CSE 4512 [Computer Networks Lab]

OSPF Routing Protocol

WHAT IS OSPF AND HOW DOES IT WORK?

OSPF is a Link State protocol that's considered may be the most famous protocol among the Interior Gateway Protocol (IGP) family, developed in the mid 1980's by the OSPF working group of the IETF.

When configured, OSPF will listen to neighbors and gather all link state data available to build a topology map of all available paths in its network and then save the information in its topology database, also known as its **Link-State Database (LSDB)**. Using the information from its topology database. From the information gathered, it will calculate the best shortest path to each reachable subnet/network using an algorithm called **Shortest Path First (SFP)** that was developed by the computer scientist *Edsger W. Dijkstra* in 1956. OSPF will then construct **three tables** to store the following information:

- **Neighbor Table:** Contains all discovered OSPF neighbors with whom routing information will be interchanged
- **Topology Table:** Contains the entire road map of the network with all available OSPF routers and calculated best and alternative paths.
- **Routing Table:** Contain the current working best paths that will be used to forward data traffic between neighbors.

UNDERSTANDING OSPF AREAS

OSPF offers a very distinguishable feature named: **Routing Areas**. It means dividing routers inside a single autonomous system running OSPF, into areas where each area consists of a group of connected routers.

The idea of dividing the OSPF network into areas is to simplify administration and optimize available resources. Resource optimization is especially important for large enterprise networks with a plethora of network and links. Having many routers exchange the link state database could flood the network and reduce its efficiency – this was the need that led to the creation of concept Areas.

Areas are a logical collection of routers that carry the same **Area ID** or number inside of an OSPF network, the OSPF network itself can contain multiple areas, the first and main Area is called the backbone area **"Area 0"**, all other areas must connect to **Area 0** as shown in the diagram below:

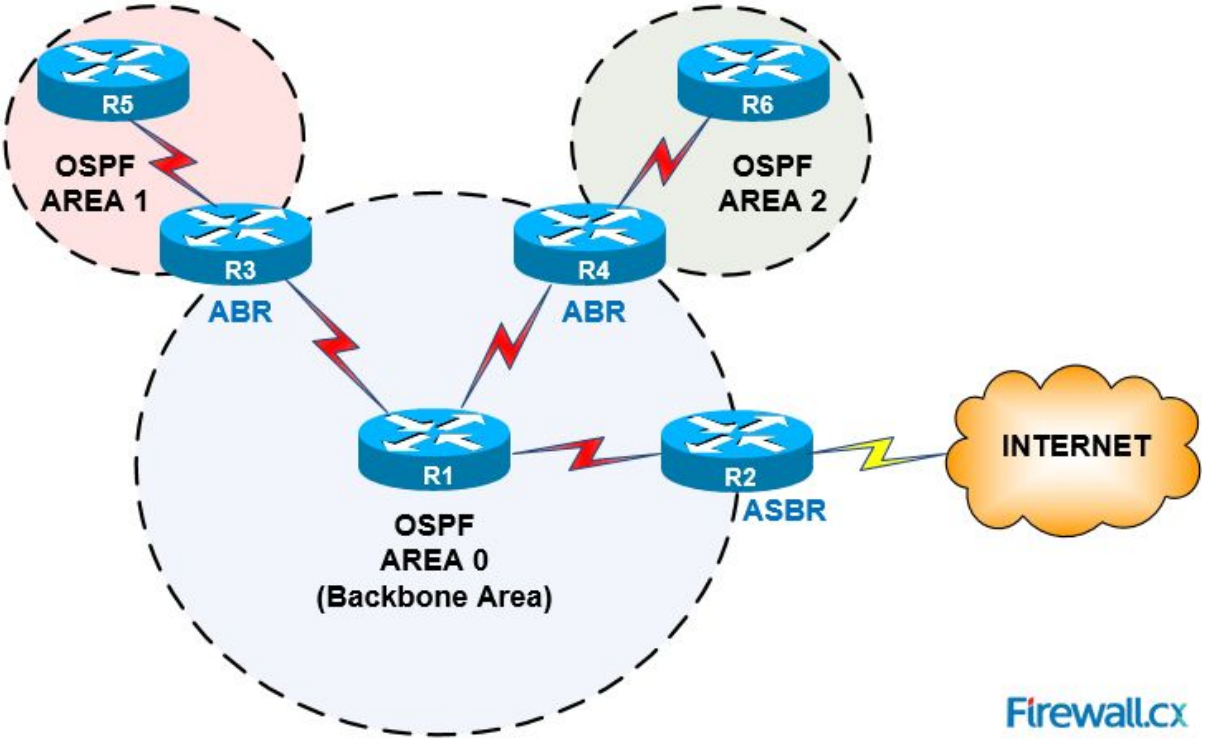

Figure 1. OSPF Areas, Area 0 (Backbone Area), ABR and ASBR OSPF routers

All routers within the same **Area** have the **same topology table** -**Link State Database**- but different **routing table** as OSPF calculates different best paths for each router depending on its location within the network topology while they will all share the same **Link State topology**.

The goal of having an **Area** is to localize the network as follow:

- The **Area boundaries** will give the opportunity of using **summarization**, as it's not possible to summarize network prefixes in normal link state protocols because routers are supposed to have the same map topology of the entire network coincide in all neighbors.
- **Area boundaries** will also help preventing fault containment by suppressing updates that take place when a change occurs in the network causing a flood of updates between routers. This also happens to be a weakness of link state protocols: When connecting large sized networks it is very difficult to avoid link state database floods.

With **Area boundaries**, updates are kept only **inside the same area**, while other areas remain completely unaware of the update

WORKING INSIDE OF A SINGLE AREA

Working inside of an Area is hierarchically organized among routers that share this area and are categorized as:

Area Border Routers (ABR): Routers located on the borders of each Area connect to more than one OSPF area, are called ABR Routers. ABR Routers are responsible for summarizing IP addresses of each area and suppressing updates among areas to prevent fault containment.

Autonomous System Boundary Router (ASBR): An ASBR is a router that has interfaces connected to one or more OSPF areas, similarly as the ABR, however the difference with an ASBRis that it also connects to other routing systems such as BGP, EIGRP, Internet and others. An ASBR router normally advertises routes from other routing systems into the OSPF area to which it belongs.

Designated Router (DR): A Designated Router is elected by the routers on multi-access segments (e.g Local Area Network), based on its priority (Router ID, priority). The DR router performs special functions such as generating Link State Advertisements (LSAs) and exchanging information with all other routers in the same Area. Every router in the same Area will create an adjacency with the DR and BDR (analysed below).

The DR sends updates to all Area routers using the Multicast address 224.0.0.5. All OSPF routers except the DR use Multicast address 224.0.0.6 to send Link State Update (LSU) and Link State Advertisements (LSAs) packets to the DR.

Backup Designated Router (BDR): The BDR is a router that becomes the DR should the existing DR fail. The BDR has the second highest priority (the DR having the highest priority) in the OSPF network. When the BDR becomes a DR, a new election is made to find a new BDR.