# **Open Shortest Path First v3**

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#### OSPFv2

- April 1998 was the most recent revision (RFC 2328)
- OSPF uses a 2-level hierarchical model
- SPF calculation is performed independently for each area
- Typically faster convergence than DVRPs
- Relatively low, steady state bandwidth requirements



#### **OSPFv3** overview

- OSPF for IPv6
- Based on OSPFv2, with enhancements
- Distributes IPv6 prefixes
- Runs directly over IPv6
- Ships-in-the-night with OSPFv2

# OSPFv3 / OSPFv2 Similarities

- Basic packet types
  - Hello, DBD, LSR, LSU, LSA
- Mechanisms for neighbor discovery and adjacency formation
- Interface types
  - P2P, P2MP, Broadcast, NBMA, Virtual
- LSA flooding and aging
- Nearly identical LSA types



# OSPFv3 / OSPFv2 Differences

- OSPFv3 runs over a link, rather than a subnet
- Multiple instances per link
- OSPFv2 topology not IPv6-specific
  - Router ID
  - Link ID
- Standard authentication mechanisms
- Uses link-local addresses
- Generalized flooding scope
- Two new LSA types



# LSA Type Review

	LSA Function Code	LSA type
Router-LSA	1	0x2001
Network-LSA	2	0x2002
Inter-Area-Prefix-LSA	3	0x2003
Inter-Area-Router-LSA	4	0x2004
AS-External-LSA	5	0x4005
Group-membership-LSA	6	0x2006
Type-7-LSA	7	0x2007
Link-LSA	8	0x0008
Intra-Area-Prefix-LSA	9	0x2009



# Link LSA

- A link LSA per link
- Link local scope flooding on the link with which they are associated
- Provide router link local address
- List all IPv6 prefixes attached to the link
- Assert a collection of option bit for the Router-LSA



# Inter-Area Prefix LSA

- Describes the destination outside the area but still in the AS
- Summary is created for one area, which is flooded out in all other areas
- Originated by an ABR
- Only intra-area routes are advertised into the backbone
- Link State ID simply serves to distinguish interarea-prefix-LSAs originated by the same router
- Link-local addresses must never be advertised in inter-area- prefix-LSAs



# Configuring OSPFv3 in Cisco IOS<sup>®</sup> Software

- Similar to OSPFv2
  - Prefixing existing Interface and Exec mode commands with "ipv6"
- Interfaces configured directly
  - Replaces network command
- "Native" IPv6 router mode
  - Not a sub-mode of router ospf



# Configuration Modes in OSPFv3

- Entering router mode
  - [no] ipv6 router ospf <process ID>
- Entering interface mode
  - [no] ipv6 ospf <process ID> area <area ID>
- Exec mode
  - [no] show ipv6 ospf [<process ID>]
  - clear ipv6 ospf [<process ID>]





# Cisco IOS OSPFv3 Specific Attributes

#### Configuring area range

[no] area <area ID> range <prefix>/<prefix length>

#### Showing new LSA

- show ipv6 ospf [<process ID>] database link
- show ipv6 ospf [<process ID>] database prefix



# OSPFv3 Debug Commands

#### Adjacency is not appearing

- [no] debug ipv6 ospf adj
- [no] debug ipv6 ospf hello

#### SPF is running constantly

- [no] debug ipv6 ospf spf
- [no] debug ipv6 ospf flooding
- [no] debug ipv6 ospf events
- [no] debug ipv6 ospf lsa-generation
- [no] debug ipv6 ospf database-timer
- General purpose
- [no] debug ipv6 ospf packets
- [no] debug ipv6 ospf retransmission
- [no] debug ipv6 ospf tree





# OSPFv3 configuration example



#### Cisco IOS OSPFv3 Display



#### Cisco IOS OSPFv3 Database Display

Router2# show ipv6 ospf database								
OSPF Router with ID (3.3.3.3) (Process ID 1)								
	Router Link States (Area 0)							
Link ID	ADV Router	Age	Seq#	Checksum	Link count			
0	1.1.1.1	2009	0x800000A	0x2DB1	1			
0	3.3.3.3	501	0x8000007	0xF3E6	1			
	Net Link States (Area 0)							
Link ID	ADV Router	Age	Seq#	Checksum				
7	1.1.1.1	480	0x8000006	0x3BAD				
	Inter Area Prefix Link States (Area 0)							
ADV Router	Age	Seq#	Prefix					
1.1.1.1	1761	0x80000005	2001:2:2:2::/6	4				
1.1.1.1	982	0x80000005	2001:2:2:4::2/3	128				
	Link (Type-8) Link States (Area 0)							
Link ID	ADV Router	Age	Seq#	Checksum	Interface			
11	3.3.3.3	245	0x8000006	0xF3DC	Lo0			
7	1.1.1.1	236	0x8000008	0x68F	Fa2/0			
7	3.3.3.3	501	0x8000008	0xE7BC	Fa2/0			
	Intra Area Prefix Link States (Area 0)							
Link ID	ADV Router	Age	Seq#	Checksum	Ref lstype			
0	1.1.1.1	480	0x8000008	0xD670	0x2001			
107	1.1.1.1	236	0x8000008	0xC05F	0x2002			
0	3.3.3.3	245	0x8000006	0x3FF7	0x2001			

