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IS-IS Route Leaking

« Multi-Level IS-IS (/workbook/view/service-provider-v4/task/multi-level-is-is-Mjg0Mg%3D%3D) | Single-Topology IS-IS (/workbook/view/service-provider-v4/task/single-topology-is-is-Mjg0NA%3D%3D) »

Last updated: April 23, 2016

Note:

This task assumes that you have already completed the Multi-Level IS-IS (http://labs.ine.com/workbook/view/service-provider-v4/task/multi-level-is-is-Mjg0Mg%3D%3D) task. Refer to the **Base IPv4 Diagram** in order to complete this task.

Task

- Configure IS-IS Route Leaking from Level 2 to Level 1 on the L1/L2 routers as follows:
  - R3 should advertise the L2 prefix 5.5.5.5/32 to its L1 routers.
  - R4 should advertise the L2 prefix 6.6.6.6/32 to its L1 routers.
  - XR1 should advertise the 3.3.3.3/32 and 4.4.4.4/32 prefixes to its L1 routers.
- Configure IS-IS Route Leaking from Level 1 to Level 2 on the L1/L2 routers as follows:
  - R3 should not advertise the L1 prefix 2.2.2.2/32 to its L2 routers.
  - R4 should not advertise the L1 prefix 1.1.1.1/32 to its L2 routers

Configuration **Click to *collapse***

```
R3:
router isis
 redistribute isis ip level-1 into level-2 route-map L1_TO_L2_LEAK
 redistribute isis ip level-2 into level-1 route-map L2_TO_L1_LEAK
!
ip prefix-list L2_TO_L1_PL permit 5.5.5.5/32
!
ip prefix-list L1_TO_L2_PL permit 2.2.2.2/32
!
route-map L2_TO_L1_LEAK permit 10
 match ip address prefix L2_TO_L1_PL
!
route-map L1_TO_L2_LEAK deny 10
 match ip address prefix L1_TO_L2_PL
!
route-map L1_TO_L2_LEAK permit 20



R4:
router isis
 redistribute isis ip level-1 into level-2 route-map L1_TO_L2_LEAK
 redistribute isis ip level-2 into level-1 route-map L2_TO_L1_LEAK
!
ip prefix-list L2_TO_L1_PL permit 6.6.6.6/32
!
ip prefix-list L1_TO_L2_PL permit 1.1.1.1/32
!
route-map L2_TO_L1_LEAK permit 10
 match ip address prefix L2_TO_L1_PL
!
route-map L1_TO_L2_LEAK deny 10
 match ip address prefix L1_TO_L2_PL
!
route-map L1_TO_L2_LEAK permit 20



XR1:
route-policy ISIS_ROUTE_LEAKING
  if destination in (3.3.3.3/32, 4.4.4.4/32) then
    pass
  endif
end-policy
!
router isis 1
 address-family ipv4 unicast
  propagate level 2 into level 1 route-policy ISIS_ROUTE_LEAKING
 !
!
end
```

Verification

Previously R1 and R2 only knew their own L1 routes as well as a default route to the L1/L2 routes. Now the specific routes 5.5.5.5/32 and 6.6.6.6/32 are advertised via R3 and R4 respectively.

```
R2#show ip route isis
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area , * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is 20.2.4.4 to network 0.0.0.0

i*L1  0.0.0.0/0 [115/10] via 20.2.4.4, 00:21:12, GigabitEthernet1.24
                [115/10] via 20.2.3.3, 00:21:12, GigabitEthernet1.23
      1.0.0.0/32 is subnetted, 1 subnets
i L1     1.1.1.1 [115/10] via 10.1.2.1, 00:21:43, GigabitEthernet1.12
      5.0.0.0/32 is subnetted, 1 subnets
i ia     5.5.5.5 [115/158] via 20.2.3.3, 00:13:20, GigabitEthernet1.23
      6.0.0.0/32 is subnetted, 1 subnets
i ia     6.6.6.6 [115/148] via 20.2.4.4, 00:13:12, GigabitEthernet1.24
```

