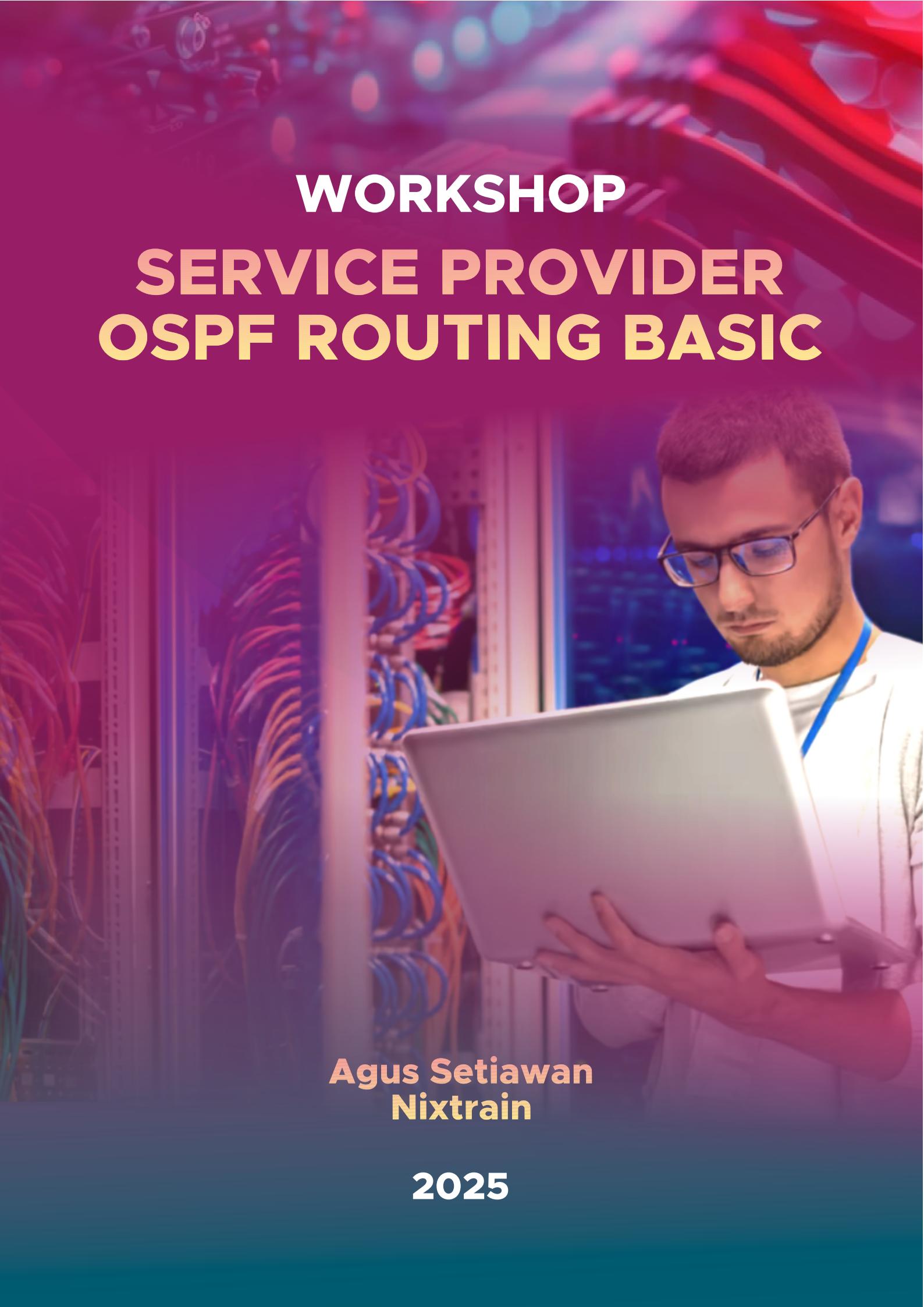


WORKSHOP

SERVICE PROVIDER

OSPF ROUTING BASIC



Agus Setiawan
Nixtrain

2025

Daftar Isi

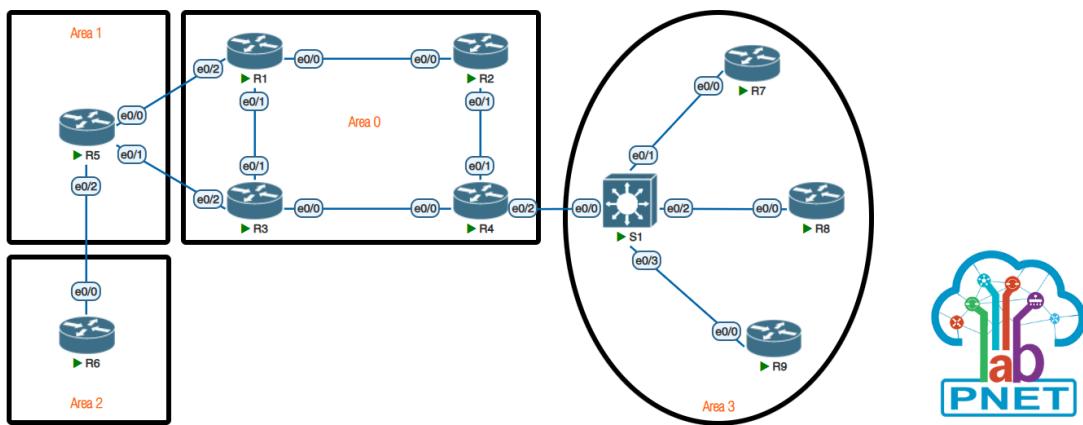
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Lab 1. OSPF Basic Configuration Single-Area

Topology

Topology Workshop SP - OSPF Routing Basic

Created By Agus Setiawan



Konfigurasi

- OSPF Basic Routing Single-Area

IP Addressing Initial Configuration

R1

```
!
interface Ethernet0/0
 ip address 10.1.2.1 255.255.255.0
 duplex auto
!
interface Ethernet0/1
 ip address 10.1.3.1 255.255.255.0
 duplex auto
!
interface Ethernet0/2
 ip address 10.1.5.1 255.255.255.0
 duplex auto
!
```

R2

```
!
interface Ethernet0/0
 ip address 10.1.2.2 255.255.255.0
 duplex auto
!
interface Ethernet0/1
 ip address 10.2.4.2 255.255.255.0
 duplex auto
!
```

R3

```
!
interface Ethernet0/0
 ip address 10.3.4.3 255.255.255.0
 duplex auto
!
interface Ethernet0/1
 ip address 10.1.3.3 255.255.255.0
 duplex auto
!
interface Ethernet0/2
 ip address 10.3.5.3 255.255.255.0
 duplex auto
!
```

R4

```
!
interface Ethernet0/0
 ip address 10.3.4.4 255.255.255.0
 duplex auto
!
interface Ethernet0/1
 ip address 10.2.4.4 255.255.255.0
 duplex auto
!
interface Ethernet0/2
 ip address 10.10.10.4 255.255.255.0
 duplex auto
!
```

R5

```
!
interface Ethernet0/0
 ip address 10.1.5.5 255.255.255.0
 duplex auto
!
interface Ethernet0/1
 ip address 10.3.5.5 255.255.255.0
 duplex auto
!
interface Ethernet0/2
 ip address 10.5.6.5 255.255.255.0
 duplex auto
!
```

R6

```
!
interface Ethernet0/0
 ip address 10.5.6.6 255.255.255.0
 duplex auto
!
```

R7

```
!
interface Ethernet0/0
 ip address 10.10.10.7 255.255.255.0
 duplex auto
!
```

R8

```
!
interface Ethernet0/0
 ip address 10.10.10.8 255.255.255.0
 duplex auto
!
```

R9

```
!
interface Ethernet0/0
 ip address 10.10.10.9 255.255.255.0
 duplex auto
!
```

Setelah semua router dikonfigurasi IP, lakukan tes ping antar node router. Pastikan semua ping berhasil.

R1

```
R1#ping 10.1.2.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.2.2, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
1/1/1 ms
R1#
R1#ping 10.1.3.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.3.3, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
1/1/1 ms
R1#
R1#ping 10.1.5.5
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.5.5, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
1/4/6 ms
R1#
```

Konfigurasi OSPF Area 0 / Backbone Area

- Hanya interface router yang berada dalam Area 0 yang di konfigurasi
 - Input command untuk mengaktifkan routing ospf, process ID 1 dan ikutsertakan interface router yang berada di dalam Area 0 masuk proses OSPF Area 0
 - Contoh command seperti dibawah ini :

R1, R2, R3, R4

```
RX(config)#router ospf 1  
RX(config-router)#interface e0/0  
RX(config-if)#ip ospf 1 area 0
```

Log yang akan tampil ketika router berhasil melakukan adjacency OSPF.

```
*Aug 14 21:02:14.801: %OSPF-5-ADJCHG: Process 1, Nbr 10.1.5.1  
on Ethernet0/0 from LOADING to FULL, Loading Done
```

Verifikasi

Setelah konfigurasi OSPF Basic Routing Single-Area di semua node router dilakukan, ada beberapa cara untuk verifikasi apakah sudah benar atau belum konfigurasi yang kita inputkan:

1. Verifikasi neighbor
2. Verifikasi routing table
3. Verifikasi end-to-end ping
4. Verifikasi traceroute

1. Verifikasi neighbor

```
R1#show ip ospf neighbor  
  
Neighbor ID      Pri   State            Dead Time     Address          Interface  
10.3.5.3          1     FULL/BDR        00:00:31      10.1.3.3        Ethernet0/1  
10.2.4.2          1     FULL/BDR        00:00:35      10.1.2.2        Ethernet0/0  
R1#
```

2. Verifikasi routing table

```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        10.1.2.0/24 is directly connected, Ethernet0/0
L        10.1.2.1/32 is directly connected, Ethernet0/0
C        10.1.3.0/24 is directly connected, Ethernet0/1
L        10.1.3.1/32 is directly connected, Ethernet0/1
C        10.1.5.0/24 is directly connected, Ethernet0/2
L        10.1.5.1/32 is directly connected, Ethernet0/2
O        10.2.4.0/24 [110/20] via 10.1.2.2, 00:08:20, Ethernet0/0
O        10.3.4.0/24 [110/20] via 10.1.3.3, 00:05:35, Ethernet0/1
R1#
R1#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
O        10.2.4.0/24 [110/20] via 10.1.2.2, 00:08:28, Ethernet0/0
O        10.3.4.0/24 [110/20] via 10.1.3.3, 00:05:43, Ethernet0/1
R1#
R1#
```

