Background Information

Within OSPF, there are LSAs, or Link-state advertisements. OSPF is a routing protocol for IP (Internet Protocol) networks which determines a path across the network by calculating the shortest route to the destination. OSPF is used to link multiple routers together into areas by registering each router as a neighbor. LSAs, or link-state advertisements, are the basic communication within OSPF. It helps communicate a router’s topology to all other routers within the same OSPF area. This is very useful and generally used in big networks with lots of routers and spread between multiple buildings. When a network is this big, they use multi-area OSPF and stub areas to make everything work efficiently. Multi-area OSPF is used to divide up large networks, because it is a way of limiting the amount of neighbors in an area. In multi-area OPSF, there must be a backbone area, area 0, and at least one other area with a number other than 0. The backbone area is the center of the areas and connects all of them together. When OSPF networks start to get large, the LSDB (Link-State Data Base) starts to fill up with a lot of unnecessary LSAs from other networks. This is when stub areas are put into effect. In order to fully understand stub areas, I first need to go through the first seven types of link-state advertisements. These directly correlate with stub areas, so it is essential to understand them.

The first type of LSA is LSA type 1. These LSAs are used within a single area. Each router in a single area will flood all the routers in the area with a type 1 LSA. Type 1 LSAs are sent to describe their own interfaces, but they also carry information about their neighbors to the adjacent routers. Basically, an LSA type 1 is the blueprint of the router, containing essential information that the other routers need in order for them to connect with one another.

The next LSA type is LSA type 2. This type of LSA is generated by the DR in the area. The DR (Designated Router) is the router that has all the LSAs sent to. Because large LANs have higher traffic, having all the routers receive outside LSAs could be a problem, so the DR is there to alleviate this issue and accept the LSAs itself. Type 2 LSAs are only sent out by the DR, and are just informative ones, as they contain information about the attached routers and about the network segment. Just like LSA type 1, these types stay only within a single area and are flooded to all routers in the area.

The next type of LSA is LSA type 3. This LSA type is generated by the ABR. The ABR is the area border router, and it sits on the border between two different OSPF areas. The ABR is used to establish connections between the backbone area and the OSPF areas, and it is a member of both areas through different interfaces. The LSA type 3 is used to send information from an area to all other areas that have been setup. It summarizes the information for scalability and sends it to all the routers within an area. Generally, all routers setup within multi-area OSPF should have an LSA type 3 in their database. These are shown in the routing table as “O IA”.

The next type of LSA is LSA type 4. This LSA type is created by the ASBR. The ASBR is the Autonomous System Border Router. The ASBR is the router that can run multiple protocols and is served as the gateway to routers which are not part of the OSPF domain. This router is able to use a process known as redistribution to import and translate different protocol routes into OSPF. The type 4 LSAs are sent by the ASBR in order to let all routers know where this router is. Once the router is identified as an ASBR, it creates the type 4 summary LSA and floods it into area 0, and from there it is flooded into all the areas.

The next type of LSA is LSA type 5. This LSA is also created by the ASBR. While LSA type 4 simply let’s all the routers know which one is the ASBR, LSA type 5 is used to represent any external routes from another Autonomous System (or routing protocol) that is done through redistribution. These LSAs are flooded through the backbone area and into all of the areas similarly to type 4 LSAs. Type 5 LSAs also contain information about the metric and cost of a route and are shown in the routing table as “O E1” or “O E2”.

The next type of LSA, and the least important one, is LSA type 6. These are multicast LSAs, which aren’t even used anymore. Cisco doesn’t support these LSAs anymore because a better alternative was created. Even though, it is important to know about them.

The next type of LSA leads directly into stubby areas, and it is LSA type 7. This LSA type is only found when using NSSAs, or Not So Stubby Areas. In order for these types of LSAs to travel to other areas, they must go into the ABR of the area, and from there they are converted into type 5 LSAs which are flooded across the network. These LSAs exist because LSA type 5s are not allowed into an NSSA, so instead they take in these LSA type 7’s which are allowed to travel through the area. When shown in the routing table, they are show as “N1” or “N2”.

Now, I will talk about stub areas and the different kinds of it. There are three different kinds of stub areas. These are stub areas, not so stubby areas (NSSA), and totally stubby areas. The purpose of stub areas is to reduce the size of the link state database, because when you have very large networks, these databases grow very large and it is not good. What stub areas do is they do not allow certain LSA types into them and it helps reduce the database. These external routes are instead replaced with a default summary route.

Ordinary stub areas allow within them LSA types 1, 2, and 3. Normally, these areas would have LSA types of 4 and 5 in order to propagate external routes, but instead these routes are summarized as a default route within an LSA type 3. This ensures that the routers in the stub area can route traffic to external destinations without maintaining all the external routes individually. In order to configure a stub area, you would need to use the command “area x stub”.

The next type of stub area is called a totally stubby area. Similarly to stub areas, totally stubby areas do not receive LSA types 4 or 5 from their ABRs. However, they also do not receive type 3 LSAs from other routers, and they instead rely on a single default route which is injected into the ABR. In order to setup a totally stubby area, you need to use the command “area x stub no-summary”.

A potential problem with these two stub areas is that they cannot contain an ASBR. In order to fix this problem, the concept of not so stubby areas was invented by cisco. Not so stubby areas, or NSSAs, use type 7 LSAs primarily instead of type 5 LSAs. These type 7 LSAs allow an ASBR to advertise external links to an ABR, which will then convert these LSAs into type 5 LSAs after leaving the area. NSSAs can actually function as either a stub area or a totally stubby area. For a stub NSSA, type 3 LSAs will pass in and out of the area. Unlike a regular stub area, the ABR will not inject a default route into the NSSA unless it is specifically told to do so. For a totally stubby NSSA, the ABR will inject a default route into the area without any further configuration. In order to configure a stub NSSA, you need to use the command “area x nssa”. If you want to configure a totally stubby NSSA, you need to use the command “area x nssa no-summary”. A useful way to identify stubby areas is by using a program called Wireshark, which captures packets on a network and allows you to read them. If you want to identify if there are stubby areas on a network, you need to search through Wireshark and see if you can find an area without LSA type 4 or LSA type 5s, or if you see any LSA type 7s. Areas that have LSA type 7s can be identified as not-so-stubby areas, and areas only with LSA types 1, 2, and 3 are stubby or totally-stubby areas. If you see any of these clues, you can determine if a network has stubby areas or not.

Overall, stubby areas, not so stubby areas, and totally stubby areas are a very useful tool for shortening the size of your network, so it isn’t too large. By filtering out certain LSA types to prevent their databases from growing large, stub areas can shorten the size of the network and make it much easier to manage for IT specialists.