### Cisco IOS OSPFv3 Detailed LSA Display

```
show ipv6 ospf 1 database inter-area prefix
 LS age: 1714
 LS Type: Inter Area Prefix Links
 Link State ID: 0
 Advertising Router: 1.1.1.1
 LS Seq Number: 8000006
 Checksum: 0x25A0
 Length: 36
 Metric: 1
 Prefix Address: 2001:2:2:2::
 Prefix Length: 64, Options: None
 show ipv6 ospf 1 database link
 LS age: 283
 Options: (IPv6 Router, Transit Router, E-Bit, No Type 7-to-5, DC)
 LS Type: Link-LSA (Interface: Loopback0)
 Link State ID: 11 (Interface ID)
 Advertising Router: 3.3.3.3
 LS Seq Number: 80000007
 Checksum: 0xF1DD
 Length: 60
 Router Priority: 1
 Link Local Address: FE80::205:5FFF:FEAC:1808
 Number of Prefixes: 2
 Prefix Address: 2001:1:1:3::
 Prefix Length: 64, Options: None
 Prefix Address: 2001:1:1:3::
 Prefix Length: 64, Options: None
```

# OSPFv3 on IPv6 Tunnels over IPv4



#### Conclusion

- Based on existing OSPFv2 implementation
- Similar CLI and functionality
- Fully functional available now
- Cisco IOS Software availability:
  - Release 12.2(15)T
  - Release 12.2(RLS3)S for Cisco 7000 Series
     Routers and Cisco Catalyst 6000 Series Switches
  - Release 12.0(24)S the Cisco 12000 Series Internet Routers



#### References

- RFC 2740 "OSPF for IPv6"
- RFC 2328 "OSPF version 2"



2nd SEE 6DISS Workshop (Plovdiv, June '07)

IPv6DISSemination and Exploitation

#### LAB

#### Group 1

- -7200-2 (194.254.101.1)
- GSR-2 (194.254.101.5)
- -7200-3 (194.254.101.9)
- Group 2
  - 7200-1 ((194.254.101.7)
  - -7200-2 (194.254.101.8)
  - GSR-3 (194.254.101.6)



# IS-IS

- A different IGP with no IP as transport mechanism
- Link state protocol with 2 hierarchies
- Used for CLNS bu then extended for IP with NLPID (network Layer Protocol ID)
- Don't need to know OSI to run ISIS ( only addresses - NSAP)
- TLV instead of packet coding



### IS-IS / OSPF

- Levels vs areas
- DIS vs DR
- Levels terminate on links not on routers
- Backbone area = 0
- IS-IS adjacency = OSPF neighbour



## IS-IS for IPv6

#### New TLV

- IPv6 Reachability TLV, IPv6 Interface TLV (Link local addressing)
- Transition to ipv6 (D day) vs gradual except with multitopology



# NSAPs and Addressing

- Network Service Access Point
- The NSAP is the network layer address for CLNS packets
- One NSAP per box, not per interface
- SNPA means SubNetwork Point of Attachment, which is the layer2 or MAC address



# How do I read an NSAP ?



Kariable length Area address \_\_\_\_\_\_ 6 bytes\_\_\_\_\_ 1 byte

An NSAP consists of 3 parts

area-address, systemID and n-selector Total length between 8 and 20 bytes example: 49.0001.0000.0000.0007.00



### NETs versus NSAPs

- A NET is an NSAP with n-selector 0
- A NET implies the routing layer of the IS itself (no transport layer)
- On routers we always deal with NETs
   We haven't implemented TP4 (or another
  - We haven't implemented TP4 (or another transport layer)



Do I need an NSAP if I want to use IS-IS for IP routing ?

- Yes, still needed for IP routing only
- Area address is like OSPF area nr
- SystemID is like an OSPF routerID

- LSP identifier is derived from systemID



# Creating unique systemIDs

- SystemID is 6 bytes
- Start numbering 1, 2, 3, 4 .... etc
- Convert your loopback IP address
  - 192.31.231.16 -> 192.031.231.016 -> systemID 1920.3123.1016



### Creating area addresses

- If you do CLNS routing, request an official NSAP prefix
- If you do just IP routing, use AFI 49
- AFI 49 denotes private address space
   like network 10.0.0.0 in IP
- Just number your areas 49.0001...
   49.0002...., 49.0003,... etc



# OSI protocol family

- IS-IS is not encapsulated in CLNS

   and not encapsulated in IP (yet)
- Encapsulated directly in layer2
- Protocol family is OSI
  - usually values like 0xFE or 0xFEFE
  - (ppp uses 0x0023 and 0x8023)



#### IOS isis conf

#### • Ipv6 router isis

- net 49.000.1111.2222.3333.5555.00
- Enable isis per interface
- Ipv6 router isis



# **Typical configuration**

. . . .

#### router isis

net 49 .... is-type level-2-only log-adjacency-changes

address-family ipv6 no-adjacency-check redistribute connected exit address-family router isis NSAP definition Level choice log-adjacency-changes

Ipv6 conf follows no check of the neighbor to protect them

IP Addresses are inserted in the routing protocol exit address-family



### ISIS OAM

- sh isis neighbor
- sh isis database

