

Exercise: ISIS

Summary of Generic ISIS commands

router isis process-name

Enter ISIS configuration mode. The **process-name** is simply the name of the ISIS process - a router can run more than one ISIS process if required.

redistribute connected subnets

Advertise all networks to which we are connected, including those which are not being used to talk to other ISIS routers. The use of this command is not recommended within ISP backbones, but is included here for completeness. ("redistributed connected" by itself only distributes classful routes, i.e. whole class A/B/C networks, so it's important to add "subnets")

redistribute static subnets

Advertise all static routes we have (except defaultroute). The use of this command isn't ordinarily required or recommended. However, there will be circumstances where redistribution of statics into ISIS are required. An example will be shown in the lab.

default-information originate [route-map route-map]

Advertise a default route into ISIS, optionally using route-map route-map. Typically this would go on your border router(s).

is-type level-2-only

Set the the IS type to be in Level-2 only. ISP backbones only ever use level-2. Cisco IOS puts all interfaces in level 1 and 2 by default.

metric-style wide

Set the metric style to be wide. Cisco IOS uses narrow metrics by default which only gives 6 bits available for setting the IGP metric - not suitable for today's backbones, and won't permit IPv6 support.

ISIS interface configuration

ip router isis process-name	Initiate ISIS process process-name on interface
isis circuit-type level-2-only	Set IS type to level 2
isis metric n level-2	Set outbound interface cost to n
isis authentication mode md5 level-2	Use MD5 authentication on all ISIS packets
isis authentication key-chain chain-name level-2	Use chain-name as the key-chain for ISIS authentication

Part 1: Loopback interfaces

A loopback interface is a single (/32) IP address, which belongs to a device, independent of its physical interface addresses. It's very convenient when managing routers, because you can use the loopback address as a fixed address to telnet to, or monitor using SNMP, which will continue to work even if one or more of the interfaces has failed.

1. Check that there is no ISIS process running from any previous exercises. To do this you can do `sh run | include isis`. If there is one there, remove it, for example:

```
router-a#conf t
router-a(config)#no router isis nog
router-a(config-if)# [Hit ctrl-Z]
router-a#write mem
```

2. Check that you have no static routes. If you do have some, remove them.

```
router-a#show ip route
```

The only routes you should see are (C)onnected routes for your own interfaces. If you have any (S)tatic routes, delete them like this:

```
router-a#conf t
router-a(config)#no ip route 196.200.220.32 255.255.255.240 196.200.220.30
router-a(config-if)# [Hit ctrl-Z]
router-a#write mem
```

3. Now check your router can still ping the PC on your desk, and other routers on the backbone.

(Your PC won't be able to ping any other PCs though, because your router doesn't have the routes any more)

4. You will need to subdivide your assigned network space. You will need one subnet for your desk network, and a /32 for the loopback. (In real life you would have a number of routers, and say a /29 block would be enough for 8 loopbacks).

Configure your loopback address into your router.

The example below is for the router belonging to Team A. They have decided to subdivide their address block 196.200.220.32/28 such that 196.200.220.47/32 is the address of the loopback interface of their router.

```
router-a#conf t
router-a(config)#int loopback0
router-a(config-if)#ip address 196.200.220.47 255.255.255.255
router-a(config-if)# [Hit ctrl-Z]
```

5. Now save your configuration.

```
router-a#write mem
```

Part 2: Learning routes via ISIS

The initial network topology is the same as for the static routing exercise.

1. Enable ISIS on the backbone interface (only). Create the **NSAP address** from your loopback interface address as described in the presentation

```
router-a#conf t
router-a(config)#router isis nog
router-a(config-router)#net 49.0001.1962.0022.0047.00
router-a(config-router)#is-type level-2-only
router-a(config-router)#metric-style wide
router-a(config-router)#log-adjacency-changes
router-a(config-router)# [Hit ctrl-Z]
```

2. We will now set ISIS on the backbone interface. We will also set the link cost to 100.

```
router-a(config-router)#int faste0/1
router-a(config-if)#ip router isis nog
router-a(config-if)#isis circuit-type level-2-only
router-a(config-if)#isis metric 100 level-2
router-a(config-if)# [Hit ctrl-Z]
```

3. We will now mark the Loopback interface as passive to ensure that ISIS will install the loopback interface address into ISIS. RIB but will not actually run ISIS on the interface itself.

```
router-a(config)#router isis nog
router-a(config-router)#passive-interface Loopback 0
```

4. We also need to mark the internal LAN interface as passive to ensure that ISIS will announce our local LAN to the other routers in the classroom. As with the loopback, this will not run ISIS on the interface itself, but simply announce the interface's subnet.

```
router-a(config)#router isis nog
router-a(config-router)#passive-interface faste0/0
```

5. Look at the ISIS status

```
router-a#show clns int
router-a#show clns neighbor
router-a#show clns protocol
```

6. Once you have established a neighbor relationship with another router, you should automatically have learned some new routes:

```
router-a#show ip route
```

Routes learned through ISIS are tagged with I followed by an indication as to whether the prefix is L1 or L2. Check that the next hop IP address for each route is correct. Also, the far router should also have picked up your route. You can go over to the other desk and ask to see the output of "show ip route"

7. Check that your PC can ping the PCs on other desks

```
$ ping 196.200.220.129
```

8. Once all desks are running, the instructors will add a class router into the ISIS cloud, and get it to announce a default route.

NOTE: Students should inform the instructor when they get to this step.

NOTE: Don't type this - it goes on the class border router

```
border-1(config)#router isis nog
border-1(config-router)#default-information originate
```

9. Check that you can see the new router as a neighbor, and that you have picked up a default route (0.0.0.0) This should be sufficient to establish connectivity to the outside Internet! Use ping, traceroute etc. to test this

10. Save your config

```
router-a#write mem
```

Part 3: Configuration storage via TFTP (Optional)

As discussed in the preceding TFTP exercise, save your configuration to your TFTP server

Part 4: IPv6 ISIS

1. We are now going to take the above topology and enable IPv6 on it. To enable ISIS for IPv6, we do:

```
ip router isis nog
  address-family ipv6
```

2. We now add an IPv6 address for the interfaces we will be running IPv6 over. The active interface will be the classroom backbone, so the example might be:

```
interface fastethernet 0/1
  ipv6 address 2001:4348:220:10::1/64
```

Configure addresses on the active interfaces on the router. You will need one /64 for the link to your PC, one /128 for the loopback interface, and of course an address on the backbone network.

3. We now go to each interface we want to run ISIS for IPv6, and activate it for IPv6. Here is an example:

```
interface fastethernet 0/1
  ipv6 router isis nog
```

So this example says that we are going to run ISIS for IPv6 on FastEthernet 0/0. It also says that the IPv6 address/subnet configured on FastEthernet 0/0 will be automatically inserted into the ISIS IPv6 routing table.

4. We now set metric 100 on the interface as we did for IPv4 earlier:

```
interface fastethernet 0/1
  isis ipv6 metric 100 level-2
```

5. Once all desks are running, the instructors will configure a default route on the class router.

NOTE: Don't type this - it goes on the class border router

```
border-1(config)#router isis nog
border-1(config-router)#address-family ipv6
border-1(config-router-af)#default-information originate
```

6. Check that you can see the new router as a neighbor, and that you have picked up a default route (::/0)

This should be sufficient to establish IPv6 connectivity to the outside Internet! Use ping, traceroute etc. to test this

7. Save your config

```
router-a#write mem
```

Part 5: Dynamic changes in topology

Above you showed how ISIS can learn routes from the rest of your network, without having to manually insert static routes. Now you can show how ISIS can adapt to topology changes and choose better (lower cost) routes when they are available

1. In the past, students used to work in pairs with an adjacent desk to physically interconnect the backbone links
2. They would connect a DTE/DCE cable pair between one interface on one router and then the other. We will not be doing that since our lab environment is virtualized.
3. Now, one of the student group for example group A will need to allocate a /30 subnet out of your address space for the p2p link, and assign an IP address to each end. Then each end need to configure an IP on their p2p link.

```
router-a#conf t
router-a(config)#int Fa0/0 (or int Fa0/1)
router-a(config-if)#description Ethernet link to desk B
router-a(config-if)#ip address 196.200.220.37 255.255.255.252
router-a(config-if)#no shutdown
```

4. You will need to do the same for IPv6. Agree between you and your neighbor on a /64 network to use for the point to point link between your routers. Suggested /64s are in the addressing notes.

And now configure the link with its IPv6 addresses:

```
router-a#conf t
router-a(config)#int Fa0/0 (or int Fa0/1)
router-a(config-if)#ipv6 address 2001:4348:220:11::1/64
```

5. Once this is done on both routers, run the command "show int Fa0/0 or show int Fa0/1" which should show that the Interface is up (layer 1)

7. Line protocol should be up. Check you can ping the remote IP address.

```
router-a#ping 196.200.220.34
```

Try this with IPv6 as well:

```
router-a#ping
 2001:4348:220:11::2
```

8. Enable ISIS on the Ethernet line. We will use a larger cost of 500 to reflect the fact that this is a slower-speed link

```
router-a#conf t
router-a(config-router)#int Fa0/0 (or Fa0/1)
router-a(config-if)#ip router isis nog
router-a(config-if)#isis metric 500 level-2
router-a(config-if)# [Hit ctrl-Z]
```

9. Both desks: look at your forwarding table

```
router-a#show ip route
```

Look carefully at the route to your neighbor's desk network, and your neighbor's router loopback interface, and make a note of it.

10. On one desk, unplug the ethernet connection into the backbone, wait a few seconds, and look at the forwarding table again.

Does the desk which had its ethernet unplugged still have connectivity to the Internet? When you traceroute, what route do the packets take?

11. Plug the ethernet back in. Set the cost of the Ethernet link to 50.

Look at the routes again. What has happened to the route to your neighbor's desk network, and to their loopback interface?

12. Try setting the cost of the Ethernet link to 100.

Check the forwarding table ("show ip route"). Now what do you notice about the route to your neighboring desk's network?

13. We now do the same for ISIS for IPv6. Again we will use a larger cost of 500 to reflect the fact that this is a slower-speed link

```
router-a#conf t
router-a(config-if)#int Fa0/0 (or Fa0/1)
router-a(config-if)#ipv6 router isis nog
router-a(config-if)#isis ipv6 metric 500 level-2
router-a(config-if)# [Hit ctrl-Z]
```

14. Both desks: look at your forwarding table

```
router-a#show ipv6 route
```

Look carefully at the route to your neighbor's desk network, and your neighbor's router loopback interface, and make a note of it.

15. On one desk, unplug the ethernet connection into the backbone, wait a few seconds, and look at the forwarding table again.

Does the desk which had its ethernet unplugged still have connectivity to the Internet? When you traceroute, what route do the packets take?

16. Plug the ethernet back in. Set the cost of the Ethernet link to 50.

Look at the routes again. What has happened to the route to your neighbor's desk network?

17. Try setting the cost of the Ethernet link to 100

Check the forwarding table ("show ipv6 route"). Now what do you notice about the route to your neighboring desk's network?

NOTE: Before finishing this exercise, remove the Ethernet links and reboot the router to get back to the saved configuration.

Part 6: Extras

When finished, revert to the saved configuration from the end of Part 3.

HINT: Use the file saved to the tftp server.