

IPv6 Module 10 – An IPv6 Internet Exchange Point

Objective: To investigate methods for connecting to an Internet Exchange Point.

Prerequisites: Modules 1, 6 to 8, and the Exchange Points Presentation

Lab Notes

The purpose of this module is to introduce the concept of an Internet Exchange Point, how to peer at IXPs, and look at some of the recommended configuration practices.

This module concentrates more on IXP peering, so setting up the eBGP sessions, implementing correct prefix-filters, and so on. It is more suited to where workshop participants are interested in participating in an IX in their region, and so can get first hand experience at configuring the eBGP sessions with the other participants. However it misses out some important details regarding connecting a fully fledged ISP network to an IX.

Module 16 on the other hand looks at a more realistic IXP. It has six ASNs participating at the IX, with two routers being assigned to each autonomous system. One router peers at the IX, the other router is internal to the autonomous system (so will have an OSPF and iBGP session with the IX facing router). It also has three routers operating as three transit provider or Tier1 ISPs. That module is strongly recommended over this one as it covers correct OSPF and iBGP configuration practices for connecting the IXP facing router to the rest of the ISP network.

Lab Exercises

1. **A Simple IXP.** This example is of a very simple IXP. But using this configuration, any participant in this workshop should be able to go away and set up a working IXP in their own economy. Technically they are not hard to implement. Politics & business economics are not covered in this workshop.

Only prefix lists are used to filter BGP announcements. eBGP peers should be in peer-groups, and route refresh should be used to implement any policy changes as in other modules.

2. **Basic Configuration.** Each router team should configure their router to fit into the network layout depicted in Figure 1. Check all connections. Note that all links are by ethernet.
3. **Addressing Plan.** The following address ranges should be used throughout this module. You are welcome to use your own range within an AS if you desire, just so long as you consult with the teams in other ASes to ensure there is no overlap.

AS101	2001:db8:1000::/40	AS108	2001:db8:8000::/40
AS102	2001:db8:2000::/40	AS109	2001:db8:9000::/40
AS103	2001:db8:3000::/40	AS110	2001:db8:a000::/40
AS104	2001:db8:4000::/40	AS111	2001:db9:b000::/40
AS105	2001:db8:5000::/40	AS112	2001:db8:c000::/40
AS106	2001:db8:6000::/40	AS113	2001:db8:d000::/40
AS107	2001:db8:7000::/40	AS114	2001:db8:e000::/40

4. **Basic Router Setup.** Set up the routers as you would have done in previous modules. That is, basic security, the BGP outline configuration, IOS Essentials, etc.

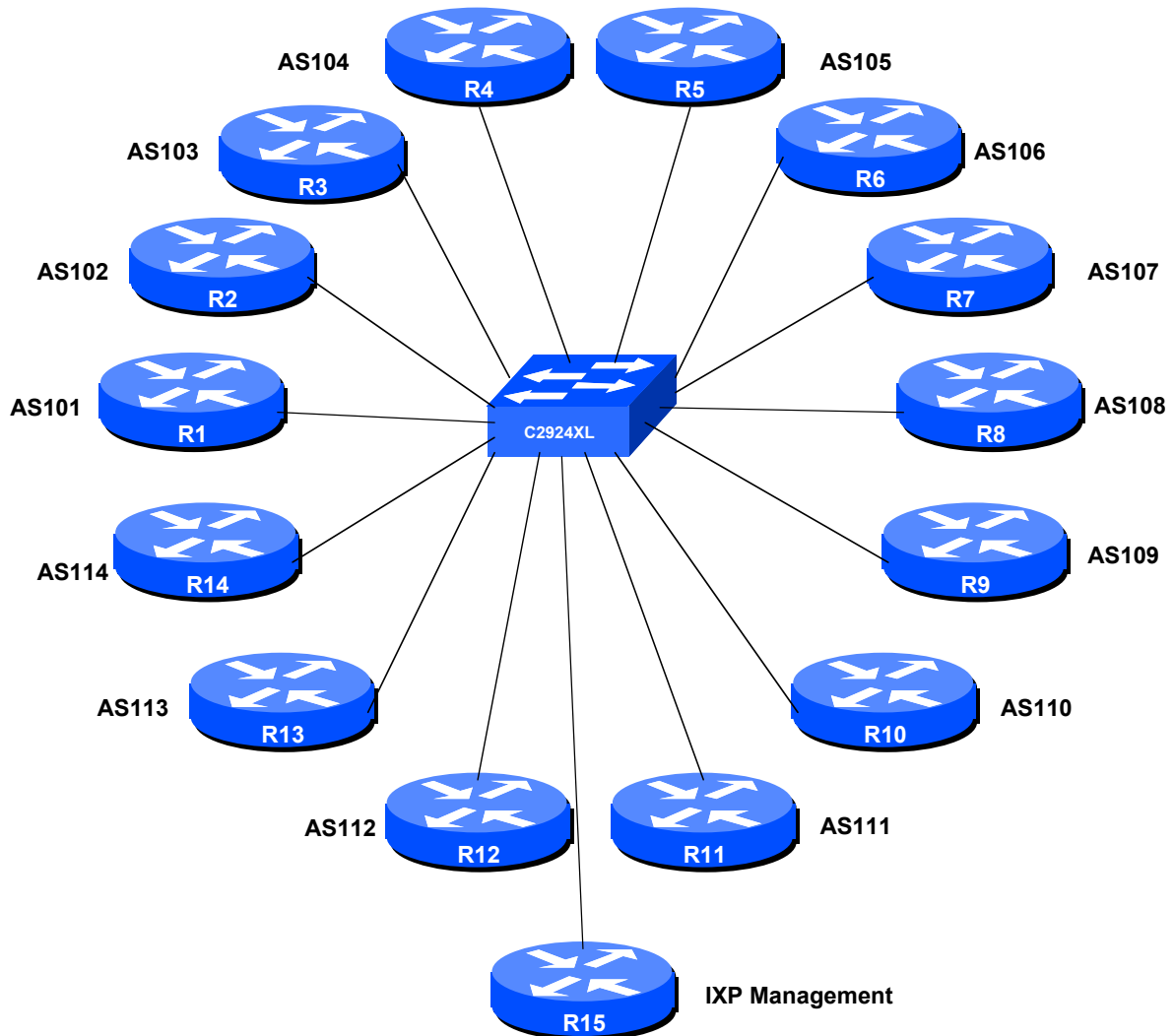


Figure 1 – IXP Configuration

5. **Management Router and IXP LAN.** The lab instructor will have connected another router to the exchange point – this is Router 15 in the figure. Each router team should set up their router to synchronise time off that router using NTP. The password on the NTP session is “cisco” as in previous Modules. The address range used for the IXP LAN is 2001:db8::/64– the management router in this module has an IP address of 2001:db8::1. Each of the ASes is assigned a block of addresses to use on the exchange point LAN; they receive a /112 out of the /64. So, for example, AS101 receives 2001:db8::101:1, 2001:db8::101:2, 2001:db8::101:3, etc for any devices it wishes to place on the IXP LAN. AS102 receives 2001:db8::102:1, 2001:db8::102:2, 2001:db8::102:3, etc for any devices it wishes to place on the IXP LAN. And so on.

Q. Why do you think this addressing scheme has been used at the IXP?

Checkpoint #1: When you have properly configured your router, and the other routers at the IXP are reachable (i.e. you can ping the other routers), please let the instructor know.

- 6. Configure the ethernet of each router at the IXP.** The ethernet interfaces connected to the IXP should be configured appropriately for a public connection. Review the IOS Essentials materials and the IXP presentation. The configuration for Router 14 might be:

```
interface fastethernet 0
  description Exchange Point LAN
  ipv6 address 2001:db8::114:1/64
!
```

If you are unclear as to what any of the configuration lines do, please ask the lab instructor.

