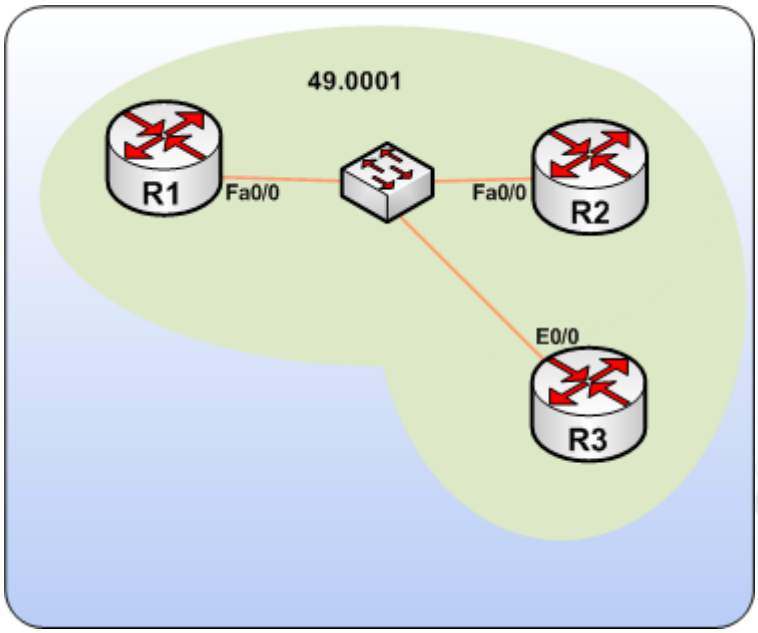
Lab 1 – ISIS Adjacencies over Ethernet



R1 Loopback 1	1.1.1.1/32
FastEthernet0/0	10.1.1.1/24
R2 Loopback 1	2.2.2.2/32
FastEthernet0/0	10.1.1.2/24
R3 Loopback 1	3.3.3.3/32
FastEthernet0/0	10.1.1.3/24

Task 1: Configure R1 and R2 as per the table. Enable ISIS using routing tag 1 and advertise all interfaces. Use the loopback address as the system-id.

Solution:

Note – The most common way to convert an ip address for use as the system-id is to make each octet three numbers by inserting zeros in front. Eg. 1.1.1.1 = 0010.0100.1001. An alternative method of defining the system-id is to use the mac-address of the device.

Cisco routers operate at both Level1 and Level2 by default. So two isis neighbor adjacencies will be formed. The command **show clns neighbor** displays neighboring devices, while **show isis neighbors** shows level1 and level2 adjacencies.

R1 Configuration:

```
interface Loopback1
 ip address 1.1.1.1 255.255.255.255
 ip router isis 1
!
interface FastEthernet0/0
 ip address 10.1.1.1 255.255.255.0
 ip router isis 1
 speed 100
 full-duplex
!
router isis 1
 net 49.0001.0010.0100.1001.00
```

R2 Configuration:

```
interface Loopback1
 ip address 2.2.2.2 255.255.255.255
 ip router isis 1
!
interface FastEthernet0/0
 ip address 10.1.1.2 255.255.255.0
 ip router isis 1
 speed 100
 full-duplex
!
router isis 1
 net 49.0001.0020.0200.2002.00
```

Verification on R1:

```
R1#show clns neigh
System Id      Interface   SNPA            State  Holdtime  Type Protocol
R2             Fa0/0       cc01.2650.0000  Up     7         L1L2 IS-IS

R1#show isis neighbors
System Id      Type Interface IP Address      State Holdtime Circuit Id
R2               L1   Fa0/0     10.1.1.2        UP    7        R2.02
R2               L2   Fa0/0     10.1.1.2        UP    7        R2.02

R1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area,
Gateway of last resort is not set

    1.0.0.0/32 is subnetted, 1 subnets
```

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```
C       1.1.1.1 is directly connected, Loopback1
     2.0.0.0/32 is subnetted, 1 subnets
i L1    2.2.2.2 [115/20] via 10.1.1.2, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
R1#ping 2.2.2.2 source loop1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 1.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/17/32 ms
```

Verification on R2:

```
R2#show clns neighbors
System Id      Interface   SNPA            State  Holdtime  Type Protocol
R1             Fa0/0       cc00.2650.0000  Up     23        L1L2 IS-IS

R2#show isis neighbors
System Id      Type Interface IP Address      State Holdtime Circuit Id
R1               L1   Fa0/0     10.1.1.1        UP    21       R2.02
R1               L2   Fa0/0     10.1.1.1        UP    28       R2.02

R2#ping 1.1.1.1 source loop1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/12/24 ms
```

Task 2: In a Multiaccess network ISIS uses a DIS, The DIS is similar in functionality to the ospf DR. Force R1 to be the DIS by increasing the interface priority.

Solution:

Note – Unlike ospf, The ISIS DIS allows preemption, The default interface priority is 64 and the device with the highest SNPA(Layer2 identifier) becomes the DIS. If the SNPA addresses are the same then the system-id is the tie breaker.

The DIS can be identified with either the **show clns is-neighbor** or **show isis neighbor.** The device listed under the Circuit-Id field is the DIS.

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R1 Configuration:

```
interface Fa0/0
 isis priority 100
```

Verification on R1:

```
R1#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R2               L1   Fa0/0    10.1.1.2         UP    26       R1.02
R2               L2   Fa0/0    10.1.1.2         UP    26       R1.02
R1#show clns is-neighbors

System Id      Interface   State  Type Priority  Circuit Id       Format
R2               Fa0/0       Up     L1L2 64/64     R1.02            Phase V
```

Task 3: Configure R3 as per the table and enable ISIS using routing tag 1 on all interfaces. Use the loopback as the system-id

Solution:

R3 Configuration:

```
interface Loopback1
 ip address 3.3.3.3 255.255.255.255
 ip router isis 1
!
interface Ethernet0/0
 ip address 10.1.1.3 255.255.255.0
 ip router isis 1
 full-duplex
!
router isis 1
 net 49.0001.0030.0300.3003.00
```

Verification on R3:

```
R3
System Id      Type Interface IP Address      State Holdtime Circuit Id
R1               L1   Et0/0    10.1.1.1         UP    8        R1.02
R1               L2   Et0/0    10.1.1.1         UP    7        R1.02
R2               L1   Et0/0    10.1.1.2         UP    21       R1.02
R2               L2   Et0/0    10.1.1.2         UP    25       R1.02
```

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R1 is the DIS for the ethernet segment

```
R3#show clns interface e0/0
Ethernet0/0 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 32 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x1, local circuit ID 0x2
    Level-1 Metric: 10, Priority: 64, Circuit ID: R1.02
    DR ID: R1.02
    Level-1 IPv6 Metric: 10
    Number of active level-1 adjacencies: 2
    Level-2 Metric: 10, Priority: 64, Circuit ID: R1.02
    DR ID: R1.02
    Level-2 IPv6 Metric: 10
    Number of active level-2 adjacencies: 2
    Next IS-IS LAN Level-1 Hello in 874 milliseconds
    Next IS-IS LAN Level-2 Hello in 5 seconds

R3#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/20] via 10.1.1.1, Ethernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
i L1    2.2.2.2 [115/20] via 10.1.1.2, Ethernet0/0
     3.0.0.0/32 is subnetted, 1 subnets
C       3.3.3.3 is directly connected, Loopback1
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Ethernet0/0

R3#ping 1.1.1.1 source loop1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/23/36 ms
R3#ping 2.2.2.2 source loop1

Type escape sequence to abort.
```

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```
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/15/28 ms
```

Task 4: Prevent R2 and R3 from ever becoming the DIS by setting the interface priority to 0

Solution:

R2 Configuration:

```
interface fa0/0
 isis priority 0
```

R3 Configuration:

```
interface e0/0
 isis priority 0
```

Verification on R2:

```
R2#show clns int fa0/0
FastEthernet0/0 is up, line protocol is up
....
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x1, local circuit ID 0x2
    Level-1 Metric: 10, Priority: 0, Circuit ID: R1.02
    DR ID: R1.02
    Level-1 IPv6 Metric: 10
    Number of active level-1 adjacencies: 2
    Level-2 Metric: 10, Priority: 0, Circuit ID: R1.02
    DR ID: R1.02
    Level-2 IPv6 Metric: 10
```

Verification on R3:

```
R3#show clns int e0/0
Ethernet0/0 is up, line protocol is up
....
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x1, local circuit ID 0x2
    Level-1 Metric: 10, Priority: 0, Circuit ID: R1.02
    DR ID: R1.02
```

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```
Level-1 IPv6 Metric: 10
Number of active level-1 adjacencies: 2
Level-2 Metric: 10, Priority: 0, Circuit ID: R1.02
DR ID: R1.02
Level-2 IPv6 Metric: 10
```

Lab completed, Do Not erase the config and continue to next lab.

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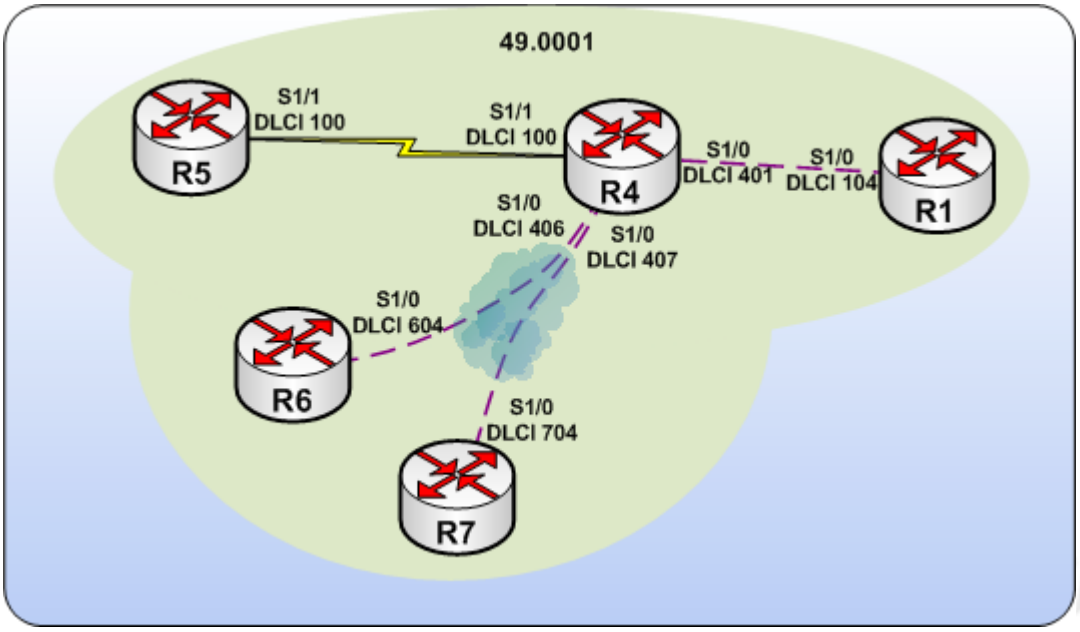
Lab 2 - ISIS Adjacencies over Frame Relay



R1 S1/0 Dlci - 104	14.14.14.1/24
R4 Loopback 1	4.4.4.4/32
S1/1 Dlci – 100	45.45.45.1/30
S1/0 Dlci – 401	14.14.14.4/24
S1/0 Dlci – 406/407	46.47.67.4/24
R5 Loopback 1	5.5.5.5/32
S1/1 Dlci – 100	45.45.45.2/30
R6 Loopback 1	6.6.6.6/32
S1/0 Dlci – 604	46.47.67.6/24
R7 Loopback 1	7.7.7.7/32
S1/0 Dlci – 704	46.47.67.7/24

Task 1: Configure frame relay between R1 and R4 using a point-to-point sub-interface. Configure this interface to participate in ISIS on R1. Enable ISIS on R4 using routing tag 1, Use the loopback as the system-id and advertise the link to R1 and the loopback.

Solution:

Note –ISIS supports two network types, Broadcast Multi-access and Point-to-point, As this is a point-

to-point link the configuration is quite simple.

R1 Configuration:

```
interface Serial1/0
 no ip address
 encapsulation frame-relay
!
interface Serial1/0.104 point-to-point
 ip address 14.14.14.1 255.255.255.0
 ip router isis 1
 frame-relay interface-dlci 104
```

R4 Configuration:

```
interface Loopback1
 ip address 4.4.4.4 255.255.255.255
 ip router isis 1
!
interface Serial1/0
 no ip address
 encapsulation frame-relay
!
interface Serial1/0.401 point-to-point
 ip address 14.14.14.4 255.255.255.0
 ip router isis 1
 frame-relay interface-dlci 401
!
router isis 1
 net 49.0001.0040.0400.4004.00
```

Verification on R4:

```
R4#show clns is-neighbors

System Id      Interface   State  Type Priority  Circuit Id         Format
R1             Se1/0.401   Up     L1L2 0 /0      00                 Phase V

R4#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L1L2 Se1/0.401 14.14.14.1      UP    28       00

R4#show clns interface s1/0.401
Serial1/0.401 is up, line protocol is up
  Checksums enabled, MTU 1500, Encapsulation FRAME-RELAY
  ERPDUs enabled, min. interval 10 msec.
```

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```
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 12 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x1, local circuit ID 0x100
    Neighbor System-ID: R1
    Level-1 Metric: 10, Priority: 64, Circuit ID: R4.00
    Level-1 IPv6 Metric: 10
    Number of active level-1 adjacencies: 1
    Level-2 Metric: 10, Priority: 64, Circuit ID: R4.00
    Level-2 IPv6 Metric: 10
    Number of active level-2 adjacencies: 1
    Next IS-IS Hello in 1 seconds
    if state UP
```

Verification on R1:

```
R1#ping 4.4.4.4 source 1.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
Packet sent with a source address of 1.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/18/32 ms
```

Task 2: Configure Back2Back frame relay between R4 and R5 using the physical interface. On R4 advertise the interface in ISIS. Enable and Configure ISIS on R5 using routing tag 1, Use the loopback as the system-id and advertise all interfaces.
Do not use inverse-arp and ensure broadcasts are forwarded

Solution:

Note – When using a physical interface or multipoint sub-interface we need to allow clns data across the pvc by using the **frame map clns broad** command. As ISIS only recognises broadcast and point2point links we need to change the underlying network to suit. It is generally recommended to configure point2point wan links.

In this setup R5 will be the DIS, As the physical interface is treated like a broadcast multiaccess network. Both devices have the same priority and layer 2 identifier, So the device with the highest system-id becomes the DIS.

