LSA Details

Troubleshooting Commands

Common Issues

Troubleshooting Tips
**LSA Type Review**

<table>
<thead>
<tr>
<th>Type</th>
<th>LSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Router</td>
</tr>
<tr>
<td>2</td>
<td>Network</td>
</tr>
<tr>
<td>3</td>
<td>Summary Network</td>
</tr>
<tr>
<td>4</td>
<td>Summary ASBR</td>
</tr>
<tr>
<td>5</td>
<td>External</td>
</tr>
<tr>
<td>7</td>
<td>NSSA</td>
</tr>
</tbody>
</table>

**Different Types of LSAs**

Sample Network for Each LSA
Common LSA Header

- Common LSA 20 byte header

<table>
<thead>
<tr>
<th>LS Age</th>
<th>Options</th>
<th>LS Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link State ID</td>
<td>Advertising Router</td>
<td>LS Sequence Number</td>
</tr>
<tr>
<td>LS Checksum</td>
<td>Length</td>
<td></td>
</tr>
</tbody>
</table>

Router LSA Details

- Router LSA (Type 1)
  - Describes the state and cost of the router’s links to the area
  - All of the router’s links in an area must be described in a single LSA
  - Flooded throughout the particular area and no more
  - Router indicates whether it is an ASBR, ABR, or end point of virtual link
Router LSA of R3 for Area 1

```
show ip ospf database router 192.1.1.3
```

- **LS age = 0**
  - Always 0 at origination
- **Options = (E-bit)**
  - This is a router LSA
- **LS type = 1**
  - Router ID of R3
- **Link State ID = 192.1.1.3**
  - Not an ASBR
- **Advertising Router = 192.1.1.3**
  - This is an ABR
- **bit E = 0**
  - IP address of the DR
- **bit B = 1**
  - Interface address of this router
- **# links = 2**
  - This is a transit network
  - Cost to reach the interface
  - Type = 2
  - IP network number
  - # TOS metrics = 0
  - Subnet mask of the interface
  - metric = 1
- **Link ID = 192.1.1.4**
  - Stub network
  - # TOS metrics = 0
  - metric = 2

### Route LSA Details

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Link ID</th>
<th>Link Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Point-to-Point numbered</td>
<td>Neighbors’ RID</td>
<td>Interface IP Address</td>
</tr>
<tr>
<td>1</td>
<td>Point-to-Point Unnumbered</td>
<td>Neighbors’ RID</td>
<td>MIB-II Ifindex Value</td>
</tr>
<tr>
<td>2</td>
<td>Transit</td>
<td>IP Address of the DR</td>
<td>Interface IP Address</td>
</tr>
<tr>
<td>3</td>
<td>Stub</td>
<td>IP Network Number</td>
<td>Subnet Mask</td>
</tr>
<tr>
<td>4</td>
<td>Virtual Link</td>
<td>Neighbors’ RID</td>
<td>Interface IP Address</td>
</tr>
</tbody>
</table>
Router LSA of R3 for Area 0

**show ip ospf database router 192.1.1.3**

<table>
<thead>
<tr>
<th>LS age</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Options</td>
<td>(E-bit)</td>
</tr>
<tr>
<td>LS type</td>
<td>1</td>
</tr>
<tr>
<td>Link State ID</td>
<td>192.1.1.3</td>
</tr>
<tr>
<td>Advertising Router</td>
<td>192.1.1.3</td>
</tr>
<tr>
<td>bit E</td>
<td>0</td>
</tr>
<tr>
<td>bit B</td>
<td>1</td>
</tr>
<tr>
<td># links</td>
<td>1</td>
</tr>
<tr>
<td>Link ID</td>
<td>195.12.1.1</td>
</tr>
<tr>
<td>Link Data</td>
<td>18.10.0.7</td>
</tr>
<tr>
<td>Type</td>
<td>1</td>
</tr>
<tr>
<td># TOS metrics</td>
<td>0</td>
</tr>
<tr>
<td>metric</td>
<td>8</td>
</tr>
<tr>
<td>Link ID</td>
<td>18.10.0.0</td>
</tr>
<tr>
<td>Link Data</td>
<td>255.255.255.0</td>
</tr>
<tr>
<td>Type</td>
<td>3</td>
</tr>
<tr>
<td># TOS metrics</td>
<td>0</td>
</tr>
<tr>
<td>metric</td>
<td>8</td>
</tr>
</tbody>
</table>

- **Link ID**: 195.12.1.1
- **Link Data**: 18.10.0.7
- **Type**: 1 (point-to-point link)
- **Router id of the neighbor**: 192.1.1.3
- **IP interface address of the router**: 192.1.1.3
- **Subnet address**: 18.10.0.0/24
- **Subnet mask**: 255.255.255.0
- **TOS metrics**: 0
- **Metric**: 8