- 7. Configuring BGP on the routers.** Next, eBGP needs to be set up on the routers. Create a peer-group and apply that peer-group to each eBGP neighbour. A sample configuration for Router13 might be:

```
ipv6 prefix-list myprefixes permit 2001:db8:d000::/40
ipv6 prefix-list peer101 permit 2001:db8:1000::/40
..
ipv6 prefix-list peer114 permit 2001:db8:e000::/40
!
router bgp 113
  address-family ipv6
    no synchronization
    bgp log-neighbor-changes
    network 2001:db8:d000::/40
    neighbor ixp-peers peer-group
    neighbor ixp-peers remove-private-AS
    neighbor ixp-peers prefix-list myprefixes out
    neighbor ixp-peers route-map set-local-pref in
    neighbor <router1> remote-as 101
    neighbor <router1> description Peering with AS101
    neighbor <router1> peer-group ixp-peers
    neighbor <router1> prefix-list peer101 in
  ..
    neighbor <router14> remote-as 114
    neighbor <router14> description Peering with AS114
    neighbor <router14> peer-group ixp-peers
    neighbor <router14> prefix-list peer114 in
  !
  route-map set-local-pref permit 10
    set local-preference 150
  !
```

The configurations for the other routers will be similar to this one. All router teams will have done sufficient BGP configuration throughout this workshop to extrapolate from the above examples. If in any doubt, ask the lab demonstrator for assistance.

Note the prefix-lists. There is a per-peer inbound prefix-list. Some service providers only filter ASes – that has inherent dangers, and does not prevent against inbound leaking of prefixes incorrectly originated by the peer AS. But only filtering on prefixes doesn't scale, especially in larger IXPs with large participating service providers as they are frequently adding to the prefixes they announce. The Internet Routing Registry is usually used to solve this problem.

- 8. Connectivity Test.** Check connectivity throughout the IXP network. Each router team should be able to see all the other routers at the IXP. When you are satisfied that BGP is working correctly, try running traceroutes to check the paths being followed.

Checkpoint #2: *Once the BGP configuration has been completed, check the routing table and ensure that you have complete reachability over the entire network. If there are any problems, work with the other router teams to resolve those.*

- 9. Set up passwords on the eBGP sessions.** Negotiate with each ASN a password which you can use on your BGP session with them. And then agree to cut the eBGP session over to using passwords such that the eBGP session does not fall over due to password mismatches (as in Module 6).

```
router bgp 113
  address-family ipv6
    neighbor <router14> password peer114
!
```

- 10. Set up eBGP session with Router 15.** The lab instructors will have now configured Router 15 to be a route collector. This is a router which collects all the routes available at the IX. It serves purpose other than to be an information repository showing how many routes are available at the IX – quite often the IXP management will operate such a router, connected to a Looking Glass web interface, to increase the marketing value of the IX. The more peers who get attracted by the routes available at the IX, the greater the value proposition the IX is to the rest of the members. It's in everyone's interest to peer with the router collector:

```
router bgp 113
  address-family ipv6
  ...
  neighbor 2001:db8::1 remote-as 65534
  neighbor 2001:db8::1 description eBGP with the IX Route Collector
  neighbor 2001:db8::1 password cisco
  neighbor 2001:db8::1 remove-private-AS
  neighbor 2001:db8::1 prefix-list deny-all in
  neighbor 2001:db8::1 prefix-list myprefixes out
  ...
!
```

```
ipv6 prefix-list deny-all ::/0 le 128
...
```

Notice that the route collector is running in a private AS – there isn't really any need for it to use a public AS because the Collector does not need to be directly visible outside of the IXP.

Note also the inbound prefix filter blocking all prefixes on the eBGP session with the Route Collector. The Collector will not advertise any prefixes, by design. However, ISPs should never trust any other AS or its operator, so the inbound prefix filter is provided for safety, just in case of problems at the Route Collector.

- 11. Connectivity Test.** Check connectivity throughout the IXP network. Each router team should be able to see all the other routers at the IXP. When you are satisfied that BGP is working correctly, try running traceroutes to check the paths being followed.

12. Completed! The IXP is now complete, up and running. The lab instructors will log into the route collector and show the prefixes visible. All 14 announcements should be clearly seen in the output of *sh bgp ipv6 unicast* on the route collector.

Checkpoint #3: *Compare your BGP routing table with that you see on the route collector. If you have missing prefixes, or some other problems, ask the lab demonstrators.*