Border Gateway Protocol- Implementation

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Abstract: An Interior Gateway Protocol (IGP) is used or configured on routers belonging to a single Autonomous System (AS). An Autonomous System (AS) is a collection of routers, whose prefixes and router policies are under common administrative control. IGPs like OSPF, RIPv1 and v2, EIGRP etc… are configured within an AS. But the internet is a collection of interconnected Autonomous Systems (ASs). BGP (Border Gateway Protocol) which is an Exterior Gateway Protocol (EGP) was built to route between AS's. BGP is considered to be a "Path Vector" routing protocol unlike IGP's which follow distance vector or Link-State routing protocols. In this paper we connect two or more Autonomous Systems using EBGP between the border routers. Before establishing BGP connection the routers within the AS must be configured with IGP such as OSPF. We also configure IBGP within the Autonomous System and eventually differentiate between EBGP and IBGP. The concept of synchronization is practically implemented and explained. We also stress on establishment of BGP neighborship or BGP Peers (IBGP and EBGP peers). BGP peer messages like OPEN, KEEPALIVE, UPDATE and NOTIFICATION messages are explained in brief.

Keywords: Interior Gateway Protocol (IGP), Exterior Gateway Protocol (EGP), OPEN, KEEPALIVE, UPDATE and NOTIFICATION messages.

I. INTRODUCTION

Internet is not actually a network of computers, but of a network of computer networks or Autonomous Systems (AS) [1].
The Border Gateway Protocol (BGP) is the fundamental protocol to move packets on the internetwork. BGP is the routing protocol of choice on the internet.

BGP has the following characteristics and used in the following cases
- Generally used in ISP or web hosting companies to provide for multiple ways to get in and out of the network.
- Helps in redundancy and load balancing
- It is an Exterior Gateway Protocol and is used to connect different Autonomous System unlike IGPs which are configured within an AS.
- Router ID or a loopback interface is used to source out BGP packets.
- BGP Autonomous System are assigned an Autonomous System Number (ASN) by IANA, which is a 16-bit number ranging from 1- 65535 and the range 64512- 65535 has been reserved for private use.
- BGP utilizes TCP for reliable transfer of its packets, on port 179, and it needs something to run on top off generally an IGP or static routing.
- There are three tables- Neighbor Table, BGP table and Routing table. Second best path goes into the BGP table. There are 2 types of BGP neighbors- EBGP and IBGP neighbors/peers. BGP neighbors connecting separate AS's are called EBGP Peers.

II. BGP ATTRIBUTES

1. Well known attributes – must be supported by every BGP implementation
2. Mandatory attributes- must be included with every route entry. Any one of the attribute missed would result in an error message.
3. Discretionary attributes- every BGP routes must recognize, but not necessary to be presented with every route entry, like in mandatory attributes.
4. Optional attributes- not necessarily supported by all BGP implementations.

III.   BGP ROUTE SELECTION PROCESS

1) Prefer highest weight (local to router)
2) Prefer highest local preference (global within AS)
3) Prefer route originated by the local router
4) Prefer shortest AS path
5) Prefer lowest origin code
6) Prefer lowest MED
7) Prefer EBGP over IBGP
8) Prefer the path through the closest IGP neighbor
9) Prefer oldest route for EBGP path
10) Prefer thee path with the lowest neighbor BGP router ID

Table 1 shows several specific BGP attributes [4].

Sl no	Attribute	Description	Code
1.	AS-path	Identifies the list (or path) of traversed AS's to reach a specific destination	Code 2
2.	Next Hop	Identifies the next hop IP address to reach a particular destination	Code 3
3.	Origion	Identifies the originator of the route	Code 1
4.	Local Preference	Preference to determine the best path for outbound traffic	Code 5
5.	Atomic Aggregate	Identifies routes that have been summarized	Code 6
6.	Aggregator	Identifies the BGP routes that performs an address aggregation	Code 7
7.	Community	Tags routes that share common characteristics into communities	Code8
8.	MED	Provides a preference to eBGP peers to a specific inbound router	Code9
9.	Weight	Cisco Proprietary	-

IV.   NETWORK

A.   Topology

We consider 2 Internet Service Providers (ISPs) - ISP A and ISP B. ISP A is active in business and is providing internet access to many areas or regions within a metro. It may include homes, corporate offices, small or medium businesses, mega or super market etc… ISP B is a contender in the ISP market to ISP A. Suppose ISP A and ISP B sign a business pact or treaty to share the services and infrastructure, there arises a need to connect these to ISPs. Border Gateway Protocol (BGP) is used to do so. Figure 1 shows the sample network of the above situation and the implementation of EBGP between Border routers of AS 500 and AS 700. ISP A and ISP B exist within AS 500 and AS 700 respectively and run IGP such as EIGRP or OSPF [2] before EBGP or IBGP configuration on the routers.