Due to the longest match routing principle, traffic going to 5.5.5.5/32 will always prefer R3 as the exit point, while traffic going to 6.6.6.6/32 will always prefer R4.

```
R1#traceroute 5.5.5.5

Type escape sequence to abort.
Tracing the route to 5.5.5.5
VRF info: (vrf in name/id, vrf out name/id)
  1 10.1.2.2 2 msec 1 msec 1 msec
  2 20.2.3.3 6 msec 2 msec 1 msec
  3 20.3.6.6 1 msec 1 msec 1 msec
  4 20.5.6.5 10 msec *  3 msec

R1#traceroute 6.6.6.6

Type escape sequence to abort.
Tracing the route to 6.6.6.6
VRF info: (vrf in name/id, vrf out name/id)
  1 10.1.2.2 1 msec 2 msec 1 msec
  2 20.2.4.4 1 msec 6 msec 2 msec
  3 20.4.6.6 2 msec *  2 msec
```

In the case that one of these exit points are down, traffic will fall back to the least specific match of 0.0.0.0/0 that is installed due to the Attached (ATT) bit being set in the IS-IS LSDB.

```
R1#show ip cef 6.6.6.6 detail
6.6.6.6/32, epoch 2
  nexthop 10.1.2.2 GigabitEthernet1.12


R1#traceroute 6.6.6.6

Type escape sequence to abort.
Tracing the route to 6.6.6.6
VRF info: (vrf in name/id, vrf out name/id)
  1 10.1.2.2 1 msec 2 msec 1 msec
  2 20.2.4.4 1 msec 6 msec 2 msec
  3 20.4.6.6 2 msec *  2 msec

R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#interface Gig1.24
R2(config-subif)#shutdown
R2(config-subif)#end

R2#show ip cef 6.6.6.6 detail
0.0.0.0/0 , epoch 2, flags [default route]
  nexthop 10.1.2.2 GigabitEthernet1.12

R1#traceroute 6.6.6.6
Type escape sequence to abort.
Tracing the route to 6.6.6.6
VRF info: (vrf in name/id, vrf out name/id)
  1 10.1.2.2 4 msec 1 msec 6 msec
  2 20.2.3.3 2 msec 1 msec 1 msec
  3 20.3.6.6 2 msec *  2 msec
```

Route leaking can also be used to filter routes as they are converted from L1 to L2. Previously R6 had equal longest matches to 1.1.1.1/32 and 2.2.2.2/32 via R3 and R4. After route leaking filtering is applied, R6 has only one possible path to each of these destinations.

```
R6#show ip route 1.1.1.1
Routing entry for 1.1.1.1/32
  Known via "isis", distance 115, metric 30, type level-2
  Redistributing via isis
  Last update from 20.3.6.3 on GigabitEthernet1.36, 00:20:33 ago
  Routing Descriptor Blocks:
  * 20.3.6.3, from 3.3.3.3, 00:20:33 ago, via GigabitEthernet1.36
      Route metric is 30, traffic share count is 1

R6#show ip route 2.2.2.2
Routing entry for 2.2.2.2/32
  Known via "isis", distance 115, metric 20, type level-2
  Redistributing via isis
  Last update from 20.4.6.4 on GigabitEthernet1.46, 00:00:02 ago
  Routing Descriptor Blocks:
  * 20.4.6.4, from 4.4.4.4, 00:00:02 ago, via GigabitEthernet1.46
      Route metric is 20, traffic share count is 1
```

Unlike L2 to L1 route leaking, which allows traffic engineering based on longest match, but still allows for fallback to a default route, filtering of L1 to L2 origination via route leaking does not allow for redundancy. For example in this case that R3 loses its link to the L1 domain, the 1.1.1.1/32 prefix becomes unreachable because R4 is configured to deny origination of this prefix from L1 into L2.

```
R6#show ip route 1.1.1.1
Routing entry for 1.1.1.1/32
 Known via "isis", distance 115, metric 30, type level-2
 Redistributing via isis
 Last update from 20.3.6.3 on FastEthernet0/0.36, 00:20:02 ago
 Routing Descriptor Blocks:
 * 20.3.6.3, from 3.3.3.3 , 00:20:02 ago, via FastEthernet0/0.36
     Route metric is 30, traffic share count is 1


R6#ping 1.1.1.1


Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
 !!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
R6#


R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#int Gig1.23
R3(config-subif)#shut
R3(config-subif)#end


R6#show ip route 1.1.1.1
 % Network not in table


R6#show ip cef 1.1.1.1
0.0.0.0/0
   no route


R6#ping 1.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
 .....
Success rate is 0 percent (0/5)
```

