-REG2 reflect-client
quit
```
IPv4 RR Configuration on Router6 (One RR Server per region):

No configuration required

Wait for R5 to finish configuration then perform following verification to analyse network effect.

IPv6 RR Configuration Router6 (One RR Server per region):

No configuration required

Wait for R5 to finish configuration then perform following verification to analyse network effect.
iBGP configuration for training ISP network Region3:

IPv4 iBGP Conf Router7:

```
system-view
bgp 17821
  group IPV4-iBGP-REG3 internal
  peer IPV4-iBGP-REG3 connect-interface LoopBack 0
  peer 172.16.15.8 group IPV4-iBGP-REG3
  peer 172.16.15.9 group IPV4-iBGP-REG3
  ipv4-family unicast
  peer IPV4-iBGP-REG3 enable
  peer 172.16.15.8 group IPV4-iBGP-REG3
  peer 172.16.15.9 group IPV4-iBGP-REG3
quit
quit
quit
save
```

IPv6 iBGP Conf Router7:

```
system-view
bgp 17821
  undo default ipv4-unicast
  group IPV6-iBGP-REG3 internal
  peer IPV6-iBGP-REG3 connect-interface LoopBack 0
  peer 2406:6400::8 group IPV6-iBGP-REG3
  peer 2406:6400::9 group IPV6-iBGP-REG3
  ipv6-family unicast
  peer IPV6-iBGP-REG3 enable
  peer 2406:6400::8 group IPV6-iBGP-REG3
  peer 2406:6400::9 group IPV6-iBGP-REG3
quit
```
IPv4 iBGP Conf Router8:

system-view
bgp 17821
group IPV4-iBGP-REG3 internal
peer IPV4-iBGP-REG3 connect-interface LoopBack 0
peer 172.16.15.7 group IPV4-iBGP-REG3
peer 172.16.15.9 group IPV4-iBGP-REG3
group IPV4-iBGP-TRCORE internal
peer IPV4-iBGP-TRCORE connect-interface LoopBack 0
peer 172.16.15.2 group IPV4-iBGP-TRCORE
peer 172.16.15.5 group IPV4-iBGP-TRCORE
peer 172.16.15.11 group IPV4-iBGP-TRCORE
ipv4-famigl unicast
peer IPV4-iBGP-REG3 enable
peer 172.16.15.7 group IPV4-iBGP-REG3
peer 172.16.15.9 group IPV4-iBGP-REG3
peer IPV4-iBGP-TRCORE enable
peer 172.16.15.2 group IPV4-iBGP-TRCORE
peer 172.16.15.5 group IPV4-iBGP-TRCORE
peer 172.16.15.11 group IPV4-iBGP-TRCORE
quit
quit
quit
save

IPv6 iBGP Conf Router8:

system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG3 internal
peer IPV6-iBGP-REG3 connect-interface LoopBack 0
peer 2406:6400::7 group IPV6-iBGP-REG3
peer 2406:6400::9 group IPV6-iBGP-REG3
group IPV6-iBGP-TRCORE internal
peer IPV6-iBGP-TRCORE connect-interface LoopBack 0
peer 2406:6400::2 group IPV6-iBGP-TRCORE
peer 2406:6400::5 group IPV6-iBGP-TRCORE
peer 2406:6400::11 group IPV6-iBGP-TRCORE
ipv6-family unicast
peer IPV6-iBGP-REG3 enable
peer 2406:6400::7 group IPV6-iBGP-REG3
peer 2406:6400::9 group IPV6-iBGP-REG3
peer IPV6-iBGP-TRCORE enable
peer 2406:6400::2 group IPV6-iBGP-TRCORE
peer 2406:6400::5 group IPV6-iBGP-TRCORE
peer 2406:6400::11 group IPV6-iBGP-TRCORE
quit
quit
quit
save

IPv4 iBGP Conf Router9:

system-view
IPv4 iBGP Conf Router9:

```plaintext
system-view
bgp 17821
undo default ipv4-unicast
group IPV4-iBGP-REG3 internal
peer IPV4-iBGP-REG3 connect-interface LoopBack 0
peer 172.16.15.7 group IPV4-iBGP-REG3
ipv4-family unicast
peer IPV4-iBGP-REG3 enable
peer 172.16.15.7 group IPV4-iBGP-REG3
peer 172.16.15.8 group IPV4-iBGP-REG3
quit
quit
quit
save
```

IPv6 iBGP Conf Router9:

```plaintext
system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG3 internal
peer IPV6-iBGP-REG3 connect-interface LoopBack 0
peer 2406:6400::7 group IPV6-iBGP-REG3
peer 2406:6400::8 group IPV6-iBGP-REG3
ipv6-family unicast
peer IPV6-iBGP-REG3 enable
peer 2406:6400::7 group IPV6-iBGP-REG3
peer 2406:6400::8 group IPV6-iBGP-REG3
quit
quit
quit
save
```
Prefix Announcement/Advertisement from Region 3:

IPv4 Prefix Announcement on Router7:

```
system-view
bgp 17821
ipv4-family unicast
network 172.16.11.128 255.255.255.224
quit
quit
ip route-static 172.16.11.128 255.255.255.224 null 0  permanent
quit
save
```

IPv6 Prefix Announcement on Router7:

```
system-view
bgp 17821
ipv6-family unicast
network 2406:6400:0020:0000:: 48
quit
quit
ipv6 route-static 2406:6400:0020:0000:: 48 null 0
quit
save
```

IPv4 Prefix Announcement on Router8:

```
system-view
bgp 17821
ipv4-family unicast
```
network 172.16.4.0 255.255.255.0
quit
quit
ip route-static 172.16.4.0 255.255.255.0 null 0 permanent
quit
save

IPv6 Prefix Announcement on Router8:

system-view
bgp 17821
ipv6-family unicast
network 2406:6400:0C00:0000:: 48
quit
quit
ipv6 route-static 2406:6400:0C00:0000:: 48 null 0
quit
save

IPv4 Prefix Announcement on Router9:

system-view
bgp 17821
ipv4-family unicast
network 172.16.11.160 255.255.255.224
quit
quit
ip route-static 172.16.11.160 255.255.255.224 null 0 permanent
quit
save

IPv6 Prefix Announcement on Router9:

system-view
bgp 17821
ipv6-family unicast
network 2406:6400:0024:0000:: 48
quit
quit
ipv6 route-static 2406:6400:0024:0000:: 48 null 0
quit
save
Route Reflector (RR) Conf Training ISP Network Region 3 (One RR per region):

IPv4 RR Configuration on Router7 (One RR Server per region):

No configuration required

Wait for R8 to finish configuration then perform following verification to analyse network effect.

IPv6 RR Configuration Router7 (One RR Server per region):

No configuration required

Wait for R8 to finish configuration then perform following verification to analyse network effect.

IPv4 RR Configuration on Router8 (One RR Server per region):

```bash
system-view
bgp 17821
ipv4-family unicast
peer IPV4-iBGP-REG3 reflect-client
quit
quit
quit
save
```

IPv6 RR Configuration Router8 (One RR Server per region):

```bash
system-view
bgp 17821
ipv6-family unicast
peer IPV6-iBGP-REG3 reflect-client
```
IPv4 RR Configuration on Router9 (One RR Server per region):

No configuration required

Wait for R8 to finish configuration then perform following verification to analyse network effect.

IPv6 RR Configuration Router9 (One RR Server per region):

No configuration required

Wait for R8 to finish configuration then perform following verification to analyse network effect.
iBGP configuration for training ISP network Region4:

IPv4 iBGP Conf Router10:

system-view
bgp 17821
group IPV4-iBGP-REG4 internal
peer IPV4-iBGP-REG4 connect-interface LoopBack 0
peer 172.16.15.11 group IPV4-iBGP-REG4
peer 172.16.15.12 group IPV4-iBGP-REG4
ipv4-family unicast
peer IPV4-iBGP-REG4 enable
peer 172.16.15.11 group IPV4-iBGP-REG4
peer 172.16.15.12 group IPV4-iBGP-REG4
quit
quit
save

IPv6 iBGP Conf Router10:

system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG4 internal
peer IPV6-iBGP-REG4 connect-interface LoopBack 0
peer 2406:6400::11 group IPV6-iBGP-REG4
peer 2406:6400::12 group IPV6-iBGP-REG4
ipv6-family unicast
peer IPV6-iBGP-REG4 enable
peer 2406:6400::11 group IPV6-iBGP-REG4
peer 2406:6400::12 group IPV6-iBGP-REG4
quit
quit
IPv4 iBGP Conf Router11:

```
system-view
bgp 17821
group IPV4-iBGP-REG4 internal
peer IPV4-iBGP-REG4 connect-interface LoopBack 0
peer 172.16.15.10 group IPV4-iBGP-REG4
peer 172.16.15.12 group IPV4-iBGP-REG4
group IPV4-iBGP-TRCORE internal
peer IPV4-iBGP-TRCORE connect-interface LoopBack 0
peer 172.16.15.2 group IPV4-iBGP-TRCORE
peer 172.16.15.5 group IPV4-iBGP-TRCORE
peer 172.16.15.8 group IPV4-iBGP-TRCORE
ipv4-family unicast
peer IPV4-iBGP-REG4 enable
peer 172.16.15.10 group IPV4-iBGP-REG4
peer 172.16.15.12 group IPV4-iBGP-REG4
peer IPV4-iBGP-TRCORE enable
peer 172.16.15.2 group IPV4-iBGP-TRCORE
peer 172.16.15.5 group IPV4-iBGP-TRCORE
peer 172.16.15.8 group IPV4-iBGP-TRCORE
quit
quit
quit
save
```

IPv6 iBGP Conf Router11:

```
system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG4 internal
peer IPV6-iBGP-REG4 connect-interface LoopBack 0
peer 2406:6400::10 group IPV6-iBGP-REG4
peer 2406:6400::12 group IPV6-iBGP-REG4
group IPV6-iBGP-TRCORE internal
peer IPV6-iBGP-TRCORE connect-interface LoopBack 0
peer 2406:6400::2 group IPV6-iBGP-TRCORE
peer 2406:6400::5 group IPV6-iBGP-TRCORE
peer 2406:6400::8 group IPV6-iBGP-TRCORE
ipv6-family unicast
peer IPV6-iBGP-REG4 enable
peer 2406:6400::10 group IPV6-iBGP-REG4
peer 2406:6400::12 group IPV6-iBGP-REG4
peer IPV6-iBGP-TRCORE enable
peer 2406:6400::2 group IPV6-iBGP-TRCORE
peer 2406:6400::5 group IPV6-iBGP-TRCORE
peer 2406:6400::8 group IPV6-iBGP-TRCORE
quit
quit
quit
save
```

IPv4 iBGP Conf Router12:

```
system-view
bgp 17821
```
Wednesday, June 08, 2016

group IPV4-iBGP-REG4 internal
peer IPV4-iBGP-REG4 connect-interface LoopBack 0
peer 172.16.15.10 group IPV4-iBGP-REG4
peer 172.16.15.11 group IPV4-iBGP-REG4
ipv4-family unicast
peer IPV4-iBGP-REG4 enable
peer 172.16.15.10 group IPV4-iBGP-REG4
peer 172.16.15.11 group IPV4-iBGP-REG4
quit
quit
save

IPv6 iBGP Conf Router12:

system-view
bgp 17821
undo default ipv4-unicast
group IPV6-iBGP-REG4 internal
peer IPV6-iBGP-REG4 connect-interface LoopBack 0
peer 2406:6400::10 group IPV6-iBGP-REG4
peer 2406:6400::11 group IPV6-iBGP-REG4
ipv6-family unicast
peer IPV6-iBGP-REG4 enable
peer 2406:6400::10 group IPV6-iBGP-REG4
peer 2406:6400::11 group IPV6-iBGP-REG4
quit
quit
save
Prefix Announcement/Advertisement from Region 4:

IPv4 Prefix Announcement on Router10:

```
  system-view
  bgp 17821
  ipv4-family unicast
  network 172.16.11.192 255.255.255.224
  quit
  quit
  ip route-static 172.16.11.192 255.255.255.224 null 0 permanent
  quit
  save
```

IPv6 Prefix Announcement on Router10:

```
  system-view
  bgp 17821
  ipv6-family unicast
  network 2406:6400:0028:0000:: 48
  quit
  quit
  ipv6 route-static 2406:6400:0028:0000:: 48 null 0
  quit
  save
```

IPv4 Prefix Announcement on Router11:

```
  system-view
  bgp 17821
```
ipv4-family unicast
network 172.16.6.0 255.255.255.0
quit
quit
ip route-static 172.16.6.0 255.255.255.0 null 0 permanent
quit
save

IPv6 Prefix Announcement on Router11:

system-view
bgp 17821
ipv6-family unicast
network 2406:6400:0E00:0000:: 48
quit
quit
ipv6 route-static 2406:6400:0E00:0000:: 48 null 0
quit
save

IPv4 Prefix Announcement on Router12:

system-view
bgp 17821
ipv4-family unicast
network 172.16.11.224 255.255.255.224
quit
quit
ip route-static 172.16.11.224 255.255.255.224 null 0 permanent
quit
save

IPv6 Prefix Announcement on Router12:

system-view
bgp 17821
ipv6-family unicast
network 2406:6400:002C:0000:: 48
quit
quit
ipv6 route-static 2406:6400:002C:0000:: 48 null 0
quit
save
Route Reflector (RR) Conf Training ISP Network Region 4 (One RR per region):

IPv4 RR Configuration on Router10 (One RR Server per region):

No configuration required

Wait for R11 to finish configuration then perform following verification to analyse network effect.

IPv6 RR Configuration on Router10 (One RR Server per region):

No configuration required

Wait for R11 to finish configuration then perform following verification to analyse network effect.

IPv4 RR Configuration on Router11 (One RR Server per region):

```
system-view
bgp 17821
ipv4-family unicast
peer IPV4-iBGP-REG4 reflect-client
quit
quit
quit
save
```

IPv6 RR Configuration on Router11 (One RR Server per region):

```
system-view
bgp 17821
ipv6-family unicast
peer IPV6-iBGP-REG4 reflect-client
quit
quit
```
IPv4 RR Configuration on Router12 (One RR Server per region):
No configuration required
Wait for R11 to finish configuration then perform following verification to analyse network effect.

IPv6 RR Configuration Router12 (One RR Server per region):
No configuration required
Wait for R11 to finish configuration then perform following verification to analyse network effect.