Network LSA

- **Network LSA (Type 2)**
  - Generated for every transit broadcast and NBMA network
  - Describes all the routers attached to the network
  - Only the designated router originates this LSA
  - Flooded throughout the area and no more
Network LSA for 192.1.1.0

show ip ospf database network 192.1.1.4

<table>
<thead>
<tr>
<th>LS age</th>
<th>Options</th>
<th>LS type</th>
<th>Link State ID</th>
<th>Advertising Router</th>
<th>Network Mask</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(E-bit)</td>
<td>2</td>
<td>192.1.1.4</td>
<td>192.1.1.4</td>
<td>255.255.255.0</td>
</tr>
</tbody>
</table>

- Attached Router = 192.1.1.4
- Attached Router = 192.1.1.1
- Attached Router = 192.1.1.3
- Attached Router = 192.1.1.2

IP interface address of DR: 192.1.1.4
RID of DR: 192.1.1.4
 RID of attached routers FULL with the DR

Summary LSA

- Describes the destination outside the area but still in the AS
- Flooded throughout a single area
- Originated by an ABR
- Only intra-area routes are advertised into the backbone (to avoid loops)
- Type 4 is the information about the ASBR
Type 3 and 4

• Summary LSA

  In Stub area: O IA* 0.0.0.0/0
  Link State ID: 0.0.0.0 Network Mask: 0.0.0.0
  Network mask field is always 0.0.0.0 for summary LSA Type 4

Type 3 Details

show ip ospf database summary 192.1.2.0

- LS age = 0
- Options = (E-bit)
- LS type = 3
- Link State ID = 192.1.2.0
- Advertising Router = 192.1.1.4
- Network Mask = 255.255.255.0
- metric = 4

IP network number
RID of ABR

ABR
192.1.2.0/24
metric 4

Area 0

R1
192.1.2.0/24
192.1.1.1
3
192.1.1.1.4
R4
192.1.1.3
R2
192.1.1.2
R3
192.1.4.0/24
18.10.0.7
195.12.1.1
8
8
192.1.1.4
8
**Type 4 Details**

```shell
show ip ospf database summary-asbr 192.1.2.0
```

<table>
<thead>
<tr>
<th>LS age</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Options</td>
<td>(E-bit)</td>
</tr>
<tr>
<td>LS type</td>
<td>4</td>
</tr>
<tr>
<td>Link State ID</td>
<td>131.108.1.1</td>
</tr>
<tr>
<td>Advertising Router</td>
<td>192.1.1.4</td>
</tr>
<tr>
<td>Network Mask</td>
<td>0.0.0.0</td>
</tr>
<tr>
<td>metric</td>
<td>16</td>
</tr>
</tbody>
</table>

**Type 4 summary**

**External Route**

140.10.0.0

**External LSA**

- **External LSA (Type 5)**
  - Defines routes to destination external to the AS
  - Default route is also sent as external
  - Two types of external LSA:
    - E1: Consider the total cost up to the external destination
    - E2: Considers only the cost of the outgoing interface to the external destination
External LSA

External Type 1

<table>
<thead>
<tr>
<th>Network</th>
<th>Type 1</th>
<th>Next Hop</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>11</td>
<td>R1</td>
</tr>
<tr>
<td>N1</td>
<td>10</td>
<td>R2</td>
</tr>
</tbody>
</table>

Cost = 8

Cost = 10

To N1
External Cost = 1

To N1
External Cost = 2

Selected Route

External LSA

External Type 2

<table>
<thead>
<tr>
<th>Network</th>
<th>Type 1</th>
<th>Next Hop</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>1</td>
<td>R1</td>
</tr>
<tr>
<td>N1</td>
<td>2</td>
<td>R2</td>
</tr>
</tbody>
</table>

Cost = 8

Cost = 10

To N1
External Cost = 1

To N1
External Cost = 2

Selected Route
**Type 5 Details**

**show ip ospf database external 140.10.0.0**

- LS age = 0
- Options = (E-bit)
- LS type = 5
- Link State ID = 140.10.0.0
- Advertising Router = 131.108.1.1
- Network Mask = 255.255.0.0
- bit E = 1
- metric = 4
- Forwarding address = 0.0.0.0

**External Route**

- Traffic should be forwarded to the ASBR
- E = 1 -> O E2 (Default)

**Forwarding address**

Must be known via intra or inter area route

**RIP Between the Routers**

**OSPF Is Enabled on this Interface**

**Rest of the OSPF Network**

**router ospf 1 redistribute rip subnets**
**Type 7 Details**

```
show ip ospf database nssa-external 140.10.0.0
```

- **LS age** = 0
- **Options** = (No TOS-capability, No Type 7/5 translation, DC)
- **LS type** = 7
- **Link State ID** = 140.10.0.0
- **Advertising Router** = 131.108.1.1
- **Network Mask** = 255.255.0.0
- **bit P** = 0
- **metric** = 4
- **Forwarding address** = 0.0.0.0

