Configuring OSPF

Cisco Style

Part 7

"Much of the excitement we get out of our work is that we don't really know what we are doing"

E. Dijkstra

Basic Verifications

- Verify what stage an interface running OSPF is in with the commands:
  - show ip ospf neighbor
  - debug ip ospf adjacency

```
Router#debug ip ospf packet
    OSPF: rcv. v:2 t:1 l:48 rid:200.0.0.116
    aid:0.0.0.0 chk:0 aut:2 keyid:1 seq:0x0
```

v = OSPF version, t = packet type (1: Hello, 2: DDP, 3: LS-Request, 4: LS-Update, 5: LS-Ack)
l = length in bytes, rid = Router ID, aid = Area ID, chk = checksum, aut = authentication type
auk = authentication key, keyid = MD5 key, seq =sequence number

DR Election

- DR election is determined by either the highest IP address or the priority:
  - (config-if)# ip ospf priority *[0-255]*
    - The higher the better
  - The value of 0 means that the router cannot be a DR or BDR; otherwise, the higher the priority, the more favorable the chances are of winning the election.

NBMA – The Problem

- Non-Broadcast Multi-Access networks
  - Frame Relay, X.25, ATM
- Layer 3: One IP subnet, broadcast defined
- Layer 2: No broadcast defined (!)
- DR must act as reflector (next hop)

Four Different Options

	IP-Subnet	Neighbour Discovery	DR/BDR	RFC/Cisco	Logical View
Broadcast	Same	Automatic	Yes	Cisco	LAN
NBMA	Same	Manual	Yes	RFC	LAN
Point2Multipoint	Same	Automatic	No	RFC	Hub & Spoke
Point2Multipoint Non Broadcast	Same	Manual	No	Cisco	Hub & Spoke

Option Broadcast

- Optimal flooding via DR
- No per VC costing
- Requires full mesh all the time
- Good if your NBMA cloud has rerouting capabilities

Option NBMA

- Very similar to broadcast model
- Flooding the same as the broadcast model
- Requires more configuration because neighbors need to be defined
- Slower convergence

Option Point-to-Point

- Each VC is like a regular point -to-point interface
- Per VC costing
- Faster convergence
- Partial mesh allowed
- Flooding is a problem

Option Point-to-Multipoint

- One IP address for the cloud
- No per VC costing available (for now)
- Sub optimal flooding
- Maintains host routes for every router in the cloud

Which Model To Choose?

- If rerouting at layer 2 is not an issue or your cloud is capable of rerouting, use broadcast model for large mesh
- Otherwise use point -to-point; it is more robust

Mesh Groups

- Normal interface (do normal flooding)
- Blocked (never send LSPs over this interface)
- Part of a mesh group
  - When LSP is received on non -meshgroup interface, flood it out over all interfaces (meshgroup or not)
  - If LSP is received on a meshgroup interface, flood on non -meshgroup interfaces, but don't flood on other interfaces in this meshgroup

Check Topology Table – LSA1

- show ip ospf database **command**
  - **Link ID**
  - **ADV Router**
  - **Age**
  - **Seq#**
  - **Checksum**
  - **Link-count**

Check Topology Database – LSA2

- show ip ospf database network **command**

```
OSPF Router with ID (188.4.3.3) (Process ID 7)

            Net Link States (Area 0)

Routing Bit Set on this LSA
LS age: 431
Options: (No TOS-capability)
LS Type: Network Links
Link State ID: 188.4.9.2 (address of Designated Router)
Advertising Router: 188.4.3.2
LS Seq Number: 80000012
Checksum: 0xC22A
Length: 32
Network Mask: /20
      Attached Router: 188.4.3.2
      Attached Router: 188.4.3.3
      Attached Router: 188.4.3.3
```

AS External Link State Advertisements

- show ip ospf database **command**

OSPF Router with ID (188.4.3.3) (Process ID 7)

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
35.1.0.0	188.4.3.2	320	0x80000004	0x43EE	0
176.15.254.0	188.4.3.2	320	0x80000004	0xA4C2	5
192.168.2.0	188.4.3.4	1116	0x80000007	0xD3D2	8
192.168.3.0	188.4.3.2	531	0x80000005	0xB81A	0
195.6.19.0	188.4.3.4	1102	0x80000093	0x772B	200
0.0.0.0	188.4.3.4	1168	0x80000003	0x54E2	200

