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Period 0-2

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OSPF Stubby, Totally Stubby, and NSSA Area Setup and Configuration Lab

Purpose:

Establish and assess different configurations for OSPF areas, validating their operational effectiveness, before settling on a final solution.

Background Information:

The OSPF and OSPFv3 protocols utilize eight types of Link-State Advertisement (LSA) messages to communicate changes in topology, encompassing modifications outside the immediate area. These LSAs are assigned numerical values from 1 to 9, excluding 6 for CISCO routers. Consequently, OSPF routers in disparate areas receive LSA updates and acknowledgments even for alterations in remote areas. In expansive and dynamic networks, the transmission of these LSAs consumes a substantial amount of bandwidth whenever a router undergoes a modification.

To address this issue, diverse modes have been developed to diminish the variety of LSAs transmitted, thereby conserving more bandwidth for actual data. This reduction is predominantly implemented in "stub" areas, characterized by a singular connection to another area. Stub areas, akin to stubs, feature only one inbound and outbound connection, preventing LSAs from traversing the entire network. Different area types disable or substitute unnecessary LSAs.

Common area types encompass Standard, Stubby, Totally Stubby, Not-so-Stubby (referred to as NSSA when combined with Area), and Totally Not-so-Stubby. The latter four are collectively denoted as stub areas, with Standard Areas serving as the default.

Standard OSPF Area:

* Default OSPF area where all LSAs (excluding type 7) can be disseminated across the network.
* Features a straightforward configuration but transmits more LSAs than stub areas.

Stubby OSPF Area:

* The simplest form of OSPF stub area, widely supported by routers.
* Blocks type 4 and 5 LSAs, thereby reducing OSPF bandwidth usage.
* Configured through a single command on each router within the area.

Totally Stubby OSPF Area:

* Similar in configuration complexity to Stubby.
* Blocks type 4 and 5 LSAs while consolidating type 3 LSAs to the border router.
* Results in a reduction in the number of type 3 LSAs transmitted.

Not-so-Stubby Area (NSSA):

* A proprietary CISCO stub area resembling Stubby.
* Configured with a single command utilizing LSA 7, a CISCO-specific LSA.
* Replaces type 5 LSAs with type 7 LSAs.

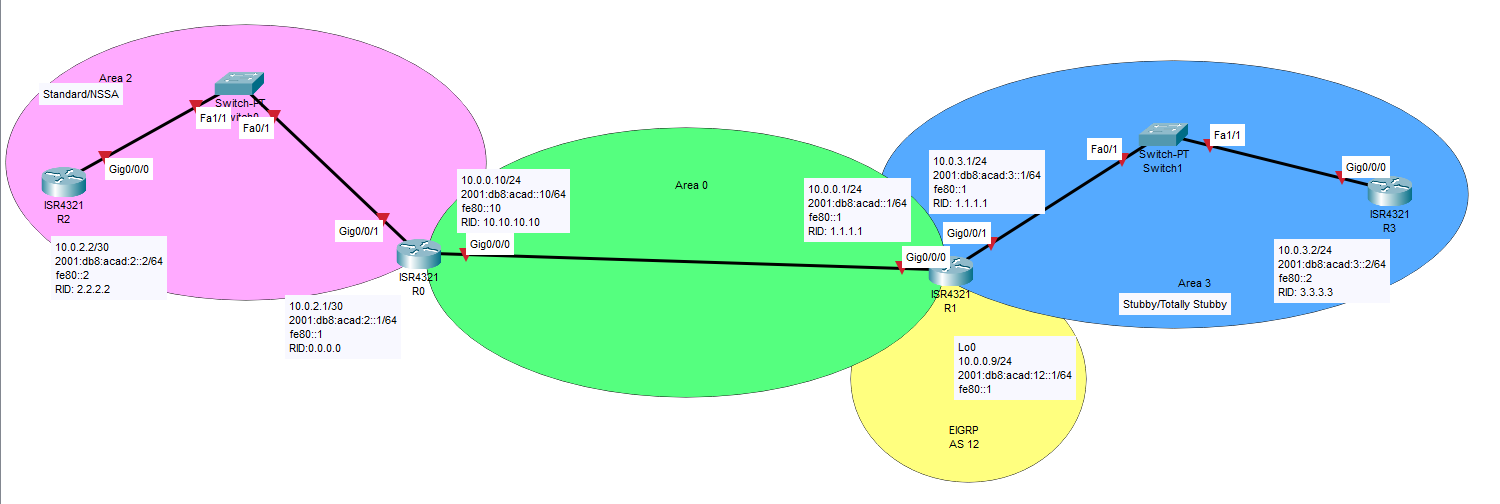
Lab Summary:

We established IPv4 and IPv6 networks across all four routers. Specifically, R1, R2, and R3 were configured using OSPF. Simultaneously, EIGRP was applied to R4's loopback, and its G0/0/0 interface underwent OSPF configuration. Area assignments were implemented, and we conducted experiments, utilizing packet sniffing techniques, to scrutinize the configurations of Standard, Stubby, Totally Stubby, and NSSA stub areas.

Lab Commands:

1. To convert an OSPF area into a Stubby Area, implement the command "area [area number] stub" in the configuration of both "router ospf [process id]" and "ipv6 router ospf [process id]" for all routers within the specified area.
2. For the Area Border Router (ABR) aiming to configure Totally Stubby Areas, substitute the previous command with "area [area number] stub no-summary" to ensure a more restrictive configuration.
3. To create a Not-so-Stubby Area (NSSA) OSPF area, replace the commands "area [area number] stub" and "area [area number] stub no-summary" with "area [area number] nssa." This transition designates the area as an NSSA OSPF area.
4. For NSSA ABRs, replace the aforementioned commands with "area [area number] nssa default-information-originate" to properly configure NSSA areas and generate default route information.
5. On Autonomous System Boundary Routers (ASBRs) within "router ospf [area]," apply the command "redistribute eigrp [AS number] metric 1000 subnets" to efficiently redistribute EIGRP routes into OSPF, taking into account the specified area.
6. For ASBRs within "ipv6 router ospf [area]," use the command "redistribute eigrp [AS number] include-connected" to ensure the proper redistribution of EIGRP routes into OSPFv3, while considering the designated area.
7. ASBRs within "router eigrp [AS number]" should employ the command "redistribute ospf [area] metric 1500 10 255 1 1500 include-connected" to correctly redistribute OSPF routes into EIGRP, considering the specified area.
8. For ASBRs within "ipv6 router eigrp [AS number]," implement the command "redistribute ospf [area] metric 1500 10 255 1 1500" to efficiently redistribute OSPFv3 routes into EIGRP, accounting for the designated area.

Network Diagram:



Configurations:

## **Configuration, in order: R0, R1, R2, R3.**

|  |
| --- |
| en  erase startup-config    conf t  no ip domain-loo  line con 0  loggi sync  exit  ipv6 unicast-r    host R0    router ospf 1  no shut  router-id 10.10.10.10  no area 2 nssa  ipv6 router ospf 1  no shut  router-id 10.10.10.10  no area 2 nssa  exit    int g0/0/0  no shut  no ipv6 add  ip add 10.0.0.10 255.255.255.0  ipv6 add 2001:db8:acad::10/64  ipv6 add fe80::10 link-l  ip ospf 1 a 0  ipv6 ospf 1 a 0    int g0/0/1  no shut  no ipv6 add  ip add 10.0.2.1 255.255.255.0  ipv6 add 2001:db8:acad:2::1/64  ipv6 add fe80::1 link-l  ip ospf 1 a 2  ipv6 ospf 1 a 2 |
| en  erase startup-config    conf t  no ip domain-loo  line con 0  loggi sync  exit  ipv6 unicast-r    host R1    router ospf 1  no shut  router-id 1.1.1.1  ipv6 router ospf 1  no shut  router-id 1.1.1.1  exit    int g0/0/0  no shut  ip add 10.0.0.1 255.255.255.0  ipv6 add 2001:db8:acad::1/64  ipv6 add fe80::1 link-l  ip ospf 1 a 0  ipv6 ospf 1 a 0    int g0/0/1  no shut  ip add 10.0.3.1 255.255.255.0  ipv6 add 2001:db8:acad:3::1/64  ipv6 add fe80::1 link-local  ip ospf 1 a 3  ipv6 ospf 1 a 3    int lo0  no shut  ip add 10.0.12.1 255.255.255.0  ipv6 add 2001:db8:acad:12::1/64  ipv6 add fe80::1 link-l  ipv6 eigrp 12    router eigrp 12  network 10.0.12.0 0.0.0.255  redistribute ospf 1 metric 1500 10 255 1 1500  ipv6 router eigrp 12  redistribute ospf 1 metric 1500 10 255 1 1500 include-connected    router ospf 1  redistribute eigrp 12 metric 1000 subnets  ipv6 router ospf 1  redistribute eigrp 12 include-connected |
| en  erase startup-config    conf t  no ip domain-loo  line con 0  loggi sync  exit  ipv6 unicast-r    host R2    router ospf 1  no shut  router-id 2.2.2.2  no area 2 nssa  ipv6 router ospf 1  no shut  router-id 2.2.2.2  no area 2 nssa  exit    int g0/0/0  no shut  ip add 10.0.2.2 255.255.255.0  no ipv6 add  ipv6 add 2001:db8:acad:2::2/64  ipv6 add fe80::2 link-l  ip ospf 1 a 2  ipv6 ospf 1 a 2 |
| en  erase startup-config    conf t  no ip domain-loo  line con 0  loggi sync  exit  ipv6 unicast-r    host R3    router ospf 1  no shut  router-id 3.3.3.3  ipv6 router ospf 1  no shut  router-id 3.3.3.3  exit    int g0/0/0  no shut  no ipv6 add  ip add 10.0.3.2 255.255.255.0  ipv6 add 2001:db8:acad:3::2/64  ipv6 add fe80::2 link-l  ip ospf 1 a 3  ipv6 ospf 1 a 3 |

## **Additional Commands for Stubby Areas - R1, R3**

|  |
| --- |
| router ospf 1  area 3 stub  ipv6 router ospf 1  area 3 stub |
| router ospf 1  area 3 stub  ipv6 router ospf 1  area 3 stub |

## **Additional Commands for Totally Stubby Areas - R1, R3**

|  |
| --- |
| router ospf 1  area 3 stub no-sum  ipv6 router ospf 1  area 3 stub no-sum |
| router ospf 1  area 3 stub  ipv6 router ospf 1  area 3 stub |

## **Additional Commands for NSSA - R0, R2**

|  |
| --- |
| router ospf 1  no area 2 stub  area 2 nssa default-information-originate  ipv6 router ospf 1  no area 2 stub  area 2 nssa default-information-originate |
| router ospf 1  no area 2 stub  area 2 nssa  ipv6 router ospf 1  no area 2 stub  area 2 nssa |

## **sh ip route - R0, R1, R2, R3**

|  |
| --- |
| Gateway of last resort is not set    10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks  C 10.0.0.0/24 is directly connected, GigabitEthernet0/0/0  L 10.0.0.10/32 is directly connected, GigabitEthernet0/0/0  C 10.0.2.0/24 is directly connected, GigabitEthernet0/0/1  L 10.0.2.1/32 is directly connected, GigabitEthernet0/0/1  O IA 10.0.3.0/24 [110/2] via 10.0.0.1, 00:05:53, GigabitEthernet0/0/0  O E2 10.0.12.0/24 [110/1000] via 10.0.0.1, 00:05:53, GigabitEthernet0/0/0 |
| Gateway of last resort is not set    10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks  C 10.0.0.0/24 is directly connected, GigabitEthernet0/0/0  L 10.0.0.1/32 is directly connected, GigabitEthernet0/0/0  O IA 10.0.2.0/24 [110/2] via 10.0.0.10, 00:10:19, GigabitEthernet0/0/0  C 10.0.3.0/24 is directly connected, GigabitEthernet0/0/1  L 10.0.3.1/32 is directly connected, GigabitEthernet0/0/1  C 10.0.12.0/24 is directly connected, Loopback0  L 10.0.12.1/32 is directly connected, Loopback0 |
| Gateway of last resort is not set    10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks  O IA 10.0.0.0/24 [110/2] via 10.0.2.1, 00:00:45, GigabitEthernet0/0/0  C 10.0.2.0/24 is directly connected, GigabitEthernet0/0/0  L 10.0.2.2/32 is directly connected, GigabitEthernet0/0/0  O IA 10.0.3.0/24 [110/3] via 10.0.2.1, 00:00:34, GigabitEthernet0/0/0  O E2 10.0.12.0/24 [110/1000] via 10.0.2.1, 00:00:34, GigabitEthernet0/0/0 |
| Gateway of last resort is not set    10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks  O IA 10.0.0.0/24 [110/2] via 10.0.3.1, 00:10:25, GigabitEthernet0/0/0  O IA 10.0.2.0/24 [110/3] via 10.0.3.1, 00:10:29, GigabitEthernet0/0/0  C 10.0.3.0/24 is directly connected, GigabitEthernet0/0/0  L 10.0.3.2/32 is directly connected, GigabitEthernet0/0/0  O E2 10.0.12.0/24 [110/1000] via 10.0.3.1, 00:10:28, GigabitEthernet0/0/0 |