B.   Steps in configuration

i. IP address selection & assignment and creating interface loopbacks.
ii. Configuration of IGP – OSPF on the routers belonging to AS 500 and AS 700.
iii. To configure BGP on all the routers with synchronization and auto summary disabled.
iv. Establish BGP neighborship [5].
v. The synchronization rule states that – "do not advertise or receive BGP routes from/ to an IBGP neighbour until those routes are available in the IGP table [3] (Routing table). Since there is no IGP protocol being running you need to disable synchronization". Figure 2 and 3 shows the above 2 steps being implemented on the network.
vi. To configure route reflectors [5].
vii. To configure update – source loop back.
viii. Policy routing configuration.
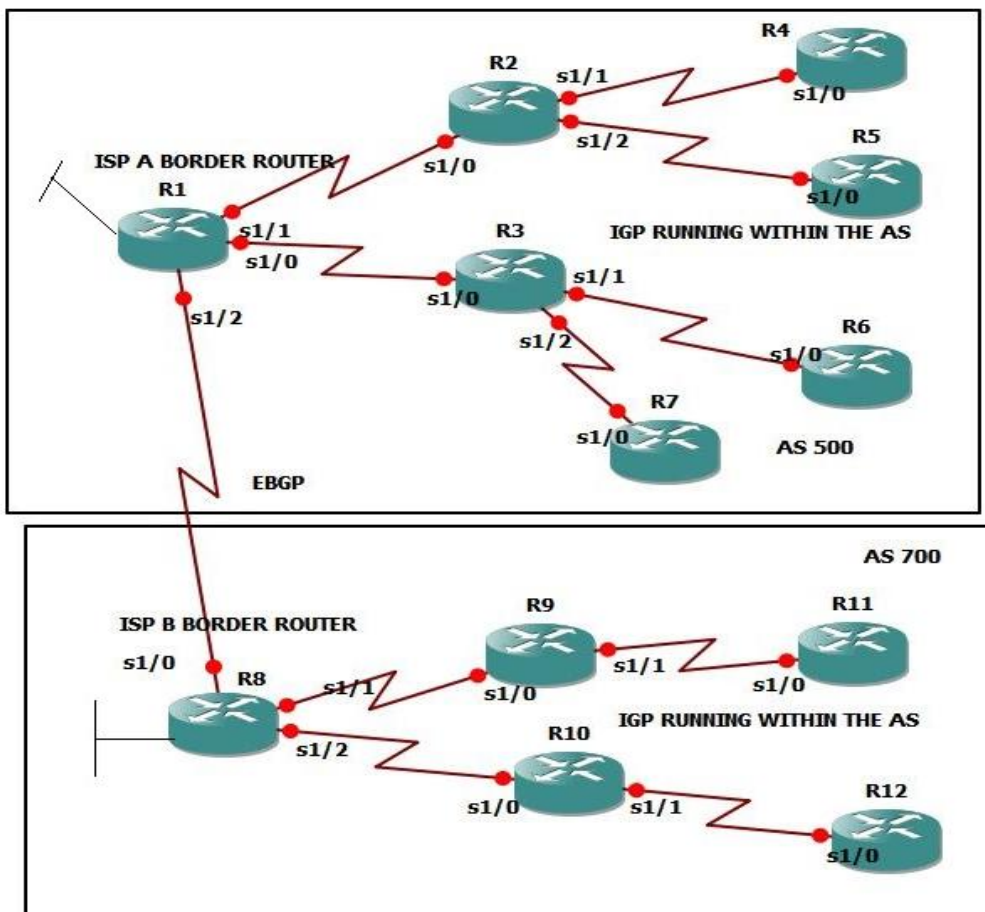ix. The above 3 steps will be dealt with in detail in the next paper.

Figure (1) shows the sample network of the above situation and the implementation of EBGP between Border routers of AS 500 and AS 700.

Figure 2 shows the commands for implementation of OSPF on a router.

Figure 3 shows the commands for establishing BGP neighborship.

V.   CONCLUSIONS

Border Gateway Protocol (BGP) is an Exterior Gateway Protocol (EGP) used to connect to Autonomous Systems (AS) with a specific Autonomous System Number (ASN). It is the protocol of the internet and is used to route the packets between two ISPs and also provide multiple ways to get in and out of the network. In this paper we have configured EBGP on the border routers between the two AS's. ISP A and ISP B with the ASN 500 and 700 respectively are two different Internet Service Providers. IGP runs on all routers within the AS and BGP between the two AS.

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