**IP network number**

**Router ID of R7 (NSSA ASBR)**

**P = 0** -> This router is an NSSA ABR+ASBR

**P = 1** -> This router is an NSSA ASBR

**Traffic should be forwarded to the ASBR**

---

**Troubleshooting Commands**
GSR-3#sh ip ospf
Routing Process "ospf 100" with ID 10.10.128.3
Supports only single TOS(TOS0) routes
Supports opaque LSA
It is an area border router
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 0. Checksum Sum 0x0
Number of opaque AS LSA 0. Checksum Sum 0x0
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 2. 2 normal 0 stub 0 nssa
External flood list length 0
Area BACKBONE(0)
  Number of interfaces in this area is 5
  Area has no authentication
  SPF algorithm executed 2773 times
  Area ranges are
  Number of LSA 97. Checksum Sum 0x2B19E3
  Number of opaque link LSA 0. Checksum Sum 0x0
  Number of DCbitless LSA 0
  Number of indication LSA 0
  Number of DoNotAge LSA 0
  Flood list length 0

Area 8
  Number of interfaces in this area is 2
  It is a stub area, no summary LSA in this area
  Area has no authentication
  SPF algorithm executed 11 times
  Area ranges are
  Number of LSA 5. Checksum Sum 0x22812
  Number of DCbitless LSA 0
  Number of indication LSA 0
  Number of DoNotAge LSA 0
  Flood list length 0
3600-g1#sh ip ospf data

OSPF Router with ID (30.8.1.1) (Process ID 1)

Router Link States (Area 0)

<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
<th>Link count</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.8.1.1</td>
<td>30.8.1.1</td>
<td>1592</td>
<td>0x800001D0</td>
<td>0xA180</td>
<td>0</td>
</tr>
</tbody>
</table>

Router Link States (Area 8)

<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
<th>Link count</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.8.1.1</td>
<td>30.8.1.1</td>
<td>1592</td>
<td>0x800023F</td>
<td>0xC782</td>
<td>1</td>
</tr>
<tr>
<td>30.8.1.2</td>
<td>30.8.1.2</td>
<td>298</td>
<td>0x80003D1</td>
<td>0x2967</td>
<td>2</td>
</tr>
<tr>
<td>30.8.3.2</td>
<td>30.8.3.2</td>
<td>666</td>
<td>0x80002B8</td>
<td>0xE52B</td>
<td>1</td>
</tr>
</tbody>
</table>

Net Link States (Area 8)

<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.8.1.2</td>
<td>30.8.1.2</td>
<td>299</td>
<td>0x8000203</td>
<td>0x4153</td>
</tr>
<tr>
<td>30.100.1.2</td>
<td>30.8.3.2</td>
<td>666</td>
<td>0x8000027A</td>
<td>0x10AB</td>
</tr>
</tbody>
</table>

GSR-3#show ip ospf database database-summary

OSPF Router with ID (10.10.128.3) (Process ID 100)

Area 0 database summary

<table>
<thead>
<tr>
<th>LSA Type</th>
<th>Count</th>
<th>Delete</th>
<th>Maxage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router</td>
<td>63</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Network</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Summary Net</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Summary ASBR</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Type-7 Ext</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Opaque Link</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Opaque Area</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Subtotal</td>
<td>97</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
**OSPF Neighbor**

```
GSR-3#sh ip ospf neighbor

<table>
<thead>
<tr>
<th>Neighbor ID</th>
<th>Pri</th>
<th>State</th>
<th>Dead Time</th>
<th>Address</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.64.1.2</td>
<td>1</td>
<td>FULL/DR</td>
<td>00:00:38</td>
<td>10.128.16.2</td>
<td>GigabitEthernet3/0</td>
</tr>
<tr>
<td>10.10.128.1</td>
<td>1</td>
<td>2WAY/DROTHER</td>
<td>00:00:31</td>
<td>10.128.1.1</td>
<td>Ethernet 6/0</td>
</tr>
<tr>
<td>10.10.128.2</td>
<td>1</td>
<td>FULL/BDR</td>
<td>00:00:36</td>
<td>10.128.1.2</td>
<td>Ethernet 6/0</td>
</tr>
<tr>
<td>10.10.128.4</td>
<td>1</td>
<td>FULL/DR</td>
<td>00:00:38</td>
<td>10.128.1.4</td>
<td>Ethernet 6/0</td>
</tr>
</tbody>
</table>

GSR-3#```

**OSPF Adjacency Changes**

