Module 4 – eBGP with CPE Router for Training Lab Network

Objective: All the workshop lab routers are configured with required basic, interface, OSPF/IS-IS and iBGP configuration according to the topology diagram below. Network level reachability testing for all twelve routers loopback interfaces, all twelve point-to-point links, two transport links, eight customer sider point-to-point aggregated and four datacentre aggregated prefixes are successfully done in our previous modules (Module 1, 2 & 3). Participants will require to configure eBGP peering with the corresponding CPE routers and related configuration on this module for both IPv6 and IPv4 protocol. Workshop instructor will be presenting customer side eBGP 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, iBGP), Cisco router CLI, Telnet/SSH software etc.

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

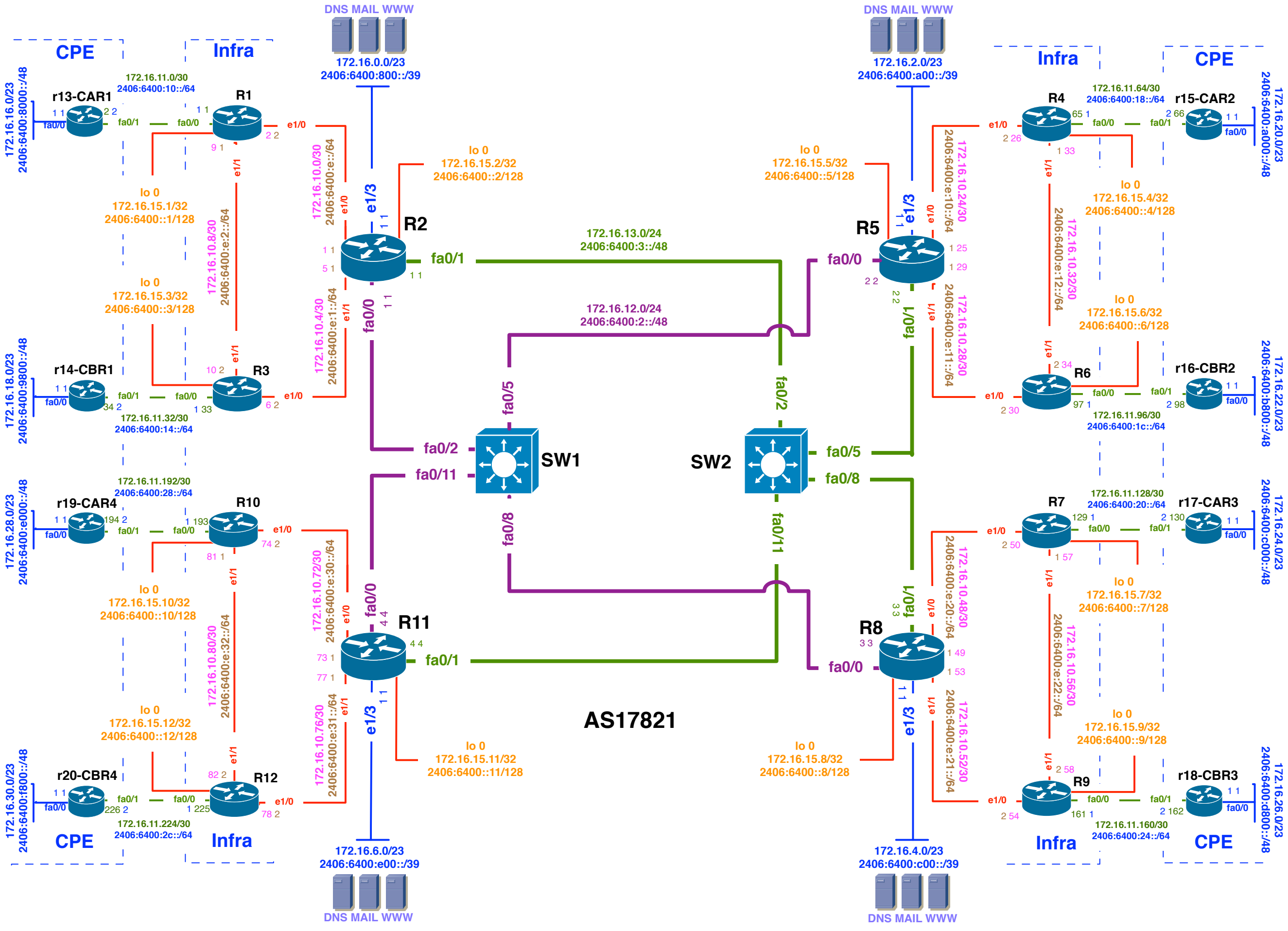

DNS MAIL WWW
172.16.0.0/23
2406:6400:800::/39
DNS MAIL WWW
172.16.2.0/23
2406:6400:a00::/39
CPE
Infra
Infra
CPE
r13-CAR1
R1
R2
R3
r14-CBR1
r19-CAR4
R10
R11
R12
r20-CBR4
R4
r15-CAR2
R5
R6
r16-CBR2
R7
r17-CAR3
R8
R9
r18-CBR3
SW1
SW2
AS17821
172.16.16.0/23
2406:6400:8000::/48
172.16.11.0/30
2406:6400:10::/64
lo 0
172.16.15.1/32
2406:6400::1/128
lo 0
172.16.15.2/32
2406:6400::2/128
lo 0
172.16.15.3/32
2406:6400::3/128
172.16.10.0/30
2406:6400:e::/64
172.16.10.8/30
2406:6400:e:2::/64
172.16.10.4/30
2406:6400:e:1::/64
172.16.18.0/23
2406:6400:9800::/48
172.16.11.32/30
2406:6400:14::/64
172.16.13.0/24
2406:6400:3::/48
172.16.12.0/24
2406:6400:2::/48
lo 0
172.16.15.5/32
2406:6400::5/128
lo 0
172.16.15.4/32
2406:6400::4/128
172.16.11.64/30
2406:6400:18::/64
172.16.20.0/23
2406:6400:a000::/48
172.16.10.24/30
2406:6400:e:10::/64
172.16.10.32/30
2406:6400:e:12::/64
172.16.10.28/30
2406:6400:e:11::/64
lo 0
172.16.15.6/32
2406:6400::6/128
172.16.22.0/23
2406:6400:b800::/48
172.16.11.96/30
2406:6400:1c::/64
172.16.11.192/30
2406:6400:28::/64
172.16.28.0/23
2406:6400:e000::/48
lo 0
172.16.15.10/32
2406:6400::10/128
172.16.10.72/30
2406:6400:e:30::/64
172.16.10.80/30
2406:6400:e:32::/64
172.16.10.76/30
2406:6400:e:31::/64
lo 0
172.16.15.12/32
2406:6400::12/128
lo 0
172.16.15.11/32
2406:6400::11/128
172.16.30.0/23
2406:6400:f800::/48
172.16.11.224/30
2406:6400:2c::/64
172.16.6.0/23
2406:6400:e00::/39
DNS MAIL WWW
172.16.11.128/30
2406:6400:20::/64
172.16.24.0/23
2406:6400:c000::/48
lo 0
172.16.15.7/32
2406:6400::7/128
172.16.10.48/30
2406:6400:e:20::/64
172.16.10.56/30
2406:6400:e:22::/64
172.16.10.52/30
2406:6400:e:21::/64
lo 0
172.16.15.9/32
2406:6400::9/128
lo 0
172.16.15.8/32
2406:6400::8/128
172.16.26.0/23
2406:6400:d800::/48
172.16.11.160/30
2406:6400:24::/64
172.16.4.0/23
2406:6400:c00::/39
DNS MAIL WWW
fa0/0
fa0/1
fa0/2
fa0/5
fa0/8
fa0/11
e1/0
e1/1
e1/3

Figure 1 – ISP Lab Topology

Lab Notes

This workshop is intended to be run on a real cisco routers or Dynamips server with the above lab topologies set up. The routers are using both IPv4 and IPv6 supported IOS software. Participants should do their workshop module four configuration to achieve following goals.