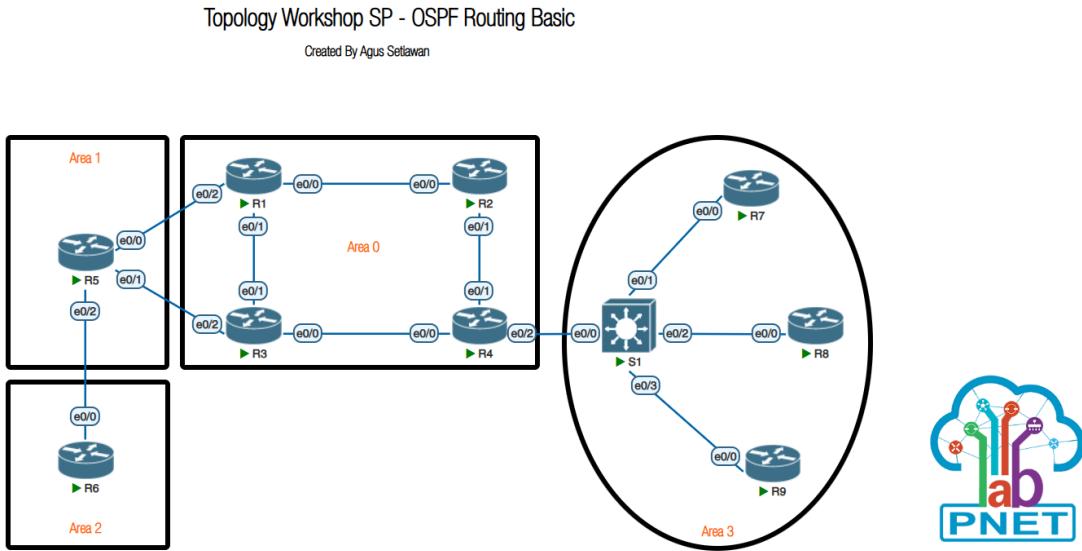
3. Verifikasi end-to-end ping

```
R1#ping 10.2.4.4
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.4.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/8 ms
R1#
R1#ping 10.3.4.4
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.4.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R1#
```

4. Verifikasi traceroute

```
R1#traceroute 10.2.4.4
Type escape sequence to abort.
Tracing the route to 10.2.4.4
VRF info: (vrf in name/id, vrf out name/id)
  1 10.1.2.2 2 msec 2 msec 1 msec
  2 10.2.4.4 1 msec 6 msec *
R1#
R1#traceroute 10.3.4.4
Type escape sequence to abort.
Tracing the route to 10.3.4.4
VRF info: (vrf in name/id, vrf out name/id)
  1 10.1.3.3 2 msec 2 msec 1 msec
  2 10.3.4.4 2 msec 4 msec *
R1#
```

Lab 2. OSPF Basic Configuration Multi-Area Topology



Konfigurasi

- OSPF Basic Routing Multi-Area

Konfigurasi OSPF Multi-Area

- Input command untuk mengaktifkan routing ospf, process ID 1 dan ikutsertakan interface router sesuai dengan area-nya
- ABR memiliki lebih dari satu area
- Contoh command seperti dibawah ini :

R1-R9

```
RX(config)#router ospf 1
RX(config-router)#interface e0/0
RX(config-if)#ip ospf 1 area 0
RX(config-if)#interface e0/1
RX(config-if)#ip ospf 1 area 1
```

Verifikasi

1. Verifikasi neighbor
2. Verifikasi interface ospf
3. Verifikasi routing table
4. Verifikasi end-to-end ping
5. Verifikasi traceroute

1. Verifikasi neighbor

```
R4#show ip ospf neighbor
Neighbor ID      Pri  State            Dead Time    Address          Interface
10.3.5.3          1    FULL/BDR        00:00:33    10.3.4.3        Ethernet0/0
10.2.4.2          1    FULL/DR         00:00:33    10.2.4.2        Ethernet0/1
10.10.10.7        1    FULL/BDR        00:00:36    10.10.10.7     Ethernet0/2
10.10.10.8        1    FULL/DROTHER   00:00:30    10.10.10.8     Ethernet0/2
10.10.10.9        1    FULL/DROTHER   00:00:33    10.10.10.9     Ethernet0/2
R4#
```

2. Verifikasi interface ospf

```
R4#show ip ospf interface brief
Interface      PID  Area           IP Address/Mask   Cost  State Nbrs F/C
Et0/0          1    0              10.3.4.4/24       10    DR   1/1
Et0/1          1    0              10.2.4.4/24       10    BDR  1/1
Et0/2          1    3              10.10.10.4/24     10    DR   3/3
R4#
```

R4 sebagai ABR karena menghubungkan Area 0 dan Area 3.

3. Verifikasi routing table

```
R4#
R4#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from Pfr
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
O        10.1.2.0/24 [110/20] via 10.2.4.2, 00:05:36, Ethernet0/1
O        10.1.3.0/24 [110/20] via 10.3.4.3, 00:05:36, Ethernet0/0
O  IA     10.1.5.0/24 [110/30] via 10.3.4.3, 00:03:13, Ethernet0/0
O  IA     10.3.5.0/24 [110/20] via 10.2.4.2, 00:05:36, Ethernet0/1
R4#
R4#
```

```
O IA      10.1.5.0/24 [110/30] via 10.3.4.3, 00:03:13, Ethernet0/0
                                [110/30] via 10.2.4.2, 00:05:36, Ethernet0/1
```

Keterangan :

- O : intra-area
- O IA : inter-area OSPF
- 10.1.5.0/24 : network destination
- 110 : administrative Distance
- 30 : metric (cost)
- via 10.3.4.3, 10.2.4.2 : next-hop yang dilewati dan terdapat 2 jalur sehingga terjadi load balancing karena memiliki cost yang sama
- 00:03:13 : waktu last update
- Ethernet0/0 : outgoing interface

4. Verifikasi end-to-end ping

```
R9#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
O IA    10.1.2.0/24 [110/30] via 10.10.10.4, 00:04:03, Ethernet0/0
O IA    10.1.3.0/24 [110/30] via 10.10.10.4, 00:04:03, Ethernet0/0
O IA    10.1.5.0/24 [110/40] via 10.10.10.4, 00:04:03, Ethernet0/0
O IA    10.2.4.0/24 [110/20] via 10.10.10.4, 00:04:03, Ethernet0/0
O IA    10.3.4.0/24 [110/20] via 10.10.10.4, 00:04:03, Ethernet0/0
O IA    10.3.5.0/24 [110/30] via 10.10.10.4, 00:04:03, Ethernet0/0
C      10.10.10.0/24 is directly connected, Ethernet0/0
L      10.10.10.9/32 is directly connected, Ethernet0/0

R9#
R9#ping 10.3.5.5
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.5.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/3 ms
R9#
```

5. Verifikasi traceroute

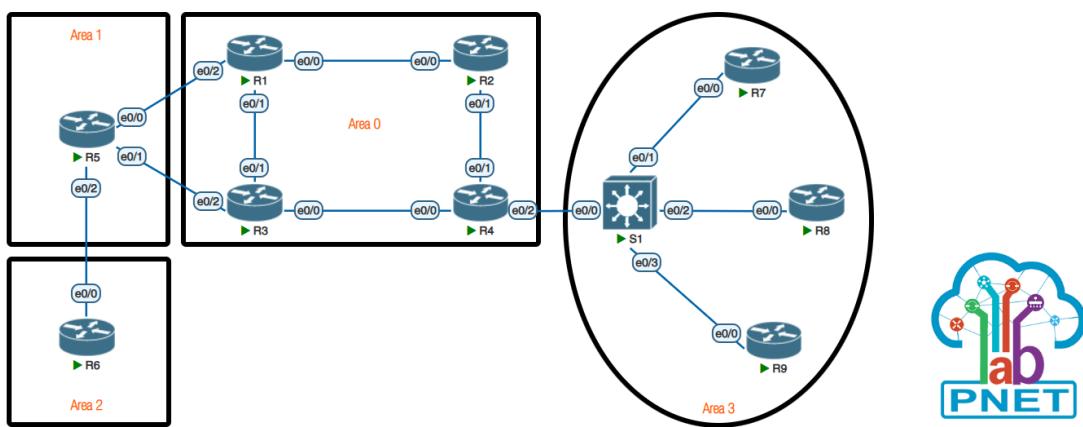
```
R9#trace 10.3.5.5
Type escape sequence to abort.
Tracing the route to 10.3.5.5
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.4 3 msec 3 msec 2 msec
  2 10.3.4.3 3 msec 2 msec 1 msec
  3 10.3.5.5 2 msec 3 msec *
R9#
```

Lab 3. OSPF Router-ID

Topology

Topology Workshop SP - OSPF Routing Basic

Created By Agus Setiawan



Konfigurasi

- Konfigurasi OSPF Router-ID menggunakan interface loopback

Pemilihan router-id OSPF secara default :

1. Konfigurasi manual menggunakan command **router-id** dibawah proses OSPF
2. Pemilihan IP address tertinggi interface loopback
3. Pemilihan IP address tertinggi interface non-loopback

Tampilkan interface pada router, kemudian tampilkan router-id router.

Command yang dapat digunakan untuk cek ip address interface / router-id :

```
show run  
show ip int brief  
show ip ospf interface  
show ip ospf neighbor
```

R1

```
R1#show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
Ethernet0/0        10.1.2.1        YES NVRAM up        up
Ethernet0/1        10.1.3.1        YES NVRAM up        up
Ethernet0/2        10.1.5.1        YES NVRAM up        up
Ethernet0/3        unassigned     YES NVRAM administratively down down
R1#
R1#show ip ospf interface brief
Interface   PID  Area          IP Address/Mask    Cost  State Nbrs F/C
Et0/1       1    0             10.1.3.1/24        10    BDR   1/1
Et0/0       1    0             10.1.2.1/24        10    BDR   1/1
Et0/2       1    1             10.1.5.1/24        10    BDR   1/1
R1#
R1#show ip ospf interface et0/1
Ethernet0/1 is up, line protocol is up
  Internet Address 10.1.3.1/24, Area 0, Attached via Interface Enable
  Process ID 1, Router ID 10.1.5.1, Network Type BROADCAST, Cost: 10
  Topology-MTID Cost  Disabled Shutdown Topology Name
    0      10    no      no      Base
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 10.3.5.3, Interface address 10.1.3.3
  Backup Designated router (ID) 10.1.5.1, Interface address 10.1.3.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:06
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/2/2, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 10.3.5.3 (Designated Router)
  Suppress hello for 0 neighbor(s)

R1#show ip ospf interface et0/0
Ethernet0/0 is up, line protocol is up
  Internet Address 10.1.2.1/24, Area 0, Attached via Interface Enable
  Process ID 1, Router ID 10.1.5.1, Network Type BROADCAST, Cost: 10
  Topology-MTID Cost  Disabled Shutdown Topology Name
    0      10    no      no      Base
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 10.2.4.2, Interface address 10.1.2.2
  Backup Designated router (ID) 10.1.5.1, Interface address 10.1.2.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1/1, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 10.2.4.2 (Designated Router)
  Suppress hello for 0 neighbor(s)
R1#
```

```

R1#show ip ospf interface et0/2
Ethernet0/2 is up, line protocol is up
  Internet Address 10.1.5.1/24, Area 1, Attached via Interface Enable
  Process ID 1, Router ID 10.1.5.1, Network Type BROADCAST, Cost: 10
  Topology-MTID    Cost    Disabled    Shutdown    Topology Name
    0            10      no        no        Base
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 10.5.6.5, Interface address 10.1.5.5
  Backup Designated router (ID) 10.1.5.1, Interface address 10.1.5.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:04
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1/3, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 10.5.6.5 (Designated Router)
  Suppress hello for 0 neighbor(s)
R1#

```

```

R1#show ip int brief
Interface          IP-Address      OK? Method Status
Protocol
Ethernet0/0        10.1.2.1       YES NVRAM   up
Ethernet0/1        10.1.3.1       YES NVRAM   up
Ethernet0/2        10.1.5.1       YES NVRAM   up
Ethernet0/3        unassigned     YES NVRAM   administratively down down

```

Dari output R1, secara default R1 menggunakan IP address non-loopback tertinggi yaitu Ethernet0/2 10.1.5.1.