```
r4-1#
router ospf 1
ospf log-adjacency-changes

%OSPF-5-ADJCHG: Process 1, Nbr 172.16.16.2 on Serial0.1 from FULL to DOWN, Neighbor Down
%OSPF-5-ADJCHG: Process 1, Nbr 0.0.0.0 on Serial0.1 from DOWN to ATTEMPT, NBMA Start```
Neighbor Details

r4-1#sh ip ospf nei
detr4-1#sh ip ospf nei
det

Neighbor 172.16.133.5, interface address 172.16.133.5
  in the area 0 via interface Ethernet0
  Neighbor priority is 1, State is FULL, 6 state changes
  DR is 172.16.133.29 BDR is 172.16.133.6
  Options is 0x2
  Dead timer due in 00:00:37
  Neighbor is up for 00:01:24
  Index 2/2, retransmission queue length 0, number of retransmission 1
  First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
  Last retransmission scan length is 1, maximum is 1
  Last retransmission scan time is 4 msec, maximum is 4 msec
Neighbor 172.16.133.29, interface address 172.16.133.29
  In the area 0 via interface Ethernet0
  Neighbor priority is 1, State is FULL, 6 state changes
  DR is 172.16.133.29 BDR is 172.16.133.6
  Options is 0x2
  Dead timer due in 00:00:31
  Neighbor is up for 00:01:58
  Index 1/1, retransmission queue length 0, number of retransmission 2
  First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
  Last retransmission scan length is 1, maximum is 1
  Last retransmission scan time is 0 msec, maximum is 0 msec

r4-1#

Show IP OSPF Interface

r4-1#show ip ospf int
detr4-1#show ip ospf int
det

Serial0.1 is up, line protocol is up
  Internet Address 172.16.7.1/24, Area 0
  Process ID 1, Router ID 172.16.14.1, Network Type NON_BROADCAST, Cost: 64
  Transmit Delay is 1 sec, State DR, Priority 100
  Designated Router (ID) 172.16.14.1, Interface address 172.16.7.1
  No backup designated router on this network
  Timer intervals configured, Hello 30, Dead 120, Wait 120, Retransmit 5
  Hello due in 00:00:12
  Neighbor Count is 2, Adjacent neighbor count is 2
  Adjacent with neighbor 172.16.30.1
  Adjacent with neighbor 172.16.16.2
  Suppress hello for 0 neighbor(s)
Serial0.2 is up, line protocol is up
  Internet Address 172.16.14.1/24, Area 33
  Process ID 1, Router ID 172.16.14.1, Network Type NON_BROADCAST, Cost: 64
  Transmit Delay is 1 sec, State DR, Priority 100
  Designated Router (ID) 172.16.14.1, Interface address 172.16.14.1
  No backup designated router on this network
  Timer intervals configured, Hello 30, Dead 120, Wait 120, Retransmit 5
  Hello due in 00:00:11
  Neighbor Count is 1, Adjacent neighbor count is 1
  Adjacent with neighbor 172.16.100.2
  Suppress hello for 0 neighbor(s)
r4-1#sh ip ospf virtual-links
Virtual Link OSPF_VL0 to router 172.16.100.2 is up
Run as demand circuit
DoNotAge LSA allowed.
Transit area 33, via interface Serial0.2, Cost of using 64
Transmit Delay is 1 sec, State POINT_TO_POINT,
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:09
Adjacency State FULL (Hello suppressed)
r4-1#

Other show Commands

R6-2500#sh ip ospf database self-originate (shows the LSAs this router is generating)
OSPF Router with ID (192.168.6.1) (Process ID 100)
Router Link States (Area 0)
<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
<th>Link count</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.168.6.1</td>
<td>192.168.6.1</td>
<td>773</td>
<td>0x8000005B</td>
<td>0xC608</td>
<td>1</td>
</tr>
</tbody>
</table>
Net Link States (Area 0)
<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
</tr>
</thead>
<tbody>
<tr>
<td>135.4.1.2</td>
<td>192.168.6.1</td>
<td>773</td>
<td>0x80000056</td>
<td>0x4D14</td>
</tr>
</tbody>
</table>
Router Link States (Area 5)
<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
<th>Link count</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.168.6.1</td>
<td>192.168.6.1</td>
<td>264</td>
<td>0x80000053</td>
<td>0xC745</td>
<td>0</td>
</tr>
</tbody>
</table>
Summary Net Link States (Area 5)
<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
</tr>
</thead>
<tbody>
<tr>
<td>135.4.1.0</td>
<td>192.168.6.1</td>
<td>774</td>
<td>0x8000005C</td>
<td>0xDDFC</td>
</tr>
</tbody>
</table>
Summary ASB Link States (Area 5)
<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5.5.5</td>
<td>192.168.6.1</td>
<td>774</td>
<td>0x8000002B</td>
<td>0x681B</td>
</tr>
</tbody>
</table>
Type-5 AS External Link States
<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.1.0</td>
<td>192.168.6.1</td>
<td>266</td>
<td>0x8000002C</td>
<td>0x31D0</td>
</tr>
</tbody>
</table>
**Other show Commands**

R6-2500#sh ip ospf database adv-router 5.5.5.5
(shows the LSAs neighbor is generating)

OSPF Router with ID (192.168.6.1) (Process ID 100)

<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
<th>Link count</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5.5.5</td>
<td>5.5.5.5</td>
<td>1479</td>
<td>0x80000034</td>
<td>0xA52A</td>
<td>1</td>
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</table>

Type-5 AS External Link States

<table>
<thead>
<tr>
<th>Link ID</th>
<th>ADV Router</th>
<th>Age</th>
<th>Seq#</th>
<th>Checksum</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.1.0</td>
<td>5.5.5.5</td>
<td>1478</td>
<td>0x80000032</td>
<td>0xACCB</td>
<td>0</td>
</tr>
<tr>
<td>5.5.5.0</td>
<td>5.5.5.5</td>
<td>1478</td>
<td>0x80000030</td>
<td>0x204E</td>
<td>0</td>
</tr>
<tr>
<td>135.4.1.0</td>
<td>5.5.5.5</td>
<td>1478</td>
<td>0x80000032</td>
<td>0xCB3B</td>
<td>0</td>
</tr>
</tbody>
</table>

R6-2500#

**Show IP OSPF stat**

r4-1#sh ip ospf stat

Area 0: SPF algorithm executed 16 times
Area 33: SPF algorithm executed 8 times

<table>
<thead>
<tr>
<th>SPF calculation time</th>
<th>Delta T</th>
<th>Intra</th>
<th>D-Intra</th>
<th>Summ</th>
<th>D-Summ</th>
<th>Ext</th>
<th>D-Ext</th>
<th>Total</th>
<th>Reason</th>
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<tbody>
<tr>
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<td>0</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>20</td>
<td>R, SN,</td>
</tr>
<tr>
<td></td>
<td>3d18h</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>0</td>
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<td>R, N, SN,</td>
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<td>16</td>
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<tr>
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<td>28</td>
<td>R, N, SN,</td>
</tr>
<tr>
<td></td>
<td>00:04:45</td>
<td>4</td>
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<td>8</td>
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<td>N, SN,</td>
</tr>
<tr>
<td></td>
<td>00:02:51</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>8</td>
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<td>8</td>
<td>0</td>
<td>28</td>
<td>R, SN,</td>
</tr>
</tbody>
</table>
**Troubleshooting**

- **Most common issues**
  - Adjacency is not coming up
  - OSPF neighbor stuck in ? state
  - Information is in database not in routing table
  - CPU Hogs, SPF running constantly
  - Seq # mismatch
  - Neighbor flapping (Frame-relay)
  - NSSA ABR not translating
  - DC is constantly bringing up the link
Troubleshooting

- Adjacencies not coming up
  Command to look for the neighbor adj
  show ip ospf neighbor
  show ip ospf interface
  debug ip ospf adjacency

- Layer 2 is down

r4-4k#show ip ospf neighbor
r4-4k#
no neighbor

r4-4k#show ip ospf interface s2
Serial2 is down, line protocol is down
  Internet Address 10.10.1.4/16, Area 0
  Process ID 1, Router ID 10.34.1.1, Network Type POINT_TO_POINT, Cost: 64
  Transmit Delay is 1 sec, State DOWN,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Troubleshooting

- OSPF not enabled on the interface

```
r4-4k#show ip ospf neighbor
no neighbor
```

```
r4-4k#show ip ospf interface s0
Serial0 is up, line protocol is up
OSPF not enabled on this interface
```

In 12.0:

```
r4-4k#show ip ospf interface s0
```

Tip: check for the wrong network statement
re-enter the network statement

- Interface is defined as passive

```
r4-4k#show ip ospf neighbor
no neighbor
```

```
r4-4k#show ip ospf interface e0
Ethernet0 is up, line protocol is up
Internet Address 172.16.133.6/26, Area 0
Process ID 1, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 10
Transmit Delay is 1 sec, State DR, Priority 1
Designated Router (ID) 1.1.1.1, Interface address 172.16.133.6
No backup designated router on this network
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
No Hellos (Passive interface)
```
Troubleshooting

• Mismatched subnet mask

```
r4-4k#debug ip ospf adj
OSPF adjacency events debugging is on
r4-4k#
OSPF: Mismatched hello parameters from 172.16.133.6
Dead R 40 C 40, Hello R 10 C 10 Mask R 255.255.255.0 C 255.255.255.192
```

Troubleshooting

• Mismatched hello/dead interval

```
r4-4k#debug ip ospf adj
OSPF adjacency events debugging is on
r4-4k#
OSPF: Mismatched hello parameters from 172.16.133.6
Dead R 40 C 40, Hello R 15 C 10 Mask R 255.255.255.192 C 255.255.255.192
```
Troubleshooting

- Mismatched Authentication key

r4-4k#debug ip ospf adj
OSPF adjacency events debugging is on
r4-4k#
OSPF: Rcv pkt from 172.16.133.6, Ethernet0: Mismatch Authentication Key
- Clear Text

Tip: Watch for the “space” at the end of the Authentication key

Troubleshooting

- Mismatched area ID

r9-2500#show ip ospf neighbor
r9-2500#
no neighbors
r9-2500#debug ip ospf adj
OSPF adjacency events debugging is on
r9-2500#
OSPF: Rcv pkt from 172.16.133.6, Ethernet0, area 0.0.0.1
Mismatch area 0.0.0.2 in the header

Neighbor is in area 0 but we are not:

%OSPF-4-ERRRCV: Received invalid packet: mismatch area ID, from backbone area must be virtual-link but not found from 172.16.133.29, Ethernet0
Troubleshooting

• Mismatched Transit/Stub area

r9-2500#show ip ospf neighbor
r9-2500#
no neighbors
r9-2500#debug ip ospf adj
OSPF adjacency events debugging is on
r9-2500#
OSPF: Hello from 172.16.133.6 with mismatched Stub/Transit area option bit

Troubleshooting

• OSPF neighbor stuck in ? state

Command to look for the neighbor adj
show ip ospf neighbor
ddebug ip ospf adjacency
Bringing Up Adjacencies

• Neighbor states

  **Down**
  No information has been received from the neighbor

  **Attempt**
  Valid for neighbors on NBMA network, no information is received from the neighbor but serious effort is made to contact the neighbor

  **Init**
  Hello packet has been received from the neighbor, but the router itself is not listed in that hello packet

Bringing Up Adjacencies

• Neighbor States (Cont.)

  **2Way**
  Bi-directional communication with the neighbor is established; this is the beginning of adjacency; DR/BDR are elected in this state

  **Exstart**
  This is used in deciding the DBD sync, which router will be master/slave and what will be the first sequence number for DBD packet
Bringing Up Adjacencies

- Neighbor states (Cont.)

**Exchange**

In this state the router describes the entire link state database through the DBD packet, each DBD sequence is explicitly acked, only one DBD packet is allowed outstanding at one time, link state request packets are also sent to request the newer LSA

**Loading**

In this state, link-state request packets are requested for the more recent LSA that have not been received during Exchange

**Full**

In this state complete information has been exchanged

Troubleshooting

**Problem:**

OSPF stuck in ATTEMPT

**Reasons:**

We are sending hellos to contact neighbor on NBMA but received no reply

Neighbor hellos are getting lost in NBMA cloud

Neighbor received our hello but rejecting that for some reason (Layer 2)

Neighbor is not pingable
Problem:

OSPF stuck in INIT (one way hello)

Reasons:

1. One side is blocking the hello packet with
2. One side is translating (NAT) ospf hello
3. One side multicast capabilities is broken
4. Must be a Layer 2 problem
5. Dialer map or frame-relay map is missing ‘broadcast’

http://www.cisco.com/warp/customer/104/7.html

Problem:

OSPF stuck in 2-WAY

Reasons:

This is normal on broadcast network types
This is to reduce the amount of flooding on the wire
Problems can happen if Layer 2 is broken

http://www.cisco.com/warp/customer/104/11.html
Problem:
OSPF stuck in EXSTART/EXCHANGE

Reasons:
1. If the neighbor is bay router adjust the interface mtu to match bays.
3. Neighbor RID is same as ours
4. Unicast is broken
   a. wrong VC/DLCi mapping in frame/ATM environment in highly redundant network
   b. mtu problem, can’t ping across with more than certain length packet
   c. access-list blocking unicast. After 2-way OSPF send unicast packet except p2p links
   d. NAT is translating unicast packet
http://www.cisco.com/warp/customer/104/12.html
5. Between PRI and BRI/dialer and network type is p2p

Problem:
OSPF stuck in LOADING

Reasons:
1. LS request is being made and neighbor is sending bad packet or mem corrupt
   a. do show ip ospf request-list <neighbor RID> <interface> to see bad Lsa
   b. show log will show OSPF-4-BADLSATYPE msg
2. LS request is being made and neighbor is ignoring the request
3. MTU mismatch problem. Old IOS won’t detect it (RFC 1583)
Troubleshooting

• Information is in the database but not in the routing table
  Command to look for
  `show ip ospf database <x>`
  ‘x’ can be router, network, summary, summary-asbr, external, nssa

• Mismatched Network Types

  r9-2500#show ip ospf interface s 0.2
  Serial0.2 is up, line protocol is up
  Internet Address 10.1.2.3/24, Area 0
  Process ID 1, Router ID 10.1.2.3, Network Type **BROADCAST**, Cost: 64

  r4-4k#show ip ospf interface s 0.1
  Serial0.1 is up, line protocol is up
  Internet Address 10.1.2.1/24, Area 0.0.0.0
  Process ID 1, Router ID 10.1.2.1, Network Type **POINT_TO_POINT**, Cost: 64

  TIP: Adv-router not reachable msg

Problem:
OSPF routes in the database but not in the routing table

Reasons:
- One side is numbered and the other unnumbered (O, O IA, O E1, O E2)
- IP addresses are flipped, dual serial (O, O IA, O E1, O E2)
- Forwarding address is not known or is known via external/static (O E1, O E2) - route sum and redistribute conn?
- Different mask or IP address in p2p (O, O IA, O E1, O E2)
- Distribute-list in is configured
- Backbone area became discontiguous (O, OIA, OE1, OE2)
- OSPF is enabled on secondary but not on primary

Troubleshooting

- SPF is running constantly
  - Look at `sh ip ospf stat, Seq #, LS Age`
  - Debug `ip ospf monitor`
  - Show `ip ospf database database-sum`

For CPU hogs:
- Summarize if too many inter area or external routes
- 12.0 LSA group pacing
**Show IP OSPF stat**

r4-1#sh ip ospf stat

Area 0: SPF algorithm executed 16 times
Area 33: SPF algorithm executed 8 times

<table>
<thead>
<tr>
<th>SPF calculation time</th>
<th>Delta T</th>
<th>Intra D-Intra</th>
<th>Summ</th>
<th>D-Summ</th>
<th>Ext</th>
<th>D-Ext</th>
<th>Total</th>
<th>Reason</th>
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<tr>
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<td>00:04:45</td>
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<td>R, SN,</td>
</tr>
</tbody>
</table>

**Debug ip ospf monitor**

r4-1#deb ip ospf mon

OSPF: Schedule SPF in area 0
- Change in LS ID 1.1.1.1, LSA type R,
  OSPF: schedule SPF: spf_time 0ms wait_interval 861421816s
  OSPF: Begin SPF at 0x33585480ms, process time 752ms
    spf_time 0ms, wait_interval 861421816s
  OSPF: End SPF at 0x33585488ms, Total elapsed time 8ms
    Intra: 4ms, Inter: 0ms, External: 0ms

OSPF: Schedule SPF in area 33
- Change in LS ID 1.1.1.1, LSA type R,
  OSPF: schedule SPF: spf_time 0ms wait_interval 861421816s
  OSPF: Begin SPF at 0x33585480ms, process time 752ms
    spf_time 0ms, wait_interval 861421816s
  OSPF: End SPF at 0x33585488ms, Total elapsed time 8ms
    Intra: 4ms, Inter: 0ms, External: 0ms
LSA Group Pacing

- All LSA refresh every 30 min (bad!)
- Timers of each LSA get sync (worse!)
- With group pacing only LSAs that reach max-age get refreshed periodically
- interval is configurable

Troubleshooting

- Seq # mismatch
  Command to look for
  **debug ip ospf adjacency**
Troubleshooting

• Seq # mismatch:
  1. LSA should one of 5 LSAs
  2. If LSA is type 5 and the neighbor is associated with a stub area
  3. If one of the options change
  4. If the state of MS bit is inconsistent with master slave connection
  5. If the I-bit is set
  6. If the master receives a DBD packet after a dead interval
  7. If the requested LSA is not found, then something has gone wrong with the database exchange
Troubleshooting

• Neighbor flapping
  Command to look for
ddebug ip ospf adjacency
ospf log-adjacency-change
show ip ospf neighbors det
dshow interface

If the media is Frame Relay look for
broadcast queue drops:

```
Serial0 is up, line protocol is up
  Hardware is MK5025
  Description: Charlotte Frame Relay Port DLCI 100
  MTU 1500 bytes, BW 1024 Kbit, DLY 20000 usec, rely 255/255, load 44/255
  Encapsulation FRAME-RELAY, loopback not set, keepalive set (10 sec)
  LMI enq sent 7940, LMI stat recvd 7937, LMI upd recvd 0, DTE LMI up
  LMI enq recvd 0, LMI stat sent 0, LMI upd sent 0
  LMI DLCI 1023 LMI type is CISCO frame relay DTE
  Broadcast queue 64/64, broadcasts sent/dropped: 1769202/1849660, interface broadcasts 3579215
```

Troubleshooting NSSA

- Only NSSA ABR with the highest RID does the conversion

Troubleshooting Demand Circuits

- DC is bringing up the link
- There is a change in OSPF topology
- `debug ip ospf monitor` is helpful in this case
- network type on DC is defined broadcast
- The reduces flooding but doesn’t suppress hellos
DC is bringing up the link
- PPP host route is also own by RIP
- When PPP host route disappears, the database is change
- Solution1: no peer neighbor-route
- Solution2: distribute-list
- Solution3: Use different majornet for RIP

Troubleshooting Tips
Troubleshooting Tips

- Cannot allocate router ID
- OSPF unknown routing protocol
- OSPF and secondary address
- Options and flags
- How to read `debug ip ospf adj`
- Route Preference