1. In our previous module (Module 3) exercise we have successfully finished building our infrastructure routers with iBGP. So that when any perimeter router learns external prefix (i.e. downstream customer or Internet) that will be propagated across other part of the network using iBGP protocol.
2. In this module we will connect our customer routers to the corresponding POP routers i.e R13-R1, R14-R3, R15-R4, R16-R6, R17-R7, R18-R9, R19-R10 and R20-R12 using eBGP. After finishing the required configuration in this module we will be able to see eight new external prefixes in our lab routers routing table.
3. For the scalability purpose of customer network growth we will use separate peer group to reflect common customer profile I.e default originate, route filter etc.
4. Each customer will be allocate a non-portable prefixes to be advertised from their BGP originated from their own AS number.
5. Each team will need to configure both side of the customer link. I.e POP side and CPE side.
    a. Steps involved in POP side are:
        i. Customer side interface configuration
        ii. Connectivity testing
        iii. eBGP peering configuration
        iv. Configuring eBGP next hop behaviour use Next-hop Self on the POP routers
    b. Steps involved in CPE side are:
        i. Basic and standard interface configuration for the CPE router
        ii. Upstream side interface configuration
        iii. Connectivity testing
        iv. eBGP peering configuration
        v. Prefix advertisement
        vi. Chang the next-hop to self on the customer border router (Need if customer has internal (iBGP) peer.
6. After finishing eBGP configuration on all CPE and POP routers we would like to see following 8 new prefixes are learn by our infrastructure routers using eBGP originated by the customer AS numbers listed on the table below.

Customer	AS Number	Prefix
r-13-CAR1	65001	2406:6400:8000::/48
r-14-CBR1	65002	2406:6400:9800::/48
r-15-CAR2	65003	2406:6400:a000::/48
r-16-CBR2	65004	2406:6400:b800::/48
r-17-CAR3	65005	2406:6400:c000::/48
r-18-CBR3	65006	2406:6400:d800::/48
r-19-CAR4	65007	2406:6400:e000::/48
r-20-CBR4	65008	2406:6400:f800::/48

7. Due to time restriction in workshop eBGP analysis and example will cover IPv6 prefixes only. You can check IPv4 prefixes for your own understanding purpose.
8. 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.

Lab Exercise

1. **POP Router Configuration:** In general customers are classified under peer-group on the POP router to scale the growing number of customer in each POP. In our workshop case we have created a single peer-group for our customers. This peer-group will inherit common set of attribute for all our customer. Individual command for each customer (i.e remote-AS) need to apply outside the peer group.

Step one example interface config:

```
config t
interface fa0/0
```

This interface is connecting to a customer

```
ipv6 address 2406:6400:0010:0000::1/64
```

This point-to-point link address usually given by ISP

```
no shutdown
exit
exit
wr
```

Step two example interface connectivity verification:

```
Ping 2406:6400:0010:0000::1 [!!!!!]
```

Other side of point-to-point link

Step three example eBGP peering config:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-eBGP-CUSTOMER-REG1-POP1 peer-group
neighbor IPV6-eBGP-CUSTOMER-REG1-POP1 default-originate
```

This command will send a default [::/0] prefix to the CPE router.

```
neighbor 2406:6400:0010:0000::2 peer-group IPV6-eBGP-CUSTOMER-REG1-POP1
```

Add a BGP peer into this peer group

```
neighbor 2406:6400:0010:0000::2 remote-as 65001
```

Individual remote AS number configuration for each customer

```
neighbor 2406:6400:0010:0000::2 activate
```

This command will enable the corresponding address family for this Neighbor.

```
neighbor IPV6-iBGP-REG1 next-hop-self
```

In a POP router customer prefix next hop will be point-to-point interface address of the customer router. Since customer prefix is collected by eBGP when POP router forward it to its iBGP peer it will not change the next hop by default unless the above command is executed.

```
exit
exit
exit
wr
```

2. **CPE Router Configuration:** So far CPE routers are in Cisco default configuration. Participants need to build the necessary configuration to those CPE routers assigned to their team. Please note that you need to configure both IPv4 & IPv6 protocol related configuration. Following only IPv6 related configuration template might not work since it will forget some basic interface related configuration i.e. no shutdown. Here are the steps involved.

   Step one example basic config: Please check module one for command description.

```
config t
hostname r13-CAR1
ip routing
ipv6 unicast-routing
ip cef
ipv6 cef
no ip domain-lookup
no ip http server
no ip http secure-server
no ip finger
no service pad
no service udp-small-servers
no service tcp-small-server
no ip bootp server
no ip source-route
no ipv6 source-route
logging source-interface loopback 0
service timestamps log datetime localtime msec show-timezone year
service timestamps debug datetime localtime msec show-timezone year
clock timezone AEST 10
ip subnet-zero
ip classless
line console 0
logging synchronous
transport preferred none
ip tcp synwait-time 15
security authentication failure rate 3 log
exit
exit
wr
```

   Step two example interface config: Please check module one for command description.

   IPv4:

```
config t
interface loopback 0
description r15-CAR2 Loopback
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.20.254 255.255.255.255
no shutdown
interface fa0/0
description LAN r15-CAR2
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.20.1 255.255.255.224
no shutdown
interface fa0/1
```

```
description Upstream WAN R4-r15-CAR2
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.11.66 255.255.255.252
no cdp enable
no shutdown
exit
exit
wr
```

IPv6:

```
config t
interface loopback 0
ipv6 address 2406:6400:9800:0000::1/128
interface fa0/1
ipv6 address 2406:6400:0014:0000::2/64
interface fa0/0
ipv6 address 2406:6400:9800:0001::1/64
exit
exit
wr
```

Step three example eBGP peering config: Check previous section for command description.

```
config t
router bgp 65002
no bgp default ipv4-unicast
address-family ipv6
no synchronization
neighbor 2406:6400:0014:0000::1 remote-as 17821
neighbor 2406:6400:0014:0000::1 activate
exit
exit
exit
wr
```

Step four example prefix advertisement config: Module 3 for command description.

