Comparing IS-IS and OSPF

ISP Workshops
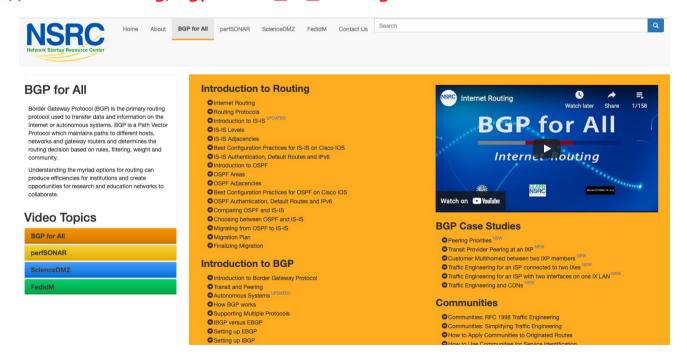
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Acknowledgements

- 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*

Philip Smith

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

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

- **O**pen **S**hortest **P**ath **F**irst
- **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

- **I**ntermediate **S**ystem to **I**ntermediate **S**ystem
- ISO 10589 specifies OSI IS-IS routing protocol for **C**onnection**L**ess-mode **N**etwork **S**ervices (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

Data Link Header	IP Header	OSPF Header	OSPF Data

□ IS-IS is directly encapsulated in Layer 2

Data Link Header	IS-IS Header	IS-IS Data

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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