R4 Configuration:

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```
interface Serial1/1
 ip address 45.45.45.1 255.255.255.252
 ip router isis 1
 encapsulation frame-relay
 no keepalive
 serial restart-delay 0
 frame-relay map ip 45.45.45.1 100
 frame-relay map ip 45.45.45.2 100 broadcast
 frame-relay map clns 100 broadcast
 no frame-relay inverse-arp
end
```

R5 Configuration:

```
interface Loopback1
 ip address 5.5.5.5 255.255.255.255
 ip router isis 1
!
interface Serial1/1
 ip address 45.45.45.2 255.255.255.252
 ip router isis 1
 encapsulation frame-relay
 no keepalive
 serial restart-delay 0
 frame-relay map ip 45.45.45.1 100 broadcast
 frame-relay map ip 45.45.45.2 100
 frame-relay map clns 100 broadcast
 no frame-relay inverse-arp
!
router isis 1
 net 49.0001.0050.0500.5005.00
```

Verification on R5:

```
R5#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R4             L1   Se1/1     45.45.45.1      UP    23       R5.02
R4             L2   Se1/1     45.45.45.1      UP    25       R5.02
R5#show ip route
Codes: 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
```

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```
Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/30] via 45.45.45.1, Serial1/1
     4.0.0.0/32 is subnetted, 1 subnets
i L1    4.4.4.4 [115/20] via 45.45.45.1, Serial1/1
     5.0.0.0/32 is subnetted, 1 subnets
C       5.5.5.5 is directly connected, Loopback1
     10.0.0.0/24 is subnetted, 1 subnets
i L1    10.1.1.0 [115/30] via 45.45.45.1, Serial1/1
     14.0.0.0/24 is subnetted, 1 subnets
i L1    14.14.14.0 [115/20] via 45.45.45.1, Serial1/1
     45.0.0.0/30 is subnetted, 1 subnets
C       45.45.45.0 is directly connected, Serial1/1
R5#ping 4.4.4.4 source 5.5.5.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
Packet sent with a source address of 5.5.5.5
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/34/56 ms
```

Task 3: Configure the Frame relay cloud between R4 and R6/R7 in a multipoint manner, Use a multipoint sub-interface on R4 and point2point sub-interfaces on R6 and R7. Advertise this interface on R4 using ISIS.
Enable and Configure ISIS on R6 and R7 as per the previous guidelines. Enable debugging of ISIS adjacency packets on R4

Solution:

Note – Adjacencies between R4 and R6/R7 will not form as R4 expects broadcast hello's but is receiving point2point hello's. The debug output below shows this.

```
R4#debug isis adj-packets
IS-IS Adjacency related packets debugging is on
R4#
*Mar  1 01:54:43.099: ISIS-Adj: Sending L1 LAN IIH on Loopback1, length 1514
*Mar  1 01:54:43.187: ISIS-Adj: Sending L2 LAN IIH on Loopback1, length 1514
*Mar  1 01:54:43.787: ISIS-Adj: Sending L2 LAN IIH on Serial1/1, length 1500
*Mar  1 01:54:43.903: ISIS-Adj: Rec L2 IIH from DLCI 100 (Serial1/1), cir type L1L2, cir id
0050.0500.5005.02, length 1500
*Mar  1 01:54:44.143: ISIS-Adj: Rec serial IIH from DLCI 407 (Serial1/0.467), cir type L1L2,
```

cir id 00, length 1499
***Mar 1 01:54:44.147: ISIS-Adj: Point-to-point IIH received on multi-point interface: ignored IIH**
*Mar 1 01:54:45.411: ISIS-Adj: Rec L1 IIH from DLCI 100 (Serial1/1), cir type L1L2, cir id 0050.0500.5005.02, length 1500

R4 Configuration:

```
interface Serial1/0.467 multipoint
 ip address 46.47.67.4 255.255.255.0
 ip router isis 1
 frame-relay map clns 406 broadcast
 frame-relay map clns 407 broadcast
 frame-relay map ip 46.47.67.6 406 broadcast
 frame-relay map ip 46.47.67.7 407 broadcast
 no frame-relay inverse-arp
end
```

R6 Configuration:

```
interface Loopback1
 ip address 6.6.6.6 255.255.255.255
 ip router isis 1
!
interface Serial1/0
 no ip address
 encapsulation frame-relay
 serial restart-delay 0
 no frame-relay inverse-arp
!
interface Serial1/0.604 point-to-point
 ip address 46.47.67.6 255.255.255.0
 ip router isis 1
 frame-relay interface-dlci 604
!
router isis 1
 net 49.0001.0060.0600.6006.00
```

R7 Configuration:

```
interface Loopback1
 ip address 7.7.7.7 255.255.255.255
 ip router isis 1
!
interface Serial3/0
 no ip address
 encapsulation frame-relay
 serial restart-delay 0
```

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```
 no frame-relay inverse-arp
!
interface Serial3/0.704 point-to-point
 ip address 46.47.67.7 255.255.255.0
 ip router isis 1
 frame-relay interface-dlci 704
!
router isis 1
 net 49.0001.0070.0700.7007.00
```

Task 4: Remove the multipoint interface on R4 and create two point2point sub-interfaces. Configure as per the table below and re-address R6 and R7 as per the table. Enable ISIS on all interfaces.

R4 Dlci 406 – 46.46.46.1/30	R6 Dlci 604 – 46.46.46.2/30
R4 Dlci 407 – 47.47.47.1/30	R7 Dlci 704 – 47.47.47.2/30

Solution:

R4 Configuration:

```
no interface Serial1/0.467 multipoint
!
int s1/0.46 point
 ip addr 46.46.46.1 255.255.255.252
 frame interface-dlci 406
 ip router isis 1
!
int s1/0.47 point
 ip addr 47.47.47.1 255.255.255.252
 frame interface-dlci 407
 ip router isis 1
```

R6 Configuration:

```
interface Serial1/0.604 point-to-point
 no ip addr
 ip address 46.46.46.2 255.255.255.0252
 ip router isis 1
 frame-relay interface-dlci 604
```

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R7 Configuration:

```
interface Serial3/0.704 point-to-point
 no ip addr
 ip address 47.47.47.2 255.255.255.252
 ip router isis 1
 frame-relay interface-dlci 704
```

Verification on R4:

```
R4#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L1L2 Se1/0.401 14.14.14.1      UP    27       00
R5             L1   Se1/1     45.45.45.2      UP    6        R5.02
R5             L2   Se1/1     45.45.45.2      UP    8        R5.02
R6             L1L2 Se1/0.46  46.46.46.2      UP    28       00
R7             L1L2 Se1/0.47  47.47.47.2      UP    21       00
R4#show ip route
Gateway of last resort is 47.47.47.2 to network 0.0.0.0
..
     6.0.0.0/32 is subnetted, 1 subnets
i L1    6.6.6.6 [115/20] via 46.46.46.2, Serial1/0.46
     7.0.0.0/32 is subnetted, 1 subnets
i L1    7.7.7.7 [115/20] via 47.47.47.2, Serial1/0.47
..
R4#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 = 16/22/32 ms
R4#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 = 12/20/36 ms
```

Verification on R6:

```
R6#show clns nei

System Id      Interface   SNPA            State  Holdtime  Type Protocol
R4             Se1/0.604   DLCI 604        Up     29        L1L2 IS-IS
R6#show isis neigh

System Id      Type Interface IP Address      State Holdtime Circuit Id
```

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```
R4           L1L2 Se1/0.604 46.46.46.1      UP    27       01
R6#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 = 32/40/48 ms
```

Lab completed, Save configuration and continue to LAB 3. The current config is the starting point for Lab 3, 4, 5 and 6

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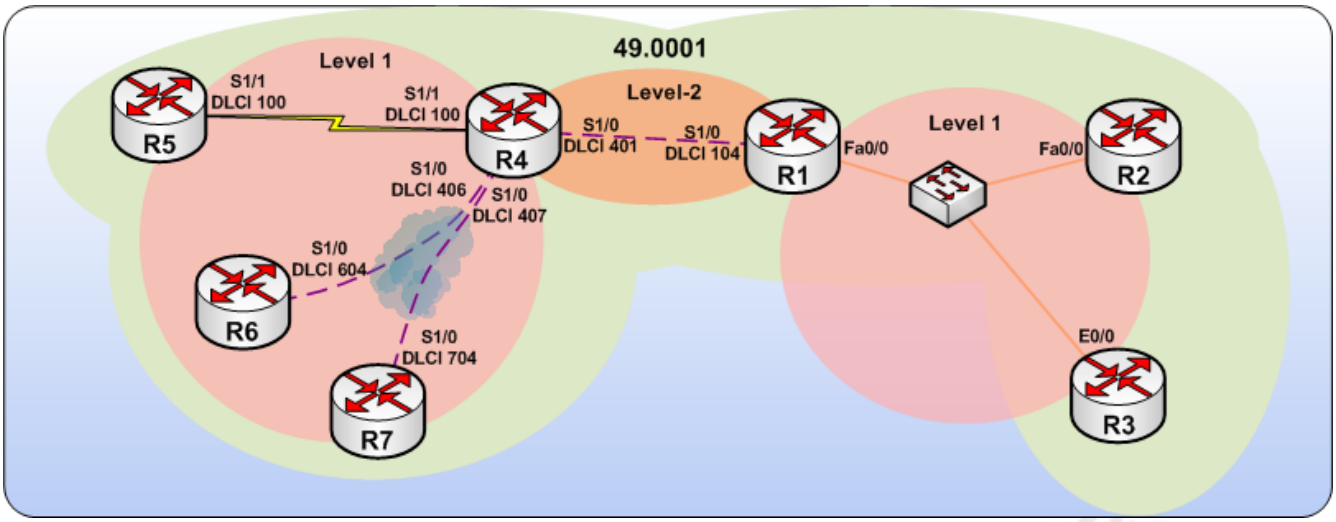
Lab 3 - ISIS Multi-Level 1



Task 1: Reconfigure the routers so that ISIS is in the appropriate level. If a router is wholly in a Level use a router mode command, For the Level-1-2 routers use interface commands. Make all loopbacks Level-1 passive interfaces.

Solution:

Note – By default Cisco routers participate in both Level1 and 2 routing. While this allows easy configuration of the devices it increases the router utilization. Careful design of both Areas and Levels allows optimized use of resources.
After completing the changes the network is now segregated as each Level1 only knows its own routes, The Level1-2 router by default only generates a default route if it knows how to reach another Area.

R1 Configuration:

```
interface S1/0.104
 isis circuit-type Level-2
!
int Fa0/0
 isis circuit-type Level-1
!
int loopback 1
 isis circuit-type Level-1
!
router isis 1
passive-interface loop1
```

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R4 Configuration:

```
interface S1/0.401
 isis circuit-type Level-2
!
int s1/1
 isis circuit-type Level-1
!
int s1/0.46
 isis circuit-type Level-1
!
int s1/0.47
 isis circuit-type Level-1
!
int loopback 1
 isis circuit-type Level-1
!
router isis 1
passive-interface loop1
```

R2, R3, R5, R6 and R7 Configuration:

```
router isis 1
passive-interface loop1
is-type Level-1
```

Verification on R2:

```
R2#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L1   Fa0/0     10.1.1.1        UP    8        R1.01
R3             L1   Fa0/0     10.1.1.3        UP    29       R1.01
R2#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/10] via 10.1.1.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     3.0.0.0/32 is subnetted, 1 subnets
i L1    3.3.3.3 [115/10] via 10.1.1.3, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
```

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Verification on R1:

```
R1#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R2             L1   Fa0/0     10.1.1.2        UP    23       R1.01
R3             L1   Fa0/0     10.1.1.3        UP    26       R1.01
R4             L2   Se1/0.104 14.14.14.4      UP    25       02
R1#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
C       1.1.1.1 is directly connected, Loopback1
     2.0.0.0/32 is subnetted, 1 subnets
i L1    2.2.2.2 [115/10] via 10.1.1.2, FastEthernet0/0
     3.0.0.0/32 is subnetted, 1 subnets
i L1    3.3.3.3 [115/10] via 10.1.1.3, FastEthernet0/0
     4.0.0.0/32 is subnetted, 1 subnets
i L2    4.4.4.4 [115/10] via 14.14.14.4, Serial1/0.104
     5.0.0.0/32 is subnetted, 1 subnets
i L2    5.5.5.5 [115/20] via 14.14.14.4, Serial1/0.104
     6.0.0.0/32 is subnetted, 1 subnets
i L2    6.6.6.6 [115/20] via 14.14.14.4, Serial1/0.104
     7.0.0.0/32 is subnetted, 1 subnets
i L2    7.7.7.7 [115/20] via 14.14.14.4, Serial1/0.104
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
     46.0.0.0/30 is subnetted, 1 subnets
i L2    46.46.46.0 [115/20] via 14.14.14.4, Serial1/0.104
     47.0.0.0/30 is subnetted, 1 subnets
i L2    47.47.47.0 [115/20] via 14.14.14.4, Serial1/0.104
     14.0.0.0/24 is subnetted, 1 subnets
C       14.14.14.0 is directly connected, Serial1/0.104
     45.0.0.0/30 is subnetted, 1 subnets
i L2    45.45.45.0 [115/20] via 14.14.14.4, Serial1/0.104
```

Task 2: The two Level-1 zones can no longer communicate, Configure Level-2 to Level-1 redistribution on both R1 and R4

Solution:

Note – Redistribution from Level-2 to Level-1 requires either a route-map or distribution list. This allows greater control of what routes are propagated.

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R1 and R4 Configuration:

```
route-map TASK-2 permit 10
!
router isis 1
 redistribute isis ip level-2 into level-1 route-map TASK-2
```

Verification on R5:

```
R5#show ip route
Codes: 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

Gateway of last resort is 45.45.45.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
i ia    1.1.1.1 [115/148] via 45.45.45.1, Serial1/1
     2.0.0.0/32 is subnetted, 1 subnets
i ia    2.2.2.2 [115/158] via 45.45.45.1, Serial1/1
     3.0.0.0/32 is subnetted, 1 subnets
i ia    3.3.3.3 [115/158] via 45.45.45.1, Serial1/1
     4.0.0.0/32 is subnetted, 1 subnets
i L1    4.4.4.4 [115/10] via 45.45.45.1, Serial1/1
     5.0.0.0/32 is subnetted, 1 subnets
C       5.5.5.5 is directly connected, Loopback1
     6.0.0.0/32 is subnetted, 1 subnets
i L1    6.6.6.6 [115/20] via 45.45.45.1, Serial1/1
     7.0.0.0/32 is subnetted, 1 subnets
i L1    7.7.7.7 [115/20] via 45.45.45.1, Serial1/1
     10.0.0.0/24 is subnetted, 1 subnets
i ia    10.1.1.0 [115/158] via 45.45.45.1, Serial1/1
     46.0.0.0/30 is subnetted, 1 subnets
i L1    46.46.46.0 [115/20] via 45.45.45.1, Serial1/1
     47.0.0.0/30 is subnetted, 1 subnets
i L1    47.47.47.0 [115/20] via 45.45.45.1, Serial1/1
     14.0.0.0/24 is subnetted, 1 subnets
i ia    14.14.14.0 [115/148] via 45.45.45.1, Serial1/1
     45.0.0.0/30 is subnetted, 1 subnets
C       45.45.45.0 is directly connected, Serial1/1

R5#ping 2.2.2.2 source 5.5.5.5
```

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```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 5.5.5.5
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 72/96/116 ms
```

Task 3: Remove the redistribution on R1 and R4, Allow inter-Level communication by advertising the summary route 0.0.0.0 into Level-1

Solution:

R1 and R4 Configuration:

```
router isis 1
 summary-address 0.0.0.0 0.0.0.0 level-1
```

Verification on R2:

```
R2#show ip route

Gateway of last resort is 10.1.1.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/10] via 10.1.1.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     3.0.0.0/32 is subnetted, 1 subnets
i L1    3.3.3.3 [115/10] via 10.1.1.3, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
i*ia 0.0.0.0/0 [115/148] via 10.1.1.1, FastEthernet0/0
R2#ping 7.7.7.7 source 2.2.2.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 7.7.7.7, timeout is 2 seconds:
Packet sent with a source address of 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/62/76 ms
```

Verification on R6:

```
R6#show ip route
```

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```
Gateway of last resort is 46.46.46.1 to network 0.0.0.0

     4.0.0.0/32 is subnetted, 1 subnets
i L1    4.4.4.4 [115/10] via 46.46.46.1, Serial1/0.604
     5.0.0.0/32 is subnetted, 1 subnets
i L1    5.5.5.5 [115/20] via 46.46.46.1, Serial1/0.604
     6.0.0.0/32 is subnetted, 1 subnets
C       6.6.6.6 is directly connected, Loopback1
     7.0.0.0/32 is subnetted, 1 subnets
i L1    7.7.7.7 [115/20] via 46.46.46.1, Serial1/0.604
     46.0.0.0/30 is subnetted, 1 subnets
C       46.46.46.0 is directly connected, Serial1/0.604
     47.0.0.0/30 is subnetted, 1 subnets
i L1    47.47.47.0 [115/20] via 46.46.46.1, Serial1/0.604
     45.0.0.0/30 is subnetted, 1 subnets
i L1    45.45.45.0 [115/20] via 46.46.46.1, Serial1/0.604
i*ia 0.0.0.0/0 [115/148] via 46.46.46.1, Serial1/0.604
R6#ping 3.3.3.3 source 6.6.6.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 6.6.6.6
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 76/125/248 ms
```

Verification on R1:

```
R1(config-router)#do show ip route
Codes: 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

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

...
i*su 0.0.0.0/0 [115/10] via 0.0.0.0, Null0
```

Lab completed, Revert config to end of Lab2.

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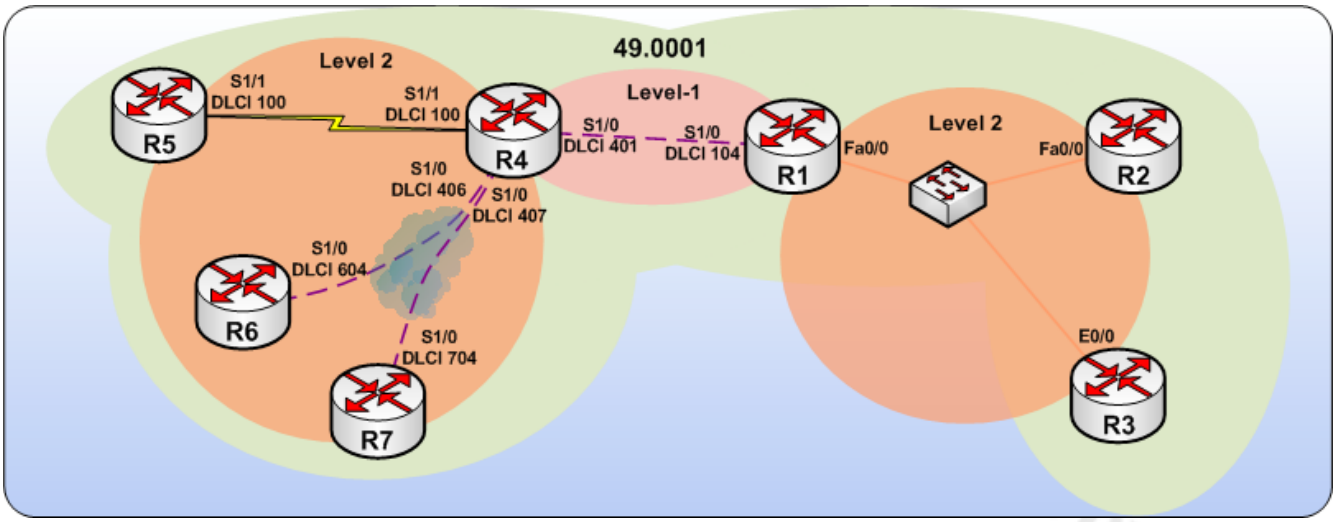
Lab 4 - ISIS Multi-Level 2



Task 1: Reconfigure the routers so that ISIS is in the appropriate level. If a router is wholly in a Level use a router mode command, For the Level-1-2 routers use interface commands. Make all loopbacks Level-2 passive interfaces.

