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Review on Enhanced Interior Gateway Routing Protocol

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Review on Enhanced Interior Gateway Routing Protocol

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I. Introduction

Routing means to select path in a network and forward a packet through the network to a device on a different network. Routing protocols play a vital role in computer network infrastructures. Routers know that how to find the remote network if a network is directly connected to the router but if network is not directly connected to the router then there are two ways to get to the remote network: Dynamic routing and Static routing. Static routing means to manually type all network locations into the routing table whereas dynamic routing protocols automatically inform all the routers about the event. Thus in large networks the combination of both static as well as the dynamic routing protocol are used. IP routing is to move the packets from one network to another network by using routers. There is a difference between routed protocol and routing protocol. Routers use routing protocol to dynamically find all the networks in the internetworks and ensure that all routers have the same routing table. Routing protocol also determines the path of a packet through an internetwork. Some of the examples of routing protocol are RIP, EIGRP, OSPF. Whereas, routed protocol is used to send packets through the established enterprise. Examples of routed protocol are IP and IPv6. To route a packet the router must know the following:

- Destination address.
- Neighbor routers which tells about remote networks.
- Routes possible to all remote networks.
- Determines the best route to each remote network.
- How to verify and maintain routing information.

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II. Classification of Routing Protocols

a) Distance Vector Routing Protocol

This protocol finds the best path to a remote network by determining the distance. In this every time packet travels through a router which is named as a 'hop'. The route that has the least number of hops is considered as the best route. The direction of the network is indicated by using the vector. RIP and IGRP is the distance vector routing protocols which sends the entire routing table to directly connected neighbors.

- RIP (Routing Information Protocol): In this the best path to a network is determined by using only hop counts. But if more than one link with same hop count to the network is obtained then RIP automatically perform a round-robin load balancing. RIP can consider up to six equal-cost links. The disadvantage of this protocol is that the problem arises when the two links to a remote network have the different bandwidth but same hop counts.
- IGRP (Interior Gateway Routing Protocol): It is the protocol which is used in large networks. It uses an autonomous system number for activation and gives a full route table update after every 90 seconds. It uses use the bandwidth and delay as a metric to determine the best route to an internetwork. IGRP has the maximum hop count of 255(default as 100). IGRP is no longer supported by the Cisco.

b) Link-State Routing Protocol

In this the routers maintain the three separate tables. One table keeps the record of directly connected neighbors, one determines the topology of the entire internetwork and one is considered as the routing table. Link state protocol sends the updates which contains the state of their own links of the other routers on the network. One of the examples of link state protocol is OSPF which is completely Link state.

- *OSPF (Open Shortest Path First):* It is an open standard routing protocol which can be implemented by number of vendors, including Cisco. OSPF use the Dijkstra algorithm which firstly constructs the shortest path tree then populates the routing table with the resulting best paths. OSPF converges quickly and also supports multiple, equal –cost routes to the same destination. Various features of OSPF are:

- Area and autonomous system
- Minimizes routing update traffic
- Scalability
- Supports VLSM/CIDR
- Unlimited hop counts

c) Hybrid Routing Protocol

Hybrid routing protocol use the characteristics of both distance vector and link state routing protocol. One of the examples of hybrid routing protocol is EIGRP.

- *(EIGRP)Enhanced Interior Gateway Routing Protocol:* It is a proprietary Cisco protocol that runs on Cisco routers. It is the most popular routing protocol which is used these days. EIGRP is a classless, enhanced distance- vector protocol as compare to the other Cisco proprietary protocol like IGRP. It is an independent system which describes the set of contiguous routers that run the same routing protocol and share routing information. In EIGRP while designing a network the subnet mask in its routes updates is included and thus advertisement of subnet information allows us to use variable length subnet masks (VLSMs) and summarization which is impossible in IGRP. EIGRP is also considered as Hybrid Routing Protocol as it has the characteristics of both distance-vector as well as the link-state routing protocol. It sends traditional distance-vector updates containing information about the network and the cost of reaching them from the aspect of advertising router unlike OSPF. It act as link-state also as it synchronizes routing tables between neighbors at startup and then sends specific updates only when topology changes occur. Thus EIGRP is suitable for very large networks. EIGRP can load-balance up to four equal-cost links. But while configuring it is determined that EIGRP can load-balance across up to six equal-/unequal cost links to a remote network. Various terms used in EIGRP are:
- Neighbor Discovery: EIGRP routers must become neighbors to exchange the routes with each other. To establish the neighbor ship three conditions that are considered are Hello or ACK received, AS numbers match and Identical metrics (K values).
- Feasible distance: It is considered as the best metric among all paths to a remote network, also includes the metric to the neighbor which advertises the remote network. This route is considered as the best path and is available in the routing table. The metric of a feasible distance is the metric reported by the neighbor and the metric to the neighbor reporting the route.
- *Reported/advertised distance:* The neighbor that reports the metric of a remote network is known as the advertised distance. It is also defined as the routing table metric of the neighbor.
- *Feasible successor:* The path whose reported distance is less than the feasible distance is the feasible successor. It also considers the backup routes. It maintains six feasible successors in the topology table and only one best metric (the successor) is copied and placed in the routing table.
- *Successor:* A successor route is the best route to a remote network which is used by EIGRP to forward traffic to a destination and is then stored in the routing table. Feasible successor routes are backed up in the routing table only if one is available. The feasible distance and the feasible successors in the topology table as backup links are used to converge network instantly, and updates to any neighbor are the only traffic sent from EIGRP.

Characteristics of EIGRP are classified as

- Backup Routes: EIGRP is the only routing protocol that supports backup routes. As in other routing protocols like OSPF, loose its best route in a network due to some failure then it has to broadcast for a help whereas EIGRP simply look at its backup routes which are maintained in the topology table.
- Simple Configuration: EIGRP considers the best of both distance-vector and link-state routing protocol. Thus from the distance vector routing protocols it attains the ease of configuration.
- Flexibility of Summarization: This means to summarize anywhere in the network rather than having the specific routers that do summarization. It is wide open to summarize while designing.
- Unequal Cost Load Balancing: No other routing protocol does it. EIGRP can take unequally load distribution by considering the metric calculations.
- Supports Multiple Networks Protocol: EIGRP can replace Novell RIP and Apple Talk Routing Table Maintenance Protocol (RTMP), serving both IPX and Apple Talk networks with powerful efficiency.

Three Tables of EIGRP

- Neighbor table: Each router maintains the state information of the adjacent neighbors. When a newly discovered neighbor is discovered, the address and interface of the neighbor is recorded, and this information is available in the neighbor table, which is stored in RAM. Each protocol-dependent module has one neighbor table. Update packets are matched to the acknowledgements by using the sequence numbers. The last sequence number received from the neighbor is recorded so that out-of-order packets can be detected.
- Topology table: The topology table is occupied by the protocol-dependent modules and acted upon by the Diffusing Update Algorithm (DUAL). All

destinations are maintained in the routing table that are advertised by neighboring routers and also holds the each destination address and a list of neighbors that are advertised to the destination. The advertised metric value of each neighbor is recorded. When neighbor advertises the destination, then it must use the route to forward packet.

- Routing table: EIGRP selects the best routes to a destination from the topology table and place these routes in the routing table.

III. Methodology

- Diffusing Update Algorithm (DUAL): EIGRP uses Diffusing Update Algorithm (DUAL) which selects and maintains the best path to each remote network. DUAL provides the fastest route convergence time to EIGRP as compare to other protocols. The two factors of EIGRP which provide speedy convergence are: Firstly, In EIGRP routers a copy of all of their neighbors' routes are maintained, which is used to calculate their own cost to each remote network. If the best path fails or goes down, it simply as examine the contents of the topology table for selecting the best replacement route. Secondly, if better alternative is not available in the local topology table, then EIGRP routers very quickly ask their neighbors for help to find the one. DUAL is meant to select and maintain information about the best paths.
- Summarization: EIGRP summarizes the network automatically at their classful boundaries. EIGRP also creates the manual summaries at any and all EIGRP routers which significantly reduces the size of the route table. Figure1. shows that how EIGRP routers see that network and the boundaries are auto summarized.

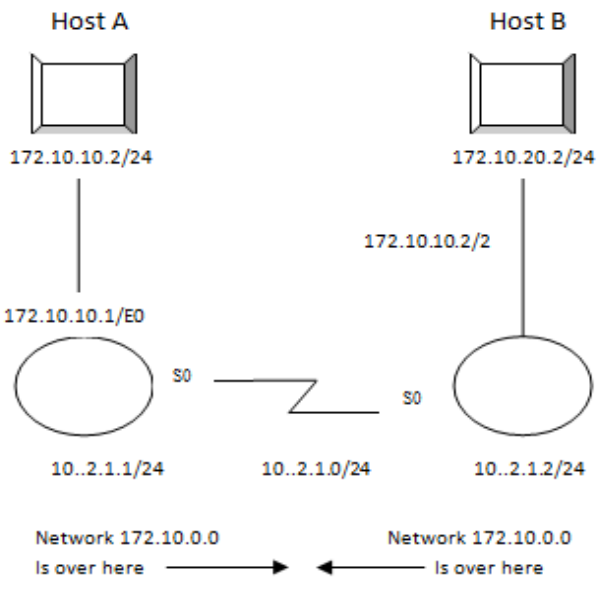

Figure 1 : Auto Summarization

- *EIGRP Metrics:* Unlike other protocols that use a single factor to compare routes and select the best possible path, EIGRP can use a combination of Bandwidth, Delay, Load, Reliability, MTU. Formula Used for default Metric Calculation: **Metric= 256*(BW + Delay)**
- *Stubbing:* Stubbing is used to improve the network stability, reduces resource utilization, and also to simplify the stub router configuration.

Table 1 : Comparison between RIP, OSPF and EIGP as in [10]

Protocol	RIP	OSPF	EIGRP
Type of protocol	Distance vector	Link –State	Hybrid
Knowledge of network topology	None	Maintain stable with complete knowledge of each area	Maintains limited topology table
Routing updates	Complete routing table sent to all neighbors every 30 seconds	Incremental updates sent to all routers in an area when necessary	Incremental updates sent to affected routers when necessary
Sends acknowledgements after receiving routing updates	No	Yes (LSAck packet)	Yes (ACK packet)
Convergence	Slow	Fast	Fast
Prone to routing loops	Yes	No	No
Supports VLSMs	No	Yes	Yes
Supports route summarization on arbitrary boundaries	No	Yes	Yes
Supports hierarchical routing	No	Yes	Yes
Proprietary to Cisco	No	No	Yes
Supports multiple protocols	No	No	Yes

IV. Conclusion

In this paper, the taxonomy of routing protocol is discussed and also classifies the different routing protocols. From the whole it is concluded that Distance vector routing protocol finds which sends the entire routing table to directly connected neighbors whereas link state routing protocols maintain the three tables.

Hybrid protocol considers the best of both above mentioned routing protocols. Thus hybrid routing protocol that is EIGRP is the best of other routing protocols like OSPF and RIP. But sometimes it is seen that while configuring EIGRP is not able to achieve maximum efficiency due its some in-built features.

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