Problem:
OSPF: Could not allocate router id

Reasons:
- Common new install problem
- If no interface up/up with valid ip address
- if no ip addresses assigned
- Configure a loopback with an ip address
Troubleshooting Tips

Problem:
OSPF unknown routing protocol

Reason:
OSPF is not supported on low end platform
For 1000 and 1600 routers download plus version
800 routes are not supported to run ospf

Troubleshooting Tips

• OSPF and secondary addresses
  Primary and secondary address should be in same area
  OSPF hellos are always send from primary interface
  To form neighbors on secondary interface configure sub-interface
  Use ISL or dot1Q encapsulation
Troubleshooting Tips

Problem:
OSPF not sending hellos on async interface
Reasons:
‘async default routing’ is not configured under the interface

Problem:
OSPF not redistributing default static route
Reasons:
need default-information originate to propagate default

Problem:
OSPF-4-ERRRCV msg on the console
Reasons:
Mismatch area ID, BAD Checksum etc.


OSPF Protocol Packets

- Options

Normal area: OSPF: Send DBD to 141.108.97.1 on Serial0 seq 0xBC4 opt 0x2 flag 0x3 len 492
  E bit is 1, Allow externals, option: 0x2(HEX) = 00000010(Bin)

Stub area: OSPF: Send DBD to 141.108.97.1 on Serial0 seq 0x1866 opt 0x0 flag 0x3 len 372
  E bit is 0, no external allowed, options: 0x0 = 00000000
  MC not supported - ospf ignore lsa mospf command

NSSA: OSPF: Send DBD to 141.108.97.1 on Serial0 seq 0x118 opt 0x8 flag 0x3 len 372
  N/P bit is on, options: 0x8 = 00001000
  EA not supported yet

Demand circuit: OSPF: Send DBD to 141.108.97.1 on Serial0 seq 0x1A1E opt 0x20 flag 0x3 len 392
  DC bit is negotiated, options: 0x20 = 00100000

*  *  DC  EA  N/P  MC  E  *
OSPF Protocol Packets

- Flags

- Useful in debugging, defines I, M and MS bits

OSPF: Send DBD to 141.108.97.1 on Serial0 seq 0xBC4 opt 0x2 flag 0x3 len 492
Flag 0x7 --> 111 means I(Initial) = 0, M = 1(More), MS = 1(Master)
Flag 0x6 --> 110 not possible
Flag 0x5 --> 101 not possible
Flag 0x4 --> 100 not possible
Flag 0x3 --> 011 means master has more data to send
Flag 0x2 --> 010 means slave has more data to send
Flag 0x1 --> 001 means master has no more data left to send
Flag 0x0 --> 000 means slave has no more data left to send

OSPF: Rcv hello from 141.108.10.2 area 0 from Serial0.1 141.108.10.2
OSPF: 2 Way Communication to 141.108.10.2 on Serial0.1, state 2WAY
OSPF: Neighbor change Event on interface Serial0.1
OSPF: DR/BDR election on Serial0.1
OSPF: Elect BDR 0.0.0.0
OSPF: Elect DR 141.108.10.2
DR: 141.108.10.2 (Id)  BDR: none
OSPF: Send DBD to 141.108.10.2 on Serial0.1 seq 0x236D opt 0x2 flag 0x7 len 32
OSPF: Rcv DBD from 141.108.10.2 on Serial0.1 seq 0x1996 opt 0x2 flag 0x7 len 32 state EXSTART
OSPF: First DBD and we are not SLAVE
OSPF: Rcv DBD from 141.108.10.2 on Serial0.1 seq 0x236D opt 0x2 flag 0x2 len 352 state EXSTART
OSPF: NBR Negotiation Done. We are the MASTER
OSPF: Send DBD to 141.108.10.2 on Serial0.1 seq 0x236E opt 0x2 flag 0x3 len 352
OSPF: Rcv DBD from 141.108.10.2 on Serial0.1 seq 0x236E opt 0x2 flag 0x0 len 32 state EXCHANGE
OSPF: Send DBD to 141.108.10.2 on Serial0.1 seq 0x236F opt 0x2 flag 0x1 len 32
OSPF: Rcv DBD from 141.108.10.2 on Serial0.1 seq 0x236F opt 0x2 flag 0x0 len 32 state EXCHANGE
OSPF: Exchange Done with 141.108.10.2 on Serial0.1
OSPF: Synchronized with 141.108.10.2 on Serial0.1, state FULL
Route Preference

- O, O IA, OE1, OE2

R7 routing table: O IA 192.1.2.0/24 via R5 metric 20 ???
Summary LSA through R6 has a metric of 15!
How to reach the Advertising router R4 (ABR)? O vs O IA

Troubleshooting OSPF
Session 2206
Please Complete Your Evaluation Form

Session 2206