Kita dapat menampilkan informasi router-id neighbor R1, R4, R5 secara default.

R1

```

R1#show ip ospf neighbor
Neighbor ID      Pri  State           Dead Time   Address      Interface
10.3.5.3          1    FULL/DR        00:00:38    10.1.3.3    Ethernet0/1
10.2.4.2          1    FULL/DR        00:00:35    10.1.2.2    Ethernet0/0
10.5.6.5          1    FULL/DR        00:00:35    10.1.5.5    Ethernet0/2
R1#

```

R4

```
R4#show ip ospf neighbor
Neighbor ID      Pri  State            Dead Time    Address          Interface
10.2.4.2          1    FULL/BDR        00:00:39     10.2.4.2        Ethernet0/1
10.3.5.3          1    FULL/BDR        00:00:39     10.3.4.3        Ethernet0/0
10.10.10.7         1   2WAY/DROTHER  00:00:36     10.10.10.7      Ethernet0/2
10.10.10.8         1   FULL/BDR        00:00:30     10.10.10.8      Ethernet0/2
10.10.10.9         1   FULL/DR         00:00:37     10.10.10.9      Ethernet0/2
R4#
```

R5

```
R5#show ip ospf neighbor
Neighbor ID      Pri  State            Dead Time    Address          Interface
10.3.5.3          1    FULL/BDR        00:00:39     10.3.5.3        Ethernet0/1
10.1.5.1          1    FULL/BDR        00:00:39     10.1.5.1        Ethernet0/0
10.5.6.6          1    FULL/DR         00:00:35     10.5.6.6        Ethernet0/2
R5#
```

Konfigurasi OSPF Router-ID menggunakan interface loopback:

1. Tambahkan interface loopback pada masing-masing router R1-R9

```
interface loopback 0
ip address x.x.x.x 255.255.255.255
```

X=adalah ID router, misalnya R1, maka IP address loopback 0 = 1.1.1.1

2. Inputkan command router-id dibawah proses OSPF 1

```
router ospf 1
router-id x.x.x.x
```

3. Lakukan reset OSPF agar pembacaan config router-id dimulai dari awal

```
clear ip ospf process [yes]
```

R5

```
R5(config)#int lo0
R5(config-if)#ip add 5.5.5.5 25
*Aug 15 07:31:29.390: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
R5(config-if)#ip add 5.5.5.5 255.255.255.255
R5(config-if)#
R5(config-if)#router ospf 1
R5(config-router)#router-id 5.5.5.5
% OSPF: Reload or use "clear ip ospf process" command, for this to take effect
R5(config-router)#
R5(config-router)#do clear ip ospf process
Reset ALL OSPF processes? [no]: yes
R5(config-router)#
R5(config-router)#
*Aug 15 07:31:49.602: %OSPF-5-ADJCHG: Process 1, Nbr 10.3.5.3 on Ethernet0/1 from FULL to DOWN, Neighbor Down: Interface down or detached
*Aug 15 07:31:49.602: %OSPF-5-ADJCHG: Process 1, Nbr 10.1.5.1 on Ethernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
*Aug 15 07:31:49.670: %OSPF-5-ADJCHG: Process 1, Nbr 10.5.6.6 on Ethernet0/2 from FULL to DOWN, Neighbor Down: Interface down or detached
*Aug 15 07:31:49.693: %OSPF-5-ADJCHG: Process 1, Nbr 10.3.5.3 on Ethernet0/1 from LOADING to FULL, Loading Done
*Aug 15 07:31:49.693: %OSPF-5-ADJCHG: Process 1, Nbr 10.1.5.1 on Ethernet0/0 from LOADING to FULL, Loading Done
R5(config-router)#
R5(config-router)#

```

R2

```
R2(config)#int lo0
R2(config-if)#ip add 2.2.2.2 255.2
*Aug 15 07:33:25.824: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
R2(config-if)#ip add 2.2.2.2 255.255.255.255
R2(config-if)#
R2(config-if)#router ospf 1
R2(config-router)#router-id 2.2.2.2
% OSPF: Reload or use "clear ip ospf process" command, for this to take effect
R2(config-router)#
R2(config-router)#do clear ip ospf process
Reset ALL OSPF processes? [no]: yes
R2(config-router)#
R2(config-router)#
*Aug 15 07:33:42.516: %OSPF-5-ADJCHG: Process 1, Nbr 10.10.10.4 on Ethernet0/1 from FULL to DOWN, Neighbor Down: Interface down or detached
*Aug 15 07:33:42.516: %OSPF-5-ADJCHG: Process 1, Nbr 10.1.5.1 on Ethernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
*Aug 15 07:33:42.518: %OSPF-5-ADJCHG: Process 1, Nbr 10.1.5.1 on Ethernet0/0 from LOADING to FULL, Loading Done
R2(config-router)#
R2(config-router)#

```

Pastikan semua node router R1-R9 sudah ditambahkan interface loopback 0 dan dikonfigurasi manual router-id.

Verifikasi

Untuk verifikasi router-id dapat menggunakan alternatif command yang lain :

```
show ip ospf
show ip protocols
```

R1

```
R1#show ip ospf
Routing Process "ospf 1" with ID 1.1.1.1
Start time: 00:00:06.082, Time elapsed: 00:39:38.025
Supports only single TOS(TOS0) routes
Supports opaque LSA
Supports Link-local Signaling (LLS)
Supports area transit capability
Supports NSSA (compatible with RFC 3101)
Supports Database Exchange Summary List Optimization (RFC 5243)
Event-log enabled, Maximum number of events: 1000, Mode: cyclic
It is an area border router
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 5000 msec
Minimum hold time between two consecutive SPFs 10000 msec
Maximum wait time between two consecutive SPFs 10000 msec
Incremental-SPF disabled
Minimum LSA interval 5 secs
Minimum LSA arrival 1000 msec
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msec
Retransmission pacing timer 66 msec
EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
Number of external LSA 0. Checksum Sum 0x0000000
Number of opaque AS LSA 0. Checksum Sum 0x0000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 2. 2 normal 0 stub 0 nssa
Number of areas transit capable is 0
External flood list length 0
IETF NSF helper support enabled
Cisco NSF helper support enabled
Reference bandwidth unit is 100 mbps
    Area BACKBONE(0)
        Number of interfaces in this area is 2
        Area has no authentication
        SPF algorithm last executed 00:03:07.801 ago
        SPF algorithm executed 6 times
        Area ranges are
        Number of LSA 13. Checksum Sum 0x0498EB
        Number of opaque link LSA 0. Checksum Sum 0x0000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
    Area 1
        Number of interfaces in this area is 1
        Area has no authentication
        SPF algorithm last executed 00:03:17.802 ago
        SPF algorithm executed 5 times
        Area ranges are
        Number of LSA 15. Checksum Sum 0x0718C8
        Number of opaque link LSA 0. Checksum Sum 0x0000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

R1

```
R1#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "application"
  Sending updates every 0 seconds
    Invalid after 0 seconds, hold down 0, flushed after 0
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Maximum path: 32
  Routing for Networks:
    Routing Information Sources:
      Gateway          Distance      Last Update
      Distance: (default is 4)

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.1.1.1
  It is an area border router
  Number of areas in this router is 2. 2 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    Routing on Interfaces Configured Explicitly (Area 0):
      Ethernet0/1
      Ethernet0/0
    Routing on Interfaces Configured Explicitly (Area 1):
      Ethernet0/2
    Routing Information Sources:
      Gateway          Distance      Last Update
      3.3.3.3          110          00:03:38
      5.5.5.5          110          00:03:38
      2.2.2.2          110          00:05:57
      10.5.6.5         110          00:32:13
      10.10.10.4       110          00:00:53
      10.2.4.2         110          00:39:12
      10.3.5.3         110          00:07:50
      Distance: (default is 110)
```

Output command diatas dapat diringkas menjadi seperti berikut ini :

R1

```
R1#show ip ospf | i ID
  Routing Process "ospf 1" with ID 1.1.1.1
R1#show ip protocols | i Router ID
  Router ID 1.1.1.1
R1#
```

R2

```
R2#show ip ospf | i ID
  Routing Process "ospf 1" with ID 2.2.2.2
R2#show ip protocols | i Router ID
  Router ID 2.2.2.2
R2#
```

R3

```
R3#show ip ospf | i ID
  Routing Process "ospf 1" with ID 3.3.3.3
R3#show ip protocols | i Router ID
  Router ID 3.3.3.3
R3#
```

R4

```
R4#show ip ospf | i ID
  Routing Process "ospf 1" with ID 4.4.4.4
R4#show ip protocols | i Router ID
  Router ID 4.4.4.4
R4#
R4#
```

R5

```
R5#show ip ospf | i ID
  Routing Process "ospf 1" with ID 5.5.5.5
R5#show ip protocols | i Router ID
  Router ID 5.5.5.5
R5#
R5#
```

R6

```
R6#show ip ospf | i ID
  Routing Process "ospf 1" with ID 6.6.6.6
R6#show ip protocols | i Router ID
  Router ID 6.6.6.6
R6#
R6#
```

R7

```
R7#show ip ospf | i ID
  Routing Process "ospf 1" with ID 7.7.7.7
R7#show ip protocols | i Router ID
  Router ID 7.7.7.7
R7#
R7#
```

R8

```
R8#show ip ospf | i ID
  Routing Process "ospf 1" with ID 8.8.8.8
R8#show ip protocols | i Router ID
  Router ID 8.8.8.8
R8#
R8#
```

R9

```
R9#show ip ospf | i ID
  Routing Process "ospf 1" with ID 9.9.9.9
R9#show ip protocols | i Router ID
  Router ID 9.9.9.9
R9#
```

Kita tampilkan informasi router-id neighbor R1, R4, R5 setelah diubah menggunakan interface loopback.

R1

```
R1#show ip ospf neighbor

Neighbor ID      Pri   State          Dead Time     Address           Interface
3.3.3.3          1     FULL/DR        00:00:39     10.1.3.3        Ethernet0/1
2.2.2.2          1     FULL/DR        00:00:31     10.1.2.2        Ethernet0/0
5.5.5.5          1     FULL/DR        00:00:37     10.1.5.5        Ethernet0/2
R1#
```

R4

```
R4#show ip ospf neighbor

Neighbor ID      Pri   State          Dead Time     Address           Interface
2.2.2.2          1     FULL/BDR       00:00:34     10.2.4.2        Ethernet0/1
3.3.3.3          1     FULL/BDR       00:00:33     10.3.4.3        Ethernet0/0
7.7.7.7          1     FULL/DROTHER  00:00:37     10.10.10.7      Ethernet0/2
8.8.8.8          1     FULL/DROTHER  00:00:32     10.10.10.8      Ethernet0/2
9.9.9.9          1     FULL/BDR       00:00:35     10.10.10.9      Ethernet0/2
R4#
```

R5

```
R5#show ip ospf neighbor

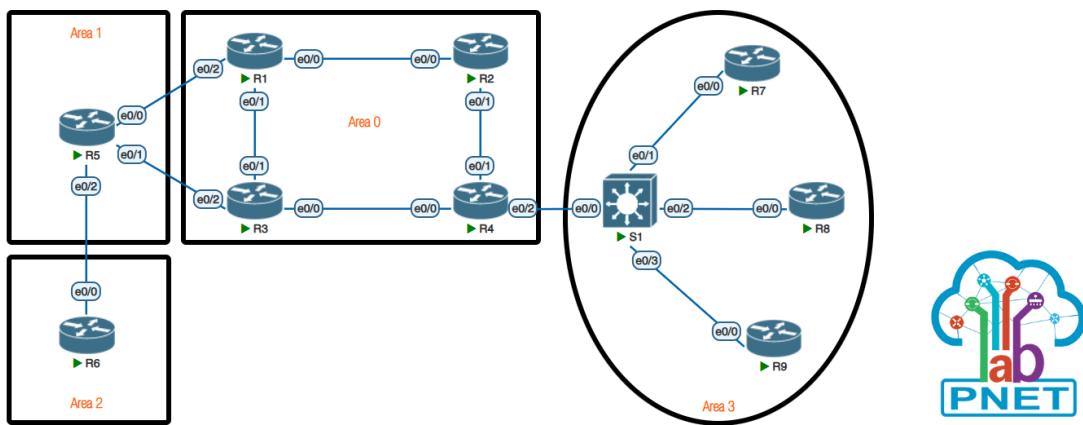
Neighbor ID      Pri   State          Dead Time     Address           Interface
3.3.3.3          1     FULL/BDR       00:00:31     10.3.5.3        Ethernet0/1
1.1.1.1          1     FULL/BDR       00:00:37     10.1.5.1        Ethernet0/0
6.6.6.6          1     FULL/BDR       00:00:38     10.5.6.6        Ethernet0/2
R5#
```

Lab 4. OSPF DR/BDR Election

Topology

Topology Workshop SP - OSPF Routing Basic

Created By Agus Setiawan



Konfigurasi

- Konfigurasi OSPF DR/BDR Election

R4
<pre>R4#show ip ospf neighbor Neighbor ID Pri State Dead Time Address Interface 2.2.2.2 1 FULL/DR 00:00:33 10.2.4.2 Ethernet0/1 3.3.3.3 1 FULL/DR 00:00:38 10.3.4.3 Ethernet0/0 7.7.7.7 1 2WAY/DROTHER 00:00:39 10.10.10.7 Ethernet0/2 8.8.8.8 1 FULL/BDR 00:00:36 10.10.10.8 Ethernet0/2 9.9.9.9 1 FULL/DR 00:00:32 10.10.10.9 Ethernet0/2 R4#</pre>

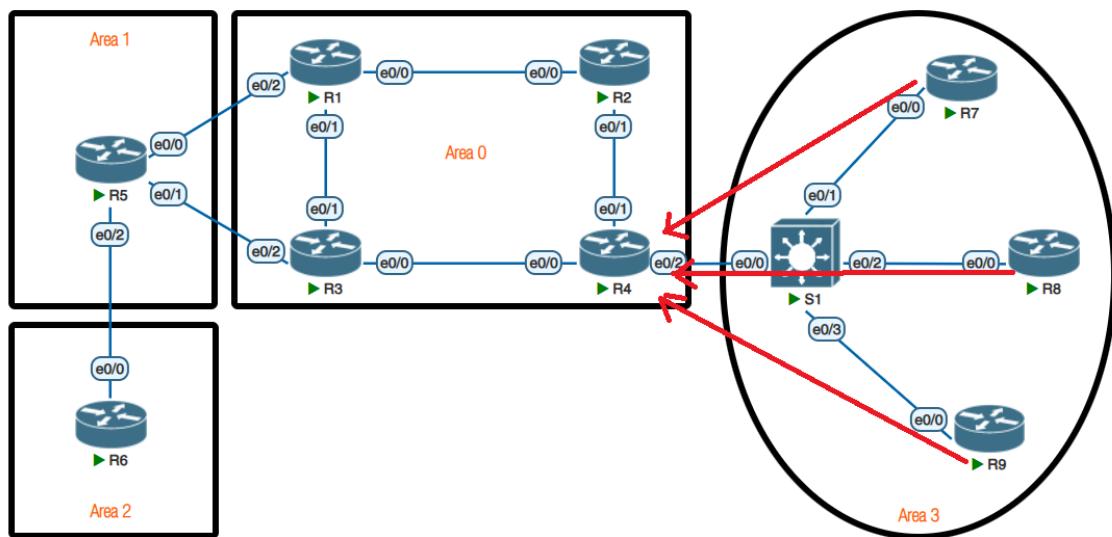
Dari output R4 diatas, R9 menjadi DR dan R8 menjadi BDR. Pada router ospf dengan segment yang sama, untuk efisiensi pengiriman LSA, maka dibutuhkan pemilihan DR/BDR. Dengan adanya DR/BDR, semua router melakukan pertukaran database secara full kepada DR. DR membutuhkan backup yaitu BDR.

Pemilihan DR/BDR :

1. DR dipilih dari router yang memiliki OSPF priority tertinggi antara 0 dan 255.
2. Jika router memiliki OSPF priority 0, maka tidak akan ikut seleksi DR/BDR.
3. By default router memiliki OSPF priority 1
4. Jika router memiliki OSPF priority sama, maka akan dipilih router yang memiliki Router-ID tertinggi.

Oleh karena itu, mengapa R9 dipilih menjadi DR? By default R4,R7,R8,R9 memiliki priority sama, sehingga dipilihlah R9 sebagai DR karena memiliki Router-ID tertinggi. Dan DR membutuhkan backup, maka dipilih router-id tertinggi kedua R8 sebagai BDR.

Sekarang, lakukan konfigurasi agar R4 menjadi DR dan R7 menjadi BDR dengan mengubah OSPF priority. Jangan lupa untuk melakukan reset proses OSPF agar update OSPFnya.



R4

```
R4(config)#int e0/2
R4(config-if)#ip ospf priority 200
R4(config-if)#
R4(config-if)#do clear ip ospf process
Reset ALL OSPF processes? [no]: yes
```

R7

```
R7(config)#int e0/0
R7(config-if)#ip ospf priority 100
R7(config-if)#
R7(config-if)#do clear ip ospf process
Reset ALL OSPF processes? [no]: yes
```

Verifikasi

Lakukan verifikasi neighbor OSPF dari R9 dan OSPF interface R4.

R9

```
R9#show ip ospf neighbor
Neighbor ID      Pri  State            Dead Time    Address          Interface
4.4.4.4          200  FULL/DR         00:00:37     10.10.10.4    Ethernet0/0
7.7.7.7          100  FULL/BDR        00:00:37     10.10.10.7    Ethernet0/0
8.8.8.8          1    2WAY/DROTHER   00:00:31     10.10.10.8    Ethernet0/0
R9#
```

R4

```
R4#show ip ospf interface eth0/2
Ethernet0/2 is up, line protocol is up
  Internet Address 10.10.10.4/24, Area 3, Attached via Interface Enable
  Process ID 1, Router ID 4.4.4.4, Network Type BROADCAST, Cost: 10
  Topology-MTID  Cost  Disabled  Shutdown  Topology Name
    0       10      no        no        Base
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State DR, Priority 200
  Designated Router (ID) 4.4.4.4, Interface address 10.10.10.4
  Backup Designated router (ID) 7.7.7.7, Interface address 10.10.10.7
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:06
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1/3, Flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 8
  Last flood scan time is 0 msec, maximum is 1 msec
  Neighbor Count is 3, Adjacent neighbor count is 3
    Adjacent with neighbor 7.7.7.7 (Backup Designated Router)
    Adjacent with neighbor 8.8.8.8
    Adjacent with neighbor 9.9.9.9
  Suppress hello for 0 neighbor(s)
R4#
```

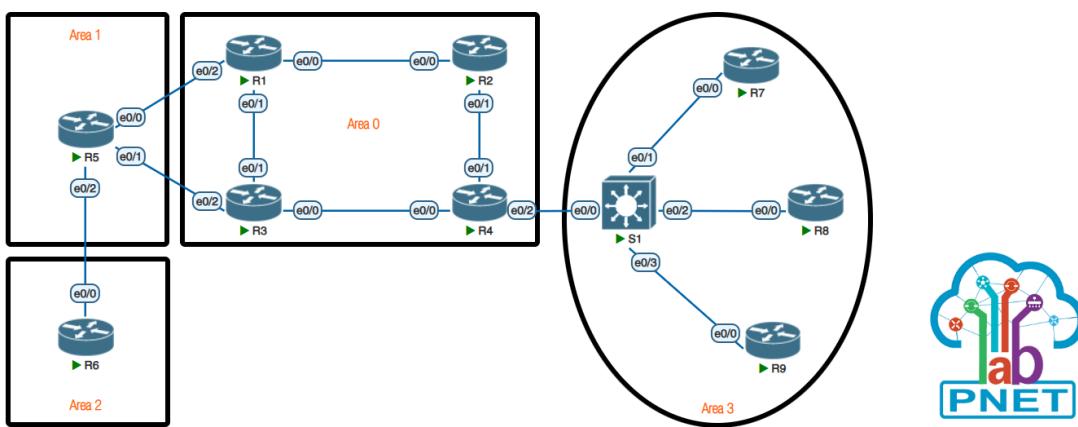
DR = R4 dan BDR = R7.

Lab 5. OSPF Redistribute Default Route

Topology

Topology Workshop SP - OSPF Routing Basic

Created By Agus Setiawan



Konfigurasi

- Konfigurasi redistribute default route kedalam OSPF

Tambahkan interface loopback 8 dengan ip address 8.8.8.8/32 di R2, buatlah default route dan redistribute kedalam OSPF.

R2

```
R2(config)#int lo8
R2(config-if)#ip add 8.8.8.8 255.255.255.255
R2(config-if)#
R2(config-if)#ip route 0.0.0.0 0.0.0.0 lo8
R2(config)#
R2(config)#router ospf 1
R2(config-router)#default-information originate
R2(config-router)#{
```

Tujuan dari redistribute default route adalah untuk mengadvertise route internet 0.0.0.0/0 kedalam routing OSPF.

Verifikasi

Untuk verifikasi dapat menggunakan command berikut ini :

```
show ip route  
show ip route ospf  
ping  
traceroute
```

R9

```
R9#show ip route  
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
      E1 - OSPF external type 1, E2 - OSPF external type 2  
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
      ia - IS-IS inter area, * - candidate default, U - per-user static route  
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LISP  
      a - application route  
      + - replicated route, % - next hop override, p - overrides from PfR  
  
