Configuration and Management of Networks

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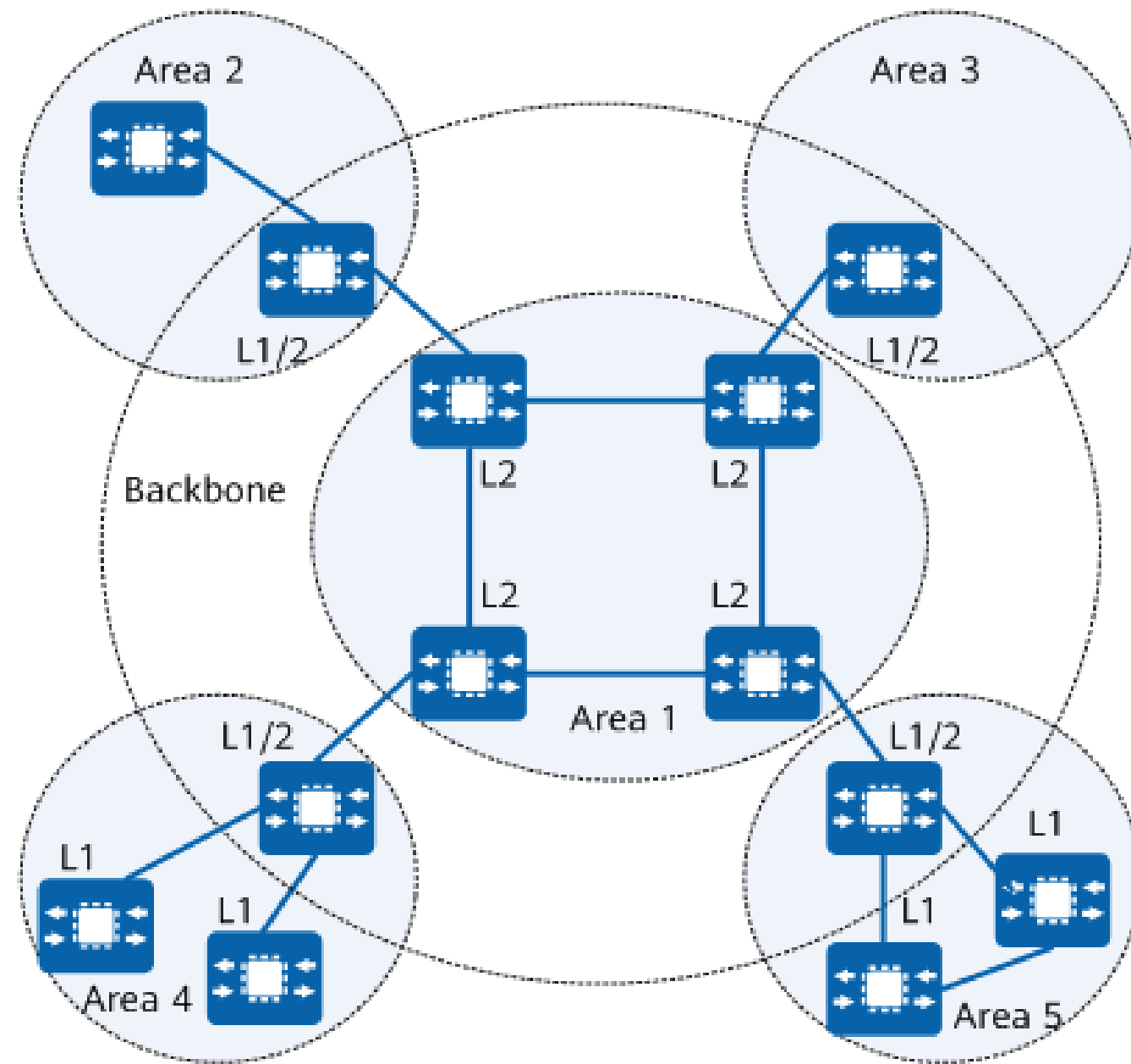
IS -IS (Intermediate System to Intermediate System)

Key differences to OSPF:

- IS-IS operates at Layer 2 (data link layer) vs OSPF at Layer 3:

    - OSPF uses IP directly to talk to neighbours (IP protocol number 89) using multicast addresses.
    - IS-IS uses Ethernet frames directly and uses a multicast MAC address

- Uses NET (Network Entity Title) instead of Router ID
- Level 1/Level 2/Level 1-2 routers vs OSPF Area architecture
- DIS (Designated Intermediate System) vs DR/BDR:
    - in IS-IS there is no backup DIS.

IS-IS hierarchy

Level-1 Router: Intra-area routing only
- Maintains Level-1 Link State Database (LSDB)
- Routes within a single area
- Similar to OSPF internal routers of normal areas