Solution:

R1 Configuration:

```
interface S1/0.104
 isis circuit-type Level-1
!
int Fa0/0
 isis circuit-type Level-2
!
int loopback 1
 isis circuit-type Level-2
!
router isis 1
passive-interface loop1
```

R4 Configuration:

```
interface S1/0.401
 isis circuit-type Level-1
!
int s1/1
 isis circuit-type Level-2
```

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```
!
int s1/0.46
 isis circuit-type Level-2
!
int s1/0.47
 isis circuit-type Level-2
!
int loopback 1
 isis circuit-type Level-2
!
router isis 1
passive-interface loop1
```

R2, R3, R5, R6 and R7 Configuration:

```
router isis 1
passive-interface loop1
is-type Level-2
```

Verification on R2:

```
R2#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L2   Fa0/0     10.1.1.1        UP    9        R1.01
R3             L2   Fa0/0     10.1.1.3        UP    27       R1.01
R2#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L2    1.1.1.1 [115/10] via 10.1.1.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     3.0.0.0/32 is subnetted, 1 subnets
i L2    3.3.3.3 [115/10] via 10.1.1.3, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
     14.0.0.0/24 is subnetted, 1 subnets
i L2    14.14.14.0 [115/20] via 10.1.1.1, FastEthernet0/0
```

Verification on R1:

```
R1#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R2             L2   Fa0/0     10.1.1.2        UP    29       R1.01
```

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```
R3          L2  Fa0/0     10.1.1.3       UP   27      R1.01
R4          L1  Se1/0.104 14.14.14.4     UP   27      02
R1#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
C       1.1.1.1 is directly connected, Loopback1
     2.0.0.0/32 is subnetted, 1 subnets
i L2    2.2.2.2 [115/10] via 10.1.1.2, FastEthernet0/0
     3.0.0.0/32 is subnetted, 1 subnets
i L2    3.3.3.3 [115/10] via 10.1.1.3, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
     14.0.0.0/24 is subnetted, 1 subnets
C       14.14.14.0 is directly connected, Serial1/0.104
```

Task 2: The two Level-2 zones can no longer communicate, Configure R1 and R4 to advertise a default route into Level-2

Solution:

Note – The two Level-1-2 routers are now dropping traffic as they are not aware of the routes in each Level-2 zone.

R1 and R4 Configuration:

```
router isis 1
 default-information originate
```

Verification on R5:

```
R5#show ip route
Codes: 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

Gateway of last resort is 45.45.45.1 to network 0.0.0.0

     4.0.0.0/32 is subnetted, 1 subnets
```

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i L2 4.4.4.4 [115/10] via 45.45.45.1, Serial1/1
    5.0.0.0/32 is subnetted, 1 subnets
C   5.5.5.5 is directly connected, Loopback1
    6.0.0.0/32 is subnetted, 1 subnets
i L2 6.6.6.6 [115/20] via 45.45.45.1, Serial1/1
    7.0.0.0/32 is subnetted, 1 subnets
i L2 7.7.7.7 [115/20] via 45.45.45.1, Serial1/1
    46.0.0.0/30 is subnetted, 1 subnets
i L2 46.46.46.0 [115/20] via 45.45.45.1, Serial1/1
    47.0.0.0/30 is subnetted, 1 subnets
i L2 47.47.47.0 [115/20] via 45.45.45.1, Serial1/1
    14.0.0.0/24 is subnetted, 1 subnets
i L2 14.14.14.0 [115/20] via 45.45.45.1, Serial1/1
    45.0.0.0/30 is subnetted, 1 subnets
C   45.45.45.0 is directly connected, Serial1/1
i*L2 0.0.0.0/0 [115/10] via 45.45.45.1, Serial1/1
R5#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:
U.U.U
Success rate is 0 percent (0/5)

Verification on R4:

R4#show ip route

Gateway of last resort is not set

    4.0.0.0/32 is subnetted, 1 subnets
C   4.4.4.4 is directly connected, Loopback1
    5.0.0.0/32 is subnetted, 1 subnets
i L2 5.5.5.5 [115/10] via 45.45.45.2, Serial1/1
    6.0.0.0/32 is subnetted, 1 subnets
i L2 6.6.6.6 [115/10] via 46.46.46.2, Serial1/0.46
    7.0.0.0/32 is subnetted, 1 subnets
i L2 7.7.7.7 [115/10] via 47.47.47.2, Serial1/0.47
    46.0.0.0/30 is subnetted, 1 subnets
C   46.46.46.0 is directly connected, Serial1/0.46
    47.0.0.0/30 is subnetted, 1 subnets
C   47.47.47.0 is directly connected, Serial1/0.47
    14.0.0.0/24 is subnetted, 1 subnets
C   14.14.14.0 is directly connected, Serial1/0.401
    45.0.0.0/30 is subnetted, 1 subnets
C   45.45.45.0 is directly connected, Serial1/1
R4#
R4#ping 2.2.2.2

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```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Task 3: Perform Level-2 to Level-1 redistribution on both R1 and R4, Make you have Level-2 to Level-2 connectivity.

Solution:

R1 and R4 Configuration:

```
route-map TASK-3 permit 10
!
router isis 1
 redistribute isis ip level-2 into level-1 route-map TASK-3
```

Verification on R4:

```
R4#show ip route
Codes: 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

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i ia    1.1.1.1 [115/138] via 14.14.14.1, Serial1/0.401
     2.0.0.0/32 is subnetted, 1 subnets
i ia    2.2.2.2 [115/148] via 14.14.14.1, Serial1/0.401
     3.0.0.0/32 is subnetted, 1 subnets
i ia    3.3.3.3 [115/148] via 14.14.14.1, Serial1/0.401
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback1
     5.0.0.0/32 is subnetted, 1 subnets
i L2    5.5.5.5 [115/10] via 45.45.45.2, Serial1/1
     6.0.0.0/32 is subnetted, 1 subnets
i L2    6.6.6.6 [115/10] via 46.46.46.2, Serial1/0.46
     7.0.0.0/32 is subnetted, 1 subnets
```

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```
i L2    7.7.7.7 [115/10] via 47.47.47.2, Serial1/0.47
     10.0.0.0/24 is subnetted, 1 subnets
i ia    10.1.1.0 [115/148] via 14.14.14.1, Serial1/0.401
     46.0.0.0/30 is subnetted, 1 subnets
C       46.46.46.0 is directly connected, Serial1/0.46
     47.0.0.0/30 is subnetted, 1 subnets
C       47.47.47.0 is directly connected, Serial1/0.47
     14.0.0.0/24 is subnetted, 1 subnets
C       14.14.14.0 is directly connected, Serial1/0.401
     45.0.0.0/30 is subnetted, 1 subnets
C       45.45.45.0 is directly connected, Serial1/1
```

Verification on R5:

```
R5#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 = 60/118/312 ms
```

Task 4: Remove the default-information originate command from Task-2. Configure R1 and R4 to advertise a default route into level 2 using another method.

Solution:

R1 and R4 Configuration:

```
router isis 1
 no default-information originate
 summary-address 0.0.0.0 0.0.0.0 level-2
```

Verification on R5:

```
R5#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 = 60/118/312 ms
```

Lab completed, Revert config to end of Lab2.

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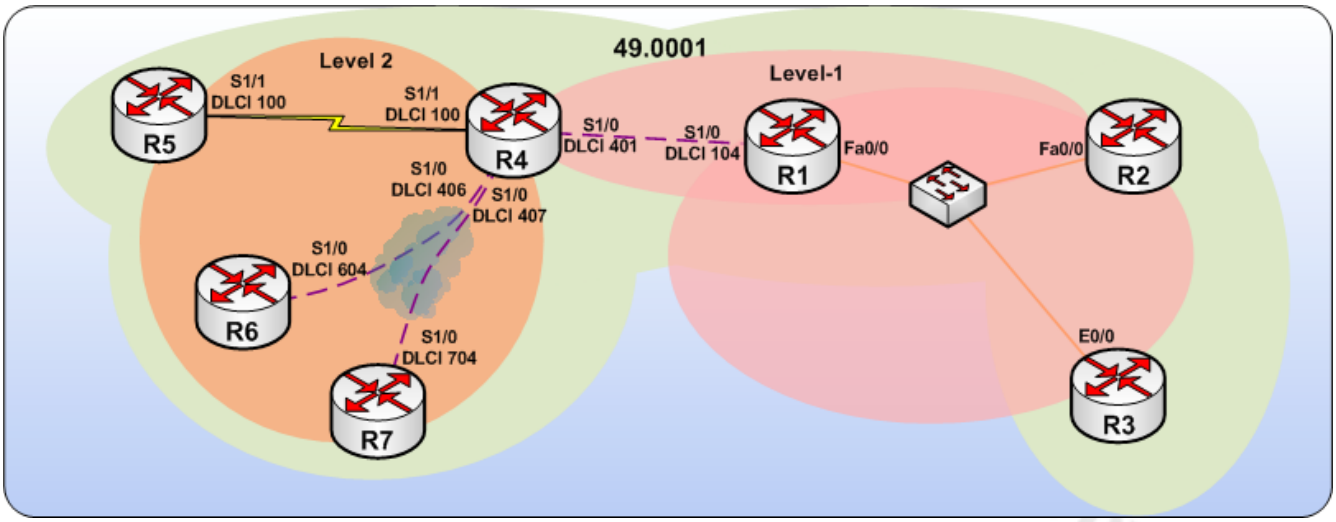
Lab 4 - ISIS Multi-Level 3



Task 1: Reconfigure the routers so that ISIS is in the appropriate level. If a router is wholly in a Level use a router mode command, For the Level-1-2 routers use interface commands. Place the loopback on R4 into level2, All other loopbacks should be in the Level defined by the router.

Solution:

Note – A Level-1-2 router automatically redistributes routes originated in Level-1 into Level-2

R1, R2 and R3 Configuration:

```
router isis 1
 is-type level-1
passive-interface loop1
```

R5, R6 and R7 Configuration:

```
router isis 1
 is-type level-2
passive-interface loop1
```

R4 Configuration:

```
interface S1/0.401
 isis circuit-type Level-1
!
int s1/1
 isis circuit-type Level-2
```

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```
!
int s1/0.46
 isis circuit-type Level-2
!
int s1/0.47
 isis circuit-type Level-2
!
int loopback 1
 isis circuit-type Level-2
!
router isis 1
passive-interface loop1
```

Verification on R4:

```
R4#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L1   Se1/0.401 14.14.14.1      UP    21       00
R5             L2   Se1/1     45.45.45.2      UP    8        R5.01
R6             L2   Se1/0.46  46.46.46.2      UP    28       00
R7             L2   Se1/0.47  47.47.47.2      UP    24       00
```

Verification on R2:

```
R2#show isis neigh

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L1   Fa0/0     10.1.1.1        UP    8        R1.01
R3             L1   Fa0/0     10.1.1.3        UP    29       R1.01
R2#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/10] via 10.1.1.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     3.0.0.0/32 is subnetted, 1 subnets
i L1    3.3.3.3 [115/10] via 10.1.1.3, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
     14.0.0.0/24 is subnetted, 1 subnets
i L1    14.14.14.0 [115/20] via 10.1.1.1, FastEthernet0/0
```

Verification on R7:

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```
R7#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R4             L2   Se3/0.704 47.47.47.1      UP    23       01
R7#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L2    1.1.1.1 [115/20] via 47.47.47.1, Serial3/0.704
     2.0.0.0/32 is subnetted, 1 subnets
i L2    2.2.2.2 [115/30] via 47.47.47.1, Serial3/0.704
     3.0.0.0/32 is subnetted, 1 subnets
i L2    3.3.3.3 [115/30] via 47.47.47.1, Serial3/0.704
     4.0.0.0/32 is subnetted, 1 subnets
i L2    4.4.4.4 [115/10] via 47.47.47.1, Serial3/0.704
     5.0.0.0/32 is subnetted, 1 subnets
i L2    5.5.5.5 [115/20] via 47.47.47.1, Serial3/0.704
     6.0.0.0/32 is subnetted, 1 subnets
i L2    6.6.6.6 [115/20] via 47.47.47.1, Serial3/0.704
     7.0.0.0/32 is subnetted, 1 subnets
C       7.7.7.7 is directly connected, Loopback1
     10.0.0.0/24 is subnetted, 1 subnets
i L2    10.1.1.0 [115/30] via 47.47.47.1, Serial3/0.704
     46.0.0.0/30 is subnetted, 1 subnets
i L2    46.46.46.0 [115/20] via 47.47.47.1, Serial3/0.704
     47.0.0.0/30 is subnetted, 1 subnets
C       47.47.47.0 is directly connected, Serial3/0.704
     14.0.0.0/24 is subnetted, 1 subnets
i L2    14.14.14.0 [115/20] via 47.47.47.1, Serial3/0.704
     45.0.0.0/30 is subnetted, 1 subnets
i L2    45.45.45.0 [115/20] via 47.47.47.1, Serial3/0.704
```

Task 2: Allow inter-level communication by redistributing Level-2 into Level-1 on R4

Solution:

R4 Configuration:

```
route-map TASK-2 permit 10
!
router isis 1
 redistribute isis ip level-2 into level-1 route-map TASK-2
!
```

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Verification on R2:

```
R2#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/10] via 10.1.1.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     3.0.0.0/32 is subnetted, 1 subnets
i L1    3.3.3.3 [115/10] via 10.1.1.3, FastEthernet0/0
     4.0.0.0/32 is subnetted, 1 subnets
i ia    4.4.4.4 [115/148] via 10.1.1.1, FastEthernet0/0
     5.0.0.0/32 is subnetted, 1 subnets
i ia    5.5.5.5 [115/158] via 10.1.1.1, FastEthernet0/0
     6.0.0.0/32 is subnetted, 1 subnets
i ia    6.6.6.6 [115/158] via 10.1.1.1, FastEthernet0/0
     7.0.0.0/32 is subnetted, 1 subnets
i ia    7.7.7.7 [115/158] via 10.1.1.1, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
     46.0.0.0/30 is subnetted, 1 subnets
i ia    46.46.46.0 [115/158] via 10.1.1.1, FastEthernet0/0
     47.0.0.0/30 is subnetted, 1 subnets
i ia    47.47.47.0 [115/158] via 10.1.1.1, FastEthernet0/0
     14.0.0.0/24 is subnetted, 1 subnets
i L1    14.14.14.0 [115/20] via 10.1.1.1, FastEthernet0/0
     45.0.0.0/30 is subnetted, 1 subnets
i ia    45.45.45.0 [115/158] via 10.1.1.1, FastEthernet0/0
R2# ping 5.5.5.5 source 2.2.2.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 5.5.5.5, timeout is 2 seconds:
Packet sent with a source address of 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/106/180 ms
```

Task 3: Minimize the router resource utilization by advertising a default route into both levels without using the default-information originate command.

Solution:

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R4 Configuration:

```
router isis 1
 summary-address 0.0.0.0 0.0.0.0 level-1-2
```

Verification on R5:

```
R5#show ip route

Gateway of last resort is 45.45.45.1 to network 0.0.0.0

     4.0.0.0/32 is subnetted, 1 subnets
i L2    4.4.4.4 [115/10] via 45.45.45.1, Serial1/1
     5.0.0.0/32 is subnetted, 1 subnets
C       5.5.5.5 is directly connected, Loopback1
     6.0.0.0/32 is subnetted, 1 subnets
i L2    6.6.6.6 [115/20] via 45.45.45.1, Serial1/1
     7.0.0.0/32 is subnetted, 1 subnets
i L2    7.7.7.7 [115/20] via 45.45.45.1, Serial1/1
     46.0.0.0/30 is subnetted, 1 subnets
i L2    46.46.46.0 [115/20] via 45.45.45.1, Serial1/1
     47.0.0.0/30 is subnetted, 1 subnets
i L2    47.47.47.0 [115/20] via 45.45.45.1, Serial1/1
     45.0.0.0/30 is subnetted, 1 subnets
C       45.45.45.0 is directly connected, Serial1/1
i*L2 0.0.0.0/0 [115/20] via 45.45.45.1, Serial1/1
R5#ping 2.2.2.2 source 5.5.5.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 5.5.5.5
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 84/132/300 ms
```

Verification on R3:

```
R3#show ip route

Gateway of last resort is 10.1.1.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/10] via 10.1.1.1, Ethernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
i L1    2.2.2.2 [115/10] via 10.1.1.2, Ethernet0/0
     3.0.0.0/32 is subnetted, 1 subnets
C       3.3.3.3 is directly connected, Loopback1
     10.0.0.0/24 is subnetted, 1 subnets
```

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```
C       10.1.1.0 is directly connected, Ethernet0/0
     14.0.0.0/24 is subnetted, 1 subnets
i L1    14.14.14.0 [115/20] via 10.1.1.1, Ethernet0/0
i*ia 0.0.0.0/0 [115/148] via 10.1.1.1, Ethernet0/0
R3#ping 6.6.6.6 source 3.3.3.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 6.6.6.6, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/103/180 ms
```

Task 4: Only advertised the default route into Level-1 with the summary command, Use a different method to advertise a default route into Level-2

Solution:

Note – The summary command prevents all matched routes from being advertised and the **default-information originate** command advertises a default route in addition to the existing routes. The Level-2 routers will now have specific routes to the level-1 networks plus the default route.