Gateway of last resort is 10.10.10.4 to network 0.0.0.0  
  
O*E2  0.0.0.0/0 [110/1] via 10.10.10.4, 00:03:08, Ethernet0/0  
      9.0.0.0/32 is subnetted, 1 subnets  
C       9.9.9.9 is directly connected, Loopback0  
      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks  
O  IA    10.1.2.0/24 [110/30] via 10.10.10.4, 00:19:03, Ethernet0/0  
O  IA    10.1.3.0/24 [110/30] via 10.10.10.4, 00:19:03, Ethernet0/0  
O  IA    10.1.5.0/24 [110/40] via 10.10.10.4, 00:19:03, Ethernet0/0  
O  IA    10.2.4.0/24 [110/20] via 10.10.10.4, 00:19:03, Ethernet0/0  
O  IA    10.3.4.0/24 [110/20] via 10.10.10.4, 00:19:03, Ethernet0/0  
O  IA    10.3.5.0/24 [110/30] via 10.10.10.4, 00:19:03, Ethernet0/0  
C       10.10.10.0/24 is directly connected, Ethernet0/0  
L       10.10.10.9/32 is directly connected, Ethernet0/0  
R9#  
R9#show ip route ospf  
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
      E1 - OSPF external type 1, E2 - OSPF external type 2  
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
      ia - IS-IS inter area, * - candidate default, U - per-user static route  
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LISP  
      a - application route  
      + - replicated route, % - next hop override, p - overrides from PfR  
  
Gateway of last resort is 10.10.10.4 to network 0.0.0.0  
  
O*E2  0.0.0.0/0 [110/1] via 10.10.10.4, 00:06:54, Ethernet0/0  
      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks  
O  IA    10.1.2.0/24 [110/30] via 10.10.10.4, 00:22:49, Ethernet0/0  
O  IA    10.1.3.0/24 [110/30] via 10.10.10.4, 00:22:49, Ethernet0/0  
O  IA    10.1.5.0/24 [110/40] via 10.10.10.4, 00:22:49, Ethernet0/0  
O  IA    10.2.4.0/24 [110/20] via 10.10.10.4, 00:22:49, Ethernet0/0  
O  IA    10.3.4.0/24 [110/20] via 10.10.10.4, 00:22:49, Ethernet0/0  
O  IA    10.3.5.0/24 [110/30] via 10.10.10.4, 00:22:49, Ethernet0/0  
R9#
```

```
R9#ping 8.8.8.8
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 8.8.8.8, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/3 ms
R9#
R9#traceroute 8.8.8.8
Type escape sequence to abort.
Tracing the route to 8.8.8.8
VRF info: (vrf in name/id, vrf out name/id)
 1 10.10.10.4 1 msec 5 msec 3 msec
 2 10.2.4.2 5 msec 7 msec *
R9#
```

R5

```
R5#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 10.1.5.1 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.1.5.1, 00:09:26, Ethernet0/0
      5.0.0.0/32 is subnetted, 1 subnets
C       5.5.5.5 is directly connected, Loopback0
      10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
O  IA   10.1.2.0/24 [110/20] via 10.1.5.1, 01:16:36, Ethernet0/0
O  IA   10.1.3.0/24 [110/20] via 10.3.5.3, 01:16:07, Ethernet0/1
                  [110/20] via 10.1.5.1, 01:16:36, Ethernet0/0
C       10.1.5.0/24 is directly connected, Ethernet0/0
L       10.1.5.5/32 is directly connected, Ethernet0/0
O  IA   10.2.4.0/24 [110/30] via 10.3.5.3, 00:46:47, Ethernet0/1
                  [110/30] via 10.1.5.1, 00:46:47, Ethernet0/0
O  IA   10.3.4.0/24 [110/20] via 10.3.5.3, 00:46:47, Ethernet0/1
C       10.3.5.0/24 is directly connected, Ethernet0/1
L       10.3.5.5/32 is directly connected, Ethernet0/1
C       10.5.6.0/24 is directly connected, Ethernet0/2
L       10.5.6.5/32 is directly connected, Ethernet0/2
O  IA   10.10.10.0/24 [110/30] via 10.3.5.3, 00:26:28, Ethernet0/1
R5#
R5#
R5#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 10.1.5.1 to network 0.0.0.0

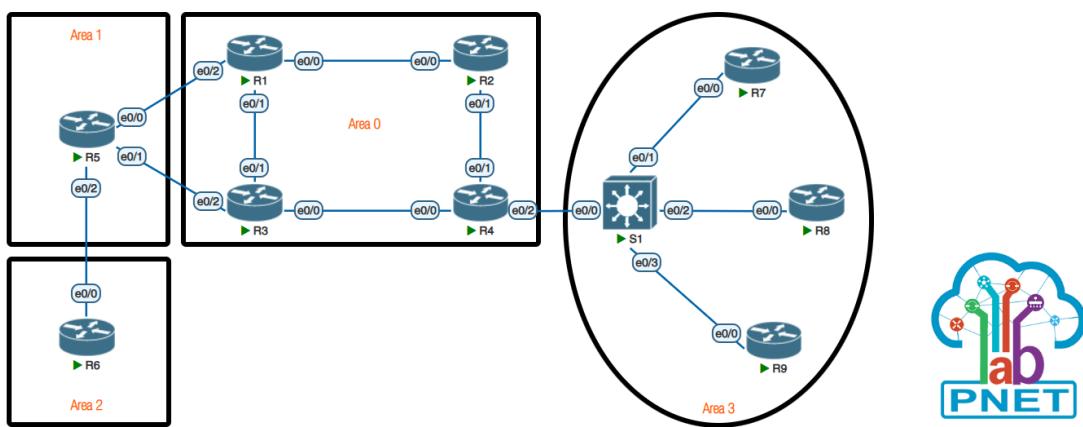
O*E2  0.0.0.0/0 [110/1] via 10.1.5.1, 00:09:30, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
O  IA   10.1.2.0/24 [110/20] via 10.1.5.1, 01:16:40, Ethernet0/0
O  IA   10.1.3.0/24 [110/20] via 10.3.5.3, 01:16:11, Ethernet0/1
                  [110/20] via 10.1.5.1, 01:16:40, Ethernet0/0
O  IA   10.2.4.0/24 [110/30] via 10.3.5.3, 00:46:51, Ethernet0/1
                  [110/30] via 10.1.5.1, 00:46:51, Ethernet0/0
O  IA   10.3.4.0/24 [110/20] via 10.3.5.3, 00:46:51, Ethernet0/1
O  IA   10.10.10.0/24 [110/30] via 10.3.5.3, 00:26:32, Ethernet0/1
R5#
R5#
R5#ping 8.8.8.8
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 8.8.8.8, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R5#
R5#traceroute 8.8.8.8
Type escape sequence to abort.
Tracing the route to 8.8.8.8
VRF info: (vrf in name/id, vrf out name/id)
  1 10.1.5.1 2 msec 2 msec 2 msec
  2 10.1.2.2 3 msec 4 msec *
R5#
```

Lab 6. OSPF Network Type

Topology

Topology Workshop SP - OSPF Routing Basic

Created By Agus Setiawan



Konfigurasi

- Konfigurasi network type OSPF

1. Tambahkan interface loopback 1 pada R8 dengan ip address 192.168.8.1/24
Fungsi dari interface loopback 1 sebagai representasi network LAN R8
2. Advertise loopback 1 kedalam OSPF Area 3
3. Tampilkan output route loopback 1 di R5

R8

```
R8(config)#int lo1
R8(config-if)#ip add 192.168.8.1 255.255.255.0
R8(config-if)#
R8(config-if)#int lo1
R8(config-if)#ip ospf 1 area 3
R8(config-if)#
R8(config-if)#do show ip ospf interface brief
Interface    PID    Area          IP Address/Mask      Cost   State Nbrs F/C
Lo1         1       3            192.168.8.1/24      1      LOOP  0/0
Et0/0        1       3            10.10.10.8/24      10     DROTH 2/3
R8(config-if)#
```

R5

```
R5#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 10.1.5.1 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.1.5.1, 00:32:10, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
O  IA    10.1.2.0/24 [110/20] via 10.1.5.1, 01:39:20, Ethernet0/0
O  IA    10.1.3.0/24 [110/20] via 10.3.5.3, 01:38:51, Ethernet0/1
      [110/20] via 10.1.5.1, 01:39:20, Ethernet0/0
O  IA    10.2.4.0/24 [110/30] via 10.3.5.3, 01:09:31, Ethernet0/1
      [110/30] via 10.1.5.1, 01:09:31, Ethernet0/0
O  IA    10.3.4.0/24 [110/20] via 10.3.5.3, 01:09:31, Ethernet0/1
O  IA    10.10.10.0/24 [110/30] via 10.3.5.3, 00:49:12, Ethernet0/1
      192.168.8.0/32 is subnetted, 1 subnets
O  IA    192.168.8.1 [110/31] via 10.3.5.3, 00:01:00, Ethernet0/1
R5#
```

Dari output R5 diatas, route lo1 R8 diterima sebagai 192.168.8.1/32 bukan sebagai 192.168.8.1/24. Oleh karena itu kita perlu mengubah network type lo1 R8.

R8 (Before)

```
R8#show ip ospf interface lo1
Loopback1 is up, line protocol is up
  Internet Address 192.168.8.1/24, Area 3, Attached via Interface Enable
  Process ID 1, Router ID 8.8.8.8, Network Type LOOPBACK, Cost: 1
  Topology-MTID    Cost    Disabled    Shutdown    Topology Name
    0            1        no          no          Base
  Enabled by interface config, including secondary ip addresses
  Loopback interface is treated as a stub Host
R8#
```

R8 (After)

```
R8(config-if)#int lo1
R8(config-if)#ip ospf network point-to-point
R8(config-if)#
R8(config-if)#end
R8#
R8#show ip ospf interface lo1
Loopback1 is up, line protocol is up
  Internet Address 192.168.8.1/24, Area 3, Attached via Interface Enable
  Process ID 1, Router ID 8.8.8.8, Network Type POINT TO POINT, Cost: 1
  Topology-MTID    Cost    Disabled    Shutdown    Topology Name
    0            1        no          no          Base
```

```

Enabled by interface config, including secondary ip addresses
Transmit Delay is 1 sec, State POINT_TO_POINT
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
Supports Link-local Signaling (LLS)
Cisco NSF helper support enabled
IETF NSF helper support enabled
Index 1/2/2, flood queue length 0
Next 0x0(0)/0x0(0)/0x0(0)
Last flood scan length is 0, maximum is 0
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 0, Adjacent neighbor count is 0
    Suppress hello for 0 neighbor(s)
R8#

```

Verifikasi

Verifikasi kembali di R5 dan lakukan end-to-end ping.

R5

```

R5#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LIS
      a - application route
      + - replicated route, % - next hop override, p - overrides from PFR
      + - replicated route, % - next hop override, p - overrides from PFR

Gateway of last resort is 10.1.5.1 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.1.5.1, 00:42:59, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
O  IA   10.1.2.0/24 [110/20] via 10.1.5.1, 01:50:09, Ethernet0/0
O  IA   10.1.3.0/24 [110/20] via 10.3.5.3, 01:49:40, Ethernet0/1
      [110/20] via 10.1.5.1, 01:50:09, Ethernet0/0
O  IA   10.2.4.0/24 [110/30] via 10.3.5.3, 01:20:20, Ethernet0/1
      [110/30] via 10.1.5.1, 01:20:20, Ethernet0/0
O  IA   10.3.4.0/24 [110/20] via 10.3.5.3, 01:20:20, Ethernet0/1
O  IA   10.10.10.0/24 [110/30] via 10.3.5.3, 01:00:01, Ethernet0/1
O  IA   192.168.8.0/24 [110/31] via 10.3.5.3, 00:04:21, Ethernet0/1
R5#
R5#ping 192.168.8.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.8.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/2/2 ms
R5#
R5#traceroute 192.168.8.1
Type escape sequence to abort.
Tracing the route to 192.168.8.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.3.5.3 1 msec 2 msec 1 msec
  2 10.3.4.4 2 msec 3 msec 2 msec
  3 10.10.10.8 5 msec 7 msec *
R5#

```

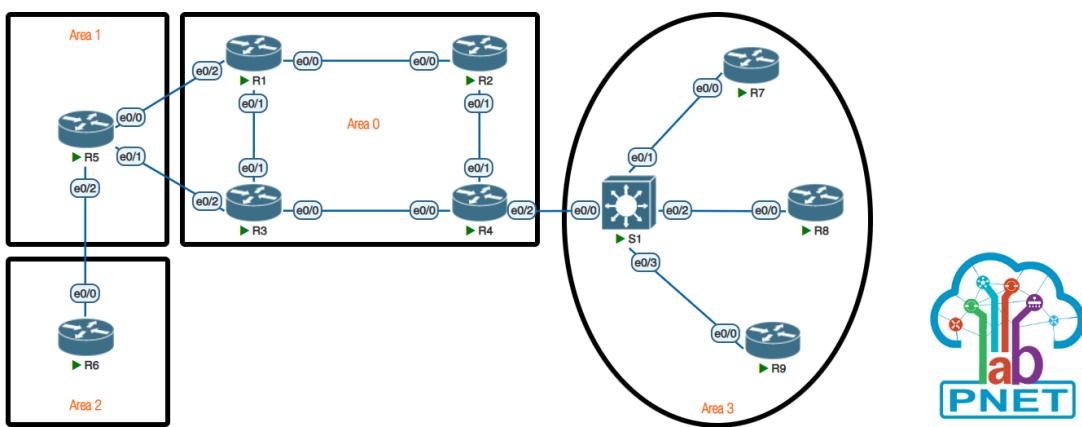
Sekarang lo1 R8 sudah diterima route-nya di R5 sebagai 192.168.8.0/24.

Lab 7. OSPF Authentication

Topology

Topology Workshop SP - OSPF Routing Basic

Created By Agus Setiawan



Konfigurasi

- Konfigurasi OSPF Authentication antara R3 dan R4 menggunakan MD5.

OSPF support 4 tipe authentication :

- Type 0: No authentication (default).
- Type 1: Plain-text authentication.
- Type 2: MD5 authentication.
- Type 3: HMAC-SHA authentication (HMAC-SHA-1, HMAC-SHA-256, etc.)

R3

```
R3(config)#int e0/0
R3(config-if)#ip ospf authentication message-digest
*Aug 15 09:35:15.297: %OSPF-4-NOVALIDKEY: No valid
authentication send key is available on interface Ethernet0/0
R3(config-if)#ip ospf message-digest-key 1 md5 Nixtrain
R3(config-if)#
R3(config-if)#
*Aug 15 09:35:42.265: %OSPF-5-ADJCHG: Process 1, Nbr 4.4.4.4
on Ethernet0/0 from FULL to DOWN, Neighbor Down: Dead timer
expired
R3(config-if) #
```

Penambahan autentikasi harus dilakukan dari dua sisi interface antara router R3 dan R4. Apabila hanya dari satu saja, maka OSPF akan Down setelah Dead Interval expired.

Konfigurasi autentikasi pada R4 dan pastikan sama dengan R3.

R4

```
R4(config)#int e0/0
R4(config-if)#ip ospf authentication message-digest
R4(config-if)#
*Aug 15 09:39:07.676: %OSPF-4-NOVALIDKEY: No valid
authentication send key is available on interface Ethernet0/0
R4(config-if)#ip ospf message-digest-key 1 md5 Nixtrain
R4(config-if)#
R4(config-if)#
*Aug 15 09:39:15.655: %OSPF-5-ADJCHG: Process 1, Nbr 3.3.3.3
on Ethernet0/0 from LOADING to FULL, Loading Done
R4(config-if)#

```

Verifikasi

Verifikasi neighborship antara R3 dan R4 setelah dikonfigurasi MD5 authentication.

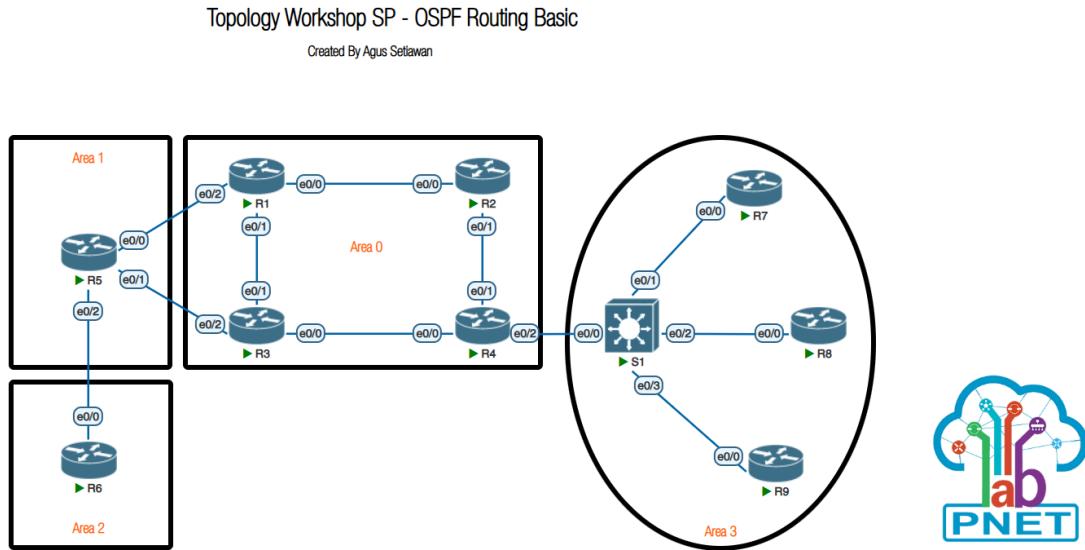
R3

```
R3#show ip ospf neighbor
Neighbor ID      Pri  State            Dead Time    Address          Interface
1.1.1.1           1    FULL/BDR        00:00:31     10.1.3.1        Ethernet0/1
4.4.4.4           1    FULL/DR         00:00:34     10.3.4.4        Ethernet0/0
5.5.5.5           1    FULL/DR         00:00:31     10.3.5.5        Ethernet0/2
R3#
R3#show ip ospf int e0/1
Ethernet0/1 is up, line protocol is up
  Internet Address 10.1.3.3/24, Area 0, Attached via Interface Enable
  Process ID 1, Router ID 3.3.3.3, Network Type BROADCAST, Cost: 10
  Topology-MTID   Cost   Disabled   Shutdown   Topology Name
    0          10      no        no        Base
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 3.3.3.3, Interface address 10.1.3.3
  Backup Designated router (ID) 1.1.1.1, Interface address 10.1.3.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:09
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/2/2, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 4
  Last flood scan time is 0 msec, maximum is 1 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 1.1.1.1 (Backup Designated Router)
  Suppress hello for 0 neighbor(s)
R3#
R3#show ip ospf int e0/0
Ethernet0/0 is up, line protocol is up
  Internet Address 10.3.4.3/24, Area 0, Attached via Interface Enable
  Process ID 1, Router ID 3.3.3.3, Network Type BROADCAST, Cost: 10
  Topology-MTID   Cost   Disabled   Shutdown   Topology Name
    0          10      no        no        Base
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 4.4.4.4, Interface address 10.3.4.4
  Backup Designated router (ID) 3.3.3.3, Interface address 10.3.4.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1/1, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 4
  Last flood scan time is 0 msec, maximum is 1 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 4.4.4.4 (Designated Router)
  Suppress hello for 0 neighbor(s)
  Cryptographic authentication enabled
    Youngest key id is 1
R3#
```

Autentikasi diaktifkan pada Ethernet0/0 R3 yang terhubung ke Ethernet0/0 R4.

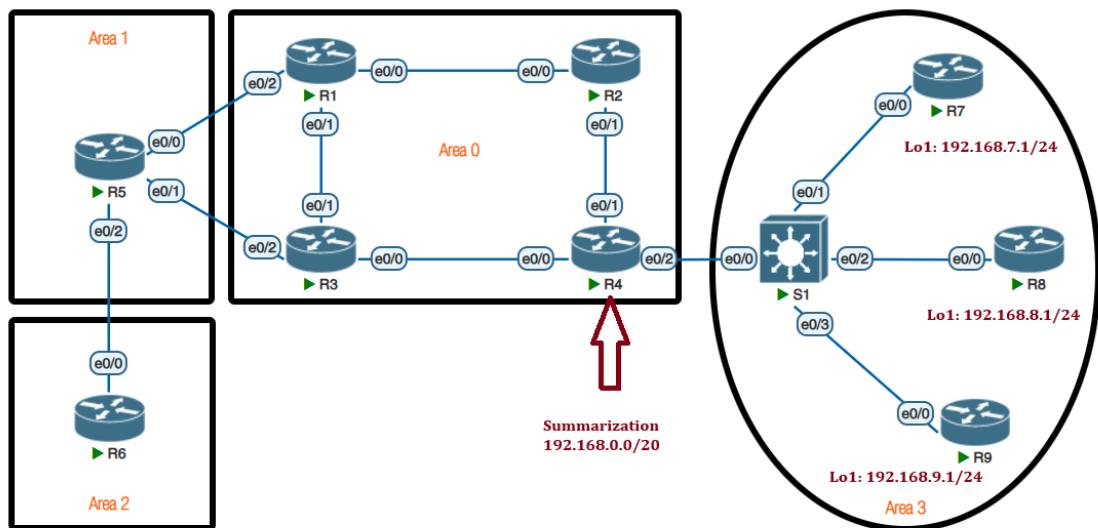
Lab 8. OSPF Route Summarization

Topology



Konfigurasi

- Tambahkan interface lo1 pada R7,R8,R9
- Konfigurasi OSPF summarization di R4



Summarization di OSPF dapat dilakukan di ABR atau ASBR. Dari gambar diatas, R4 sebagai ABR yang akan melakukan summarization network Lo1 yang di advertise oleh R7-R9 agar di kirimkan ke router uplink menjadi lebih ringkas.

R7

```
!
interface Loopback1
 ip address 192.168.7.1 255.255.255.0
 ip ospf network point-to-point
 ip ospf 1 area 3
!
```

R8

```
!
interface Loopback1
 ip address 192.168.8.1 255.255.255.0
 ip ospf network point-to-point
 ip ospf 1 area 3
!
```

R9

```
!
interface Loopback1
 ip address 192.168.9.1 255.255.255.0
 ip ospf network point-to-point
 ip ospf 1 area 3
!
```

Status network Lo1 R7-R9 saat ini sebelum dilakukan summarization.

R5

```
R5#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 10.1.5.1 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.1.5.1, 01:13:56, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
O  IA   10.1.2.0/24 [110/20] via 10.1.5.1, 02:21:06, Ethernet0/0
O  IA   10.1.3.0/24 [110/20] via 10.3.5.3, 02:20:37, Ethernet0/1
      [110/20] via 10.1.5.1, 02:21:06, Ethernet0/0
O  IA   10.2.4.0/24 [110/30] via 10.3.5.3, 00:18:02, Ethernet0/1
      [110/30] via 10.1.5.1, 01:51:17, Ethernet0/0
O  IA   10.3.4.0/24 [110/20] via 10.3.5.3, 01:51:17, Ethernet0/1
O  IA   10.10.10.0/24 [110/30] via 10.3.5.3, 00:18:02, Ethernet0/1
O  IA   192.168.7.0/24 [110/31] via 10.3.5.3, 00:00:03, Ethernet0/1
O  IA   192.168.8.0/24 [110/31] via 10.3.5.3, 00:18:02, Ethernet0/1
O  IA   192.168.9.0/24 [110/31] via 10.3.5.3, 00:01:06, Ethernet0/1
R5#
```

Konfigurasi route summarization di R4.

R4

```
R4(config)#router ospf 1
R4(config-router)#area 3 range 192.168.0.0 255.255.240.0
R4(config-router) #
```

Status network Lo1 R7-R9 saat ini setelah dilakukan summarization.

R5

```
R5#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 10.1.5.1 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.1.5.1, 01:15:20, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
O  IA   10.1.2.0/24 [110/20] via 10.1.5.1, 02:22:30, Ethernet0/0
O  IA   10.1.3.0/24 [110/20] via 10.3.5.3, 02:22:01, Ethernet0/1
      [110/20] via 10.1.5.1, 02:22:30, Ethernet0/0
O  IA   10.2.4.0/24 [110/30] via 10.3.5.3, 00:19:26, Ethernet0/1
      [110/30] via 10.1.5.1, 01:52:41, Ethernet0/0
O  IA   10.3.4.0/24 [110/20] via 10.3.5.3, 01:52:41, Ethernet0/1
O  IA   10.10.10.0/24 [110/30] via 10.3.5.3, 00:19:26, Ethernet0/1
O  IA   192.168.0.0/20 [110/31] via 10.3.5.3, 00:00:05, Ethernet0/1
R5#
```

Verifikasi

Verifikasi end-to-end device ping dari R5 menuju Lo1 R7-R9.

R5

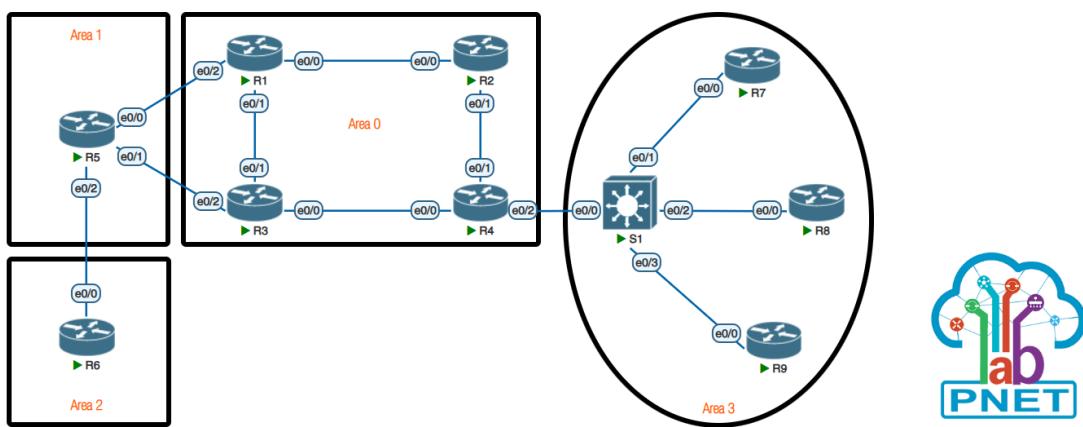
```
R5#ping 192.168.7.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.7.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/2/3 ms
R5#
R5#ping 192.168.8.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.8.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/2/3 ms
R5#
R5#ping 192.168.9.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.9.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/2/3 ms
R5#
```

Ping berhasil ke semua Lo1 R7-R9.

Lab 9. OSPF Virtual Link

Topology

Topology Workshop SP - OSPF Routing Basic
Created By Agus Setiawan



Konfigurasi

- Tambahkan semua Lo0 R1-R9 kedalam proses OSPF 1 sesuai dengan Area masing-masing

RX

```
!
interface Loopback0
 ip address X.X.X.X 255.255.255.255
 ip ospf 1 area X
!
```

Setelah diadVERTISE semua Lo0 melalui OSPF, tampilkan routing table R5, R9 dan R1.

R5

```
R5#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from Pfr

Gateway of last resort is 10.1.5.1 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.1.5.1, 02:57:18, Ethernet0/0
      1.0.0.0/32 is subnetted, 1 subnets
O  IA   1.1.1.1 [110/11] via 10.1.5.1, 00:03:44, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O  IA   2.2.2.2 [110/21] via 10.1.5.1, 00:03:30, Ethernet0/0
      3.0.0.0/32 is subnetted, 1 subnets
O  IA   3.3.3.3 [110/11] via 10.3.5.3, 00:03:20, Ethernet0/1
      4.0.0.0/32 is subnetted, 1 subnets
O  IA   4.4.4.4 [110/21] via 10.3.5.3, 00:03:07, Ethernet0/1
      6.0.0.0/32 is subnetted, 1 subnets
O   6.6.6.6 [110/11] via 10.5.6.6, 00:02:34, Ethernet0/2
      7.0.0.0/32 is subnetted, 1 subnets
O  IA   7.7.7.7 [110/31] via 10.3.5.3, 00:02:16, Ethernet0/1
      8.0.0.0/32 is subnetted, 1 subnets
O  IA   8.8.8.8 [110/31] via 10.3.5.3, 00:02:06, Ethernet0/1
      9.0.0.0/32 is subnetted, 1 subnets
O  IA   9.9.9.9 [110/31] via 10.3.5.3, 00:01:56, Ethernet0/1
      10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
O  IA   10.1.2.0/24 [110/20] via 10.1.5.1, 04:04:28, Ethernet0/0
O  IA   10.1.3.0/24 [110/20] via 10.3.5.3, 04:03:59, Ethernet0/1
      [110/20] via 10.1.5.1, 04:04:28, Ethernet0/0
O  IA   10.2.4.0/24 [110/30] via 10.3.5.3, 02:01:24, Ethernet0/1
      [110/30] via 10.1.5.1, 03:34:39, Ethernet0/0
O  IA   10.3.4.0/24 [110/20] via 10.3.5.3, 03:34:39, Ethernet0/1
O  IA   10.10.10.0/24 [110/30] via 10.3.5.3, 02:01:24, Ethernet0/1
O  IA   192.168.7.0/24 [110/31] via 10.3.5.3, 01:31:22, Ethernet0/1
O  IA   192.168.8.0/24 [110/31] via 10.3.5.3, 01:31:22, Ethernet0/1
O  IA   192.168.9.0/24 [110/31] via 10.3.5.3, 01:31:22, Ethernet0/1
R5#
```

Dari output routing table R5, Lo0 R6 muncul di routing table.

R9

```
R9#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 10.10.10.4 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.10.10.4, 02:58:16, Ethernet0/0
      1.0.0.0/32 is subnetted, 1 subnets
O  IA   1.1.1.1 [110/31] via 10.10.10.4, 00:04:42, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O  IA   2.2.2.2 [110/21] via 10.10.10.4, 00:04:28, Ethernet0/0
      3.0.0.0/32 is subnetted, 1 subnets
O  IA   3.3.3.3 [110/21] via 10.10.10.4, 00:04:18, Ethernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O  IA   4.4.4.4 [110/11] via 10.10.10.4, 00:04:05, Ethernet0/0
      5.0.0.0/32 is subnetted, 1 subnets
O  IA   5.5.5.5 [110/31] via 10.10.10.4, 00:03:49, Ethernet0/0
      7.0.0.0/32 is subnetted, 1 subnets
O     7.7.7.7 [110/11] via 10.10.10.7, 00:03:14, Ethernet0/0
      8.0.0.0/32 is subnetted, 1 subnets
O     8.8.8.8 [110/11] via 10.10.10.8, 00:03:04, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
O  IA   10.1.2.0/24 [110/30] via 10.10.10.4, 03:14:11, Ethernet0/0
O  IA   10.1.3.0/24 [110/30] via 10.10.10.4, 02:02:22, Ethernet0/0
O  IA   10.1.5.0/24 [110/40] via 10.10.10.4, 03:14:11, Ethernet0/0
O  IA   10.2.4.0/24 [110/20] via 10.10.10.4, 03:14:11, Ethernet0/0
O  IA   10.3.4.0/24 [110/20] via 10.10.10.4, 03:14:11, Ethernet0/0
O  IA   10.3.5.0/24 [110/30] via 10.10.10.4, 02:02:22, Ethernet0/0
O     192.168.7.0/24 [110/11] via 10.10.10.7, 01:44:24, Ethernet0/0
O     192.168.8.0/24 [110/11] via 10.10.10.8, 02:19:38, Ethernet0/0
R9#
```

Dari output routing table R9, Lo0 R6 tidak muncul di routing table.

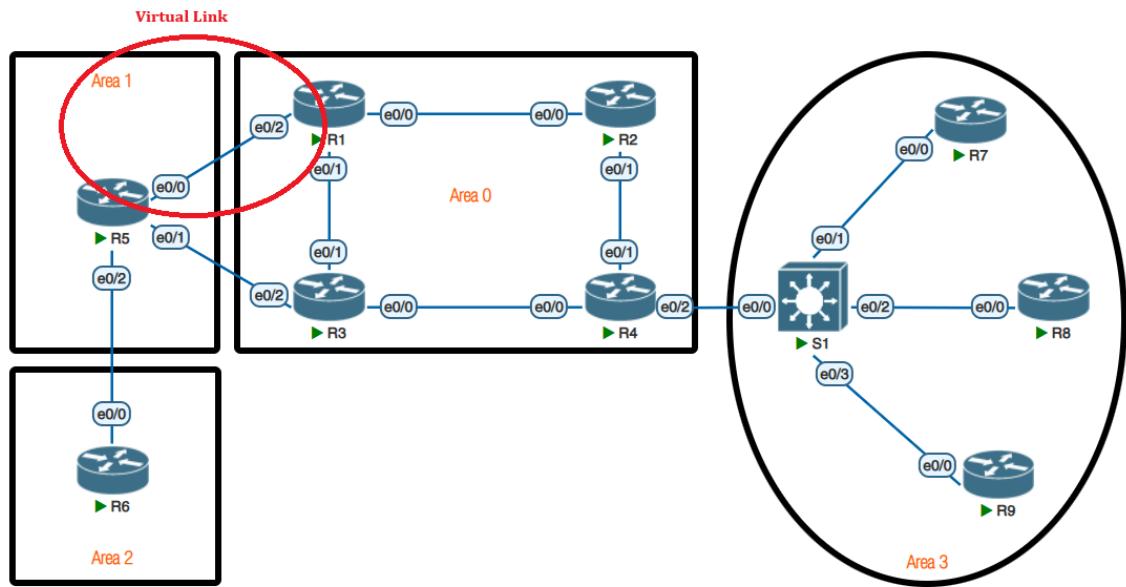
R1

```
R1#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 10.1.2.2 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.1.2.2, 02:59:22, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
      0         2.2.2.2 [110/11] via 10.1.2.2, 00:05:29, Ethernet0/0
      0         3.0.0.0/32 is subnetted, 1 subnets
      0           3.3.3.3 [110/11] via 10.1.3.3, 00:05:19, Ethernet0/1
      0         4.0.0.0/32 is subnetted, 1 subnets
      0           4.4.4.4 [110/21] via 10.1.3.3, 00:05:05, Ethernet0/1
      0             5.0.0.0/32 is subnetted, 1 subnets
      0               5.5.5.5 [110/11] via 10.1.5.5, 00:04:50, Ethernet0/2
      0             7.0.0.0/32 is subnetted, 1 subnets
      0 IA       7.7.7.7 [110/31] via 10.1.3.3, 00:04:14, Ethernet0/1
      0             [110/31] via 10.1.2.2, 00:04:14, Ethernet0/0
      0             8.0.0.0/32 is subnetted, 1 subnets
      0 IA       8.8.8.8 [110/31] via 10.1.3.3, 00:04:04, Ethernet0/1
      0             [110/31] via 10.1.2.2, 00:04:04, Ethernet0/0
      0             9.0.0.0/32 is subnetted, 1 subnets
      0 IA       9.9.9.9 [110/31] via 10.1.3.3, 00:03:54, Ethernet0/1
      0             [110/31] via 10.1.2.2, 00:03:54, Ethernet0/0
      0             10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
      0               10.2.4.0/24 [110/20] via 10.1.2.2, 03:36:38, Ethernet0/0
      0               10.3.4.0/24 [110/20] via 10.1.3.3, 02:03:22, Ethernet0/1
      0               10.3.5.0/24 [110/20] via 10.1.5.5, 04:05:56, Ethernet0/2
      0 IA       10.10.10.0/24 [110/30] via 10.1.3.3, 02:03:22, Ethernet0/1
      0             [110/30] via 10.1.2.2, 03:16:19, Ethernet0/0
      0 IA       192.168.7.0/24 [110/31] via 10.1.3.3, 01:33:21, Ethernet0/1
      0             [110/31] via 10.1.2.2, 01:33:21, Ethernet0/0
      0 IA       192.168.8.0/24 [110/31] via 10.1.3.3, 01:33:21, Ethernet0/1
      0             [110/31] via 10.1.2.2, 01:33:21, Ethernet0/0
      0 IA       192.168.9.0/24 [110/31] via 10.1.3.3, 01:33:21, Ethernet0/1
      0             [110/31] via 10.1.2.2, 01:33:21, Ethernet0/0
R1#
```

Dari output routing table R1, Lo0 R6 tidak muncul di routing table. Untuk memastikan route entry Lo0 R6, bisa dicek kembali di seluruh node kecuali R5.



Sesuai konsep OSPF, bahwa area reguler harus terhubung ke backbone area secara langsung maupun virtual. Oleh karena itu, kita akan menghubungkan Area 2 ke Area 0 melalui Area 1 sebagai transit area.

Konfigurasi virtual link antar ABR di Area 1.

R1
R1 (config-router) #area 1 virtual-link 5.5.5.5

R5
R5 (config-router) #area 1 virtual-link 1.1.1.1

```
*Aug 15 11:54:16.098: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1
on OSPF_VL0 from LOADING to FULL, Loading Done
```

Log akan muncul ketika virtual link berhasil terbentuk.

Verifikasi

Verifikasi neighborship antara R5 dengan R1.

R5

```
R5#show ip ospf neighbor
Neighbor ID      Pri  State        Dead Time    Address          Interface
1.1.1.1          0    FULL/        -           10.1.5.1        OSPF_VL0
3.3.3.3          1    FULL/BDR   00:00:33    10.3.5.3        Ethernet0/1
1.1.1.1          1    FULL/BDR   00:00:33    10.1.5.1        Ethernet0/0
6.6.6.6          1    FULL/BDR   00:00:35    10.5.6.6        Ethernet0/2
R5#
```

R1

```
R1#show ip ospf neighbor
Neighbor ID      Pri  State        Dead Time    Address          Interface
5.5.5.5          0    FULL/        -           10.1.5.5        OSPF_VL0
3.3.3.3          1    FULL/DR    00:00:39    10.1.3.3        Ethernet0/1
2.2.2.2          1    FULL/DR    00:00:35    10.1.2.2        Ethernet0/0
5.5.5.5          1    FULL/DR    00:00:35    10.1.5.5        Ethernet0/2
R1#
R1#show ip ospf interface brief
Interface      PID  Area          IP Address/Mask    Cost  State Nbrs F/C
VL0            1    0              10.1.5.1/24       10    P2P  1/1
Lo0            1    0              1.1.1.1/32        1     LOOP 0/0
Et0/1          1    0              10.1.3.1/24       10    BDR  1/1
Et0/0          1    0              10.1.2.1/24       10    BDR  1/1
Et0/2          1    1              10.1.5.1/24       10    BDR  1/1
R1#
R1#show ip ospf virtual
R1#show ip ospf virtual-links
Virtual Link OSPF_VL0 to router 5.5.5.5 is up
  Run as demand circuit
  DoNotAge LSA allowed.
  Transit area 1, via interface Ethernet0/2
Topology-MTID  Cost    Disabled    Shutdown      Topology Name
               0        10        no         no           Base
  Transmit Delay is 1 sec, State POINT_TO_POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:00
    Adjacency State FULL (Hello suppressed)
    Index 1/3/4, retransmission queue length 0, number of retransmission 0
    First 0x0(0)/0x0(0)/0x0(0) Next 0x0(0)/0x0(0)/0x0(0)
    Last retransmission scan length is 0, maximum is 0
    Last retransmission scan time is 0 msec, maximum is 0 msec
R1#
```

Verifikasi routing table di R6 dan R9.

R6

```
R6#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PFR

Gateway of last resort is 10.5.6.5 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.5.6.5, 00:09:10, Ethernet0/0
      1.0.0.0/32 is subnetted, 1 subnets
O  IA   1.1.1.1 [110/21] via 10.5.6.5, 00:09:16, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O  IA   2.2.2.2 [110/31] via 10.5.6.5, 00:09:16, Ethernet0/0
      3.0.0.0/32 is subnetted, 1 subnets
O  IA   3.3.3.3 [110/21] via 10.5.6.5, 00:09:11, Ethernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O  IA   4.4.4.4 [110/31] via 10.5.6.5, 00:09:11, Ethernet0/0
      5.0.0.0/32 is subnetted, 1 subnets
O  IA   5.5.5.5 [110/11] via 10.5.6.5, 00:09:20, Ethernet0/0
      7.0.0.0/32 is subnetted, 1 subnets
O  IA   7.7.7.7 [110/41] via 10.5.6.5, 00:09:16, Ethernet0/0
      8.0.0.0/32 is subnetted, 1 subnets
O  IA   8.8.8.8 [110/41] via 10.5.6.5, 00:09:16, Ethernet0/0
      9.0.0.0/32 is subnetted, 1 subnets
O  IA   9.9.9.9 [110/41] via 10.5.6.5, 00:09:16, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks
O  IA   10.1.2.0/24 [110/30] via 10.5.6.5, 00:09:16, Ethernet0/0
O  IA   10.1.3.0/24 [110/30] via 10.5.6.5, 00:09:16, Ethernet0/0
O  IA   10.1.5.0/24 [110/20] via 10.5.6.5, 00:09:20, Ethernet0/0
O  IA   10.2.4.0/24 [110/40] via 10.5.6.5, 00:09:16, Ethernet0/0
O  IA   10.3.4.0/24 [110/30] via 10.5.6.5, 00:09:11, Ethernet0/0
O  IA   10.3.5.0/24 [110/20] via 10.5.6.5, 00:09:20, Ethernet0/0
O  IA   10.10.10.0/24 [110/40] via 10.5.6.5, 00:09:16, Ethernet0/0
O  IA   192.168.7.0/24 [110/41] via 10.5.6.5, 00:09:16, Ethernet0/0
O  IA   192.168.8.0/24 [110/41] via 10.5.6.5, 00:09:16, Ethernet0/0
O  IA   192.168.9.0/24 [110/41] via 10.5.6.5, 00:09:16, Ethernet0/0
R6#
```

R9

```
R9#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, 1 - LISP
      a - application route
      + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 10.10.10.4 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.10.10.4, 03:21:29, Ethernet0/0
      1.0.0.0/32 is subnetted, 1 subnets
O  IA   1.1.1.1 [110/31] via 10.10.10.4, 00:27:55, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O  IA   2.2.2.2 [110/21] via 10.10.10.4, 00:27:41, Ethernet0/0
      3.0.0.0/32 is subnetted, 1 subnets
O  IA   3.3.3.3 [110/21] via 10.10.10.4, 00:27:31, Ethernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O  IA   4.4.4.4 [110/11] via 10.10.10.4, 00:27:18, Ethernet0/0
      5.0.0.0/32 is subnetted, 1 subnets
O  IA   5.5.5.5 [110/31] via 10.10.10.4, 00:27:02, Ethernet0/0
      6.0.0.0/32 is subnetted, 1 subnets
O  IA   6.6.6.6 [110/51] via 10.10.10.4, 00:10:35, Ethernet0/0
      7.0.0.0/32 is subnetted, 1 subnets
O     7.7.7.7 [110/11] via 10.10.10.7, 00:26:27, Ethernet0/0
      8.0.0.0/32 is subnetted, 1 subnets
O     8.8.8.8 [110/11] via 10.10.10.8, 00:26:17, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks
O  IA   10.1.2.0/24 [110/30] via 10.10.10.4, 03:37:24, Ethernet0/0
O  IA   10.1.3.0/24 [110/30] via 10.10.10.4, 02:25:35, Ethernet0/0
O  IA   10.1.5.0/24 [110/40] via 10.10.10.4, 03:37:24, Ethernet0/0
O  IA   10.2.4.0/24 [110/20] via 10.10.10.4, 03:37:24, Ethernet0/0
O  IA   10.3.4.0/24 [110/20] via 10.10.10.4, 03:37:24, Ethernet0/0
O  IA   10.3.5.0/24 [110/30] via 10.10.10.4, 02:25:35, Ethernet0/0
O  IA   10.5.6.0/24 [110/50] via 10.10.10.4, 00:10:35, Ethernet0/0
O     192.168.7.0/24 [110/11] via 10.10.10.7, 02:07:37, Ethernet0/0
O     192.168.8.0/24 [110/11] via 10.10.10.8, 02:42:51, Ethernet0/0
R9#
```

Dari output routing table R9, Lo0 R6 sudah muncul di routing table.

Verifikasi end-to-end ping ke semua loopback router.

R9

```
R9#ping 1.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R9#
R9#ping 2.2.2.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R9#
R9#ping 3.3.3.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R9#
R9#ping 4.4.4.4
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R9#
R9#ping 5.5.5.5
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 5.5.5.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R9#
R9#ping 6.6.6.6
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 6.6.6.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R9#
R9#ping 7.7.7.7
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 7.7.7.7, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R9#
R9#ping 8.8.8.8
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 8.8.8.8, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R9#
R9#
```

Konektivitas ke semua loopback router berhasil di ping.