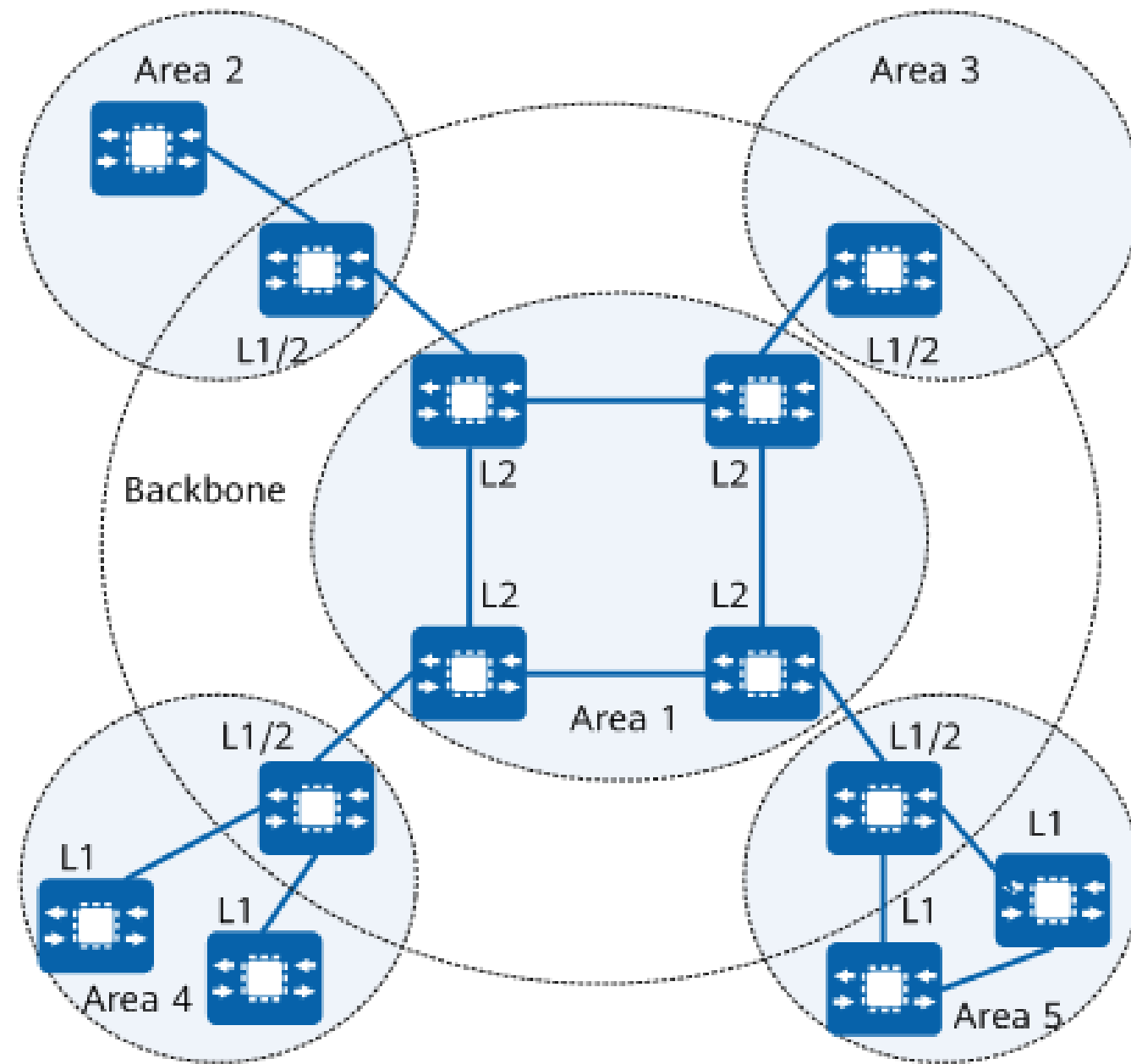*Level-2 Router:* Inter-area routing (backbone)
- Maintains Level-2 Link State Database (LSDB)
- Forms the backbone connecting areas
- Similar to OSPF backbone (area 0) routers

Level-1-2 Router: Border router.
- Maintains both Level-1 and Level-2 LSDBs
- Connects areas to the backbone
- Similar to OSPF Area Border Routers (ABRs)

IS-IS hierarchy

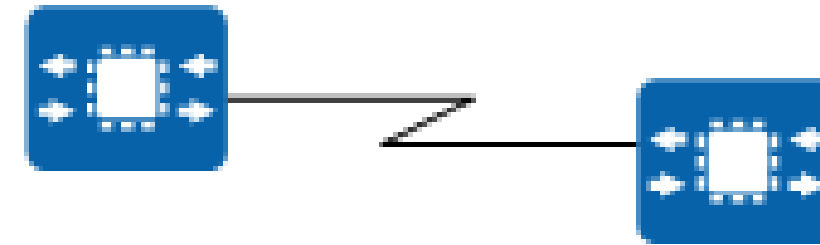
- A router belongs to one area only so no individual interface area configuration.

- Level-2 routers form a continous backbone.
- Level-1 routers use a default route to reach other areas.

- Level-1-2 routers perform inter-area route leaking from Level 1 areas to Level 2 backbone.

- Area boundary is in the link not in the router itself:
  - L1 routes are advertised by L1/2 routers to L2 routers as IP prefix reachablity information and NOT full L1 topology (same as from normal areas to area 0 in OSPF)
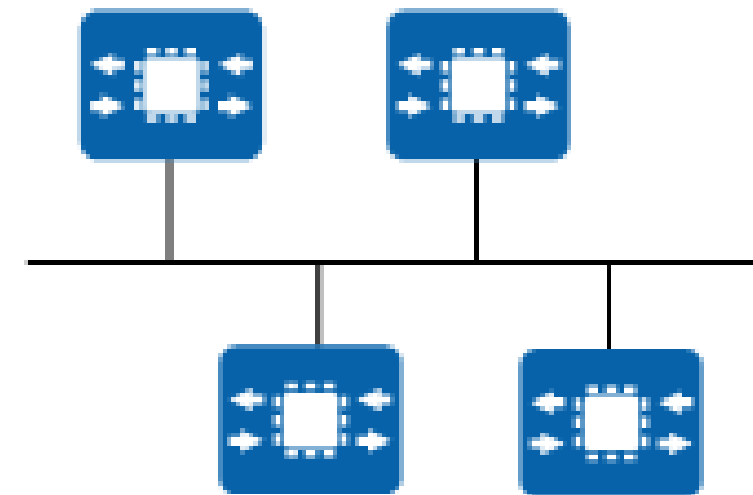
IS-IS point to point

Similar to OSPF point-to-point
- No DIS election needed
- Direct adjacency between two routers
- Interfaces are point-to-point by default in cumulus Linux.

