

OSPFv3 Support for Address Families

What You Will Learn

Open Shortest Path First Version 3 (OSPFv3) is a link state routing protocol. Unlike OSPFv2, which supports IPv4, the original implementation of OSPFv3 supports IPv6 (unicast only). With the introduction of OSPFv3 support for address families (AFs), OSPFv3 now can support IPv4 unicast address families.

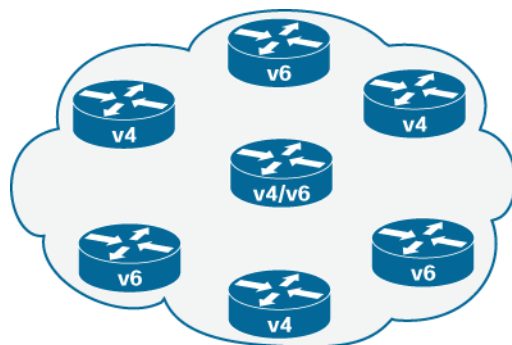
About OSPFv3 Support for Address Families

Conceptually, OSPFv3 AFs are similar to address families used today by Routing Information Protocol (RIP), Intermediate System-to-Intermediate System (IS-IS), Enhanced Interior Gateway Routing Protocol (EIGRP), and Border Gateway Protocol (BGP).

In the context of OSPFv3, AFs are used to provide multiprotocol support and offer several benefits.

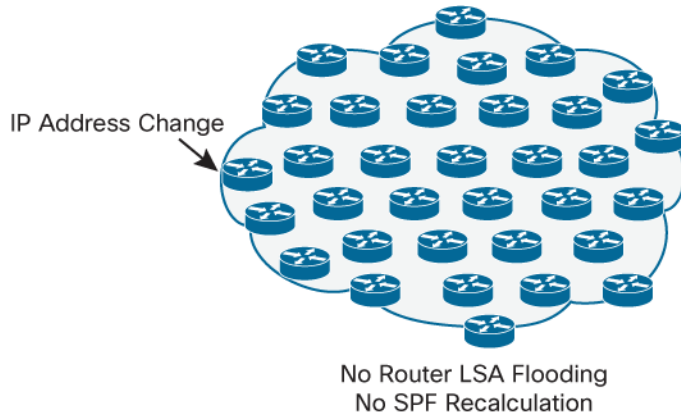
- **Reduced complexity:** Helps enable IPv4 and IPv6 address families to be supported on a single network infrastructure (Figure 1). This feature reduces or eliminates the need to maintain parallel networks and protects an organization's IPv4 technology investment.

Figure 1. Logical, Noncongruent IPv4 and IPv6 Networks on Shared Physical Infrastructure



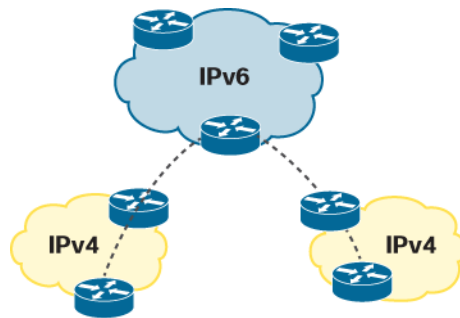
- **Increased scalability:** OSPFv3 improves upon OSPFv2 scalability for IPv4 by using the Intra-Area-Prefix Link-State Advertisement (LSA) (LS type 0x2009) to advertise connected prefixes. Because IP addressing is now separated from the calculation of the Shortest Path First (SPF) tree, OSPFv3 interior routers do not have to flood the entire area with a new Type 1 LSA to other routers in the same area when a topology change occurs such as when a prefix is added, an existing prefix is deleted, or its metric is changed, triggering a new SPF calculation (Figure 2). This is especially advantageous for large IPv4-based single-area topologies with lots of access devices.

Figure 2. No Router LSA Flooding for Prefix Change in Single-Area Topology



- **Enhanced mobility:** Mobile networks based on IPv4 can only support peering between nodes on the same subnet, which can be a significant limitation in complex mobile operations. While IPv6-based OSPFv3 eliminates a number of addressing and peering restrictions, it does not support IPv4 nodes as originally defined. The OSPFv3 address families feature enables IPv4 nodes on separate subnets to peer using IPv6 link-local addresses. The added flexibility helps enable organizations to support a more diverse group of mobile users under a wider range of conditions. See Figure 3.

Figure 3. Peering Between IPv4 Routers in Different Subnets



- **Ease of migration:** Facilitates robust interoperability within mixed IPv4 and IPv6 network environments for organizations in transition. The feature is easily configured and requires only minimal changes to existing OSPFv3 implementations. Address family-capable routers can be deployed without disturbing networks with non-capable routers.

OSPFv3 Address Family Overview

OSPFv3 Control Packets

OSPFv3 runs on top of IPv6 and uses IPv6 link local scope (FE80::/10) for control packets. As a consequence, it is required that IPv6 be enabled on an OSPFv3 link although the link may not be participating in any IPv6 routing.

Instance ID Values for New AFs

OSPFv3 originally assigned the entire instance ID number space for IPv6 unicast. With support for address families in OSPFv3, new instance ID ranges have been assigned to support other AFs (Table 1).

Table 1. Instance ID Ranges for Address Families

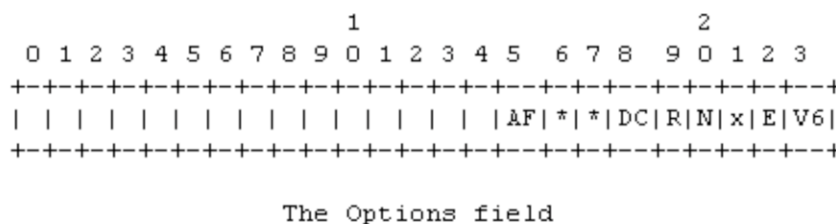
Instance ID	Description
0	IPv6 unicast (base)
1–31	IPv6 unicast
32	IPv6 multicast (base)
33–63	IPv6 multicast
64	IPv4 unicast (base)
65–95	IPv4 unicast
96	IPv4 multicast (base)
97–127	IPv4 multicast
128–255	Unassigned

An instance ID implies a separate OSPFv3 instance with its own neighbor adjacencies, link state database, and SPF computation.

OSPFv3 Options Changes

A new AF-bit has been added to the OSPFv3 options field (Figure 4).

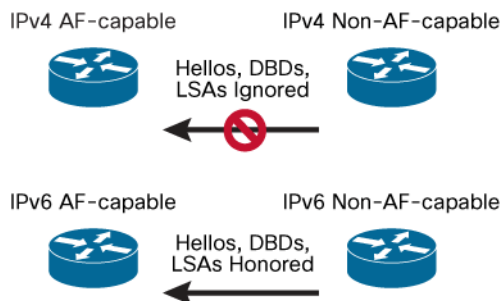
Figure 4. OSPFv3 Options Field with AF-Bit



When an OSPFv3 router is supporting AFs, the AF-bit will be set for hello packets, database description packets, and LSAs.

When an OSPFv3 router participates in an AF, hello packets having the AF-bit clear in the options field are discarded with the exception of IPv6 unicast AF, where this check is bypassed for backward compatibility with non-AF OSPFv3 IPv6 unicast-capable routers. See Figure 5.

Figure 5. OSPFv3 AF-Bit Processing



Security

OSPFv3 makes use of IPsec and therefore has a broader range of supported authentication algorithms than OSPFv2 and also supports encryption.

Conclusion

OSPFv3 is expected to be widely deployed, especially in government environments where IPv6 support has been mandated. Many organizations are also extending their network to support highly mobile users. As OSPF-based networks evolve, organizations need to ensure that IPv4 and IPv6 resources can coexist. OSPFv3 support for address families helps organizations prepare and meet these challenges while reducing complexity, enhancing mobility, easing migration, and improving scalability.

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