R4 Configuration:

```
router isis 1
 no summary-address 0.0.0.0 0.0.0.0 level-1-2
 summary-address 0.0.0.0 0.0.0.0 level-1
 default-information originate
```

Verification on R6:

R6#show ip route

Gateway of last resort is 46.46.46.1 to network 0.0.0.0

```
     1.0.0.0/32 is subnetted, 1 subnets
i L2    1.1.1.1 [115/20] via 46.46.46.1, Serial1/0.604
     2.0.0.0/32 is subnetted, 1 subnets
i L2    2.2.2.2 [115/30] via 46.46.46.1, Serial1/0.604
     3.0.0.0/32 is subnetted, 1 subnets
i L2    3.3.3.3 [115/30] via 46.46.46.1, Serial1/0.604
     4.0.0.0/32 is subnetted, 1 subnets
i L2    4.4.4.4 [115/10] via 46.46.46.1, Serial1/0.604
     5.0.0.0/32 is subnetted, 1 subnets
i L2    5.5.5.5 [115/20] via 46.46.46.1, Serial1/0.604
```

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```
     6.0.0.0/32 is subnetted, 1 subnets
C       6.6.6.6 is directly connected, Loopback1
     7.0.0.0/32 is subnetted, 1 subnets
i L2    7.7.7.7 [115/20] via 46.46.46.1, Serial1/0.604
     10.0.0.0/24 is subnetted, 1 subnets
i L2    10.1.1.0 [115/30] via 46.46.46.1, Serial1/0.604
     46.0.0.0/30 is subnetted, 1 subnets
C       46.46.46.0 is directly connected, Serial1/0.604
     47.0.0.0/30 is subnetted, 1 subnets
i L2    47.47.47.0 [115/20] via 46.46.46.1, Serial1/0.604
     14.0.0.0/24 is subnetted, 1 subnets
i L2    14.14.14.0 [115/20] via 46.46.46.1, Serial1/0.604
     45.0.0.0/30 is subnetted, 1 subnets
i L2    45.45.45.0 [115/20] via 46.46.46.1, Serial1/0.604
i*L2 0.0.0.0/0 [115/10] via 46.46.46.1, Serial1/0.604
R6#ping 3.3.3.3 source 6.6.6.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 6.6.6.6
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/100/188 ms
```

Lab completed, Revert config to end of Lab2.

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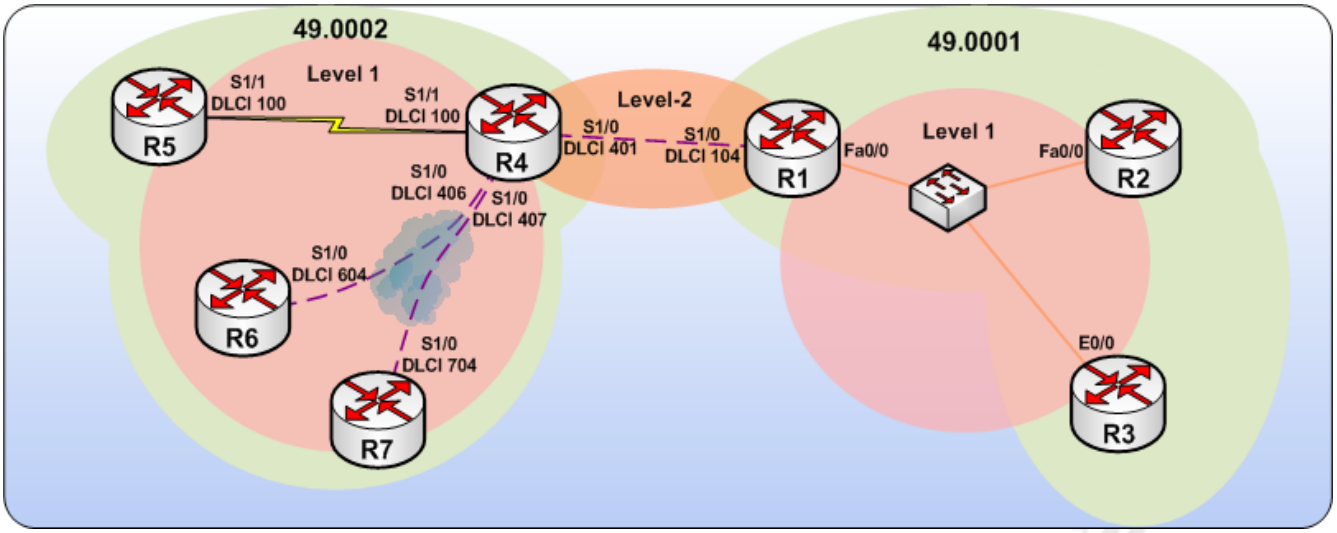
Lab 5 - ISIS Multi-Area 1



Task 1: Reconfigure the routers so that ISIS is in the appropriate Area and Level. If a router is wholly in a Level use a router mode command, For the Level-1-2 routers use interface commands. Place All loopbacks into Level-1.

Solution:

Note – When Level-1-2 routers identifies a path to another area within the same ISIS process it automatically generates a default route into its own Level-1. So unlike the issues seen in a multi-level, one area design. In this scenario there will be end-to-end comms without additional configuration.

R1 Configuration:

```
interface Loopback1
 ip router isis 1
 isis circuit-type level-1
!
interface FastEthernet0/0
 ip router isis 1
 isis circuit-type level-1
!
interface Serial1/0.104 point-to-point
 ip router isis 1
 isis circuit-type level-2-only
!
router isis 1
 net 49.0001.0010.0100.1001.00
```

R2 Configuration:

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```
interface Loopback1
 ip router isis 1
!
interface FastEthernet0/0
 ip router isis 1
!
router isis 1
 net 49.0001.0020.0200.2002.00
 is-type level-1
```

R3 Configuration:

```
interface Loopback1
 ip router isis 1
!
interface Ethernet0/0
 ip router isis 1
!
router isis 1
 net 49.0001.0030.0300.3003.00
 is-type level-1
```

R4 Configuration:

```
interface Loopback1
 ip router isis 1
 isis circuit-type level-1
!
interface Serial1/0.46 point-to-point
 ip router isis 1
 isis circuit-type level-1
!
interface Serial1/0.47 point-to-point
 ip router isis 1
 isis circuit-type level-1

!
interface Serial1/0.401 point-to-point
 ip router isis 1
 isis circuit-type level-2-only
!
interface Serial1/1
 ip router isis 1
 isis circuit-type level-1
!
router isis 1
 net 49.0002.0040.0400.4004.00
```

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R5 Configuration:

```
interface Loopback1
 ip router isis 1
 isis circuit-type level-1
!
interface Serial1/1
 ip router isis 1
 isis circuit-type level-1
!
router isis 1
 net 49.0002.0050.0500.5005.00
```

R6 Configuration:

```
interface Loopback1
 ip router isis 1
 isis circuit-type level-1
!
interface Serial1/0.604 point-to-point
 ip router isis 1
 isis circuit-type level-1
!
router isis 1
 net 49.0002.0060.0600.6006.00
```

R7 Configuration:

```
interface Loopback1
 ip router isis 1
 isis circuit-type level-1
!
interface Serial3/0.704 point-to-point
 ip router isis 1
 isis circuit-type level-1
!
router isis 1
 net 49.0002.0070.0700.7007.00
```

Verification on R1:

```
R1# show isis neighbors detail

System Id      Type Interface IP Address      State Holdtime Circuit Id
R2             L1   Fa0/0     10.1.1.2        UP    22       R3.02
  Area Address(es): 49.0001
  SNPA: cc01.2650.0000
```

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State Changed: 00:48:48
LAN Priority: 64
Format: Phase V
R3 L1 Fa0/0 10.1.1.3 UP 9 R3.02
Area Address(es): 49.0001
SNPA: cc02.2650.0000
State Changed: 00:48:49
LAN Priority: 64
Format: Phase V
R4 L2 Se1/0.104 14.14.14.4 UP 27 02
Area Address(es): 49.0002
SNPA: DLCI 104
State Changed: 00:47:49
Format: Phase V
R1#show ip route

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets
C 1.1.1.1 is directly connected, Loopback1
2.0.0.0/32 is subnetted, 1 subnets
i L1 2.2.2.2 [115/20] via 10.1.1.2, FastEthernet0/0
3.0.0.0/32 is subnetted, 1 subnets
i L1 3.3.3.3 [115/20] via 10.1.1.3, FastEthernet0/0
4.0.0.0/32 is subnetted, 1 subnets
i L2 4.4.4.4 [115/20] via 14.14.14.4, Serial1/0.104
5.0.0.0/32 is subnetted, 1 subnets
i L2 5.5.5.5 [115/30] via 14.14.14.4, Serial1/0.104
6.0.0.0/32 is subnetted, 1 subnets
i L2 6.6.6.6 [115/30] via 14.14.14.4, Serial1/0.104
7.0.0.0/32 is subnetted, 1 subnets
i L2 7.7.7.7 [115/30] via 14.14.14.4, Serial1/0.104
10.0.0.0/24 is subnetted, 1 subnets
C 10.1.1.0 is directly connected, FastEthernet0/0
46.0.0.0/30 is subnetted, 1 subnets
i L2 46.46.46.0 [115/20] via 14.14.14.4, Serial1/0.104
47.0.0.0/30 is subnetted, 1 subnets
i L2 47.47.47.0 [115/20] via 14.14.14.4, Serial1/0.104
14.0.0.0/24 is subnetted, 1 subnets
C 14.14.14.0 is directly connected, Serial1/0.104
45.0.0.0/30 is subnetted, 1 subnets
i L2 45.45.45.0 [115/20] via 14.14.14.4, Serial1/0.104

Verification on R4:

R4#show isis neighbors detail

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```
System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L2   Se1/0.401 14.14.14.1      UP    23       00
  Area Address(es): 49.0001
  SNPA: DLCI 401
  State Changed: 00:48:43
  Format: Phase V
R5             L1   Se1/1     45.45.45.2      UP    8        R5.02
  Area Address(es): 49.0002
  SNPA: DLCI 100
  State Changed: 00:47:21
  LAN Priority: 64
  Format: Phase V
R6             L1   Se1/0.46  46.46.46.2      UP    21       00
  Area Address(es): 49.0002
  SNPA: DLCI 406
  State Changed: 00:47:38
  Format: Phase V
R7             L1   Se1/0.47  47.47.47.2      UP    28       00
  Area Address(es): 49.0002
  SNPA: DLCI 407
  State Changed: 00:48:03
  Format: Phase V
R4#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L2    1.1.1.1 [115/20] via 14.14.14.1, Serial1/0.401
     2.0.0.0/32 is subnetted, 1 subnets
i L2    2.2.2.2 [115/30] via 14.14.14.1, Serial1/0.401
     3.0.0.0/32 is subnetted, 1 subnets
i L2    3.3.3.3 [115/30] via 14.14.14.1, Serial1/0.401
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback1
     5.0.0.0/32 is subnetted, 1 subnets
i L1    5.5.5.5 [115/20] via 45.45.45.2, Serial1/1
     6.0.0.0/32 is subnetted, 1 subnets
i L1    6.6.6.6 [115/20] via 46.46.46.2, Serial1/0.46
     7.0.0.0/32 is subnetted, 1 subnets
i L1    7.7.7.7 [115/20] via 47.47.47.2, Serial1/0.47
     10.0.0.0/24 is subnetted, 1 subnets
i L2    10.1.1.0 [115/20] via 14.14.14.1, Serial1/0.401
     46.0.0.0/30 is subnetted, 1 subnets
C       46.46.46.0 is directly connected, Serial1/0.46
     47.0.0.0/30 is subnetted, 1 subnets
C       47.47.47.0 is directly connected, Serial1/0.47
     14.0.0.0/24 is subnetted, 1 subnets
C       14.14.14.0 is directly connected, Serial1/0.401
```

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```
    45.0.0.0/30 is subnetted, 1 subnets
C       45.45.45.0 is directly connected, Serial1/1
```

Verification on R7:

```
R7#show ip route
Gateway of last resort is 47.47.47.1 to network 0.0.0.0

     4.0.0.0/32 is subnetted, 1 subnets
i L1    4.4.4.4 [115/20] via 47.47.47.1, Serial3/0.704
     5.0.0.0/32 is subnetted, 1 subnets
i L1    5.5.5.5 [115/30] via 47.47.47.1, Serial3/0.704
     6.0.0.0/32 is subnetted, 1 subnets
i L1    6.6.6.6 [115/30] via 47.47.47.1, Serial3/0.704
     7.0.0.0/32 is subnetted, 1 subnets
C       7.7.7.7 is directly connected, Loopback1
     46.0.0.0/30 is subnetted, 1 subnets
i L1    46.46.46.0 [115/20] via 47.47.47.1, Serial3/0.704
     47.0.0.0/30 is subnetted, 1 subnets
C       47.47.47.0 is directly connected, Serial3/0.704
     45.0.0.0/30 is subnetted, 1 subnets
i L1    45.45.45.0 [115/20] via 47.47.47.1, Serial3/0.704
i*L1 0.0.0.0/0 [115/10] via 47.47.47.1, Serial3/0.704
R7#ping 2.2.2.2 source 7.7.7.7

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 7.7.7.7
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/115/256 ms
```

Verification on R3:

```
R3#show ip route
Gateway of last resort is 10.1.1.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/20] via 10.1.1.1, Ethernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
i L1    2.2.2.2 [115/20] via 10.1.1.2, Ethernet0/0
     3.0.0.0/32 is subnetted, 1 subnets
C       3.3.3.3 is directly connected, Loopback1
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Ethernet0/0
i*L1 0.0.0.0/0 [115/10] via 10.1.1.1, Ethernet0/0
R3# ping 5.5.5.5 source 3.3.3.3

Type escape sequence to abort.
```

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Sending 5, 100-byte ICMP Echos to 5.5.5.5, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/151/284 ms

Task 2: Configure R4 to send a summary address that covers 45.45.45.0, 46.46.46.0 and 47.47.47.0 into Level-2, Set the metric to 5 and assign tag 67.

Solution:

R4 Configuration:

router isis 1
summary-address 44.0.0.0 252.0.0.0 level-2 tag 67 metric 5

Verification on R1:

R1# show ip route
Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets
C 1.1.1.1 is directly connected, Loopback1
2.0.0.0/32 is subnetted, 1 subnets
i L1 2.2.2.2 [115/20] via 10.1.1.2, FastEthernet0/0
3.0.0.0/32 is subnetted, 1 subnets
i L1 3.3.3.3 [115/20] via 10.1.1.3, FastEthernet0/0
4.0.0.0/32 is subnetted, 1 subnets
i L2 4.4.4.4 [115/20] via 14.14.14.4, Serial1/0.104
5.0.0.0/32 is subnetted, 1 subnets
i L2 5.5.5.5 [115/30] via 14.14.14.4, Serial1/0.104
6.0.0.0/32 is subnetted, 1 subnets
i L2 6.6.6.6 [115/30] via 14.14.14.4, Serial1/0.104
7.0.0.0/32 is subnetted, 1 subnets
i L2 7.7.7.7 [115/30] via 14.14.14.4, Serial1/0.104
10.0.0.0/24 is subnetted, 1 subnets
C 10.1.1.0 is directly connected, FastEthernet0/0
14.0.0.0/24 is subnetted, 1 subnets
C 14.14.14.0 is directly connected, Serial1/0.104
i L2 44.0.0.0/6 [115/15] via 14.14.14.4, Serial1/0.104

R1#ping 46.46.46.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 46.46.46.2, timeout is 2 seconds:

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```
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/75/196 ms
```

Lab completed, Erase config and continue to next lab.

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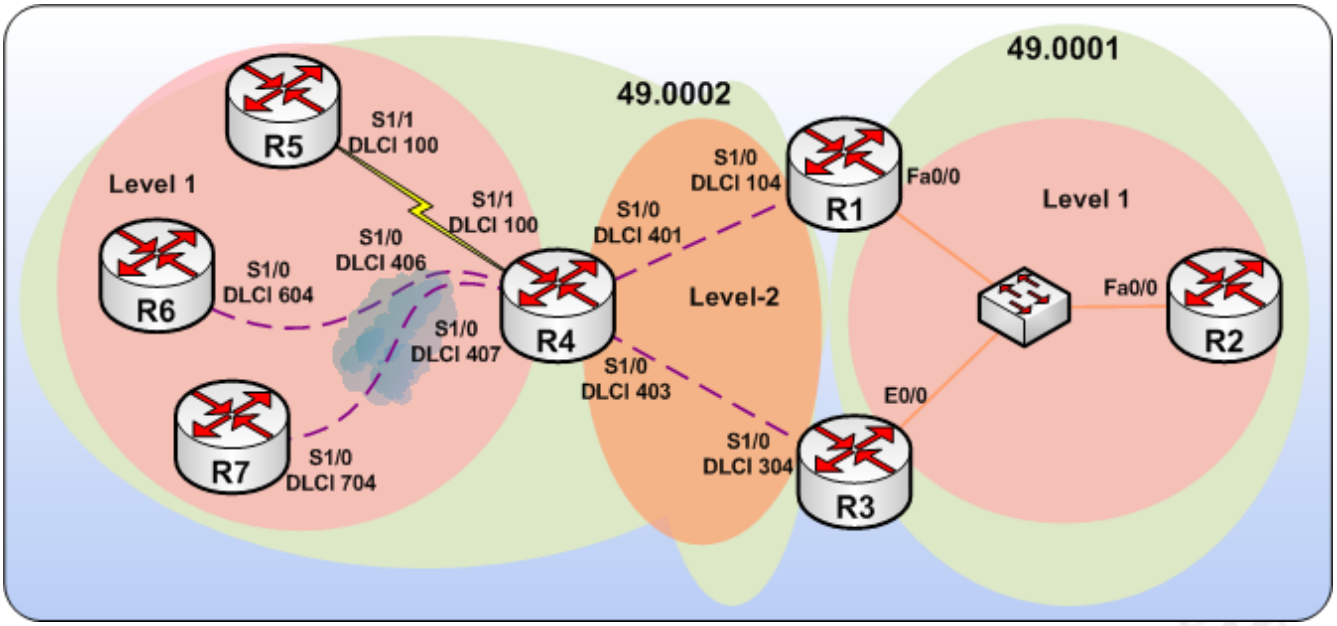
Lab 6 - ISIS Multi-Area 2



Router/Interface	Address/Mask	ISIS Routing Tag – Level - Area
R1 Loopback 1	1.1.1.1/32	ISIS 1 – Level 1 – Area 49.001
FastEthernet0/0	10.123.123.1/24	ISIS 1 – Level 1 – Area 49.001
S1/0 Dlci - 104	10.14.14.14.2/30	ISIS 2 - Level 2 – Area 49.002
R2 Loopback 1	2.2.2.2/32	ISIS 1 – Level 1 – Area 49.001
FastEthernet0/0	10.123.123.2/24	ISIS 1 – Level 1 – Area 49.001
R3 Loopback 1	3.3.3.3/32	ISIS 1 – Level 1 – Area 49.001
Ethernet0/0	10.123.123.3/24	ISIS 1 – Level 1 – Area 49.001
S1/0 Dlci 304	10.34.34.34.2/30	ISIS 2 – Level 2 – Area 49.002
R4 Loopback 1	4.4.4.4/32	ISIS 1 – Level 1 – Area 49.002
S1/0 Dlci 401	10.14.14.1/30	ISIS 1 – Level 2 – Area 49.002
S1/0 Dlci 403	10.34.34.34.1/30	ISIS 1 – Level 2 – Area 49.002
S1/0 Dlci 406	10.46.46.1/30	ISIS 1 – Level 1 – Area 49.002
S1/0 Dlci 407	10.47.47.1/30	ISIS 1 – Level 1 – Area 49.002
S1/1 Dlci 100	45.45.45.4/24	ISIS 1 – Level 1 – Area 49.002
R5 Loopback 1	5.5.5.5/32	ISIS 1 – Level 1 – Area 49.002
S1/1 Dlci 100	45.45.45.5/24	ISIS 1 – Level 1 – Area 49.002
R6 Loopback 1	6.6.6.6/32	ISIS 1 – Level 1 – Area 49.002
S1/0 Dlci 604	10.46.46.2/30	ISIS 1 – Level 1 – Area 49.002
R7 Loopback 1	7.7.7.7/32	ISIS 1 – Level 1 – Area 49.002
S3/0 Dlci 704	10.47.47.2/30	ISIS 1 – Level 1 – Area 49.002

Task 1: Configure Frame relay and ethernet connections as per the diagram and table.

Solution:

R1 Configuration:

```
en
conf t

host R1
int loop 1
ip addr 1.1.1.1 255.255.255.255

int fa0/0
du fu
speed 100
ip addr 10.123.123.1 255.255.255.0
no shut

int s1/0
encap frame
shut
no frame inver
int s1/0.104 point
ip addr 10.14.14.2 255.255.255.252
frame interface-dlci 104
int s1/0
no shut
```

R2 Configuration:

```
en
conf t

host R2
int loop 1
ip addr 2.2.2.2 255.255.255.255

int fa0/0
du fu
speed 100
ip addr 10.123.123.2 255.255.255.0
no shut
```

R3 Configuration:

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```
en
conf t

host R3
int loop 1
ip addr 3.3.3.3 255.255.255.255

int e0/0
du fu
ip addr 10.123.123.3 255.255.255.0
no shut

int s1/0
encap frame
shut
no frame inver
int s1/0.304 point
ip addr 10.34.34.2 255.255.255.252
frame interface-dlci 304
int s1/0
no shut
```

R4 Configuration:

```
en
conf t
host R4

int loop 1
ip addr 4.4.4.4 255.255.255.255
no shut

int s1/0
encap frame
shut
no frame inverse

int s1/0.401 point
ip addr 10.14.14.1 255.255.255.252
frame interface-d 401

int s1/0.403 point
ip addr 10.34.34.1 255.255.255.252
frame interface-dl 403

int s1/0.406 point
ip addr 10.46.46.1 255.255.255.252
frame interface-dl 406
```

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```
int s1/0.407 point
ip addr 10.47.47.1 255.255.255.252
frame interface-dl 407

int s1/0
no shut

int s1/1
shut
encap frame
no frame inverse
no keepalive
ip addr 45.45.45.4 255.255.255.0
frame map clns 100 broad
frame map ip 45.45.45.4 100
frame map ip 45.45.45.5 100 broad
no shut
```

R5 Configuration:

```
en
conf t
host R5

int loop 1
ip addr 5.5.5.5 255.255.255.255

int s1/1
shut
encap frame
no frame inverse
no keepalive
ip addr 45.45.45.5 255.255.255.0
frame map clns 100 broad
frame map ip 45.45.45.4 100 broad
frame map ip 45.45.45.5 100
no shut
```

R6 Configuration:

```
en
conf t
host R6

int loop 1
ip addr 6.6.6.6 255.255.255.255
no shut
```

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```
int s1/0
encap frame
shut
no frame inverse

int s1/0.406 point
ip addr 10.46.46.2 255.255.255.252
frame interface-dl 604


int s1/0
no shut
```

R7 Configuration:

```
en
conf t
host R7

int loop 1
ip addr 7.7.7.7 255.255.255.255
no shut

int s3/0
encap frame
shut
no frame inverse

int s3/0.407 point
ip addr 10.47.47.2 255.255.255.252
frame interface-dl 704


int s3/0
no shut
```

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Task 2: Configure two ISIS processes on R1 and R3 as per the diagrams using routing tags 1 and 2. ISIS process 1 should be in Area 49.0001 and ISIS process 2 should be in Area 49.0002. Enable ISIS on R2 as per diagrams and ensure adjacencies are formed with R1 and R3. Use each routers loopback for the system-id. Ensure R2 is the DIS.

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Solution:

R2 Configuration:

```
router isis 1
 net 49.0001.0020.0200.2002.00
 is-type level-1
!
int loopback 1
 ip router isis 1
!
int fa0/0
 ip router isis 1
 isis priority 65
```

R1 Configuration:

```
router isis 1
 net 49.0001.0010.0100.1001.00
 is-type level-1
!
int loop 1
 ip router isis 1
!
int fa0/0
 ip router isis 1
!
router isis 2
 net 49.0002.0010.0100.1001.00
 is-type level-2
!
int s1/0.104
 ip router isis 2
```

R3 Configuration:

```
router isis 1
 net 49.0001.0030.0300.3003.00
 is-type level-1
!
int loop 1
 ip router isis 1
!
int e0/0
 ip router isis 1
!
router isis 2
 net 49.0002.0030.0300.3003.00
```

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```
 is-type level-2
!
int s1/0.304
 Ip router isis 2
```

Verification on R2:

```
R2#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1               L1   Fa0/0    10.123.123.1    UP    24       R2.02
R3               L1   Fa0/0    10.123.123.3    UP    24       R2.02


R2#show ip route
Gateway of last resort is 10.123.123.3 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/20] via 10.123.123.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     3.0.0.0/32 is subnetted, 1 subnets
i L1    3.3.3.3 [115/20] via 10.123.123.3, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.123.123.0 is directly connected, FastEthernet0/0
i*L1 0.0.0.0/0 [115/10] via 10.123.123.3, FastEthernet0/0
                [115/10] via 10.123.123.1, FastEthernet0/0
```

Task 3: Configure ISIS on R4 as per the diagram.

Solution:

R2 Configuration:

```
router isis 1
 net 49.0002.0040.0400.4004.00
!
int loop 1
 ip router isis 1
 isis circuit-type level-1
!
int s1/0.401
 ip router isis 1
```

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```
 isis circuit-type level-2
!
int s1/0.403
 ip router isis 1
 isis circuit-type level-2
!
int s1/0.406
 ip router isis 1
 isis circuit-type level-1
!
int s1/0.407
 ip router isis 1
 isis circuit-type level-1
!
int s1/1
 ip router isis 1
 isis circuit-type level-1
```

Verification on R4:

```
R4#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L2   Se1/0.401 10.14.14.2      UP    27       00
R3             L2   Se1/0.403 10.34.34.2      UP    23       00
R4#show ip route
Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L2    1.1.1.1 [115/20] via 10.14.14.2, Serial1/0.401
     2.0.0.0/32 is subnetted, 1 subnets
i L2    2.2.2.2 [115/30] via 10.34.34.2, Serial1/0.403
                [115/30] via 10.14.14.2, Serial1/0.401
     3.0.0.0/32 is subnetted, 1 subnets
i L2    3.3.3.3 [115/20] via 10.34.34.2, Serial1/0.403
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback1
     10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
i L2    10.123.123.0/24 [115/20] via 10.34.34.2, Serial1/0.403
                        [115/20] via 10.14.14.2, Serial1/0.401
C       10.47.47.0/30 is directly connected, Serial1/0.407
C       10.46.46.0/30 is directly connected, Serial1/0.406
C       10.34.34.0/30 is directly connected, Serial1/0.403
C       10.14.14.0/30 is directly connected, Serial1/0.401
     45.0.0.0/24 is subnetted, 1 subnets
C       45.45.45.0 is directly connected, Serial1/1
```

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Task 4: ISIS be default uses a metric of 10 for all interfaces, Configure the ISIS metrics on the interfaces of R1, R2, R3 and R4 according to the table. Treat all PVC's as 64k links. Enable the use of only wide metrics for both Level 1 and 2.

64K	210
10M	50
100M	20
Loopback1	1

Solution:

Note – ISIS also by default allows a maximum metric of 63, Cisco enhanced the metric field to 16777214. This feature needs to be enabled first with the router level command **metric-style**

R2 Configuration:

```
router isis 1
 metric-style wide level-1-2
!
int loop 1
 isis metric 1
!
int fa0/0
 isis metric 20
```

R1 Configuration:

```
router isis 1
 metric-style wide level-1-2
!
router isis 2
 metric-style wide level-1-2
!
int loop 1
 isis metric 1
!
int fa0/0
 isis metric 20
!
int s1/0.104
 isis metric 210
```

R3 Configuration:

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```
router isis 1
 metric-style wide level-1-2
!
router isis 2
 metric-style wide level-1-2
!
int loop 1
 isis metric 1
!
int e0/0
 isis metric 50
!
int s1/0.304
 isis metric 210
```

R4 Configuration:

```
router isis 1
 metric-style wide level-1-2
!
int loop 1
 isis metric 1
!
int s1/0.401
 isis metric 210
!
int s1/0.403
 isis metric 210
!
int s1/0.406
 isis metric 210
!
int s1/0.407
 isis metric 210
!
int s1/1
 isis metric 210
```

Verification on R4:

```
R4#show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L2    1.1.1.1 [115/211] via 10.14.14.2, Serial1/0.401
     2.0.0.0/32 is subnetted, 1 subnets
i L2    2.2.2.2 [115/231] via 10.14.14.2, Serial1/0.401
```

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```
     3.0.0.0/32 is subnetted, 1 subnets
i L2    3.3.3.3 [115/211] via 10.34.34.2, Serial1/0.403
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback1
     10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
i L2    10.123.123.0/24 [115/230] via 10.14.14.2, Serial1/0.401
C       10.47.47.0/30 is directly connected, Serial1/0.407
C       10.46.46.0/30 is directly connected, Serial1/0.406
C       10.34.34.0/30 is directly connected, Serial1/0.403
C       10.14.14.0/30 is directly connected, Serial1/0.401
     45.0.0.0/24 is subnetted, 1 subnets
C       45.45.45.0 is directly connected, Serial1/1
```

Task 5: R2 is still load-balancing the default gateway, Force R2 to use R1 as the default gateway

Solution:

Note – If both subnet mask length and metric are the same, The router looks for the lowest next hop address. So by setting the maximum-paths to one, R2 now uses the default gateway advertised by R1.

R2 Configuration:

```
router isis 1
 maximum-paths 1
```

Verification on R2:

```
R2#show ip route
Gateway of last resort is 10.123.123.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/21] via 10.123.123.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     3.0.0.0/32 is subnetted, 1 subnets
i L1    3.3.3.3 [115/21] via 10.123.123.3, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.123.123.0 is directly connected, FastEthernet0/0
i*L1 0.0.0.0/0 [115/20] via 10.123.123.1, FastEthernet0/0
R2#ping 4.4.4.4 source 2.2.2.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
```

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```
Packet sent with a source address of 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/68/96 ms
```

Task 6: Configure ISIS on the remaining routers as per the diagram.

Solution:

R5 Configuration:

```
router isis 1
 net 49.0002.0050.0500.5005.00
 metric-style wide
 is-type level-1
!
int loop 1
 ip router isis 1
 isis metric 1
!
int s1/1
 ip router isis 1
 isis metric 210
```

R6 Configuration:

```
router isis 1
 net 49.0002.0060.0600.6006.00
 metric-style wide
 is-type level-1
!
int loop 1
 ip router isis 1
 isis metric 1
!
int s1/0.604
 ip router isis 1
 isis metric 210
```

R7 Configuration:

```
router isis 1
 net 49.0002.0070.0700.7007.00
 metric-style wide
 is-type level-1
!
int loop 1
 ip router isis 1
```

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```
 isis metric 1
!
int s3/0.704
 ip router isis 1
 isis metric 210
```

Verification on R4:

```
R4#            show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L2   Se1/0.401 10.14.14.2      UP    29       00
R3             L2   Se1/0.403 10.34.34.2      UP    27       00
R5             L1   Se1/1     45.45.45.5      UP    7        R5.02
R6             L1   Se1/0.406 10.46.46.2      UP    26       00
R7             L1   Se1/0.407 10.47.47.2      UP    22       00
```

Verification on R5:

```
R5#show ip route

Gateway of last resort is 45.45.45.4 to network 0.0.0.0

     4.0.0.0/32 is subnetted, 1 subnets
i L1    4.4.4.4 [115/211] via 45.45.45.4, Serial1/1
     5.0.0.0/32 is subnetted, 1 subnets
C       5.5.5.5 is directly connected, Loopback1
     6.0.0.0/32 is subnetted, 1 subnets
i L1    6.6.6.6 [115/421] via 45.45.45.4, Serial1/1
     7.0.0.0/32 is subnetted, 1 subnets
i L1    7.7.7.7 [115/421] via 45.45.45.4, Serial1/1
     10.0.0.0/30 is subnetted, 2 subnets
i L1    10.47.47.0 [115/420] via 45.45.45.4, Serial1/1
i L1    10.46.46.0 [115/420] via 45.45.45.4, Serial1/1
     45.0.0.0/24 is subnetted, 1 subnets
C       45.45.45.0 is directly connected, Serial1/1
i*L1 0.0.0.0/0 [115/210] via 45.45.45.4, Serial1/1

R5#ping 2.2.2.2 source 5.5.5.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 5.5.5.5
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 64/85/132 ms
```

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Task 6: Redistribute Level2 into Level 1 on R1 and R3. Configure one summary address on R1 and R3 so that R2 uses R3 to reach all networks not directly connected starting with 10. In the event that R3 fails, R2 should revert back to R1. Only one summary address should appear in the routing table of R2

Solution:

Note – When a summary route is configured, any existing routes covered will be withdrawn.

R1 Configuration:

```
route-map TST permit 10
!
router isis 1
 redistribute isis ip level-2 into level-1 route-map TST
 summary-address 10.0.0.0 255.0.0.0 level-1 metric 1000
```

R3 Configuration:

```
route-map TST permit 10
!
router isis 1
 redistribute isis ip level-2 into level-1 route-map TST
 summary-address 10.0.0.0 255.0.0.0 level-1 metric 500
```

Verification on R2:

```
R2#show ip route
Gateway of last resort is 10.123.123.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/21] via 10.123.123.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     3.0.0.0/32 is subnetted, 1 subnets
i L1    3.3.3.3 [115/21] via 10.123.123.3, FastEthernet0/0
     4.0.0.0/32 is subnetted, 1 subnets
i ia    4.4.4.4 [115/231] via 10.123.123.1, FastEthernet0/0
     5.0.0.0/32 is subnetted, 1 subnets
i ia    5.5.5.5 [115/441] via 10.123.123.1, FastEthernet0/0
     6.0.0.0/32 is subnetted, 1 subnets
i ia    6.6.6.6 [115/441] via 10.123.123.1, FastEthernet0/0
     7.0.0.0/32 is subnetted, 1 subnets
i ia    7.7.7.7 [115/441] via 10.123.123.1, FastEthernet0/0
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.123.123.0/24 is directly connected, FastEthernet0/0
i ia    10.0.0.0/8 [115/520] via 10.123.123.3, FastEthernet0/0
     45.0.0.0/24 is subnetted, 1 subnets
```

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```
i ia    45.45.45.0 [115/440] via 10.123.123.1, FastEthernet0/0
i*L1 0.0.0.0/0 [115/20] via 10.123.123.1, FastEthernet0/0
```

After shutting down R3 e0/0

```
R2#show ip route
Gateway of last resort is 10.123.123.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/21] via 10.123.123.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     4.0.0.0/32 is subnetted, 1 subnets
i ia    4.4.4.4 [115/231] via 10.123.123.1, FastEthernet0/0
     5.0.0.0/32 is subnetted, 1 subnets
i ia    5.5.5.5 [115/441] via 10.123.123.1, FastEthernet0/0
     6.0.0.0/32 is subnetted, 1 subnets
i ia    6.6.6.6 [115/441] via 10.123.123.1, FastEthernet0/0
     7.0.0.0/32 is subnetted, 1 subnets
i ia    7.7.7.7 [115/441] via 10.123.123.1, FastEthernet0/0
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.123.123.0/24 is directly connected, FastEthernet0/0
i ia    10.0.0.0/8 [115/1020] via 10.123.123.1, FastEthernet0/0
     45.0.0.0/24 is subnetted, 1 subnets
i ia    45.45.45.0 [115/440] via 10.123.123.1, FastEthernet0/0
i*L1 0.0.0.0/0 [115/20] via 10.123.123.1, FastEthernet0/0
```

Lab completed, Erase configs and continue to next lab.

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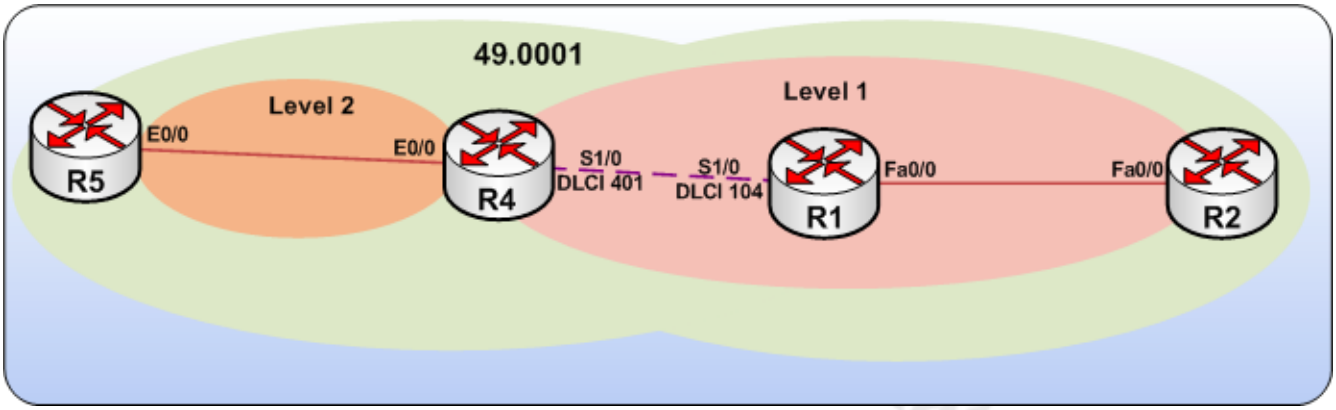
Lab 6 - ISIS Authentication



Router/Interface	Address/Mask	ISIS Routing Tag – Level - Area
R1 Loopback 1	1.1.1.1/32	ISIS 1 – Level 1 – Area 49.001
FastEthernet0/0	10.123.123.1/24	ISIS 1 – Level 1 – Area 49.001
S1/0 Dlci - 104	10.14.14.14.2/30	ISIS 1 - Level1 – Area 49.001
R2 Loopback 1	2.2.2.2/32	ISIS 1 – Level 1 – Area 49.001
FastEthernet0/0	10.123.123.2/24	ISIS 1 – Level 1 – Area 49.001
R4 Loopback 1	4.4.4.4/32	ISIS 1 – Level 1 – Area 49.001
S1/0 Dlci 401	10.14.14.1/30	ISIS 1 – Level 1 – Area 49.001
Ethernet0/0	10.45.45.4/24	ISIS 1 – Level 2 – Area 49.001
R5 Loopback 1	5.5.5.5/32	ISIS 1 – Level 2 – Area 49.001
Ethernet0/0	10.45.45.5/24	ISIS 1 – Level 2 – Area 49.001

Task 1: Configure the devices as per the diagram. Enable ISIS on all routers. Redistribute L2 routes into L1.

Solution:

R1 Configuration:

```
en
conf t
!
host R1
int loop 1
ip addr 1.1.1.1 255.255.255.255
!
int fa0/0
du fu
```

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```
speed 100
ip addr 10.123.123.1 255.255.255.0
no shut
!
int s1/0
encap frame
shut
no frame inver
int s1/0.104 point
ip addr 10.14.14.2 255.255.255.252
frame interface-dlci 104
int s1/0
no shut
!
router isis 1
net 49.0001.0010.0100.1001.00
is-type level-1
!
int loop 1
ip router isis 1
!
int fa0/0
ip router isis 1
!
int s1/0.104
ip router isis 1
```

R2 Configuration:

```
en
conf t
!
host R2
int loop 1
ip addr 2.2.2.2 255.255.255.255
!
int fa0/0
du fu
speed 100
ip addr 10.123.123.2 255.255.255.0
no shut
!
router isis 1
net 49.0001.0020.0200.2002.00
is-type level-1
!
int loopback 1
ip router isis 1
```

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```
!
int fa0/0
ip router isis 1
```

R4 Configuration:

```
en
conf t
host R4
!
int loop 1
ip addr 4.4.4.4 255.255.255.255
no shut
!
int s1/0
encap frame
shut
no frame inverse
int s1/0.401 point
ip addr 10.14.14.1 255.255.255.252
frame interface-d 401
int s1/0
no shut
!
int e0/0
ip addr 10.45.45.4 255.255.255.0
du fu
no shut
!
route-map TST permit 10
!
router isis 1
net 49.0001.0040.0400.4004.00
redistribute isis ip level-2 into level-1 route-map TST
!
int loop 1
ip router isis 1
isis circuit-type level-1
!
int s1/0.401
ip router isis 1
isis circuit-type level-1
!
int e0/0
ip router isis 1
isis circuit-type level-2
```

R5 Configuration:

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```
en
conf t
host R5
!
int loop 1
ip addr 5.5.5.5 255.255.255.255
no shut
!
int e0/0
ip addr 10.45.45.5 255.255.255.0
du fu
no shut
!
router isis 1
net 49.0001.0050.0500.5005.00
!
int loop 1
ip router isis 1
isis circuit-type level-2
!
int e0/0
ip router isis 1
isis circuit-type level-2
```

Verification:

```
R2#ping 5.5.5.5 source 2.2.2.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 5.5.5.5, timeout is 2 seconds:
Packet sent with a source address of 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/56/64 ms
```

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Task 2: Configure plain text authentication using the password TASK2 on the Ethernet link between R1 and R2, You must use a key chain on R2 but not on R1.

Solution:

Note – The old style of configuration is performed by the use of the isis password command, If the isis authentication command is used as well any isis password commands are removed.

R1 Configuration:

```
int fa0/0
 isis password TASK2
```

R2 Configuration:

```
key chain TASK2
 key 1
  key-string TASK2
!
interface FastEthernet0/0
 isis authentication mode text
 isis authentication key-chain TASK2
```

Task 3: Enable MD5 authentication using the password TASK3 between R1 and R4. Only allow this authentication to occur on Level-1 adjacencies.

Solution:

Note – To see what is occurring while configuring authentication, Use the **debug isis authentication information** command

```
R1#debug isis authentication information
IS-IS authentication information debugging is on
R1#
*Mar  1 00:20:03.239: ISIS-AuthInfo: No auth TLV found in received packet
*Mar  1 00:20:03.243: %CLNS-4-AUTH_FAIL: ISIS: Serial IIH authentication failed
*Mar  1 00:20:12.279: ISIS-AuthInfo: IIH no change, use the same hmac value
*Mar  1 00:20:12.351: ISIS-AuthInfo: No auth TLV found in received packet
*Mar  1 00:20:21.127: ISIS-AuthInfo: IIH no change, use the same hmac value
```

R1 Configuration:

```
key chain TASK3
 key 1
  key-string TASK3
!
interface Serial1/0.104 point-to-point
 isis authentication mode md5
 isis authentication key-chain TASK3
```

R4 Configuration:

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```
key chain TASK3
 key 1
  key-string TASK3
!
interface Serial1/0. point-to-point
 isis authentication mode md5
 isis authentication key-chain TASK3
```

Task 4: Reconfigure authentication between R1 and R2 to use MD5 encryption for Level-1 adjacencies, Make TASK4 the password and ensure the adjacency stay up will configuring.

Solution:

Note – To ensure the adjacencies are not disrupted while configuring authentication, Use the interface command **isis authentication send-only** before starting configuration, Once finished and status is verified remove the command. Configure one end and show the isis neighbors.

R1 and R2 Configuration:

```
key chain TASK4
 key 1
  key-string TASK4
!
interface Fa0/0
 isis authentication send-only
 isis authentication mode md5 level-1
 isis authentication key-chain TASK4
```

Task 5: Configure Level-1 wide authentication, Use Cisco1 as the md5 string.

Solution:

Note – Level-1 wide authentication is also known as Area authentication and Level-2 authentication is known as Domain authentication, Configuration for either type is performed from within the ISIS process

R1, R2 and R4 Configuration:

```
key chain TASK5
key 1
key-string Cisco1
!
router isis 1
authentication mode md5 level-1
authenti key TASK5 level-1
```

Verification on R2:

```
R2(config-router)#authentication key-chain TASK5
R2(config-router)#
*Mar  1 00:32:39.763: ISIS-AuthInfo: No auth TLV found in received packet
*Mar  1 00:32:39.763: ISIS-AuthInfo: No auth TLV found in received packet
*Mar  1 00:32:39.763: ISIS-AuthInfo: No auth TLV found in received packet
*Mar  1 00:32:39.763: ISIS-AuthInfo: No auth TLV found in received packet
*Mar  1 00:32:39.839: ISIS-AuthInfo: No auth TLV found in received packet
*Mar  1 00:32:39.839: %CLNS-4-AUTH_FAIL: ISIS: LSP authentication failed
*Mar  1 00:33:12.899: ISIS-AuthInfo: No auth TLV found in received packet
*Mar  1 00:33:12.899: %CLNS-4-AUTH_FAIL: ISIS: LSP authentication failed
*Mar  1 00:33:12.915: ISIS-AuthInfo: No auth TLV found in received packet^Z
R2#
R2#
```

---Config of R1 takes place here, Notice R1 routes are in the table but nothing from R4-----

```
*Mar  1 00:33:28.019: %SYS-5-CONFIG_I: Configured from console by consoleshow ip route
Codes: 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

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/20] via 10.123.123.1, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.123.123.0/24 is directly connected, FastEthernet0/0
i L1    10.14.14.0/30 [115/20] via 10.123.123.1, FastEthernet0/0
```

---Config of R4 takes place here, Notice we have full reachability again----

```
R2#show ip route
Codes: 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
```

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```
      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

Gateway of last resort is not set

    1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/20] via 10.123.123.1, FastEthernet0/0
    2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
    4.0.0.0/32 is subnetted, 1 subnets
i L1    4.4.4.4 [115/30] via 10.123.123.1, FastEthernet0/0
    5.0.0.0/32 is subnetted, 1 subnets
i ia    5.5.5.5 [115/168] via 10.123.123.1, FastEthernet0/0
    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C       10.123.123.0/24 is directly connected, FastEthernet0/0
i ia    10.45.45.0/24 [115/158] via 10.123.123.1, FastEthernet0/0
i L1    10.14.14.0/30 [115/20] via 10.123.123.1, FastEthernet0/0
```

Task 6: Perform Domain wide authentication using the key TASK6

Solution:

R4 and R5 Configuration:

```
router isis 1
 net 49.0002.0050.0500.5005.00
 metric-style wide
 is-type level-1
!
int loop 1
 ip router isis 1
 isis metric 1
!
int s1/1
 ip router isis 1
 isis metric 210
```

Verification on R4:

```
R4(config-router)#key chain TASK6
R4(config-keychain)#key 1
R4(config-keychain-key)#key-s TASK6
R4(config-keychain-key)#!
R4(config-keychain-key)#router isis 1
```

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```
R4(config-router)#authentication mode md5 level-2
R4(config-router)#authenti key TASK6 level-2
R4(config-router)#
*Mar  1 00:37:57.767: %CLNS-4-AUTH_FAIL: ISIS: LSP authentication failed
R4(config-router)#
```
---R5 has not been configured to the route to 5.5.5.5 has been lost---
```
R4(config-router)#do show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/20] via 10.14.14.2, Serial1/0.401
     2.0.0.0/32 is subnetted, 1 subnets
i L1    2.2.2.2 [115/30] via 10.14.14.2, Serial1/0.401
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback1
     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
i L1    10.123.123.0/24 [115/20] via 10.14.14.2, Serial1/0.401
C       10.45.45.0/24 is directly connected, Ethernet0/0
C       10.14.14.0/30 is directly connected, Serial1/0.401
R4(config-router)#
*Mar  1 00:38:35.679: %CLNS-4-AUTH_FAIL: ISIS: CSNP authentication failed
```
---R5 has now been configured and the loopback route is back---
```
R4(config-router)#do show ip route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/20] via 10.14.14.2, Serial1/0.401
     2.0.0.0/32 is subnetted, 1 subnets
i L1    2.2.2.2 [115/30] via 10.14.14.2, Serial1/0.401
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback1
     5.0.0.0/32 is subnetted, 1 subnets
```
i L2   5.5.5.5 [115/20] via 10.45.45.5, Ethernet0/0
```
     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
i L1    10.123.123.0/24 [115/20] via 10.14.14.2, Serial1/0.401
C       10.45.45.0/24 is directly connected, Ethernet0/0
C       10.14.14.0/30 is directly connected, Serial1/0.401
```

Lab completed, Erase configs and continue to next lab.

Lab 6 - ISIS Ethernet Network Types.

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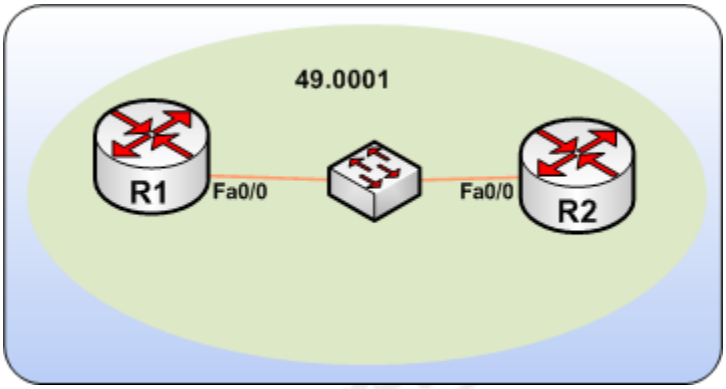

Router/Interface	Address/Mask	ISIS Routing Tag – Level - Area
R1 Loopback 1	1.1.1.1/32	ISIS 1 – Level 1 – Area 49.001
FastEthernet0/0	10.123.123.1/24	ISIS 1 – Level 1 – Area 49.001
R2 Loopback 1	2.2.2.2/32	ISIS 1 – Level 1 – Area 49.001
FastEthernet0/0	10.123.123.2/24	ISIS 1 – Level 1 – Area 49.001

Task 1: Configure the devices as per the diagram. Enable ISIS on all routers.

Solution:

R1 Configuration:

```
en
conf t
!
host R1
int loop 1
ip addr 1.1.1.1 255.255.255.255
!
int fa0/0
du fu
speed 100
ip addr 10.123.123.1 255.255.255.0
no shut
!
router isis 1
net 49.0001.0010.0100.1001.00
is-type level-1
!
int loop 1
ip router isis 1
!
int fa0/0
ip router isis 1
```

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!

R2 Configuration:

```
en
conf t
!
host R2
int loop 1
ip addr 2.2.2.2 255.255.255.255
!
int fa0/0
du fu
speed 100
ip addr 10.123.123.2 255.255.255.0
no shut
!
router isis 1
net 49.0001.0020.0200.2002.00
is-type level-1
!
int loopback 1
ip router isis 1
!
int fa0/0
ip router isis 1
```

Verification on R2:

```
R2#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1               L1   Fa0/0     10.123.123.1    UP    24       R2.02
R2#
R2#show clns in
R2#show clns interface fa0/0
FastEthernet0/0 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 30 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x1, local circuit ID 0x2
```

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```
Level-1 Metric: 10, Priority: 64, Circuit ID: R2.02
DR ID: R2.02
Level-1 IPv6 Metric: 10
Number of active level-1 adjacencies: 1
Next IS-IS LAN Level-1 Hello in 1 seconds
```

Task 2: Change the ISIS network type to point-to-point the FastEthernet interfaces on both Routers.