```
config t
router bgp 65004
address-family ipv6
network 2406:6400:b800::/48
exit
exit
ipv6 route 2406:6400:b800::/48 null 0
exit
wr
```

Step five example next-hop self config: If customer border router has iBGP peer. In our lab CPE router do not have any iBGP peer so next-hop self command is not used.

3. Verify iBGP Configuration:

Example IPv6 protocol verification on a Router:

After eBGP Peering Config:
`sh bgp ipv6 unicast summary` [To check bgp peering status in summary]
`sh bgp ipv6 unicast` [To check detail bgp table]
`sh ipv6 route bgp` [To check the routing table prefixes learned by BGP]

After prefix announcement:
`sh bgp ipv6 unicast neighbors [router 13……router20] advertised-routes` [To check prefixes advertised to eBGP peers]
`sh bgp ipv6 unicast neighbors [router 13……router20] routes` [To check prefixes learn from eBGP peers]
`sh ipv6 route [R13, R14, R15, R16, R17, R18, R19, R20]` [To check prefixes in routing table]

Note: Please make sure all 8 customer prefixes outlined in page 2 of this document is visible in BGP and routing table.

Example IPv4 protocol verification on a Router:

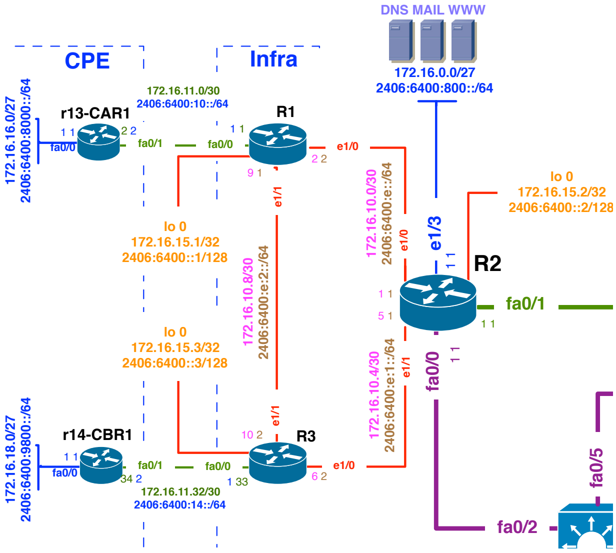
After eBGP Peering Config:
`sh bgp ipv4 unicast summary` [To check bgp peering status in summary]
`sh bgp ipv4 unicast` [To check detail bgp table]
`sh ipv4 route bgp` [To check the routing table prefixes learned by BGP]

After prefix announcement:
`sh bgp ipv4 unicast neighbors [router 13……router20] advertised-routes` [To check prefixes advertised to iBGP peers]
`sh bgp ipv4 unicast neighbors [router 13……router20] routes` [To check prefixes learn from iBGP peers]
`sh ip route [R13, R14, R15, R16, R17, R18, R19, R20]` [To check prefixes in routing table]

END OF MODULE THREE……
Next pages for reference template used on different routers….

‘Workshop templates for reference purpose only’

eBGP Customer Conf Region 1:


DNS MAIL WWW
CPE
Infra
172.16.0.0/27
2406:6400:800::/64
172.16.16.0/27
2406:6400:8000::/64
r13-CAR1
1 1
fa0/0
2 2
fa0/1
172.16.11.0/30
2406:6400:10::/64
fa0/0
1 1
R1
e1/0
2 2
9 1
e1/1
lo 0
172.16.15.1/32
2406:6400::1/128
172.16.10.8/30
2406:6400:e:2::/64
172.16.10.0/30
2406:6400:e::/64
e1/0
e1/3
1 1
lo 0
172.16.15.2/32
2406:6400::2/128
R2
1 1
5 1
fa0/1
1 1
lo 0
172.16.15.3/32
2406:6400::3/128
172.16.10.4/30
2406:6400:e:1::/64
e1/1
fa0/0
1 1
fa0/5
172.16.18.0/27
2406:6400:9800::/64
r14-CBR1
1 1
fa0/0
34 2
fa0/1
fa0/0
1 33
172.16.11.32/30
2406:6400:14::/64
10 2
e1/1
R3
e1/0
6 2
fa0/2

IPv4 WAN Interface Router1 Conf:

```
config t
interface fa0/0
description Customer WAN R1-CAR1
no ip redirects
no ip directed-broadcast
no ip unreachables
no cdp enable
ip address 172.16.11.1 255.255.255.252
no shutdown
exit
exit
wr
```

IPv6 WAN Interface Router1 Conf:

```
config t
interface fa0/0
ipv6 address 2406:6400:0010:0000::1/64
ipv6 enable
exit
exit
wr
```

IPv4 WAN Interface Router3 Conf:

```
config t
interface fa0/0
description Customer WAN R3-CBR1
no ip redirects
no ip directed-broadcast
no ip unreachables
no cdp enable
ip address 172.16.11.33 255.255.255.252
no shutdown
exit
exit
wr
```

IPv6 WAN Interface Router3 Conf:

```
config t
interface fa0/0
ipv6 address 2406:6400:0014:0000::1/64
ipv6 enable
exit
exit
wr
```

IPv4 eBGP Router1 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-eBGP-CUSTOMER-REG1-POP1 peer-group
neighbor 172.16.11.2 remote-as 65001
neighbor 172.16.11.2 peer-group IPV4-eBGP-CUSTOMER-REG1-POP1
neighbor 172.16.11.2 activate
neighbor IPV4-eBGP-CUSTOMER-REG1-POP1 default-originate
exit
exit
exit
wr
```

IPv4 Next-hop Self Router1 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-iBGP-REG1 next-hop-self
exit
exit
exit
wr
```

IPv6 eBGP Router1 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-eBGP-CUSTOMER-REG1-POP1 peer-group
neighbor 2406:6400:0010:0000::2 remote-as 65001
neighbor 2406:6400:0010:0000::2 peer-group IPV6-eBGP-CUSTOMER-REG1-POP1
neighbor 2406:6400:0010:0000::2 activate
neighbor IPV6-eBGP-CUSTOMER-REG1-POP1 default-originate
exit
exit
exit
wr
```

IPv6 Next-hop Self Router1 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-iBGP-REG1 next-hop-self
exit
exit
exit
wr
```

IPv4 eBGP Router3 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-eBGP-CUSTOMER-REG1-POP2 peer-group
neighbor 172.16.11.34 remote-as 65002
neighbor 172.16.11.34 peer-group IPV4-eBGP-CUSTOMER-REG1-POP2
neighbor 172.16.11.34 activate
neighbor IPV4-eBGP-CUSTOMER-REG1-POP2 default-originate
exit
exit
exit
wr
```

IPv4 Next-hop Self Router3 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-iBGP-REG1 next-hop-self
exit
exit
exit
wr
```

IPv6 eBGP Router3 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-eBGP-CUSTOMER-REG1-POP2 peer-group
neighbor 2406:6400:0014:0000::2 remote-as 65002
neighbor 2406:6400:0014:0000::2 peer-group IPV6-eBGP-CUSTOMER-REG1-POP2
neighbor 2406:6400:0014:0000::2 activate
neighbor IPV6-eBGP-CUSTOMER-REG1-POP2 default-originate
exit
exit
exit
wr
```

IPv6 Next-hop Self Router3 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-iBGP-REG1 next-hop-self
```

```
exit
exit
exit
wr
```

Basic Conf r13-CAR1

```
config t
hostname r13-CAR1
ip routing
ipv6 unicast-routing
ip cef
ipv6 cef
no ip domain-lookup
no ip http server
no ip http secure-server
no ip finger
no service pad
no service udp-small-servers
no service tcp-small-server
no ip bootp server
no ip source-route
no ipv6 source-route
logging source-interface loopback 0
service timestamps log datetime localtime msec show-timezone year
service timestamps debug datetime localtime msec show-timezone year
clock timezone AEST 10
ip subnet-zero
ip classless
line console 0
logging synchronous
transport preferred none
ip tcp synwait-time 15
security authentication failure rate 3 log
exit
exit
wr
```

Basic Conf r14-CBR1

```
config t
hostname r14-CBR1
iip routing
ipv6 unicast-routing
ip cef
ipv6 cef
no ip domain-lookup
no ip http server
no ip http secure-server
no ip finger
no service pad
no service udp-small-servers
no service tcp-small-server
no ip bootp server
no ip source-route
no ipv6 source-route
logging source-interface loopback 0
service timestamps log datetime localtime msec show-timezone year
service timestamps debug datetime localtime msec show-timezone year
clock timezone AEST 10
```

```
ip subnet-zero
ip classless
line console 0
logging synchronous
transport preferred none
ip tcp synwait-time 15
security authentication failure rate 3 log
exit
exit
wr
```

IPv4 Interface Router13 Conf:

```
config t
interface loopback 0
description r13-CAR1 Loopback
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.16.254 255.255.255.255
no shutdown
interface fa0/0
description LAN r13-CAR1
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.16.1 255.255.255.224
no shutdown
interface fa0/1
description Upstream WAN r13-CAR1-R1
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.11.2 255.255.255.252
no cdp enable
no shutdown
exit
exit
wr
```

IPv6 Interface Router13 Conf:

```
config t
interface loopback 0
ipv6 address 2406:6400:8000:0000::1/128
interface fa0/1
ipv6 address 2406:6400:0010:0000::2/64
interface fa0/0
ipv6 address 2406:6400:8000:0001::1/64
exit
exit
wr
```

IPv4 Interface Router14 Conf:

```
config t
interface loopback 0
description r14-CBR1 Loopback
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.18.254 255.255.255.255
no shutdown
interface fa0/0
description LAN r14-CBR1
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.18.1 255.255.255.224
no shutdown
interface fa0/1
description Upstream WAN r14-CBR1-R3
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.11.34 255.255.255.252
no cdp enable
no shutdown
exit
exit
wr
```

IPv6 Interface Router14 Conf:

```
config t
interface loopback 0
ipv6 address 2406:6400:9800:0000::1/128
interface fa0/1
ipv6 address 2406:6400:0014:0000::2/64
interface fa0/0
ipv6 address 2406:6400:9800:0001::1/64
exit
exit
wr
```

IPv4 eBGP Router13 Conf:

```
config t
router bgp 65001
address-family ipv4
no auto-summary
no synchronization
neighbor 172.16.11.1 remote-as 17821
neighbor 172.16.11.1 activate
exit
exit
exit
wr
```

IPv4 Prefix Announcement Router13 Conf:

```
config t
router bgp 65001
address-family ipv4
network 172.16.16.0 mask 255.255.255.0
exit
exit
ip route 172.16.16.0 255.255.255.0 null 0 permanent
exit
```

```
wr
```

IPv6 eBGP Router13 Conf:

```
config t
router bgp 65001
no bgp default ipv4-unicast
address-family ipv6
no synchronization
neighbor 2406:6400:0010:0000::1 remote-as 17821
neighbor 2406:6400:0010:0000::1 activate
exit
exit
exit
wr
```

IPv6 Prefix Announcement Router13 Conf:

```
config t
router bgp 65001
address-family ipv6
network 2406:6400:8000::/48
exit
exit
ipv6 route 2406:6400:8000::/48 null 0
exit
wr
```

IPv4 eBGP Router14 Conf:

```
config t
router bgp 65002
address-family ipv4
no auto-summary
no synchronization
neighbor 172.16.11.33 remote-as 17821
neighbor 172.16.11.33 activate
exit
exit
exit
wr
```

IPv4 Prefix Announcement Router14 Conf:

```
config t
router bgp 65002
address-family ipv4
network 172.16.18.0 mask 255.255.255.0
exit
exit
ip route 172.16.18.0 255.255.255.0 null 0 permanent
exit
wr
```

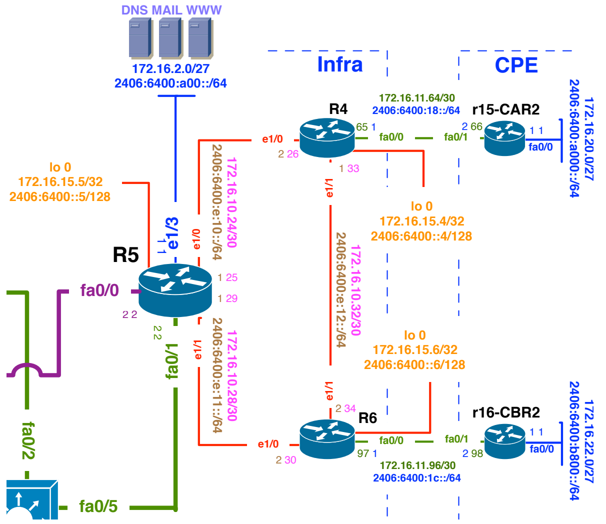
IPv6 eBGP Router14 Conf:

```
config t
router bgp 65002
no bgp default ipv4-unicast
address-family ipv6
no synchronization
neighbor 2406:6400:0014:0000::1 remote-as 17821
neighbor 2406:6400:0014:0000::1 activate
exit
exit
exit
wr
```

IPv6 Prefix Announcement Router14 Conf:

```
config t
router bgp 65002
address-family ipv6
network 2406:6400:9800::/48
exit
exit
ipv6 route 2406:6400:9800::/48 null 0
exit
wr
```

eBGP Customer Conf Region 2:


DNS MAIL WWW
172.16.2.0/27
2406:6400:a00::/64
Infra
CPE
R4
172.16.11.64/30
2406:6400:18::/64
r15-CAR2
65 1
fa0/0
fa0/1
2 66
1 1
fa0/0
172.16.20.0/27
2406:6400:a000::/64
e1/0
2 26
1 33
e1/1
lo 0
172.16.15.5/32
2406:6400::5/128
e1/3
1 1
e1/0
2406:6400:e:10::/64
172.16.10.24/30
R5
fa0/0
1 25
1 29
2 2
2 2
fa0/1
e1/1
2406:6400:e:11::/64
172.16.10.28/30
lo 0
172.16.15.4/32
2406:6400::4/128
2406:6400:e:12::/64
172.16.10.32/30
lo 0
172.16.15.6/32
2406:6400::6/128
e1/1
2 34
R6
r16-CBR2
e1/0
2 30
fa0/0
97 1
fa0/1
2 98
1 1
fa0/0
172.16.11.96/30
2406:6400:1c::/64
172.16.22.0/27
2406:6400:b800::/64
fa0/2
fa0/5

IPv4 WAN Interface Router4 Conf:

```
config t
interface fa0/0
description Customer WAN R4-CAR2
no ip redirects
no ip directed-broadcast
no ip unreachables
no cdp enable
ip address 172.16.11.65 255.255.255.252
no shutdown
exit
exit
wr
```

IPv6 WAN Interface Router4 Conf:

```
config t
interface fa0/0
ipv6 address 2406:6400:0018:0000::1/64
exit
exit
wr
```

IPv4 WAN Interface Router6 Conf:

```
config t
interface fa0/0
description Customer WAN R6-CBR2
no ip redirects
no ip directed-broadcast
no ip unreachables
no cdp enable
ip address 172.16.11.97 255.255.255.252
no shutdown
exit
exit
wr
```

IPv6 WAN Interface Router6 Conf:

```
config t
interface fa0/0
ipv6 address 2406:6400:001c:0000::1/64
exit
exit
wr
```

IPv4 eBGP Router4 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-eBGP-CUSTOMER-REG2-POP1 peer-group
neighbor 172.16.11.66 remote-as 65003
neighbor 172.16.11.66 peer-group IPV4-eBGP-CUSTOMER-REG2-POP1
neighbor 172.16.11.66 activate
neighbor IPV4-eBGP-CUSTOMER-REG2-POP1 default-originate
exit
exit
exit
wr
```

IPv4 Next-hop Self Router4 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-iBGP-REG2 next-hop-self
exit
exit
exit
wr
```

IPv6 eBGP Router4 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-eBGP-CUSTOMER-REG2-POP1 peer-group
neighbor 2406:6400:0018:0000::2 remote-as 65003
neighbor 2406:6400:0018:0000::2 peer-group IPV6-eBGP-CUSTOMER-REG2-POP1
neighbor 2406:6400:0018:0000::2 activate
neighbor IPV6-eBGP-CUSTOMER-REG2-POP1 default-originate
exit
exit
exit
wr
```

IPv6 Next-hop Self Router4 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-iBGP-REG2 next-hop-self
exit
```

```
exit
exit
wr
```

IPv4 eBGP Router6 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-eBGP-CUSTOMER-REG2-POP2 peer-group
neighbor 172.16.11.98 remote-as 65004
neighbor 172.16.11.98 peer-group IPV4-eBGP-CUSTOMER-REG2-POP2
neighbor 172.16.11.98 activate
neighbor IPV4-eBGP-CUSTOMER-REG2-POP2 default-originate
exit
exit
exit
wr
```

IPv4 Next-hop Self Router6 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-iBGP-REG2 next-hop-self
exit
exit
exit
wr
```

IPv6 eBGP Router6 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-eBGP-CUSTOMER-REG2-POP2 peer-group
neighbor 2406:6400:001c:0000::2 remote-as 65004
neighbor 2406:6400:001c:0000::2 peer-group IPV6-eBGP-CUSTOMER-REG2-POP2
neighbor 2406:6400:001c:0000::2 activate
neighbor IPV6-eBGP-CUSTOMER-REG2-POP2 default-originate
exit
exit
exit
wr
```

IPv6 Next-hop Self Router6 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-iBGP-REG2 next-hop-self
exit
exit
exit
wr
```

Basic Conf r15-CAR2

```
config t
hostname r15-CAR2
ip routing
ipv6 unicast-routing
ip cef
ipv6 cef
no ip domain-lookup
no ip http server
no ip http secure-server
no ip finger
no service pad
no service udp-small-servers
no service tcp-small-server
no ip bootp server
no ip source-route
no ipv6 source-route
logging source-interface loopback 0
service timestamps log datetime localtime msec show-timezone year
service timestamps debug datetime localtime msec show-timezone year
clock timezone AEST 10
ip subnet-zero
ip classless
line console 0
logging synchronous
transport preferred none
ip tcp synwait-time 15
security authentication failure rate 3 log
exit
exit
wr
```

Basic Conf r16-CBR2

```
config t
hostname r16-CBR2
ip routing
ipv6 unicast-routing
ip cef
ipv6 cef
no ip domain-lookup
no ip http server
no ip http secure-server
no ip finger
no service pad
no service udp-small-servers
no service tcp-small-server
no ip bootp server
no ip source-route
no ipv6 source-route
logging source-interface loopback 0
service timestamps log datetime localtime msec show-timezone year
service timestamps debug datetime localtime msec show-timezone year
clock timezone AEST 10
ip subnet-zero
ip classless
line console 0
logging synchronous
transport preferred none
```

```
ip tcp synwait-time 15
security authentication failure rate 3 log
exit
exit
wr
```

IPv4 Interface Router15 Conf:

```
config t
interface loopback 0
description r15-CAR2 Loopback
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.20.254 255.255.255.255
no shutdown
interface fa0/0
description LAN r15-CAR2
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.20.1 255.255.255.224
no shutdown
interface fa0/1
description Upstream WAN R4-r15-CAR2
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.11.66 255.255.255.252
no cdp enable
no shutdown
exit
exit
wr
```

IPv6 Interface Router15 Conf:

```
config t
interface loopback 0
ipv6 address 2406:6400:A000:0000::1/128
interface fa0/1
ipv6 address 2406:6400:0018:0000::2/64
interface fa0/0
ipv6 address 2406:6400:A000:0001::1/64
exit
exit
wr
```

IPv4 Interface Router16 Conf:

```
config t
interface loopback 0
description r16-CBR2 Loopback
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.22.254 255.255.255.255
no shutdown
interface fa0/0
```

```
description LAN r16-CBR2
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.22.1 255.255.255.224
no shutdown
interface fa0/1
description Upstream WAN R6-r16-CBR2
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.11.98 255.255.255.252
no cdp enable
no shutdown
exit
exit
wr
```

IPv6 Interface Router16 Conf:

```
config t
interface loopback 0
ipv6 address 2406:6400:B800:0000::1/128
interface fa0/1
ipv6 address 2406:6400:001C:0000::2/64
interface fa0/0
ipv6 address 2406:6400:B800:0001::1/64
exit
exit
wr
```

IPv4 eBGP Router15 Conf:

```
config t
router bgp 65003
address-family ipv4
no auto-summary
no synchronization
neighbor 172.16.11.65 remote-as 17821
neighbor 172.16.11.65 activate
exit
exit
exit
wr
```

IPv4 Prefix Announcement Router15 Conf:

```
config t
router bgp 65003
address-family ipv4
network 172.16.20.0 mask 255.255.255.0
exit
exit
ip route 172.16.20.0 255.255.255.0 null 0 permanent
exit
wr
```

IPv6 eBGP Router15 Conf:

```
config t
router bgp 65003
no bgp default ipv4-unicast
address-family ipv6
no synchronization
neighbor 2406:6400:0018:0000::1 remote-as 17821
neighbor 2406:6400:0018:0000::1 activate
exit
exit
exit
wr
```

IPv6 Prefix Announcement Router15 Conf:

```
config t
router bgp 65003
address-family ipv6
network 2406:6400:a000::/48
exit
exit
ipv6 route 2406:6400:a000::/48 null 0
exit
wr
```

IPv4 eBGP Router16 Conf:

```
config t
router bgp 65004
address-family ipv4
no auto-summary
no synchronization
neighbor 172.16.11.97 remote-as 17821
neighbor 172.16.11.97 activate
exit

exit
exit
wr
```

IPv4 Prefix Announcement Router16 Conf:

```
config t
router bgp 65004
address-family ipv4
network 172.16.22.0 mask 255.255.255.0
exit
exit
ip route 172.16.22.0 255.255.255.0 null 0 permanent
exit
wr
```

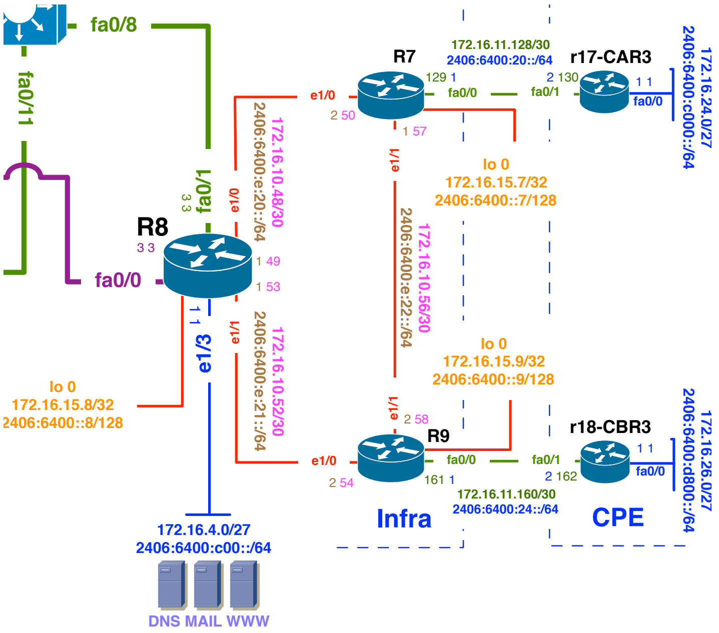
IPv6 eBGP Router16 Conf:

```
config t
router bgp 65004
no bgp default ipv4-unicast
address-family ipv6
no synchronization
neighbor 2406:6400:001c:0000::1 remote-as 17821
neighbor 2406:6400:001c:0000::1 activate
exit
exit
exit
wr
```

IPv6 Prefix Announcement Router16 Conf:

```
config t
router bgp 65004
address-family ipv6
network 2406:6400:b800::/48
exit
exit
ipv6 route 2406:6400:b800::/48 null 0
exit
wr
```

eBGP Customer Conf Region 3:


fa0/8
fa0/11
R8
3 3
fa0/1
3 3
fa0/0
e1/0
2406:6400:e:20::/64
172.16.10.48/30
1 49
1 53
1 1
e1/3
e1/1
2406:6400:e:21::/64
172.16.10.52/30
lo 0
172.16.15.8/32
2406:6400::8/128
172.16.4.0/27
2406:6400:c00::/64
DNS MAIL WWW
R7
e1/0
2 50
129 1
fa0/0
1 57
e1/1
2406:6400:e:22::/64
172.16.10.56/30
172.16.11.128/30
2406:6400:20::/64
r17-CAR3
2 130
fa0/1
1 1
fa0/0
172.16.24.0/27
2406:6400:c000::/64
lo 0
172.16.15.7/32
2406:6400::7/128
lo 0
172.16.15.9/32
2406:6400::9/128
e1/1
2 58
R9
e1/0
2 54
fa0/0
161 1
fa0/1
2 162
r18-CBR3
1 1
fa0/0
172.16.26.0/27
2406:6400:d800::/64
172.16.11.160/30
2406:6400:24::/64
Infra
CPE

IPv4 WAN Interface Router7 Conf:

```
config t
interface fa0/0
description Customer WAN R7-CAR3
no ip redirects
no ip directed-broadcast
no ip unreachables
no cdp enable
ip address 172.16.11.129 255.255.255.252
no shutdown
exit
exit
wr
```

IPv6 WAN Interface Router7 Conf:

```
config t
interface fa0/0
ipv6 address 2406:6400:0020:0000::1/64
exit
exit
wr
```

IPv4 WAN Interface Router9 Conf:

```
config t
interface fa0/0
description Customer WAN R9-CBR3
no ip redirects
no ip directed-broadcast
no ip unreachables
no cdp enable
ip address 172.16.11.161 255.255.255.252
no shutdown
```

```
exit
exit
wr
```

IPv6 WAN Interface Router9 Conf:

```
config t
interface fa0/0
ipv6 address 2406:6400:0024:0000::1/64
exit
exit
wr
```

IPv4 eBGP Router7 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-eBGP-CUSTOMER-REG3-POP1 peer-group
neighbor 172.16.11.130 remote-as 65005
neighbor 172.16.11.130 peer-group IPV4-eBGP-CUSTOMER-REG3-POP1
neighbor 172.16.11.130 activate
neighbor IPV4-eBGP-CUSTOMER-REG3-POP1 default-originate
exit
exit
exit
wr
```

IPv4 Next-hop Self Router7 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-iBGP-REG3 next-hop-self
exit
exit
exit
wr
```

IPv6 eBGP Router7 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-eBGP-CUSTOMER-REG3-POP1 peer-group
neighbor 2406:6400:0020:0000::2 remote-as 65005
neighbor 2406:6400:0020:0000::2 peer-group IPV6-eBGP-CUSTOMER-REG3-POP1
neighbor 2406:6400:0020:0000::2 activate
neighbor IPV6-eBGP-CUSTOMER-REG3-POP1 default-originate
exit
exit
exit
wr
```

IPv6 Next-hop Self Router7 Conf:

```
config t
router bgp 17821
address-family ipv6
```

```
neighbor IPV6-iBGP-REG3 next-hop-self
exit
exit
exit
wr
```

IPv4 eBGP Router9 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-eBGP-CUSTOMER-REG3-POP2 peer-group
neighbor 172.16.11.162 remote-as 65006
neighbor 172.16.11.162 peer-group IPV4-eBGP-CUSTOMER-REG3-POP2
neighbor 172.16.11.162 activate
neighbor IPV4-eBGP-CUSTOMER-REG3-POP2 default-originate
exit
exit
exit
wr
```

IPv4 Next-hop Self Router9 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-iBGP-REG3 next-hop-self
exit
exit
exit
wr
```

IPv6 eBGP Router9 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-eBGP-CUSTOMER-REG3-POP2 peer-group
neighbor 2406:6400:0024:0000::2 remote-as 65006
neighbor 2406:6400:0024:0000::2 peer-group IPV6-eBGP-CUSTOMER-REG3-POP2
neighbor 2406:6400:0024:0000::2 activate
neighbor IPV6-eBGP-CUSTOMER-REG3-POP2 default-originate
exit
exit
exit
wr
```

IPv6 Next-hop Self Router9 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-iBGP-REG3 next-hop-self
exit
exit
exit
wr
```

Basic Conf r17-CAR3

```
config t
hostname r17-CAR3
ip routing
ipv6 unicast-routing
ip cef
ipv6 cef
no ip domain-lookup
no ip http server
no ip http secure-server
no ip finger
no service pad
no service udp-small-servers
no service tcp-small-server
no ip bootp server
no ip source-route
no ipv6 source-route
logging source-interface loopback 0
service timestamps log datetime localtime msec show-timezone year
service timestamps debug datetime localtime msec show-timezone year
clock timezone AEST 10
ip subnet-zero
ip classless
line console 0
logging synchronous
transport preferred none
ip tcp synwait-time 15
security authentication failure rate 3 log
exit
exit
wr
```

Basic Conf r18-CBR3

```
config t
hostname r18-CBR3
ip routing
ipv6 unicast-routing
ip cef
ipv6 cef
no ip domain-lookup
no ip http server
no ip http secure-server
no ip finger
no service pad
no service udp-small-servers
no service tcp-small-server
no ip bootp server
no ip source-route
no ipv6 source-route
logging source-interface loopback 0
service timestamps log datetime localtime msec show-timezone year
service timestamps debug datetime localtime msec show-timezone year
clock timezone AEST 10
ip subnet-zero
ip classless
line console 0
logging synchronous
transport preferred none
```

```
ip tcp synwait-time 15
security authentication failure rate 3 log
exit
exit
wr
```

IPv4 Interface Router17 Conf:

```
config t
interface loopback 0
description r17-CAR3 Loopback
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.24.254 255.255.255.255
no shutdown
interface fa0/0
description LAN r17-CAR3
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.24.1 255.255.255.224
no shutdown
interface fa0/1
description Upstream WAN R7-r17-CAR3
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.11.130 255.255.255.252
no cdp enable
no shutdown
exit
exit
wr
```

IPv6 Interface Router17 Conf:

```
config t
interface loopback 0
ipv6 address 2406:6400:C000:0000::1/128
interface fa0/1
ipv6 address 2406:6400:0020:0000::2/64
interface fa0/0
ipv6 address 2406:6400:C000:0001::1/64
exit
exit
wr
```

IPv4 Interface Router18 Conf:

```
config t
interface loopback 0
description r18-CBR3 Loopback
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.26.254 255.255.255.255
no shutdown
interface fa0/0
```

```
description LAN r18-CBR3
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.26.1 255.255.255.224
no shutdown
interface fa0/1
description Upstream WAN R9-r18-CBR3
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.11.162 255.255.255.252
no cdp enable
no shutdown
exit
exit
wr
```

IPv6 Interface Router18 Conf:

```
config t
interface loopback 0
ipv6 address 2406:6400:D800:0000::1/128
interface fa0/1
ipv6 address 2406:6400:0024:0000::2/64
interface fa0/0
ipv6 address 2406:6400:D800:0001::1/64
exit
exit
wr
```

IPv4 eBGP Router17 Conf:

```
config t
router bgp 65005
address-family ipv4
no auto-summary
no synchronization
neighbor 172.16.11.129 remote-as 17821
neighbor 172.16.11.129 activate
exit
exit
exit
wr
```

IPv4 Prefix Announcement Router17 Conf:

```
config t
router bgp 65005
address-family ipv4
network 172.16.24.0 mask 255.255.255.0
exit
exit
ip route 172.16.24.0 255.255.255.0 null 0 permanent
exit
wr
```

IPv6 eBGP Router17 Conf:

```
config t
router bgp 65005
no bgp default ipv4-unicast
address-family ipv6
no synchronization
neighbor 2406:6400:0020:0000::1 remote-as 17821
neighbor 2406:6400:0020:0000::1 activate
exit
exit
exit
wr
```

IPv6 Prefix Announcement Router17 Conf:

```
config t
router bgp 65005
address-family ipv6
network 2406:6400:c000::/48
exit
exit
ipv6 route 2406:6400:c000::/48 null 0
exit
wr
```

IPv4 eBGP Router18 Conf:

```
config t
router bgp 65006
address-family ipv4
no auto-summary
no synchronization
neighbor 172.16.11.161 remote-as 17821
neighbor 172.16.11.161 activate
exit
exit
exit
wr
```

IPv4 Prefix Announcement Router18 Conf:

```
config t
router bgp 65006
address-family ipv4
network 172.16.26.0 mask 255.255.255.0
exit
exit
ip route 172.16.26.0 255.255.255.0 null 0 permanent
exit
wr
```

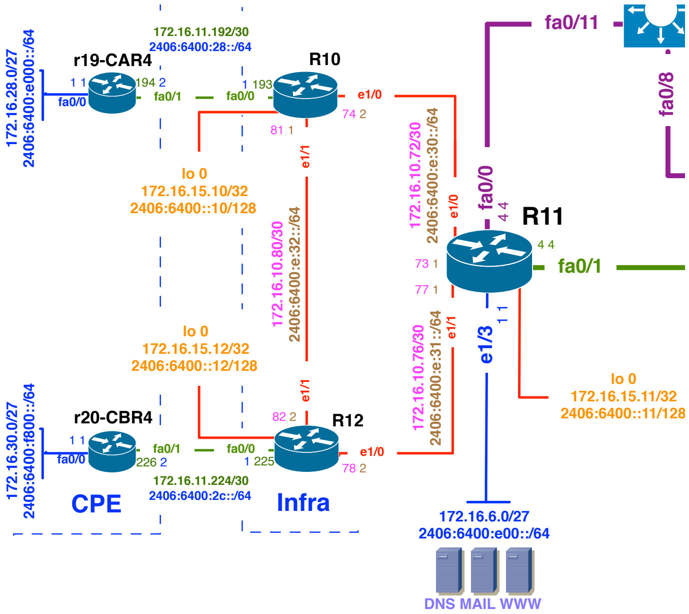
IPv6 eBGP Router18 Conf:

```
config t
router bgp 65006
no bgp default ipv4-unicast
address-family ipv6
no synchronization
neighbor 2406:6400:0024:0000::1 remote-as 17821
neighbor 2406:6400:0024:0000::1 activate
exit
exit
exit
wr
```

IPv6 Prefix Announcement Router18 Conf:

```
config t
router bgp 65006
address-family ipv6
network 2406:6400:d800::/48
exit
exit
ipv6 route 2406:6400:d800::/48 null 0
exit
wr
```

eBGP Customer Conf Region 4:


172.16.11.192/30
2406:6400:28::/64
r19-CAR4
R10
172.16.28.0/27
2406:6400:e000::/64
1 1
fa0/0
194 2
fa0/1
fa0/0
1 193
e1/0
74 2
81 1
e1/1
lo 0
172.16.15.10/32
2406:6400::10/128
172.16.10.80/30
2406:6400:e:32::/64
172.16.10.72/30
2406:6400:e:30::/64
e1/0
fa0/11
fa0/8
fa0/0
4 4
R11
4 4
fa0/1
73 1
77 1
e1/1
1 1
e1/3
172.16.10.76/30
2406:6400:e:31::/64
lo 0
172.16.15.11/32
2406:6400::11/128
lo 0
172.16.15.12/32
2406:6400::12/128
e1/1
82 2
r20-CBR4
R12
172.16.30.0/27
2406:6400:f800::/64
1 1
fa0/0
fa0/1
226 2
fa0/0
1 225
e1/0
78 2
172.16.11.224/30
2406:6400:2c::/64
CPE
Infra
172.16.6.0/27
2406:6400:e00::/64
DNS MAIL WWW

IPv4 WAN Interface Router10 Conf:

```
config t
interface fa0/0
description Customer WAN R10-CAR4
no ip redirects
no ip directed-broadcast
no ip unreachables
no cdp enable
ip address 172.16.11.193 255.255.255.252
no shutdown
exit
exit
wr
```

IPv6 WAN Interface Router10 Conf:

```
config t
interface fa0/0
ipv6 address 2406:6400:0028:0000::1/64
exit
exit
wr
```

IPv4 WAN Interface Router12 Conf:

```
config t
interface fa0/0
description Customer WAN R12-CBR4
no ip redirects
no ip directed-broadcast
no ip unreachables
no cdp enable
ip address 172.16.11.225 255.255.255.252
no shutdown
```

```
exit

exit
wr
```

IPv6 WAN Interface Router12 Conf:

```
config t
interface fa0/0
ipv6 address 2406:6400:002c:0000::1/64
exit
exit
wr
```

IPv4 eBGP Router10 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-eBGP-CUSTOMER-REG4-POP1 peer-group
neighbor 172.16.11.194 remote-as 65007
neighbor 172.16.11.194 peer-group IPV4-eBGP-CUSTOMER-REG4-POP1
neighbor 172.16.11.194 activate
neighbor IPV4-eBGP-CUSTOMER-REG4-POP1 default-originate
exit
exit
exit
wr
```

IPv4 Next-hop Self Router10 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-iBGP-REG4 next-hop-self
exit
exit
exit
wr
```

IPv6 eBGP Router10 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-eBGP-CUSTOMER-REG4-POP1 peer-group
neighbor 2406:6400:0028:0000::2 remote-as 65007
neighbor 2406:6400:0028:0000::2 peer-group IPV6-eBGP-CUSTOMER-REG4-POP1
neighbor 2406:6400:0028:0000::2 activate
neighbor IPV6-eBGP-CUSTOMER-REG4-POP1 default-originate
exit
exit
exit
wr
```

IPv6 Next-hop Self Router10 Conf:

```
config t
router bgp 17821
```

```
address-family ipv6
neighbor IPV6-iBGP-REG4 next-hop-self
exit
exit
exit
wr
```

IPv4 eBGP Router12 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-eBGP-CUSTOMER-REG4-POP2 peer-group
neighbor 172.16.11.226 remote-as 65008
neighbor 172.16.11.226 peer-group IPV4-eBGP-CUSTOMER-REG4-POP2
neighbor 172.16.11.226 activate
neighbor IPV4-eBGP-CUSTOMER-REG4-POP2 default-originate
exit
exit
exit
wr
```

IPv4 Next-hop Self Router12 Conf:

```
config t
router bgp 17821
address-family ipv4
neighbor IPV4-iBGP-REG4 next-hop-self
exit
exit
exit
wr
```

IPv6 eBGP Router12 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-eBGP-CUSTOMER-REG4-POP2 peer-group
neighbor 2406:6400:002c:0000::2 remote-as 65008
neighbor 2406:6400:002c:0000::2 peer-group IPV6-eBGP-CUSTOMER-REG4-POP2
neighbor 2406:6400:002c:0000::2 activate
neighbor IPV6-eBGP-CUSTOMER-REG4-POP2 default-originate
exit
exit
exit
wr
```

IPv6 Next-hop Self Router12 Conf:

```
config t
router bgp 17821
address-family ipv6
neighbor IPV6-iBGP-REG4 next-hop-self
exit
exit
exit
wr
```

Basic Conf r19-CAR4

```
config t
hostname r19-CAR4
ip routing
ipv6 unicast-routing
ip cef
ipv6 cef
no ip domain-lookup
no ip http server
no ip http secure-server
no ip finger
no service pad
no service udp-small-servers
no service tcp-small-server
no ip bootp server
no ip source-route
no ipv6 source-route
logging source-interface loopback 0
service timestamps log datetime localtime msec show-timezone year
service timestamps debug datetime localtime msec show-timezone year
clock timezone AEST 10
ip subnet-zero
ip classless
line console 0
logging synchronous
transport preferred none
ip tcp synwait-time 15
security authentication failure rate 3 log
exit
exit
wr
```

Basic Conf r20-CBR4

```
config t
hostname r20-CBR4
ip routing
ipv6 unicast-routing
ip cef
ipv6 cef
no ip domain-lookup
no ip http server
no ip http secure-server
no ip finger
no service pad
no service udp-small-servers
no service tcp-small-server
no ip bootp server
no ip source-route
no ipv6 source-route
logging source-interface loopback 0
service timestamps log datetime localtime msec show-timezone year
service timestamps debug datetime localtime msec show-timezone year
clock timezone AEST 10
ip subnet-zero
ip classless
line console 0
logging synchronous
transport preferred none
```

```
ip tcp synwait-time 15
security authentication failure rate 3 log
exit
exit
wr
```

IPv4 Interface Router19 Conf:

```
config t
interface loopback 0
description r19-CAR4 Loopback
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.28.254 255.255.255.255
no shutdown
interface fa0/0
description LAN r19-CAR4
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.28.1 255.255.255.224
no shutdown
interface fa0/1
description Upstream WAN r19-CAR4-R10
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.11.194 255.255.255.252
no cdp enable
no shutdown
exit
exit
wr
```

IPv6 Interface Router19 Conf:

```
config t
interface loopback 0
ipv6 address 2406:6400:E000:0000::1/128
interface fa0/1
ipv6 address 2406:6400:0028:0000::2/64
interface fa0/0
ipv6 address 2406:6400:E000:0001::1/64
exit
exit
wr
```

IPv4 Interface Router20 Conf:

```
config t
interface loopback 0
description r20-CBR4 Loopback
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.30.254 255.255.255.255
no shutdown
interface fa0/0
```

```
description LAN r20-CBR4
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.30.1 255.255.255.224
no shutdown
interface fa0/1
description Upstream WAN r20-CBR4-R12
no ip redirects
no ip directed-broadcast
no ip unreachables
ip address 172.16.11.226 255.255.255.252
no cdp enable
no shutdown
exit
exit
wr
```

IPv6 Interface Router20 Conf:

```
config t
interface loopback 0
ipv6 address 2406:6400:F800:0000::1/128
interface fa0/1
ipv6 address 2406:6400:002C:0000::2/64
interface fa0/0
ipv6 address 2406:6400:F800:0001::1/64
exit
exit
wr
```

IPv4 eBGP Router19 Conf:

```
config t
router bgp 65007
address-family ipv4
no auto-summary
no synchronization
neighbor 172.16.11.193 remote-as 17821
neighbor 172.16.11.193 activate
exit
exit
exit
wr
```

IPv4 Prefix Announcement Router19 Conf:

```
config t
router bgp 65007
address-family ipv4
network 172.16.28.0 mask 255.255.255.0
exit
exit
ip route 172.16.28.0 255.255.255.0 null 0 permanent
exit
wr
```

IPv6 eBGP Router19 Conf:

```
config t
router bgp 65007
no bgp default ipv4-unicast
address-family ipv6
no synchronization
neighbor 2406:6400:0028:0000::1 remote-as 17821
neighbor 2406:6400:0028:0000::1 activate
exit
exit
exit
wr
```

IPv6 Prefix Announcement Router19 Conf:

```
config t
router bgp 65007
address-family ipv6
network 2406:6400:e000::/48
exit
exit
ipv6 route 2406:6400:e000::/48 null 0
exit
wr
```

IPv4 eBGP Router20 Conf:

```
config t
router bgp 65008
address-family ipv4
no auto-summary
no synchronization
neighbor 172.16.11.225 remote-as 17821
neighbor 172.16.11.225 activate
exit
exit

exit
wr
```

IPv4 Prefix Announcement Router20 Conf:

```
config t
router bgp 65008
address-family ipv4
network 172.16.30.0 mask 255.255.255.0
exit
exit
ip route 172.16.30.0 255.255.255.0 null 0 permanent
exit
wr
```

IPv6 eBGP Router20 Conf:

```
config t
router bgp 65008
no bgp default ipv4-unicast
address-family ipv6
no synchronization
neighbor 2406:6400:002c:0000::1 remote-as 17821
neighbor 2406:6400:002c:0000::1 activate
exit
exit
exit
wr
```

IPv6 Prefix Announcement Router20 Conf:

```
config t
router bgp 65008
address-family ipv6
network 2406:6400:f800::/48
exit
exit
ipv6 route 2406:6400:f800::/48 null 0
exit
wr
```