IS-IS Brodcast

- All routers form adjacencies (unlike OSPF where non-DR routers don't form full adjacencies)
- DIS elected to reduce LSP flooding
- DIS generates Pseudonode LSP
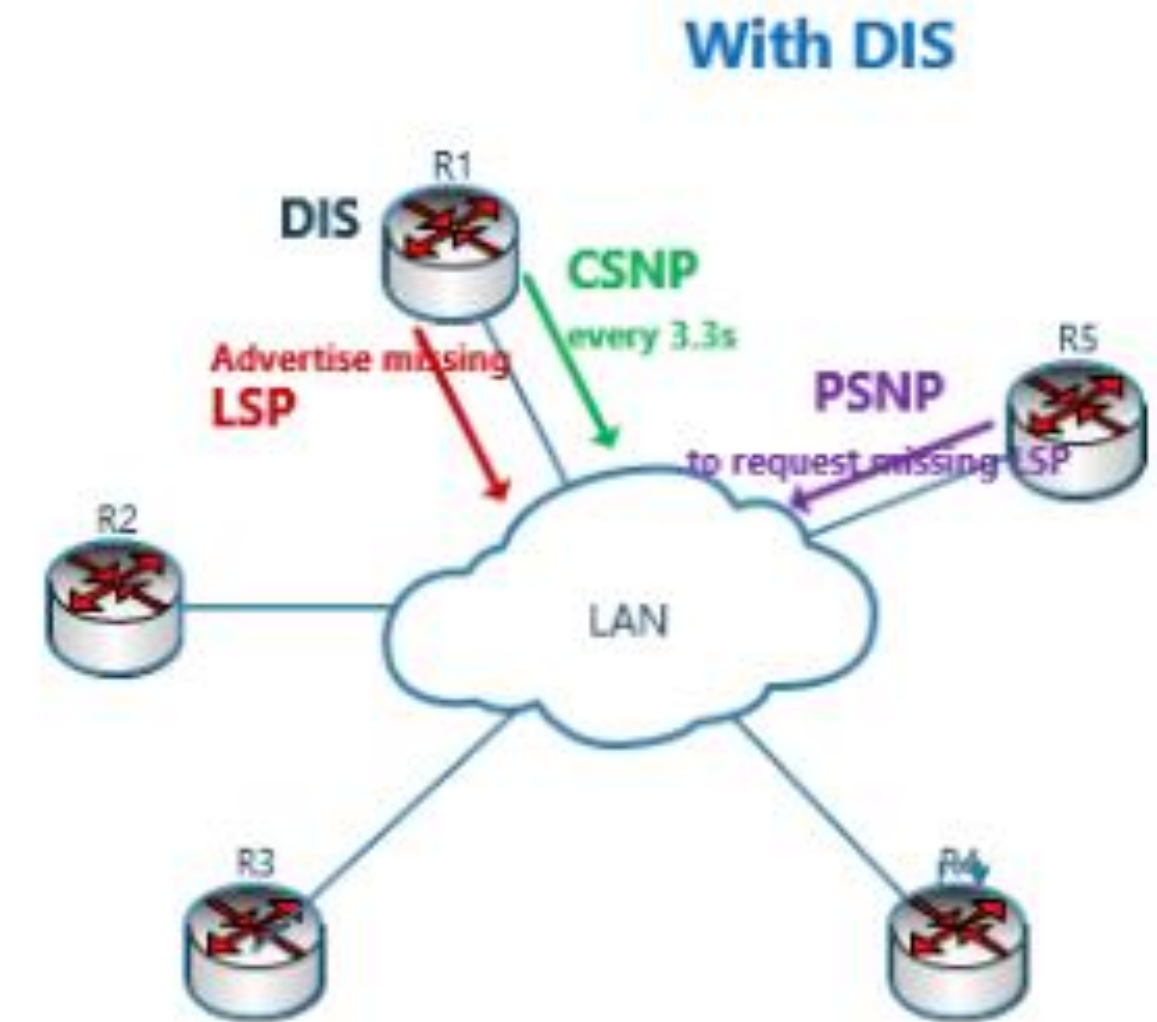
IS-IS Brodcast

- All routers form adjacencies (unlike OSPF where non-DR routers don't form full adjacencies)

- DIS elected to reduce LSP flooding

- DIS generates pseudonode LSP with all information from the LAN segment built from the individual LSPs of routers.

- DIS sends periodic CSNPs packets with all the info.

- Non-DIS nodes check if there LSPs are in the CSNP packet, if not they re-send it.

- If the CSNP has a LSP that the node does not have. The node sends a PSNP message to request it

With DIS

CSNP - Complete Sequence Number PDU

PSNP - Partial Sequence Number PDU

IS-IS Brodcast

The default interface type in cumulus linux is point to point to change an interface to broadcast:

```
nv set interface swp1 router isis network-type broadcast
nv config apply
```

Two configure an Interface with a higher IS-IS priority to ensure it becomes the DIS (Designated IS) on a broadcast segment use:

```
   nv set interface swp1 router isis priority level-2
                        100
nv config apply
```

Default priority in IS-IS is 64

IS-IS Basic Configuration

- Configure IS-IS in the routers for the wanted vrf.

- Configure the NET Address that is the identifier of the router (typically 10 bytes long):
  Example: ***49.0001.1921.6821.1138.00***
  - 49 = AFI (Authority and Format Identifier) - indicates private address space (similar to RFC1918 for IPv4).
  - 0001 = Area ID.
  - 49.0100 = Complete Area Address
  - 1921.6821.1138 = System ID (6 bytes / 12 hex digits)
  - 00 = NSEL (must always be 00 for routers)

- The NET address must be unique across the IS-IS domain.

- The whole router belongs to the same area defined by the area ID in this example area 1.

IS-IS Basic Configuration single area

Area 1

NET Addresses:
R1: 49.0001.0000.0000.0001.00
R2: 49.0001.0000.0000.0002.00
R3: 49.0001.0000.0000.0003.00
R4: 49.0001.0000.0000.0004.00

R1:

\# Enable IS-IS globally
nv set vrf default router isis enable on

\# Configure NET address
nv set vrf default router isis net 49.0001.0000.0000.0001.00
\# Enable IS-IS on all interfaces
nv set interface swp0 ip address 10.1.2.1/24
nv set interface swp0 router isis enable on
nv set interface swp0 router isis network-type point-to-point

nv set interface swp1 ip address 10.1.4.1/24
nv set interface swp1 router isis enable on
nv set interface swp1 router isis network-type point-to-point

nv set interface swp2 ip address 10.1.3.1/24
nv set interface swp2 router isis enable on
nv set interface swp2 router isis network-type point-to-point

IS-IS Basic Configuration single area

R2:

\# Enable IS-IS globally
nv set vrf default router isis enable on

\# Configure NET address
nv set vrf default router isis net 49.0001.0000.0000.0002.00
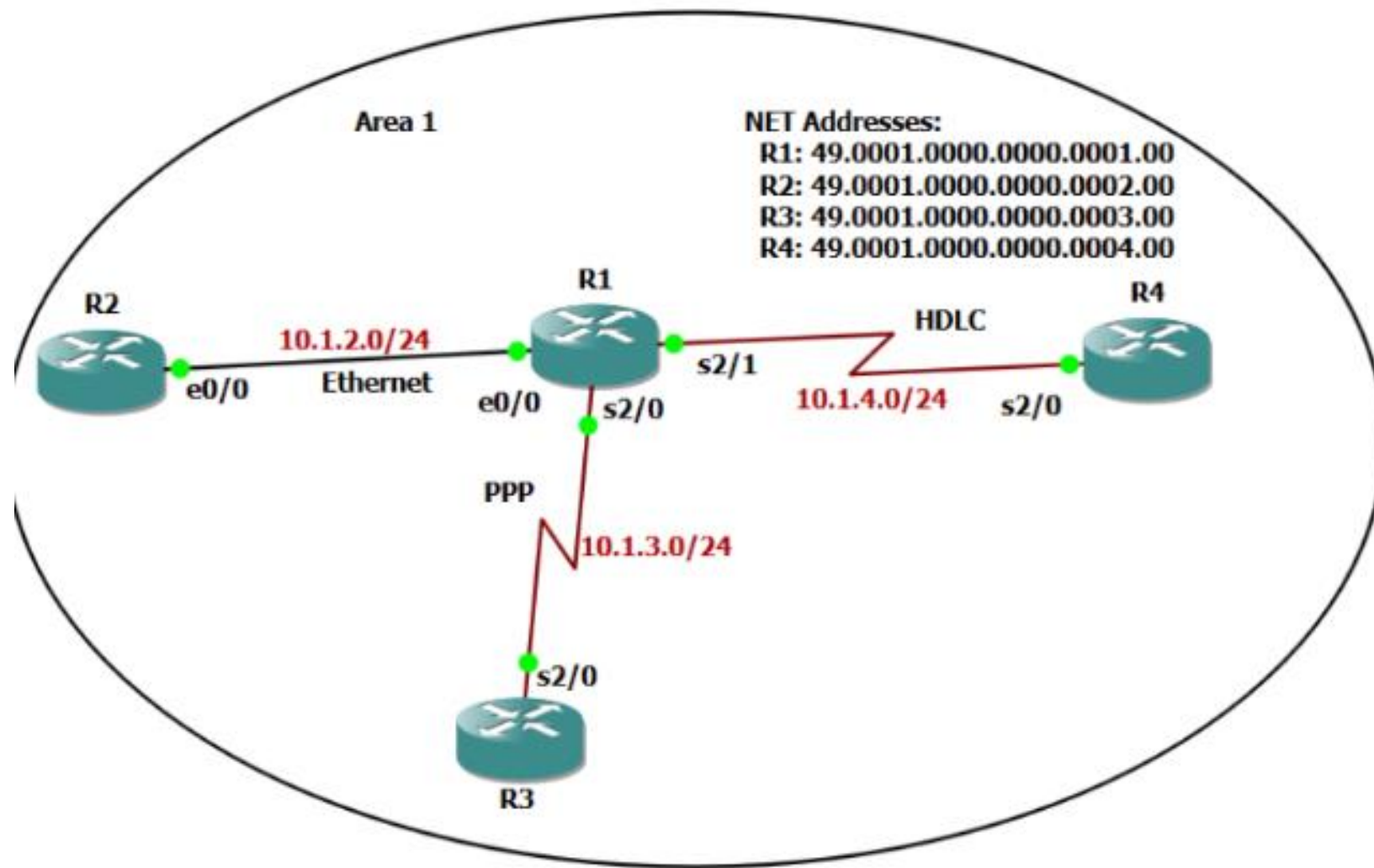
\# Enable IS-IS on interface
nv set interface swp0 ip address 10.1.2.2/24
nv set interface swp0 router isis enable on
nv set interface swp0 router isis network-type point-to-point

\# Apply configuration
nv config apply

Area 1

NET Addresses:
R1: 49.0001.0000.0000.0001.00
R2: 49.0001.0000.0000.0002.00
R3: 49.0001.0000.0000.0003.00
R4: 49.0001.0000.0000.0004.00

R1

R4

HDLC

R2

10.1.2.0/24

e0/0   Ethernet

s2/1

e0/0   s2/0

10.1.4.0/24   s2/0

PPP

10.1.3.0/24

s2/0

R3

R3 and R4 are similar just change the addresses in the Interface and the ISIS NET address

IS-IS Multiple areas

Area 1
IOU2 LP0: 10.1.2.0/24
net: 49.0001.0000.0008.0002.00 L1
e0/0
L1 10.1.1.0/24
e0/2 IOU1
L1/L2 net: 49.0001.0000.0000.0001.00
e0/0 e0/1
L2
Area 2 10.100.1.0/24 10.100.2.0/24 Area 3
L2
IOU3 e0/0 IOU5
L1/L2 e0/0 10.100.3.0/24 L1/L2
net: 49.0002.0000.0000.0003.00 e0/1 L2 e0/1 net: 49.0003.0000.0000.0005.00
10.2.1.0/24 e0/2
L1 e0/2 10.3.1.0/24
IOU4 e0/0 L1
net: 49.0002.0000.0000.0004.00 L1 e0/0 IOU6
LP0: 10.2.2.0/24 LP0: 10.3.2.0/24 L1
net: 49.0003.0000.0000.0006.00

IOU2 router Level 1

\# Enable IS-IS globally and configure NET address
nv set vrf default router isis enable on
nv set vrf default router isis net 49.0001.0000.0000.0002.0

\# Enable IS-IS on interface with Level-1
nv set interface swp0 ip address 10.1.1.1/24
nv set interface swp0 router isis enable on
nv set interface swp0 router isis circuit-type level-1
nv set interface swp0 router isis network-type point-to-point

IS-IS Multiple areas

IOU1 router Level-1-2

\# Enable IS-IS globally and configure NET address

nv set vrf default router isis enable on

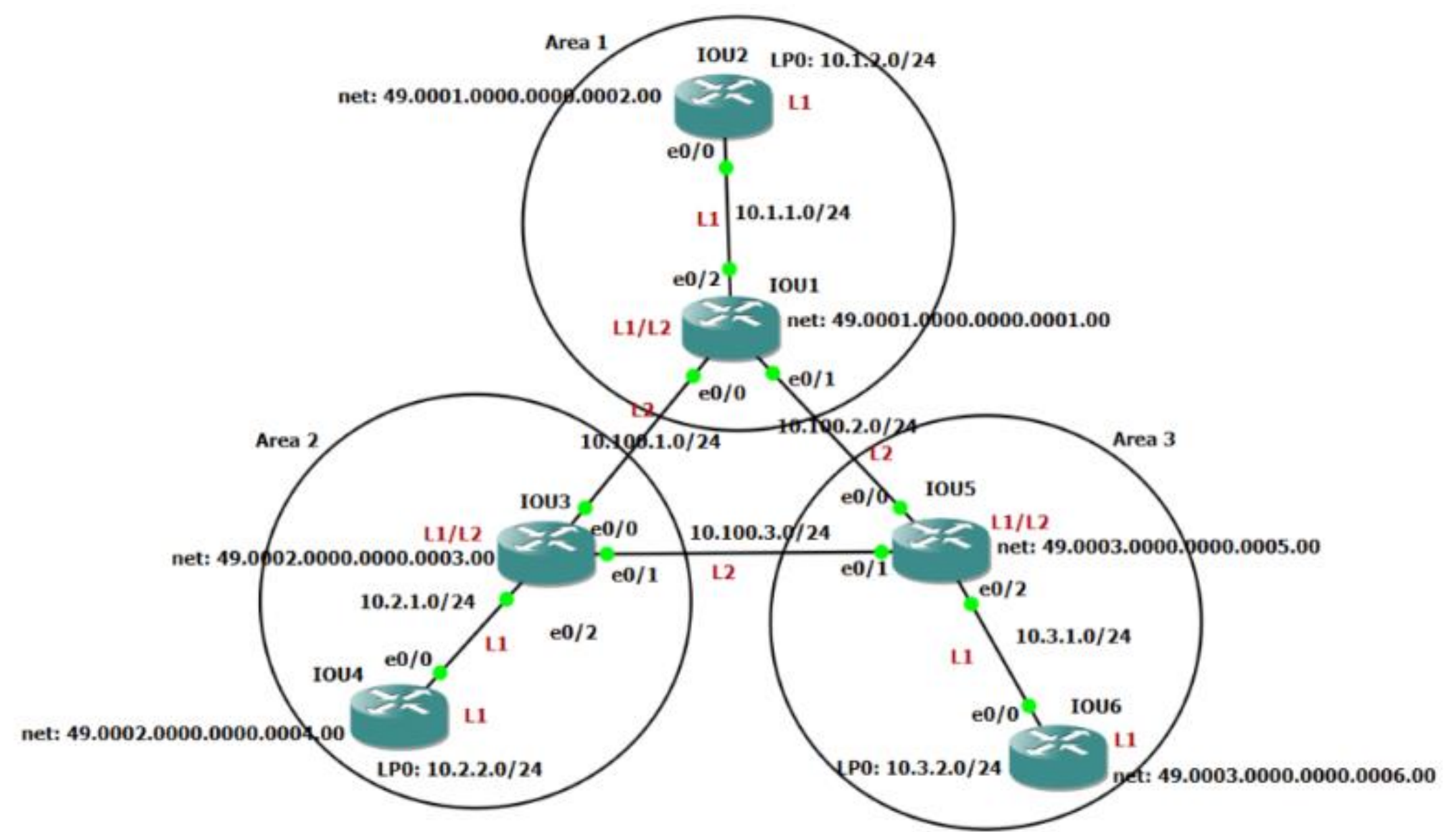nv set vrf default router isis net 49.0001.0000.0000.0001.00

\# Enable IS-IS on interfaces

nv set interface swp2 ip address 10.1.1.2/24

nv set interface swp2 router isis enable on

nv set interface swp2 router isis circuit-type *level-1*

nv set interface swp2 router isis network-type point-to-point

nv set interface swp0 ip address 10.100.1.1/24

nv set interface swp0 router isis enable on

nv set interface swp0 router isis circuit-type *level-2*

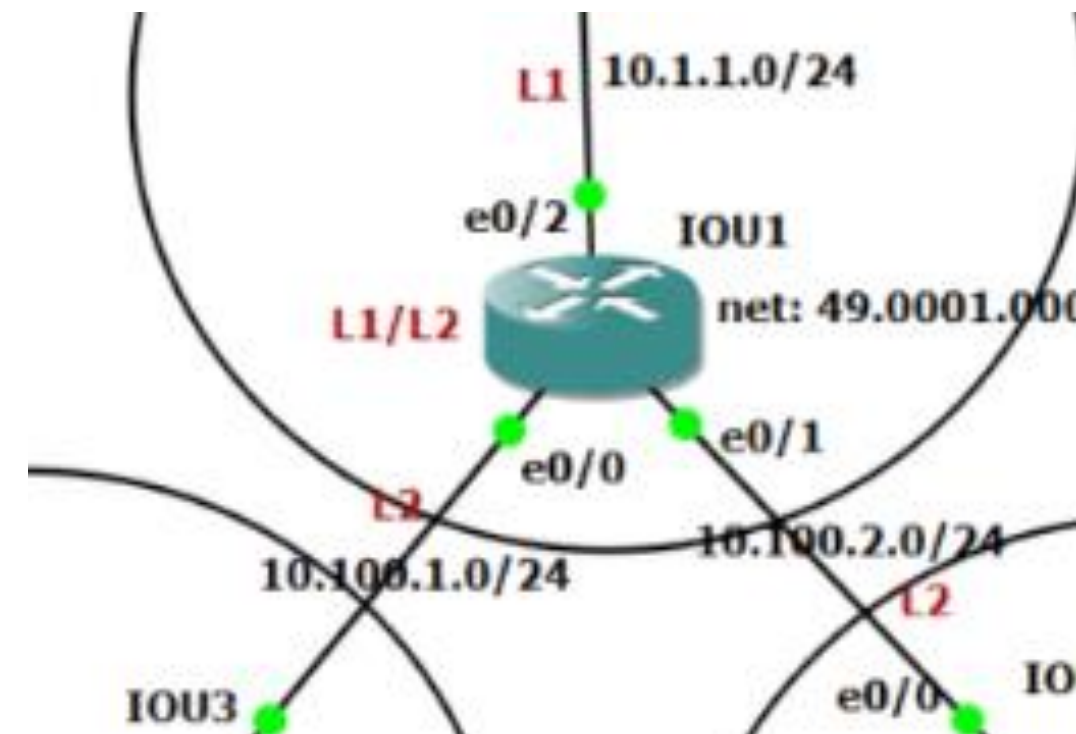nv set interface swp0 router isis network-type point-to-point

nv set interface swp1 ip address 10.100.2.1/24

nv set interface swp1 router isis enable on

nv set interface swp1 router isis circuit-type *level-2*

nv set interface swp1 router isis network-type point-to-point

L1 | 10.1.1.0/24

e0/2 IOU1

L1/L2 net: 49.0001.000

e0/1

e0/0

10.100.1.0/24 10.100.2.0/24

L2 L2

IOU3 e0/0 IO

ISIS – Limiting Adjacencies in ISIS

Similarly to OSPF, you can either set an interface as passive or set all as passive by default and then enable specific interfaces.

Set interface as passive (no hello packets)
nv set interface swp3 router isis passive on

Or set all interfaces passive by default
nv set vrf default router isis passive-default on

Then enable specific interfaces
nv set interface swp1 router isis passive off

nv config apply

Configuration and Management of Networks

ISIS –Verification

nv show vrf default router isis

• This command displays NET addresses, timers and statistics

```
               operational  applied
------------   ----------   --------------
enable                      on
net                         49.0001.0000.0000.0001.00
area-id                     49.0001
system-id                   0000.0000.0001
node-type      level-1-2
overload       off


[interface]
  lo
  swp1
  swp2

[summary-address]
  10.1.0.0/22  level-2       …
```

Configuration and Management of Networks

ISIS – verification

nv show vrf default router isis interface

Interface	Circuit-Type	State	Level-1	Level-2	Network-Type
lo	level-1-2	up	passive	passive	loopback
swp1	level-1	up	active	-	point-to-point
swp2	level-2	up	-	active	point-to-point
swp3	level-1-2	up	active	active	point-to-point
swp4	level-1	up	active	-	broadcast

OSPF – verification

nv show vrf default router isis adjacency

Interface	System-ID	Level	State	Uptime	SNPA (MAC Address)
swp1	0000.0000.0002	L1	Up	01:23:45	aa:bb:cc:dd:ee:ff
swp2	0000.0000.0003	L2	Up	02:15:30	11:22:33:44:55:66
swp3	0000.0000.0004	L1	Up	00:45:12	22:33:44:55:66:77
swp3	0000.0000.0004	L2	Up	00:45:10	22:33:44:55:66:77
swp4	0000.0000.0005	L1	Up	03:10:22	33:44:55:66:77:88
swp4	0000.0000.0006	L1	Up	01:55:08	44:55:66:77:88:99

ISIS – verification

nv show vrf default router rib isis

Prefix	Protocol	Installed	Nexthop	Interface	Distance/Metric	Uptime
10.1.1.0/24	isis	yes	via swp1	swp1	115/10	01:23:45
10.1.2.0/24	isis	yes	via swp2	swp2	115/10	02:15:30
10.1.3.0/24	isis	yes	via swp3	swp3	115/10	00:45:12
10.1.10.0/24	isis	yes	via swp4	swp4	115/10	03:10:22
10.2.1.0/24	isis	yes	via swp2	swp2	115/20	02:15:30
10.2.2.0/24	isis	yes	via swp2	swp2	115/30	02:14:18
192.168.1.2/32	isis	yes	via swp1	swp1	115/10	01:23:45
192.168.1.3/32	isis	yes	via swp2	swp2	115/10	02:15:30
192.168.1.4/32	isis	yes	via swp3	swp3	115/10	00:45:12
0.0.0.0/0	isis	yes	via swp2	swp2	115/10	02:15:30

Configuration and Management of Networks

ISIS – Route Summarization

nv set vrf default router isis enable on

nv set vrf default router isis net 49.**0010**.0000.0000.0099.00

nv set interface GE0/0 ip address 10.1.4.2/24
nv set interface GE0/0 router isis enable on
nv set interface GE0/0 router isis circuit-type level-1
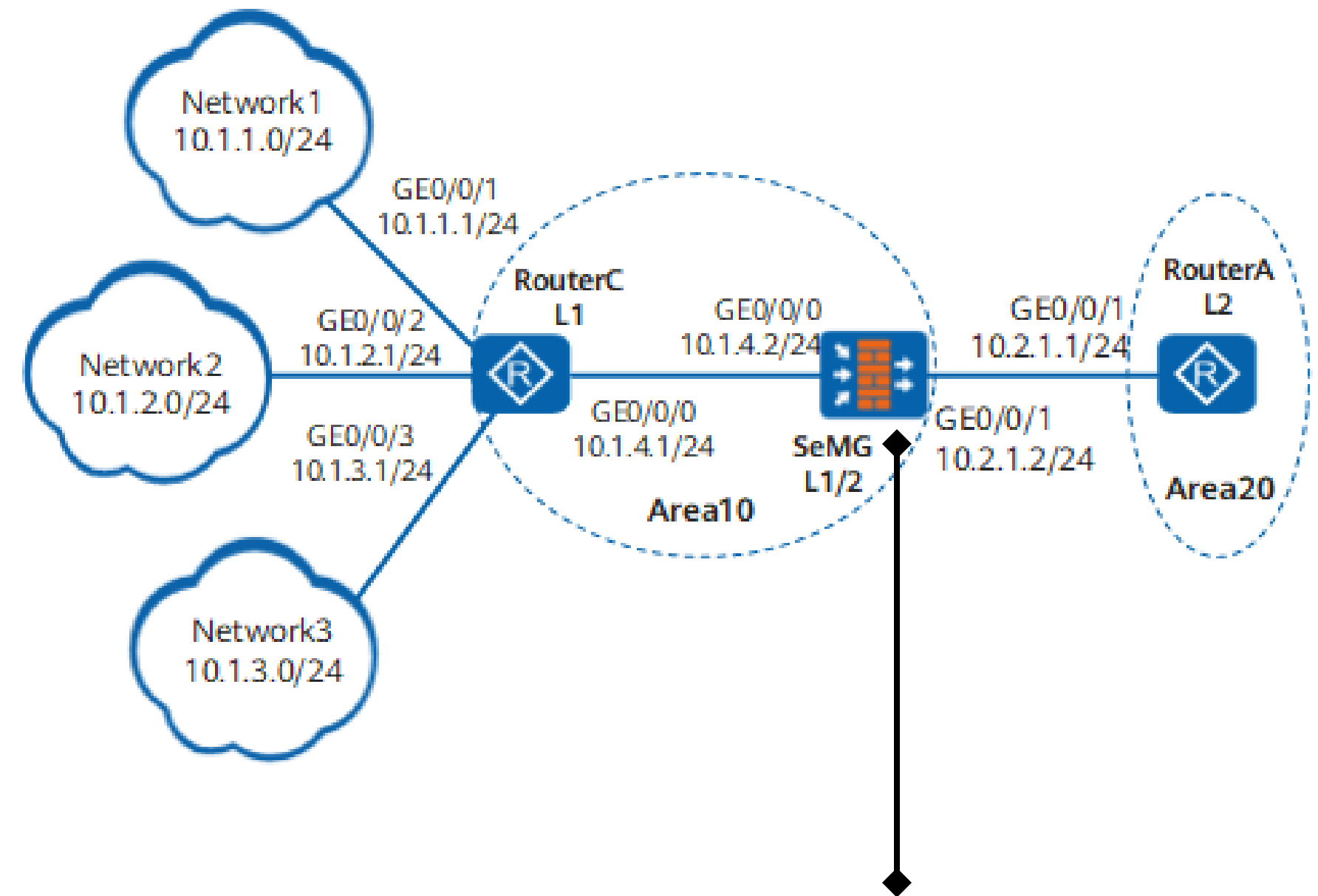nv set interface GE0/0 router isis network-type point-to-point

nv set interface GE0/1 ip address 10.2.1.1/24
nv set interface GE0/1 router isis enable on
nv set interface GE0/1 router isis circuit-type level-2
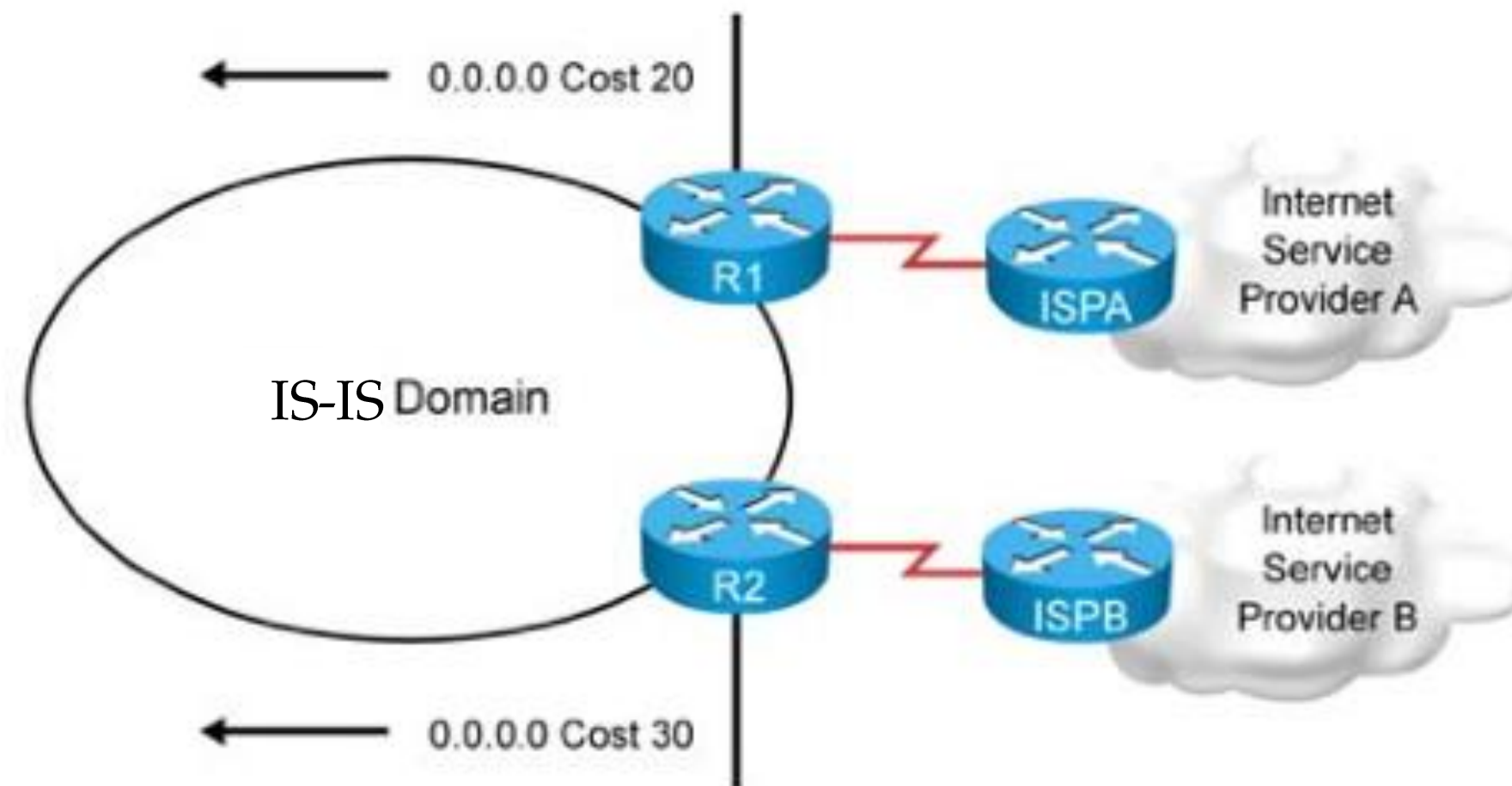nv set interface GE0/1 router isis network-type point-to-point

nv set vrf default router isis summary-address 10.1.0.0/22 level-2

Summarization occurs between L1 and L2

Configuration and Management of Networks

ISIS – Default Routes

R1 → 0.0.0.0 Cost 20

R2 → 0.0.0.0 Cost 30

IS-IS Domain

R1 — ISPA — Internet Service Provider A

R2 — ISPB — Internet Service Provider B

R1

nv set vrf default router isis enable on
nv set vrf default router isis net 49.0001.0000.0000.0001.00
nv set interface swp1 router isis enable on
nv set vrf default router static 0.0.0.0/0 via 198.1.1.2

\# Redistribute static routes into IS-IS
nv set vrf default router isis redistribute static enable on

R2

nv set vrf default router isis enable on
nv set vrf default router isis net 49.0001.0000.0000.0002.00
nv set interface swp1 router isis enable on
nv set vrf default router static 0.0.0.0/0 via 198.2.1.2

\# Redistribute static routes into IS-IS
nv set vrf default router isis redistribute static enable on