Route leaking in IOS XR uses the same logic as regular IOS, however the matching of prefixes occurs through the usage of the Routing Policy Language (RPL).

```
RP/0/0/CPU0:XR1#show rpl
Tue Apr 28 00:39:42.306 UTC
route-policy ISIS_ROUTE_LEAKING
  if destination in (3.3.3.3/32, 4.4.4.4/32) then
    pass
  endif
end-policy
!


RP/0/0/CPU0:XR1#show run router isis
Tue Apr 28 00:40:07.194 UTC
router isis 1
 net 49.1920.0000.0000.0019.00
 address-family ipv4 unicast
  propagate level 2 into level 1 route-policy ISIS_ROUTE_LEAKING
 !
<snip>
```

The result of this configuration is that XR2 learns the specific routes of 3.3.3.3/32 and 4.4.4.4/32 via XR1.

```
RP/0/0/CPU0:XR2#show route isis
Tue Apr 28 00:42:15.775 UTC


i*L1 0.0.0.0/0 [115/10] via 10.19.20.19, 00:27:24, GigabitEthernet0/0/0/0.1920
 i ia 3.3.3.3/32 [115/30] via 10.19.20.19, 00:27:24, GigabitEthernet0/0/0/0.1920
 i ia 4.4.4.4/32 [115/30] via 10.19.20.19, 00:27:24, GigabitEthernet0/0/0/0.1920
```

To make this configuration more modular, the RPL policy could have called an external prefixset, similar to a prefix-list in regular IOS, that could be used to match the prefixes in question to be leaked. A configuration such as this could be written as follows:

```
RP/0/0/CPU0:XR1#show rpl
Tue Apr 28 00:44:13.650 UTC
prefix-set ISIS_ROUTES
  3.3.3.3/32,
  4.4.4.4/32
end-set
!
route-policy ISIS_ROUTE_LEAKING
  if destination in ISIS_ROUTES then
    pass
  endif
 end-policy
!


RP/0/0/CPU0:XR1#show run router isis
Tue Apr 28 00:44:18.881 UTC
router isis 1
 net 49.1920.0000.0000.0019.00
 address-family ipv4 unicast
  propagate level 2 into level 1 route-policy ISIS_ROUTE_LEAKING
 !
<snip>
```

Route-maps can be used to control redistribution in IOS, as shown in this example, in addition to distribute-lists.

When an L1L2 router leaks L2 routes into L1, the routes are advertised in IP Internal Reachability Information TLVs. An important factor about route leaking in ISIS is the setting of the U/D bit within the TLV of the leaked route. This is similar to the "Down" bit in OSPF, and it is paramount in preventing loops. An L1L2 router that receives a route with the U/D bit attached via L1 will not re-advertise this same route into L2. This behavior is described in RFC-2966.

The leaked routes can be observed by looking at the L1L2 router's LSP doing the leaking:

```
RP/0/0/CPU0:XR2#show isis database XR1.00-00 detail
Tue Apr 28 00:48:24.390 UTC


IS-IS 1 (Level-1) Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
XR1.00-00             0x00000006   0x1a47        478             1/0/0
  Area Address: 49.1920
  NLPID:        0xcc
  Hostname:     XR1
  IP Address:   19.19.19.19
  Metric: 10         IS XR1.01
   Metric: 20         IP-Interarea 3.3.3.3/32
   Metric: 20         IP-Interarea 4.4.4.4/32
  Metric: 10         IP 10.19.20.0/24
```

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