## **sh ipv6 route - R0, R1, R2, R3**

|  |
| --- |
| C 2001:DB8:ACAD::/64 [0/0]  via GigabitEthernet0/0/0, directly connected  L 2001:DB8:ACAD::10/128 [0/0]  via GigabitEthernet0/0/0, receive  C 2001:DB8:ACAD:2::/64 [0/0]  via GigabitEthernet0/0/1, directly connected  L 2001:DB8:ACAD:2::1/128 [0/0]  via GigabitEthernet0/0/1, receive  OI 2001:DB8:ACAD:3::/64 [110/2]  via FE80::1, GigabitEthernet0/0/0  OE2 2001:DB8:ACAD:12::/64 [110/20]  via FE80::1, GigabitEthernet0/0/0  L FF00::/8 [0/0]  via Null0, receive |
| C 2001:DB8:ACAD::/64 [0/0]  via GigabitEthernet0/0/0, directly connected  L 2001:DB8:ACAD::1/128 [0/0]  via GigabitEthernet0/0/0, receive  OI 2001:DB8:ACAD:2::/64 [110/2]  via FE80::10, GigabitEthernet0/0/0  C 2001:DB8:ACAD:3::/64 [0/0]  via GigabitEthernet0/0/1, directly connected  L 2001:DB8:ACAD:3::1/128 [0/0]  via GigabitEthernet0/0/1, receive  C 2001:DB8:ACAD:12::/64 [0/0]  via Loopback0, directly connected  L 2001:DB8:ACAD:12::1/128 [0/0]  via Loopback0, receive  L FF00::/8 [0/0]  via Null0, receive |
| OI 2001:DB8:ACAD::/64 [110/2]  via FE80::1, GigabitEthernet0/0/0  C 2001:DB8:ACAD:2::/64 [0/0]  via GigabitEthernet0/0/0, directly connected  L 2001:DB8:ACAD:2::2/128 [0/0]  via GigabitEthernet0/0/0, receive  OI 2001:DB8:ACAD:3::/64 [110/3]  via FE80::1, GigabitEthernet0/0/0  OE2 2001:DB8:ACAD:12::/64 [110/20]  via FE80::1, GigabitEthernet0/0/0  L FF00::/8 [0/0]  via Null0, receive |
| OI 2001:DB8:ACAD::/64 [110/2]  via FE80::1, GigabitEthernet0/0/0  OI 2001:DB8:ACAD:2::/64 [110/3]  via FE80::1, GigabitEthernet0/0/0  C 2001:DB8:ACAD:3::/64 [0/0]  via GigabitEthernet0/0/0, directly connected  L 2001:DB8:ACAD:3::2/128 [0/0]  via GigabitEthernet0/0/0, receive  OE2 2001:DB8:ACAD:12::/64 [110/20]  via FE80::1, GigabitEthernet0/0/0  L FF00::/8 [0/0]  via Null0, receive |

