

Migrating from OSPF to IS-IS

ISP/IXP Workshops



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Acknowledgements

- ❑ This material originated from the Cisco ISP/IXP Workshop Programme developed by Philip Smith & Barry Greene
- ❑ Use of these materials is encouraged as long as the source is fully acknowledged and this notice remains in place
- ❑ Bug fixes and improvements are welcomed
 - Please email *workshop (at) bgp4all.com*

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BGP Videos

- ❑ NSRC has made a video recording of this presentation, as part of a library of BGP videos for the whole community to use:
 - https://learn.nsrc.org/bgp#intro_to_routing

The screenshot displays the NSRC (Network Startup Resource Center) website. The top navigation bar includes links for Home, About, BGP for All (highlighted), perfSONAR, ScienceDMZ, FedIdM, and Contact Us, along with a search bar. The main content area is divided into three columns. The left column features the 'BGP for All' section with a description of BGP and a 'Video Topics' sidebar with links to BGP for All, perfSONAR, ScienceDMZ, and FedIdM. The middle column, titled 'Introduction to Routing', lists various topics such as Internet Routing, Routing Protocols, and IS-IS Levels. The right column features a video player for 'BGP for All' with a play button and a 'Watch on YouTube' link, followed by 'BGP Case Studies' and 'Communities' sections.

NSRC
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BGP for All

Border Gateway Protocol (BGP) is the primary routing protocol used to transfer data and information on the Internet or autonomous systems. BGP is a Path Vector Protocol which maintains paths to different hosts, networks and gateway routers and determines the routing decision based on rules, filtering, weight and community.

Understanding the myriad options for routing can produce efficiencies for institutions and create opportunities for research and education networks to collaborate.

Video Topics

- BGP for All
- perfSONAR
- ScienceDMZ
- FedIdM

Introduction to Routing

- Internet Routing
- Routing Protocols
- Introduction to IS-IS UPDATED
- IS-IS Levels
- IS-IS Adjacencies
- Best Configuration Practices for IS-IS on Cisco IOS
- IS-IS Authentication, Default Routes and IPv6
- Introduction to OSPF
- OSPF Areas
- OSPF Adjacencies
- Best Configuration Practices for OSPF on Cisco IOS
- OSPF Authentication, Default Routes and IPv6
- Comparing OSPF and IS-IS
- Choosing between OSPF and IS-IS
- Migrating from OSPF to IS-IS
- Migration Plan
- Finalizing Migration

Introduction to BGP

- Introduction to Border Gateway Protocol
- Transit and Peering
- Autonomous Systems UPDATED
- How BGP works
- Supporting Multiple Protocols
- IBGP versus EBG
- Setting up EBG
- Setting up IBGP

BGP Case Studies

- Peering Priorities NEW
- Transit Provider Peering at an IXP NEW
- Customer Multihomed between two IXP members NEW
- Traffic Engineering for an ISP connected to two IXes NEW
- Traffic Engineering for an ISP with two interfaces on one IX LAN NEW
- Traffic Engineering and CDNs NEW

Communities

- Communities: RFC 1998 Traffic Engineering
- Communities: Simplifying Traffic Engineering
- How to Apply Communities to Originated Routes
- How to Use Communities for Service Identification

Introduction

- ❑ With the advent of IPv6 and dual stack networks, more ISPs expressing interest to migrate to IS-IS
 - Migration is not as difficult as it sounds
- ❑ Presentation describes the process
 - Based on several successful migrations
 - Uses Cisco IOS and IOS-XR CLI as examples

Motivation

- “Security”
 - IS-IS runs on link layer
 - Not possible to “attack” the IGP using IP as with OSPF
- Not dependent on IP addressing
 - IS-IS’s Network Service Access Point (NSAP) addressing scheme avoids dependencies on IPv4 such as in OSPF
- “Reliability”
 - IS-IS has long been used by the majority of the world’s biggest ISPs
 - Belief that equipment vendors pay more attention to IS-IS reliability, scalability, and features

More considerations

□ Migration to IPv6

- Adding IPv6 means OSPFv2 and OSPFv3 in network
 - Two protocols, two sets of identical configuration
- IS-IS simply requires the addition of the IPv6 address-family
 - Most networks operate single topology for IPv4 and IPv6
- Note that RFC5838 describes support of multiple address families in OSPFv3
 - Limited vendor support
 - Is not compatible with OSPFv2

Migration Plan

1. Verify OSPF configuration and operation
2. Deploy IS-IS over entire backbone
3. Set OSPF admin distance to be higher than IS-IS
4. Check for remnants in OSPF
5. Remove OSPF from entire backbone
6. Confirm IGP operation

Verify OSPF Configuration

- ❑ **next-hop-self** for iBGP
 - No external point-to-point links need to be carried on OSPF
 - If external point-to-point links are required (for monitoring), carry in iBGP tagged with specific community visible to monitoring system only
- ❑ Remove interfaces with OSPF adjacencies
 - Only Loopback and internal point-to-point links should remain
 - For Cisco IOS and IOS-XR ensure that OSPF is only activated on internal and loopback interfaces – same for OSPFv3 configuration

Configuration Example: IOS

```
interface loopback 0
  ip addr 172.16.1.1 255.255.255.255
  ip ospf 100 area 0
interface GigabitEthernet 0/0
  ip address 172.16.0.1 255.255.255.252
  ip ospf 100 area 0
interface GigabitEthernet 0/1
  ip address 172.16.0.5 255.255.255.252
  ip ospf 100 area 0
...
router ospf 100
  max-metric router-lsa on-startup wait-for-bgp
  passive-interface default
  no passive-interface fastethernet 0/0
  no passive-interface fastethernet 0/1
!
```

Configuration Example: IOS-XR

```
interface loopback 0
  ip addr 172.16.1.1 255.255.255.255
interface fastethernet 0/0
  ip address 172.16.0.1 255.255.255.252
interface fastethernet 0/1
  ip address 172.16.0.5 255.255.255.252
...
router ospf ISP
  area 0
    interface Loopback0
      passive enable
    !
    interface fastethernet 0/0
    !
    interface fastethernet 0/1
```

IPv6 configuration

- ❑ If IPv6 has already been deployed
 - OSPFv3 configuration also needs to be tidied up
- ❑ For IOS:
 - `router ospf 100` configuration should look identical to the `ipv6 router ospf 100` configuration
- ❑ For IOS-XR:
 - `router ospf ISP` configuration should look identical to the `router ospfv3 ISP` configuration
- ❑ Check that the IPv4 adjacencies match the IPv6 adjacencies

Verifying OSPF operation

- Verifying operation is important after clean up
 - iBGP peers all stable
 - Next hop values are all valid
 - Check OSPF routing table
- If OSPFv3 deployed for IPv6, compare with OSPFv2
 - As well as adjacencies, compare routing table entries

Deploy IS-IS over entire backbone

- ❑ ISPs will deploy IPv6 dual-stack across their infrastructure
 - Every device running an IPv4 IGP will also require to run an IPv6 IGP
- ❑ Single-topology IS-IS
 - IPv4 and IPv6 topology identical
 - Needs care as adjacent routers need to have both IPv4 and IPv6 on the link
- ❑ Multi-topology IS-IS
 - IPv4 and IPv6 topology could differ
 - More flexibility for operators doing incremental roll-outs of IPv6₁₃

Deploy IS-IS over entire backbone

□ IS-IS deployment:

- IS-IS protocol distance is 115 (higher than OSPF's 110)
- Use wide metrics (required for IPv6 address family support)
- Only using Level-2 IS (IOS default is L1L2)
- Passive interface configuration means IS-IS is not run on the interface, but the address is announced in the IGP

□ IPv6 addressing in backbone – choice of:

- Global unicast addresses
- Link local addressing/unnumbered interfaces

Configuration Example: IOS

```
interface loopback 0
  ip address 172.16.1.1 255.255.255.255
  ipv6 address 2001:db8::1/128
!
interface GigabitEthernet 0/0
  ip address 172.16.0.1 255.255.255.252
  ipv6 address unnumbered loopback 0
  ip router isis ISP
  isis metric 20 level-2
  ipv6 router isis ISP
  isis ipv6 metric 20 level-2
!
(next slide)
```

Both IPv4 and IPv6
configurations



Configuration Example: IOS (cont)

```
interface GigabitEthernet 0/1
  ip address 172.16.0.5 255.255.255.252
  ipv6 address unnumbered loopback 0
  ip router isis ISP
  isis metric 20 level-2
  ipv6 router isis ISP
  isis ipv6 metric 20 level-2
!
router isis ISP
  net 49.0001.1720.1600.1001.00
  passive-interface Loopback 0
  is-type level-2-only
  metric-style wide level-2
  set-overload-bit on-startup wait-for-bgp
!
address-family ipv6
  multi-topology
  set-overload-bit on-startup wait-for-bgp
exit-address-family
!
```

Both IPv4 and IPv6
configurations



Configuration Example: IOS-XR

```
interface loopback 0
  ip address 172.16.1.1 255.255.255.255
  ipv6 address 2001:db8::1/128
interface GigabitEthernet 0/0/0
  ip address 172.16.0.1 255.255.255.252
  ipv6 enable
interface GigabitEthernet 0/0/1
  ip address 172.16.0.5 255.255.255.252
  ipv6 enable
...
router isis ISP
  set-overload-bit on-startup wait-for-bgp
  is-type level-2-only
  net 49.0001.1720.1600.1001.00
  address-family ipv4 unicast
    metric-style wide
  address-family ipv6 unicast
    metric-style wide
(next slide)
```

Configuration Example: IOS-XR (cont)

```
router isis ISP
!
interface Loopback0
  passive
  address-family ipv4 unicast
    metric 1 level 2
  address-family ipv6 unicast
    metric 1 level 2
!
interface GigabitEthernet 0/0/0
  address-family ipv4 unicast
    metric 20 level 2
  address-family ipv6 unicast
    metric 20 level 2
!
interface GigabitEthernet 0/0/1
  address-family ipv4 unicast
    metric 20 level 2
  address-family ipv6 unicast
    metric 20 level 2
!
```

Set OSPF Admin Distance High

- ❑ Once IS-IS is deployed over entire backbone set OSPF's admin distance above that of IS-IS
 - For all routers across the backbone
- ❑ Example:

```
router ospf 100
  distance 120
!
ipv6 router ospf 100
  distance 120
```

- ❑ All IS-IS paths learned by the router now take priority over the OSPF paths
 - For both IPv4 and IPv6

OSPF remnants

- ❑ As IS-IS is now responsible for interior routing, if all the preparation work was completed, there should be no prefixes left in OSPF
 - If there are, check what they are, and what caused them
- ❑ Remnant prefixes could include:
 - Forgotten passive interfaces for IS-IS
 - Forgotten active adjacencies

OSPF remnants

- ❑ Check adjacencies across the backbone
 - Compare `show ip ospf neigh` with `show isis neigh`
 - There should be the same number of neighbours
 - If not, fix the problem
- ❑ End result of tidying up work should mean:
 - **No more prefixes left in OSPF**
 - **A successful deployment of IS-IS**

Remove OSPF

- ❑ OSPF can now be safely removed from the entire backbone
- ❑ IOS:

```
no router ospf 100  
no ipv6 router ospf 100
```

- For some versions of IOS, also need to go to each interface and remove OSPF metric, link type, and authentication configuration

- ❑ IOS-XR

```
no router ospf ISP  
no router ospfv3 ISP
```

- Performs a clean removal

Confirm IGP operation

- ❑ IS-IS should now be functioning normally
- ❑ Verify iBGP sessions
 - Should have been completely unaffected by the entire migration process
- ❑ Verify next hop values
 - Adjacencies should be known in IS-IS
- ❑ Verify customer and external access
- ❑ Task complete

Conclusion

- ❑ Migration from OSPFv2 and OSPFv3 to IS-IS is straightforward
 - With planning
 - With adherence to procedure developed during planning
- ❑ Can be carried out any time
 - (but planned maintenance slots strongly recommended)
- ❑ Now running single multi-address family IGP to support both IPv4 and IPv6

Footnote

- ❑ Migrating from IS-IS to OSPF
 - Use the reverse of the described process
 - But why would anyone?
- ❑ Migrating from EIGRP to IS-IS
 - Follow the same procedures described here
 - EIGRP's administrative distance is either 90 or 170, depending on prefix origin $\Rightarrow$ set IS-IS admin distance appropriately

Migrating from OSPF to IS-IS



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