Solution:

R1 and R2 Configuration:

```
int fa0/0
 isis network point-to-point
```

Before the change, LAN hellos are sent. Debug isis adj

```
*Mar  1 00:05:36.091: ISIS-Adj: Sending L1 LAN IIH on FastEthernet0/0, length 1497
*Mar  1 00:05:39.351: ISIS-Adj: Sending L1 LAN IIH on FastEthernet0/0, length 1497
*Mar  1 00:05:42.459: ISIS-Adj: Sending L1 LAN IIH on FastEthernet0/0, length 1497
*Mar  1 00:05:44.107: ISIS-Adj: Rec L1 IIH from cc00.2650.0000 (FastEthernet0/0), cir type L1, cir
id 0020.0200.2002.02, length 1497
```

After the change, Serial/Point2point hellos are sent. Debug isis adj

```
*Mar  1 00:04:25.611: ISIS-Adj: Sending serial IIH on FastEthernet0/0, length 1496
*Mar  1 00:04:32.699: ISIS-Adj: Sending L1 LAN IIH on Loopback1, length 1514
*Mar  1 00:04:34.435: ISIS-Adj: Rec serial IIH from cc00.2650.0000 (FastEthernet0/0), cir type L1,
cir id 00, length 1496
```

Lab completed, Erase configs and continue to next lab.

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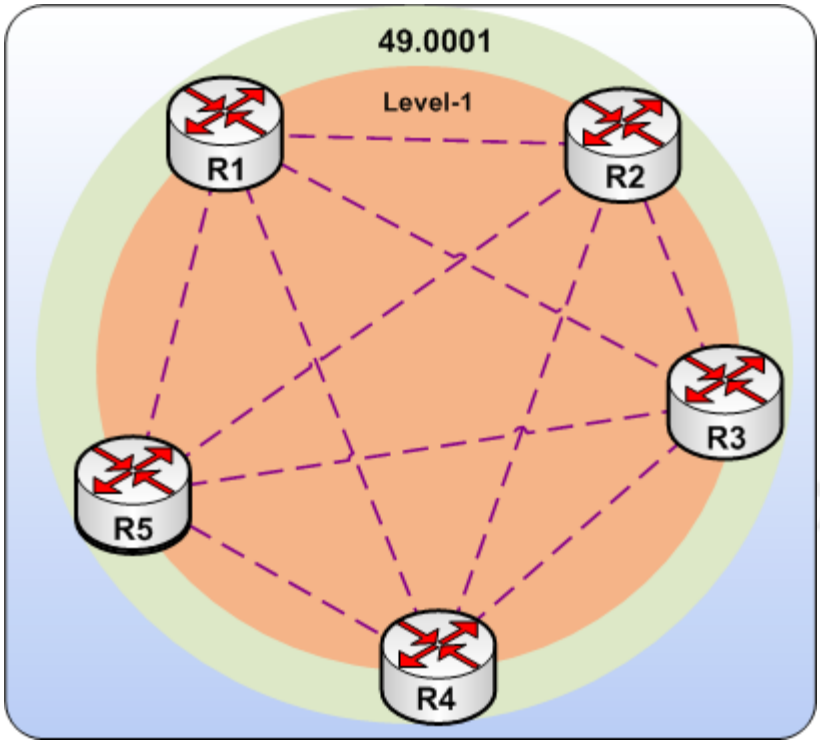
Lab 6 - ISIS Mesh Groups



Router/Interface	Address/Mask	Router/Interface	Address/Mask
R1 Loopback 1	1.1.1.1/32	R4 Loopback 1	4.4.4.4/32
S1/0 Dlci - 102	10.12.12.1/24	S1/0 Dlci - 401	10.14.14.4/24
S1/0 Dlci - 103	10.13.13.1/24	S1/0 Dlci - 402	10.24.24.4/24
S1/0 Dlci - 104	10.14.14.1/24	S1/0 Dlci - 403	10.34.34.4/24
S1/0 Dlci - 105	10.15.15.1/24	S1/0 Dlci - 405	10.45.45.4/24
R2 Loopback 1	2.2.2.2/32	R5 Loopback 1	5.5.5.5/32
S1/0 Dlci - 201	10.12.12.2/24	S1/0 Dlci - 501	10.15.15.5/24
S1/0 Dlci - 203	10.23.23.2/24	S1/0 Dlci - 502	10.25.25.5/24
S1/0 Dlci - 204	10.24.24.2/24	S1/0 Dlci - 503	10.35.35.5/24
S1/0 Dlci - 205	10.25.25.2/24	S1/0 Dlci - 504	10.45.45.5/24
R3 Loopback 1	3.3.3.3/32		
S1/0 Dlci - 301	10.13.13.3/24		
S1/0 Dlci - 302	10.23.23.3/24		
S1/0 Dlci - 304	10.34.34.3/24		
S1/0 Dlci - 305	10.35.35.3/24		

Task 1: Configure the devices as per the diagram. Enable ISIS on all interfaces on all routers.

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Solution:

R1 Configuration:

```
en
conf t
hostname R1
!
int loopback 1
 ip addr 1.1.1.1 255.255.255.255
!
int s1/0
 shut
 encap frame
 no frame inverse
!
int s1/0.102 point
 ip addr 10.12.12.1 255.255.255.0
 frame interface-dlci 102
!
int s1/0.103 point
 ip addr 10.13.13.1 255.255.255.0
 frame interface-dlci 103
!
int s1/0.104 point
 ip addr 10.14.14.1 255.255.255.0
 frame interface-dlci 104
!
int s1/0.105 point
 ip addr 10.15.15.1 255.255.255.0
 frame interface-dlci 105
!
int s1/0
 no shut
!
router isis 1
 net 49.0001.0010.0100.1001.00
 is-type level-1
!
int loopback 1
 ip router isis 1
!
int s1/0.102
 ip router isis 1
!
int s1/0.103
```

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```
 ip router isis 1
!
int s1/0.104
 ip router isis 1
!
int s1/0.105
 ip router isis 1
```

R2 Configuration:

```
en
conf t
hostname R2
!
int loopback 1
 ip addr 2.2.2.2 255.255.255.255
!
int s1/0
 shut
 encap frame
 no frame inverse
!
int s1/0.201 point
 ip addr 10.12.12.2 255.255.255.0
 frame interface-dlci 201
!
int s1/0.203 point
 ip addr 10.23.23.2 255.255.255.0
 frame interface-dlci 203
!
int s1/0.204 point
 ip addr 10.24.24.2 255.255.255.0
 frame interface-dlci 204
!
int s1/0.205 point
 ip addr 10.25.25.2 255.255.255.0
 frame interface-dlci 205
!
int s1/0
 no shut
!
router isis 1
 net 49.0001.0020.0200.2002.00
 is-type level-1
!
int loopback 1
 ip router isis 1
```

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```
!
int s1/0.201
 ip router isis 1
!
int s1/0.203
 ip router isis 1
!
int s1/0.204
 ip router isis 1
!
int s1/0.205
 ip router isis 1
```

R3 Configuration:

```
en
conf t
hostname R3
!
int loopback 1
 ip addr 3.3.3.3 255.255.255.255
!
int s1/0
 shut
 encap frame
 no frame inverse
!
int s1/0.301 point
 ip addr 10.13.13.3 255.255.255.0
 frame interface-dlci 301
!
int s1/0.302 point
 ip addr 10.23.23.3 255.255.255.0
 frame interface-dlci 302
!
int s1/0.304 point
 ip addr 10.34.34.3 255.255.255.0
 frame interface-dlci 304
!
int s1/0.305 point
 ip addr 10.35.35.3 255.255.255.0
 frame interface-dlci 305
!
int s1/0
 no shut
!
router isis 1
 net 49.0001.0030.0300.3003.00
```

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```
 is-type level-1
!
int loopback 1
 ip router isis 1
!
int s1/0.301
 ip router isis 1
!
int s1/0.302
 ip router isis 1
!
int s1/0.304
 ip router isis 1
!
int s1/0.305
 ip router isis 1
```

R4 Configuration:

```
en
conf t
hostname R4
!
int loopback 1
 ip addr 4.4.4.4 255.255.255.255
!
int s1/0
 shut
 encap frame
 no frame inverse
!
int s1/0.401 point
 ip addr 10.14.14.4 255.255.255.0
 frame interface-dlci 401
!
int s1/0.402 point
 ip addr 10.24.24.4 255.255.255.0
 frame interface-dlci 402
!
int s1/0.403 point
 ip addr 10.34.34.4 255.255.255.0
 frame interface-dlci 403
!
int s1/0.405 point
 ip addr 10.45.45.4 255.255.255.0
 frame interface-dlci 405
!
int s1/0
```

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```
 no shut
!
router isis 1
 net 49.0001.0040.0400.4004.00
 is-type level-1
!
int loopback 1
 ip router isis 1
!
int s1/0.401
 ip router isis 1
!
int s1/0.402
 ip router isis 1
!
int s1/0.403
 ip router isis 1
!
int s1/0.405
 ip router isis 1
```

R5 Configuration:

```
en
conf t
hostname R5
!
int loopback 1
 ip addr 5.5.5.5 255.255.255.255
!
int s1/0
 shut
 encap frame
 no frame inverse
!
int s1/0.501 point
 ip addr 10.15.15.5 255.255.255.0
 frame interface-dlci 501
!
int s1/0.502 point
 ip addr 10.25.25.5 255.255.255.0
 frame interface-dlci 502
!
int s1/0.503 point
 ip addr 10.35.35.5 255.255.255.0
 frame interface-dlci 503
!
int s1/0.504 point
```

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```
ip addr 10.45.45.5 255.255.255.0
 frame interface-dlci 504
!
int s1/0
 no shut
!
router isis 1
 net 49.0001.0050.0500.5005.00
 is-type level-1
!
int loopback 1
 ip router isis 1
!
int s1/0.501
 ip router isis 1
!
int s1/0.502
 ip router isis 1
!
int s1/0.503
 ip router isis 1
!
int s1/0.504
 ip router isis 1
```

Verification on R2:

```
R2#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L1   Se1/0.201 10.12.12.1      UP    25       00
R3             L1   Se1/0.203 10.23.23.3      UP    26       01
R4             L1   Se1/0.204 10.24.24.4      UP    29       01
R5             L1   Se1/0.205 10.25.25.5      UP    22       01
R2#show ip route
Codes: 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

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/20] via 10.12.12.1, Serial1/0.201
```

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```
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     3.0.0.0/32 is subnetted, 1 subnets
i L1    3.3.3.3 [115/20] via 10.23.23.3, Serial1/0.203
     4.0.0.0/32 is subnetted, 1 subnets
i L1    4.4.4.4 [115/20] via 10.24.24.4, Serial1/0.204
     5.0.0.0/32 is subnetted, 1 subnets
i L1    5.5.5.5 [115/20] via 10.25.25.5, Serial1/0.205
     10.0.0.0/24 is subnetted, 10 subnets
i L1    10.45.45.0 [115/20] via 10.25.25.5, Serial1/0.205
                   [115/20] via 10.24.24.4, Serial1/0.204
i L1    10.35.35.0 [115/20] via 10.25.25.5, Serial1/0.205
                   [115/20] via 10.23.23.3, Serial1/0.203
i L1    10.34.34.0 [115/20] via 10.24.24.4, Serial1/0.204
                   [115/20] via 10.23.23.3, Serial1/0.203
C       10.25.25.0 is directly connected, Serial1/0.205
C       10.24.24.0 is directly connected, Serial1/0.204
C       10.23.23.0 is directly connected, Serial1/0.203
i L1    10.15.15.0 [115/20] via 10.25.25.5, Serial1/0.205
                   [115/20] via 10.12.12.1, Serial1/0.201
i L1    10.14.14.0 [115/20] via 10.24.24.4, Serial1/0.204
                   [115/20] via 10.12.12.1, Serial1/0.201
i L1    10.13.13.0 [115/20] via 10.23.23.3, Serial1/0.203
                   [115/20] via 10.12.12.1, Serial1/0.201
C       10.12.12.0 is directly connected, Serial1/0.201
R2# ping 1.1.1.1 repeat 1

Type escape sequence to abort.
Sending 1, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!
Success rate is 100 percent (1/1), round-trip min/avg/max = 16/16/16 ms
R2# ping 3.3.3.3 repeat 1

Type escape sequence to abort.
Sending 1, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
!
Success rate is 100 percent (1/1), round-trip min/avg/max = 36/36/36 ms
R2# ping 4.4.4.4 repeat 1

Type escape sequence to abort.
Sending 1, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
!
Success rate is 100 percent (1/1), round-trip min/avg/max = 68/68/68 ms
R2# ping 5.5.5.5 repeat 1

Type escape sequence to abort.
Sending 1, 100-byte ICMP Echos to 5.5.5.5, timeout is 2 seconds:
!
```

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Success rate is 100 percent (1/1), round-trip min/avg/max = 24/24/24 ms

Task 2: On R1, Debug isis update-packets, Then shut loopback 1 on R5

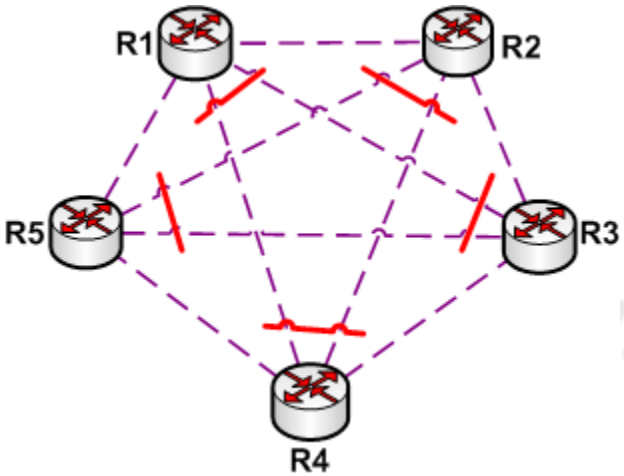
Solution:

Note – When a router receives an update packet it forwards that update out all ISIS enabled interfaces except the one it was received on, In a full mesh environment this is not needed and can cause excessive flooding in an unstable environment.
In the output below the update is received on S1/0.105 and forwarded out S1/0.102, 103 and 104.