## **traceroute from R3 to R2 - IPv4, IPv6**

|  |
| --- |
| Type escape sequence to abort.  Tracing the route to 10.0.2.2  VRF info: (vrf in name/id, vrf out name/id)  1 10.0.3.1 1 msec 1 msec 1 msec  2 10.0.0.10 1 msec 1 msec 1 msec  3 10.0.2.2 1 msec \* 1 msec |
| Type escape sequence to abort.  Tracing the route to 2001:DB8:ACAD:2::2    1 2001:DB8:ACAD:3::1 5 msec 1 msec 1 msec  2 2001:DB8:ACAD::10 2 msec 1 msec 1 msec  3 \*  2001:DB8:ACAD:2::2 1 msec 1 msec |

## **traceroute from R2 to R1 Lo0 - IPv4, IPv6**

|  |
| --- |
| Type escape sequence to abort.  Tracing the route to 10.0.12.1  VRF info: (vrf in name/id, vrf out name/id)  1 \* \*  10.0.2.1 1 msec  2 10.0.0.1 1 msec \* \* |
| Type escape sequence to abort.    Tracing the route to 2001:DB8:ACAD:12::1    1 2001:DB8:ACAD:2::1 1 msec 1 msec 0 msec    2 2001:DB8:ACAD::1 2 msec 1 msec 1 msec |

Problems:

Router IOS/Hardware Issue:

The router previously designated as R1 experienced intermittent booting into rommon at unpredictable intervals. Although a temporary fix involved resetting while in rommon, the persistent issue, coupled with heightened fan usage, led to the conclusion, following consultation with Tahmid, that the problem likely stemmed from either hardware malfunctions or the IOS image. Due to the complexity and non-trivial nature of the problem, the decision was made to replace R1 with an alternative router until a more comprehensive solution could be implemented.

NSSA Type 7:

Analysis of NSSA using Wireshark failed to uncover Type 7 LSAs. Despite several days of experimentation with various configurations, the desired Type 7 LSAs remained elusive. Collaboration with other groups proved beneficial, revealing that introducing the "area 1 nssa default-information originate" command to R2 was essential for the proper transmission of Type 7 LSAs. Subsequent application of "clear ip ospf pro" and "clear ipv6 ospf pro" commands successfully displayed Type 7 LSAs.

IPv6 EIGRP Redistribution:

Initial attempts to redistribute IPv6 EIGRP across the OSPF network posed challenges. Despite implementing multiple commands suggested by forums and CISCO, R2 and R3 failed to display the routes in "sh ipv6 route." Interestingly, IPv4 EIGRP redistribution encountered no issues. Following the resolution of the NSSA Type 7 problem, it was discovered that R3, situated farther from R4 than R2, had a default route to R4, unlike R2. The inclusion of the "include-connected" parameter in the OSPFv3 and IPv6 EIGRP redistribution commands ultimately addressed this issue.

Scope Communication:

Initially, the network design focused on addressing one stub area at a time, making necessary configuration adjustments as needed. After receiving clarified lab scope communication post-task completion, it was realized that the initial understanding was inaccurate. Swiftly adapting, a new network was constructed to handle up to two stub areas concurrently. Although concerns emerged about the feasibility of incorporating four stub areas simultaneously due to a faulty router, subsequent discussions with other lab teams revealed that such a configuration was indeed possible. Nevertheless, the decision was made not to pursue this option, as the successful completion of all tasks had already demonstrated the proper functionality of the involved systems.

Conclusion:

The incorporation of stub areas proved highly efficient in reducing the quantity of Link-State Advertisements (LSAs) transmitted, even within a network experiencing substantial traffic. Ultimately, for networks with a single Area Border Router (ABR), Totally Stubby areas emerged as the preferred choice, while Stubby areas were considered suitable in scenarios with multiple ABRs. Notably, both Stubby and Totally Stubby areas adhere to open standards, in contrast to Not-so-Stubby Areas (NSSA), making them compatible with non-CISCO devices and thereby broadening their applicability to a wider range of devices.

Despite encountering specific challenges in the lab that required the application of targeted commands for resolution, once these commands were identified, the lab procedures became comparatively straightforward. The unexpected change in scope introduced at the last minute posed a challenge, resulting in a hastily configured setup that fell short of an ideal arrangement. However, despite this rushed adjustment, the network design was meticulously planned and successfully implemented, showcasing a thoughtful and effective overall approach.

Lab Signoff:

