

Comparing IS-IS and OSPF

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
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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, titled 'BGP for All', provides a brief description of BGP as the primary routing protocol and lists 'Video Topics' with color-coded buttons for BGP for All, perfSONAR, ScienceDMZ, and FedIdM. The middle column, titled 'Introduction to Routing', lists a comprehensive set of topics including Internet Routing, Routing Protocols, IS-IS Levels, OSPF Areas, and Migration Plan. The right column features a large video player for 'BGP for All Internet Routing' with a play button and a 'Watch on YouTube' link. Below the video player, there are sections for 'BGP Case Studies' and 'Communities', each listing related topics.

NSRC Network Startup Resource Center

Home About **BGP for All** perfSONAR ScienceDMZ FedIdM Contact Us Search

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

Comparing IS-IS and OSPF

- ❑ Both are Link State Routing Protocols using the Dijkstra SPF Algorithm
- ❑ So what's the difference then?
- ❑ And why do ISP engineers end up arguing so much about which is superior?

OSPF

- Open Shortest Path First

- Open:

- Meaning an Open Standard
- Developed by IETF (OSPF Working Group) for IP – RFC1247
- Current standard is OSPFv2 (RFC2328)

- Shortest Path First:

- Edsger Dijkstra's algorithm for producing shortest path tree through a graph
 - ▣ Dijkstra, E. W. (1959). "A note on two problems in connexion with graphs". *Numerische Mathematik* **1**: 269–271
 - ▣ <http://www-m3.ma.tum.de/foswiki/pub/MN0506/WebHome/dijkstra.pdf>

IS-IS

- ❑ Intermediate System to Intermediate System
- ❑ ISO 10589 specifies OSI IS-IS routing protocol for ConnectionLess-mode Network Services (CLNS) traffic
 - A Link State protocol with a 2 level hierarchical architecture
 - Type/Length/Value (TLV) options to enhance the protocol
- ❑ RFC 1195 added IP support
 - Integrated IS-IS
 - I/IS-IS runs on top of the Data Link Layer

IS-IS & OSPF:

Similarities

- ❑ Both are Interior Gateway Protocols (IGP)
 - They distribute routing information between routers belonging to a single Autonomous System (AS)
 - Both use Edsger Dijkstra's algorithm
- ❑ With support for:
 - Classless Inter-Domain Routing (CIDR)
 - Variable Subnet Length Masking (VLSM)
 - Authentication
 - Multi-path
 - IP unnumbered links

IS-IS and OSPF Terminology

OSPF

- ❑ Host
- ❑ Router
- ❑ Link
- ❑ Packet
- ❑ Designated router (DR)
- ❑ Backup DR (BDR)
- ❑ Link-State Advertisement (LSA)
- ❑ Hello packet
- ❑ Database Description (DBD)

IS-IS

- ❑ End System (ES)
- ❑ Intermediate System (IS)
- ❑ Circuit
- ❑ Protocol Data Unit (PDU)
- ❑ Designated IS (DIS)
- ❑ N/A (no BDIS is used)
- ❑ Link-State PDU (LSP)
- ❑ IIH PDU
- ❑ Complete sequence number PDU (CSNP)

IS-IS and OSPF Terminology (Cont.)

OSPF

- ❑ Area
- ❑ Non-backbone area
- ❑ Backbone area
- ❑ Area Border Router (ABR)
- ❑ Autonomous System Boundary Router (ASBR)

IS-IS

- ❑ Sub domain
- ❑ Level-1 (station)
- ❑ Level-2 (area)
- ❑ L1L2 (station & area)
- ❑ Any IS

Transport

- OSPF uses IP as transport – Protocol 89



- IS-IS is directly encapsulated in Layer 2



For Service Providers

- ❑ Which IGP should an ISP choose?
 - Both OSPF and IS-IS use Dijkstra SPF algorithm
 - Exhibit same convergence properties
 - IS-IS less widely implemented on router platforms
 - IS-IS runs on data link layer, OSPF runs on IP layer
- ❑ Why do we keep discussing the merits of each IGP?

For Service Providers

- ❑ Biggest ISPs tend to use IS-IS – why?
 - In early 1990s, Cisco implementation of IS-IS was much more stable and reliable than OSPF implementation – ISPs naturally preferred IS-IS
 - Main IS-IS implementations are more tuneable than equivalent OSPF implementations
 - ❑ Because biggest ISPs using IS-IS put more pressure on Cisco to implement “knobs” to improve performance

For Service Providers

- Moving forward a decade
 - Early Cisco OSPF implementation substantially rewritten
 - Now competitive with IS-IS in features and performance
 - Router vendors wishing a slice of the core market need an IS-IS implementation as solid and as flexible as that from Cisco
 - Those with IS-IS & OSPF support tend to ensure they exhibit performance and feature parity

How to choose an IGP?

□ OSPF

- Rigid area design – all networks must have area 0 core, with sub-areas distributed around
- Suits ISPs with central high speed core network linking regional PoPs

How to choose an IGP?

□ IS-IS

- Relaxed two level design – L2 routers must be linked through the backbone
- Suits ISPs with “stringy” networks, diverse infrastructure, etc, not fitting central core model of OSPF
- More flexible than OSPF, but easier to make mistakes too

Considerations

- “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 NSAP addressing scheme avoids dependencies on IP as with 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 independent 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

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