Output on R1:

R1#debug isis update-packets
IS-IS Update related packet debugging is on
R1#
***Mar 1 00:40:38.739: ISIS-Upd: Rec L1 LSP 0050.0500.5005.00-00, seq A, ht 1199,**
***Mar 1 00:40:38.739: ISIS-Upd: from SNPA DLCI 105 (Serial1/0.105)**
*Mar 1 00:40:38.739: ISIS-Upd: LSP newer than database copy
*Mar 1 00:40:38.739: ISIS-Upd: TLV contents different, code 132
*Mar 1 00:40:38.739: ISIS-Upd: leaf routes changed
***Mar 1 00:40:38.759: ISIS-Upd: Sending L1 LSP 0050.0500.5005.00-00, seq A, ht 1197 on Serial1/0.102**
***Mar 1 00:40:38.763: ISIS-Upd: Sending L1 LSP 0050.0500.5005.00-00, seq A, ht 1197 on Serial1/0.103**
***Mar 1 00:40:38.767: ISIS-Upd: Sending L1 LSP 0050.0500.5005.00-00, seq A, ht 1197 on Serial1/0.104**

Task 3: Reconfigure the router interface as ISIS blocked according to the following diagram.



Solution:

R1 Configuration:

```
int s1/0.103
isis mesh-group blocked
!
int s1/0.104
isis mesh-group blocked
!
```

R2 Configuration:

```
int s1/0.204
isis mesh-group blocked
!
int s1/0.205
isis mesh-group blocked
!
```

R3 Configuration:

```
int s1/0.301
isis mesh-group blocked
!
int s1/0.305
isis mesh-group blocked
!
```

R4 Configuration:

```
int s1/0.401
isis mesh-group blocked
!
int s1/0.402
isis mesh-group blocked
!
```

R5 Configuration:

```
int s1/0.502
isis mesh-group blocked
!
int s1/0.503
isis mesh-group blocked
```

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!

Debug Output on R1:

Note – The update is now only propagated out S1/0.102. A shut/no shut was performed on Loopback 1 of R5.

```
R1#
*Mar  1 01:10:31.087: ISIS-Upd: Rec L1 LSP 0050.0500.5005.00-00, seq D, ht 1199,
*Mar  1 01:10:31.091: ISIS-Upd: from SNPA DLCI 105 (Serial1/0.105)
*Mar  1 01:10:31.091: ISIS-Upd: LSP newer than database copy
*Mar  1 01:10:31.095: ISIS-Upd: TLV contents different, code 132
*Mar  1 01:10:31.095: ISIS-Upd:  leaf routes changed
*Mar  1 01:10:31.115: ISIS-Upd: Sending L1 LSP 0050.0500.5005.00-00, seq D, ht 1197 on
Serial1/0.102

R1#show isis mesh-groups


Mesh group (blocked)
  Serial1/0.104
  Serial1/0.103
R1#
```

Task 4: Change the configuration so the interfaces that are currently blocked are part of mesh-group 2 and all other interfaces are part of mesh-group 1

Solution:

When configuring ISIS mesh groups, Either manually blocked interfaces or mesh-groups can be used.

R1 Configuration:

```
int s1/0.103
isis mesh-group 2
!
int s1/0.104
isis mesh-group 2
!
int s1/0.102
isis mesh-group 1
!
int s1/0.105
isis mesh-group 1
```

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R2 Configuration:

```
int s1/0.204
isis mesh-group 2
!
int s1/0.205
isis mesh-group 2
!
int s1/0.201
isis mesh-group 1
!
int s1/0.203
isis mesh-group 1
```

R3 Configuration:

```
int s1/0.301
isis mesh-group 2
!
int s1/0.305
isis mesh-group 2
!
int s1/0.302
isis mesh-group 1
!
int s1/0.304
isis mesh-group 1
```

R4 Configuration:

```
int s1/0.401
isis mesh-group 2
!
int s1/0.402
isis mesh-group 2
!
int s1/0.403
isis mesh-group 1
!
int s1/0.405
isis mesh-group 1
```

R5 Configuration:

```
int s1/0.502
isis mesh-group 2
!
```

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```
int s1/0.503
isis mesh-group 2
!
int s1/0.501
isis mesh-group 1
!
int s1/0.504
isis mesh-group 1
```

Debug Output on R1:

Note – When the loopback on R5 is shut the ingress update packet is now received on S1/0.105. The packet is then replicated out S1/0.103 and s1/0.104. But not s1/0.102, this is because s1/0.102 is in the same mesh group as S1/0.105

```
R1#
*Mar  1 00:34:26.619: ISIS-Upd: Rec L1 LSP 0050.0500.5005.00-00, seq 6, ht 1197,
*Mar  1 00:34:26.623: ISIS-Upd: from SNPA DLCI 105 (Serial1/0.105)
*Mar  1 00:34:26.623: ISIS-Upd: LSP newer than database copy
*Mar  1 00:34:26.627: ISIS-Upd: TLV contents different, code 132
*Mar  1 00:34:26.631: ISIS-Upd:  leaf routes changed
*Mar  1 00:34:26.655: ISIS-Upd: Sending L1 LSP 0050.0500.5005.00-00, seq 6, ht 1195 on
Serial1/0.104
*Mar  1 00:34:26.667: ISIS-Upd: Sending L1 LSP 0050.0500.5005.00-00, seq 6, ht 1195 on
Serial1/0.103
```

R1#**show isis mesh-groups**

```
Mesh group 1:
  Serial1/0.105
  Serial1/0.102

Mesh group 2:
  Serial1/0.104
  Serial1/0.103
R1#
```

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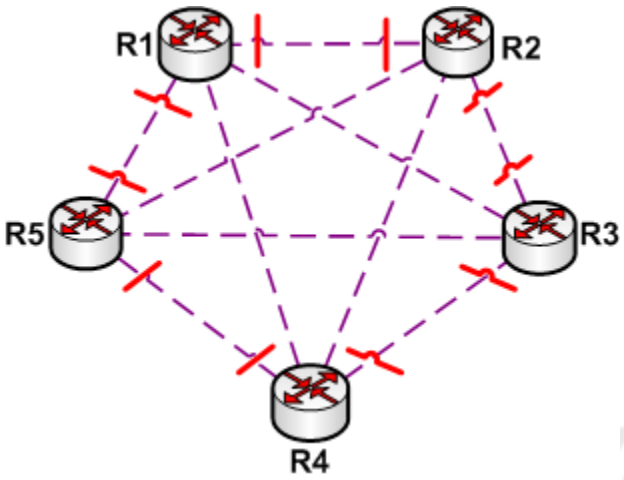
Task 5: Remove the commands from Task 4 and configure the interfaces as blocked according to the following diagram.



Solution:

R1 Configuration:

```
int s1/0.103
no isis mesh-group 2
!
int s1/0.104
no isis mesh-group 2
!
int s1/0.102
isis mesh-group blocked
!
int s1/0.105
isis mesh-group blocked
```

R2 Configuration:

```
int s1/0.204
no isis mesh-group 2
!
int s1/0.205
no isis mesh-group 2
!
int s1/0.201
isis mesh-group blocked
!
int s1/0.203
isis mesh-group blocked
```

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R3 Configuration:

```
int s1/0.301
no isis mesh-group 2
!
int s1/0.305
no isis mesh-group 2
!
int s1/0.302
isis mesh-group blocked
!
int s1/0.304
isis mesh-group blocked
```

R4 Configuration:

```
int s1/0.401
no isis mesh-group 2
!
int s1/0.402
no isis mesh-group 2
!
int s1/0.403
isis mesh-group blocked
!xit
int s1/0.405
isis mesh-group blocked
```

R5 Configuration:

```
int s1/0.502
no isis mesh-group 2
!
int s1/0.503
no isis mesh-group b2
!
int s1/0.501
isis mesh-group blocked
!
int s1/0.504
isis mesh-group blocked
```

Debug Output on R1:

Note – When the loopback on R5 is shut the ingress update packet is now received on S1/0.103. The packet is then replicated out S1/0.104

```
*Mar  1 01:38:45.627: ISIS-Upd: Rec L1 LSP 0050.0500.5005.00-00, seq 10, ht 1197,
```

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```
*Mar  1 01:38:45.631: ISIS-Upd: from SNPA DLCI 103 (Serial1/0.103)
*Mar  1 01:38:45.631: ISIS-Upd: LSP newer than database copy
*Mar  1 01:38:45.635: ISIS-Upd: TLV contents different, code 132
*Mar  1 01:38:45.635: ISIS-Upd:  leaf routes changed
*Mar  1 01:38:45.659: ISIS-Upd: Sending L1 LSP 0050.0500.5005.00-00, seq 10, ht 1195 on
Serial1/0.104
```

Lab completed, Erase configs and continue to next lab.

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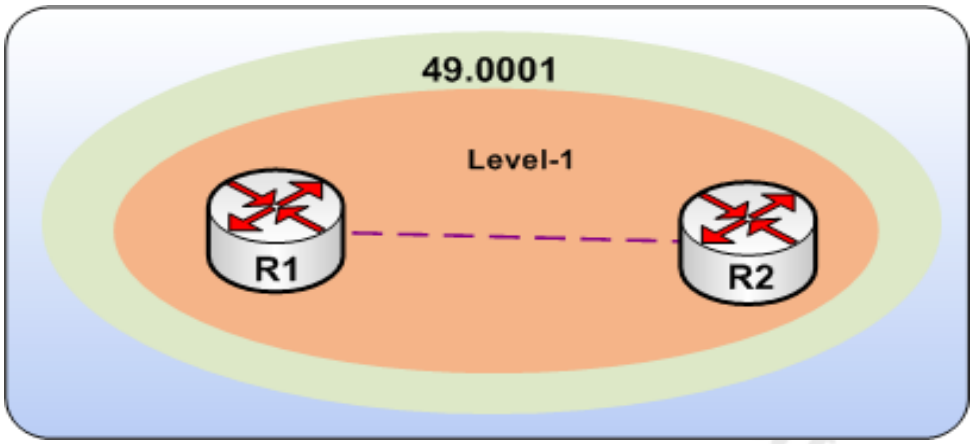
Lab 6 - ISIS Timers



Router/Interface	Address/Mask
R1 Loopback 1	1.1.1.1/32
S1/0 Dlci - 102	10.12.12.1/24
R2 Loopback 1	2.2.2.2/32
S1/0 Dlci - 201	10.12.12.2/24

Task 1: Configure the devices as per the diagram. Enable ISIS on all interfaces on all routers.

Solution:

R1 Configuration:

```
en
conf t
hostname R1
!
int loopback 1
 ip addr 1.1.1.1 255.255.255.255
!
int s1/0
 shut
 encap frame
 no frame inverse
!
int s1/0.102 point
 ip addr 10.12.12.1 255.255.255.0
 frame interface-dlci 102
!
```

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```
int s1/0
 no shut
!
router isis 1
 net 49.0001.0010.0100.1001.00
 is-type level-1
!
int loopback 1
 ip router isis 1
!
int s1/0.102
 ip router isis 1
```

R2 Configuration:

```
en
conf t
hostname R2
!
int loopback 1
 ip addr 2.2.2.2 255.255.255.255
!
int s1/0
 shut
 encap frame
 no frame inverse
!
int s1/0.201 point
 ip addr 10.12.12.2 255.255.255.0
 frame interface-dlci 201
!
int s1/0
 no shut
!
router isis 1
 net 49.0001.0020.0200.2002.00
 is-type level-1
!
int loopback 1
 ip router isis 1
!
int s1/0.201
 ip router isis 1
```

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Verification on R2:

```
R2#show isis neighbors

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L1   Se1/0.201 10.12.12.1      UP    25       00

R2#show ip route
Codes: 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

     1.0.0.0/32 is subnetted, 1 subnets
i L1    1.1.1.1 [115/20] via 10.12.12.1, Serial1/0.201
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback1
     10.0.0.0/24 is subnetted, 1 subnets
C       10.12.12.0 is directly connected, Serial1/0.201

R2# ping 1.1.1.1 repeat 1

Type escape sequence to abort.
Sending 1, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!
Success rate is 100 percent (1/1), round-trip min/avg/max = 16/16/16 ms
```

Task 2: Configure the ISIS hold-time to 1second and the hello interval to 250ms on both Routers serial interfaces.

Solution:

R1 Configuration:

```
interface Serial1/0.102 point-to-point
 isis hello-multiplier 4
 isis hello-interval minimal
```

R2 Configuration:

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```
interface Serial1/0.201 point-to-point
 isis hello-multiplier 4
 isis hello-interval minimal
```

Verification on R1:

```
R1#show clns int s1/0.102
Serial1/0.102 is up, line protocol is up
  Checksums enabled, MTU 1500, Encapsulation FRAME-RELAY
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 24 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x1, local circuit ID 0x100
    Neighbor System-ID: R2
    Level-1 Metric: 10, Priority: 64, Circuit ID: R2.00
    Level-1 IPv6 Metric: 10
    Number of active level-1 adjacencies: 1
    Next IS-IS Hello in 115 milliseconds
    if state UP

R1#debug isis adj-packets
IS-IS Adjacency related packets debugging is on
R1#
*Mar  1 01:14:15.619: ISIS-Adj: Rec serial IIH from DLCI 102 (Serial1/0.102), cir type L1, cir id 00, length 1499
*Mar  1 01:14:15.619: ISIS-Adj: rcpt state UP, old state UP, new state UP
*Mar  1 01:14:15.619: ISIS-Adj: Action = ACCEPT
*Mar  1 01:14:15.635: ISIS-Adj: Sending serial IIH on Serial1/0.102, length 1499
*Mar  1 01:14:15.827: ISIS-Adj: Rec serial IIH from DLCI 102 (Serial1/0.102), cir type L1, cir id 00, length 1499
*Mar  1 01:14:15.831: ISIS-Adj: rcvd state UP, old state UP, new state UP
*Mar  1 01:14:15.835: ISIS-Adj: Action = ACCEPT
*Mar  1 01:14:15.871: ISIS-Adj: Sending serial IIH on Serial1/0.102, length 1499
*Mar  1 01:14:16.043: ISIS-Adj: Rec serial IIH from DLCI 102 (Serial1/0.102), cir type L1, cir id 00, length 1499
*Mar  1 01:14:16.047: ISIS-Adj: rcvd state UP, old state UP, new state UP
*Mar  1 01:14:16.047: ISIS-Adj: Action = ACCEPT
*Mar  1 01:14:16.123: ISIS-Adj: Sending serial IIH on Serial1/0.102, length 1499
*Mar  1 01:14:16.215: ISIS-Adj: Rec serial IIH from DLCI 102 (Serial1/0.102), cir type L1, cir id 00, length 1499
```

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Task 3: R1 needs to be configured so the following rules are met for local link flaps. R1 must wait 100ms before generating an initial LSP. The delay between the first and second LSP should be 3sec and the longest delay allowed is 6sec. Configure this for both Level-1 and 2 routes.

Solution:

R1 Configuration:

```
router isis 1
 lsp-gen-interval 6 100 3000
```

Task 4: Change the SPF calculations on both routers to met the following requirements. Both Routers must wait 5sec at the most between spf calculations. After the receipt of the first LSP, R1 must wait 500ms before running the SPF process. The hold time between the first and second spf calculation should be the default value of 5.5sec

Solution:

R1 and R2 Configuration:

```
router isis 1
 spf-interval 5 500 5500
```

Task 5: Enable fast flooding on R1 and R2, Send 10 LSP before starting the SPF process.

Solution:

R1 and R2 Configuration:

```
router isis 1
 fast-flood 10
```

Task 6: On both R1 and R2 change the lsp refresh interval to 30min. The lsp max lifetime should also be set to 35min

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Solution:

R1 and R2 Configuration:

```
router isis 1
 max-lsp-lifetime 3900
 lsp-refresh-interval 3600
```

Task 7: Configure the retransmission of LSP's on the serial interface on R2 so that the retransmission interval in 30seconds, Throttle the retransmission on LSP's to one every 100ms.

Solution:

R2 Configuration:

```
interface s1/0.201
 isis retransmit-throttle-interval 100
 isis retransmit-interval 30
```

Task 8: Set the partial route calculation values on R1 so the maximum wait time between two PRC calculations is 4sec, The initial delay should be 50ms and the delay between the first and second calculation should be 100ms

Solution:

R1 Configuration:

```
router isis 1
 prc-interval 4 50 100
```

Task 9: Enable incremental SPF on both routers with an initial delay of 3minutes. Both this for both Level1 and 2 routes.

Solution:

R1 and R2 Configuration:

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```
router isis 1
 ispf level-1-2 180
```

Verification on R2:

```
R2#show clns 1 protocol

IS-IS Router: 1
  System Id: 0020.0200.2002.00  IS-Type: level-1
  Manual area address(es):
        49.0001
  Routing for area address(es):
        49.0001
  Interfaces supported by IS-IS:
        Serial1/0.201 - IP
        Loopback1 - IP
  Redistribute:
    static (on by default)
  Distance for L2 CLNS routes: 110
  Incremental SPF enabled for: level-1-2
  Incremental SPF startup delay: 180
  RRR level: none
  Generate narrow metrics: level-1-2
  Accept narrow metrics:   level-1-2
  Generate wide metrics:   none
  Accept wide metrics:     none
```

Lab completed, Erase configs and continue to next lab.

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