AS External Link State Advertisements

- show ip ospf database external **command**

OSPF Router with ID (188.4.3.2) (Process ID 7)
Type-5 AS External Link States

LS age: 257
Options: (No TOS-capability, DC)
LS Type: **AS External Link**
Link State ID: 35.1.0.0 (External Network Number)
Advertising Router: 188.4.3.2
LS Seq Number: 80000004
Checksum: 0x43EE
Length: 36
Network Mask: /16
Metric Type: 2 (Larger than any link state path)
TOS: 0
Metric: 20
Forward Address: 0.0.0.0
External Route Tag: 0

AS External Link State Advertisements

- show ip ospf database external **command**

```
OSPF Router with ID (188.4.3.2) (Process ID 7)
            Type-5 AS External Link States

Routing Bit Set on this LSA
LS age: 686
Options: (No TOS-capability, DC)
LS Type: AS External Link
Link State ID: 192.168.2.0 (External Network Number )
Advertising Router: 188.4.3.4
LS Seq Number: 80000007
Checksum: 0xD3D2
Length: 36
Network Mask: /24
      Metric Type: 2 (Larger than any link state path)
      TOS: 0
      Metric: 20
      Forward Address: 188.4.3.20
      External Route Tag: 8
```


Routing Table Flags

- "O" OSPF Routing Entry
  - Learned through intra-area LSAs (1, 2)
- "IA" Inter Area
  - Learned through summary LSAs (3)
- "E1" Type 1 external routes
  - Learned through external LSAs (5)
  - Type 1 metric (sum of internal and external metrics)
- "E2" Type 2 external routes (default)
  - Learned through external LSAs (5)
  - Type 2 metric (external metrics only)

OSPF Neighbor States

- Down
  - No OSPF message received
- Attempt
  - No recent information has been received from the neighbor on NBMA networks
- Init
  - Interface detected a hello packet coming from a neighbor
  - But bi-directional communication not yet established

OSPF Neighbor States

- Two-way
  - Bi-directional communication with neighbor
  - This router is listed in hello packet but will not become a DR or BDR
- Exstart
  - Initial sequence number is established
- Exchange
  - Database description packets are exchanged

OSPF Neighbor States

- Loading
  - Missing topology information is updated by sending LS Requests
- Full
  - Adjacency completed
  - Adjacent routers have same link-state database

Configuration Tasks

- Configure a loopback interface
- Enable OSPF routing
- Specify networks to be advertised
  - OSPF interface and area ID
- Consider different physical networks
  - Configure OSPF network type
  - Configure OSPF for NBMA networks
- Create virtual links

OSPF Configuration Commands

- Enable OSPF routing process
  - router(config)#

router ospf *process-id*

- Associate networks with OSPF routing
  - router(config-router)#

network *address wildcard-mask* **area** *area-id*

- Configure the OSPF network type
  - router(config-if)#

ip ospf network { **broadcast** | **non-broadcast** | **point-to-multipoint** }

OSPF Configuration Commands

- Configure routers interconnecting to NBMA
  - router(config-router)#

neighbor *ip-address* [**priority** *number*]

- Create virtual links
  - router(config-router)#

area *area-id* **virtual-link** *router-id*

- Configure router ID - loopback interface
  - router(config)#

interface loopback 0

Example: Basic OSPF Configuration

```
hostname r1
!
interface loopback 0
  ip address 199.5.3.3 255.255.255.255
!
router ospf 100
  network 199.5.6.144 0.0.0.15 area 0
  network 199.5.6.128 0.0.0.7 area 54
  area 12 virtual-link 199.1.4.4
  area 12 virtual-link 199.1.5.5
!
interface serial s0
encapsulation frame-relay
ip address 199.5.6.129 255.255.255.248
ip ospf network point-to-multipoint
!
interface ethernet 0
ip address 199.5.6.145 255.255.255.240
```

```
hostname r2
!
interface loopback 0
  ip address 199.5.4.4 255.255.255.255
!
router ospf 100
  network 195.2.200.0 0.0.0.255 area 30
  network 199.5.6.128 0.0.0.7 area 54
  area 54 virtual-link 199.5.3.3
  area 54 virtual-link 199.5.5.5
!
interface serial s0
encapsulation frame-relay
!
interface serial 0.1 point-to-point
ip address 199.5.6.130 255.255.255.248
frame-relay interface-dlci 200
ip ospf network point-to-multipoint
```