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Analysis of RIP, EIGRP, and OSPF Routing Protocols in a Network

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ABSTRACT

There are many routing protocols out there today, some old and some new, but all are used for the same purpose. In general, to ideally select routes between any two nodes on a computer network and disseminate information. Routing of data packets is one of the important process in the internet. A routing protocol specifies the method of communication among routers used in the inter connection of networks. This paper takes into consideration three of such routing protocols (RIP, OSPF, and EIGRP), expresses them and analyzes their way of operation. In this paper, we have analyzed and simulated a proposed Local Area Network using different routing protocols. So, configuration of these different routing protocols are done using CISCO packet tracer simulator.

KEYWORDS: *RIP, EIGRP, OSPF, Cisco Packet Tracer*

1. INTRODUCTION

There are many routing protocols out there today, some old and some new, but all are used for the same purpose. In general, to ideally select routes between any two nodes on a computer network and disseminate information.

Each routing protocols have their own algorithm and have difference in performance basically. Three typical types of routing protocol are chosen as the simulation samples: RIP, OSPF and EIGRP. RIP (Routing Information Protocol) is one of the oldest routing protocols still in service. Hop count is the metric that RIP uses, and the hop limit limits the network size that RIP can support.

OSPF (Open Shortest Path First) is the most widely used IOSPF is based on the Shortest Path First (SPF) algorithm which is used to calculate the shortest path to each node. EIGRP Enhanced Interior Gateway Routing Protocol) is Cisco's proprietary routing protocol based on Diffusing Update Algorithm [4].

A routing protocol is the language a router speaks with other routers in order to share information about the reachability and status of network. It includes a procedure to select the best path based on the reachability information it has and for recording this information in a route table. Regarding to select the best path, a routing metric will be applied and it is computed by a routing algorithm [8].

A metric is a variable assigned to routers as a means of ranking them from the best to worst or from most preferred to least preferred [9]. Different routing protocols have different metrics. When there is more than one route between two nodes, a router must determine a method of metrics by choose the routing protocol to calculate the best path.

2. CLASSIFYING ROUTING PROTOCOLS

The classification of routing protocol is depicted in below. Where there is some dynamic routing protocol can be used to configuring routing tables in the router. There is Interior Gateway Protocol (IGP) than should be used for the routers in same domain network such as Routing Information Protocol (RIP), Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF) and ISIS (Intermediate System – Intermediate System). And for the routers in different domain network, Exterior Gateway Protocol (EGP) can be used such as Border Gateway Protocol (BGP). For the router in the same domain network, there are two types of dynamic routing protocols that can be used on computer networks, namely distance vector and link-state routing protocols.

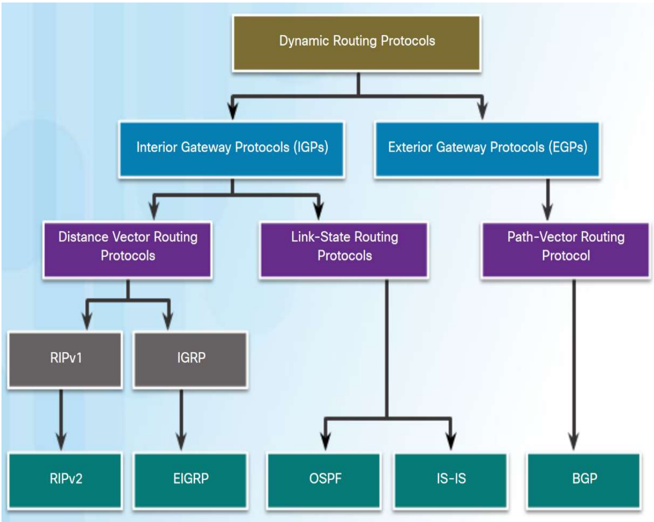

Figure1. Routing Protocol Classification

2.1. Distance Vector Routing Protocols
Distance vector means that routes are advertised by providing two characteristics: Distance - Identifies how far it is to the destination network based on a metric such as hop count, cost, bandwidth, delay.

Vector - Specifies the direction of the next-hop router or exit interface to reach the destination.

Example. RIPv1 (legacy), RIPv2, IGRP Cisco proprietary (obsolete), EIGRP

2.1.1. Routing Information Protocol (RIP)
The RIP is a distance-vector routing protocol that is based on the Bellman-Ford algorithm and uses hops as a routing metric. It is easy to configure. Routing updates broadcasted 255.255.255.255 every 30 seconds. Metric is hop count, the maximum number of hops allowed are 15, which limits the size of networks RIP can support.

RIV2 is the classless routing protocol that supports VLSM and CIDR. Increased efficiency sends updates to multicast address 224.0.0.9. Reduced routing entries supports manual route summarization and secure supports authentication. RIPng supports IPv6 enabled version of RIP and 15 hop limit and administrative distance is 120.

2.1.2. Enhanced Interior-Gateway Routing Protocol (EIGRP)

Characteristics and Features	IGRP	EIGRP
Metric	Both use a composite metric consisting of bandwidth and delay. Reliability and load can also be included in the metric calculation.	
Updates Forwarded to Address	255.255.255.255	224.0.0.10
Supports VLSM	✗	✓
Supports CIDR	✗	✓
Supports Summarization	✗	✓
Supports Authentication	✗	✓

EIGRP replaced IGRP in 1992. It includes the following features:
Bounded triggered updates – sends updates only to routers that need it. Hello keepalive mechanism - Hello messages are periodically exchanged to maintain adjacencies. Maintains a topology table - maintains all the routes received from neighbors (not only the best paths) in a topology table. Rapid convergence – because it maintains alternate routes. Multiple network layer protocol support – uses Protocol Dependent Modules (PDM) to support layer 3 protocols.

2.2. Link-State Routing Protocols
A link-State router uses the link-state information received from other routers: to create a topology map and to select the best path to all destination networks in the topology. Link-state routing protocols do not use periodic updates. Updates are only sent when there is a change in the topology.

Both of the following Interior Gateway Algorithms (OSPF and IS-IS) are based on the Dijkstra algorithm.

2.2.1. Shortest Path First Protocols (OSPF)
Link-state routing protocols, also known as shortest path first protocols, are built around Edsger Dijkstra's shortest path first (SPF) algorithm. IPv4 Link-State routing protocols:

A. Open Shortest Path First (OSPF)
B. Intermediate System-to-Intermediate System (IS-IS)
Dijkstra's Algorithm, all link-state routing protocols apply
Dijkstra's algorithm (also known as shortest path first (SPF)) to calculate the best path route:

A. Uses accumulated costs along each path, from source to destination.
B. Each router determines its own cost to each destination in the topology.

2.3. Routing Protocol Metrics
A metric is a measurable value that is assigned by the routing protocol to different routes based on the usefulness of that route. Routing metrics are used to determine the overall "cost" of a path from source to destination. Best path is route with the lowest cost. Metrics used by various dynamic protocols:

- RIP – Hop count
- OSPF – Cost based on cumulative bandwidth
- EIGRP - Bandwidth, delay, load, and reliability.

2.4. Routing Protocol Characteristics

	Distance Vector				Link State	
	RIPv1	RIPv2	IGRP	EIGRP	OSPF	IS-IS
Speed of Convergence	Slow	Slow	Slow	Fast	Fast	Fast
Scalability - Size of Network	Small	Small	Small	Large	Large	Large
Use of VLSM	No	Yes	No	Yes	Yes	Yes
Resource Usage	Low	Low	Low	Medium	High	High
Implementation and Maintenance	Simple	Simple	Simple	Complex	Complex	Complex

3. COMPARATIVE STUDY OF RIP, OSPF & EIGRP

Protocols Comparison				
Feature	**RIP- V1**	**RIP- V2**	**OSPF**	**EIGRP**
Type	Distance Vector	Distance Vector	Link State	Hybrid
Algorithm	Bellman-ford	Bellman-ford	Dijkstra	DUAL
Class full/ Classless	Class full	Class less	Classless	Classless
Metric	Hop Count	Hop Count	Cost	Bandwidth/ Delay
Timers Update (Hello/Dead)	30 sec	30 sec	Triggered when network charge occurs, send periodic update LSA refreshes every 30 minutes	Triggered (LAN3/15,WAN 60/180)
Administrative Distance	120	120	110	Internal 90 External 170

Authentication	No	Yes	MD5 Authentication	MD5 Authentication
Hop Limit	15	15	224	None
Convergence	Slow	Slow	Fast	Very Fast
Type of Updates	Full table	Full table	Only Changes	Only Changes
Support VLSM	No	Yes	Yes	Yes
Network Size	Small	Small	Large	Large
Split Horizon Sensitive	No	No -	Yes	Yes
Area Types	-	-	Backbone, stubby, Not so-stubby, totally stubbing	-

Table1. Comparison of RIP, EIGRP, OSPF

4. CONFIGURATION USING CISCO PACKET TRACER

Cisco Packet Tracer is a multitasking network simulation software that can be used to perform and analyze various network activities such as implementation of different topologies, selection of optimum path based on various routing algorithms, creation of appropriate servers, subnetting, and analysis of various network configuration and troubleshooting commands. Cisco Packet Tracer is a powerful network simulation that allows educates to experiment with network behavior and ask "what if" queries. In this work we have configured the network using various dynamic configuration protocols such as RIPv2, EIGRP and OSPF.

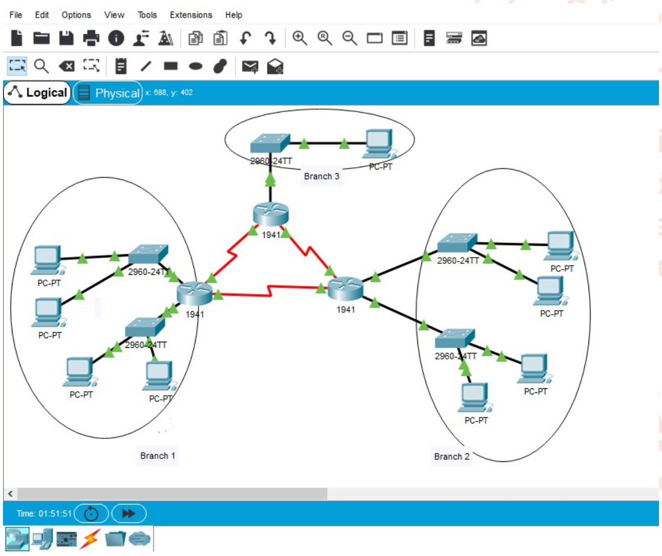

Figure1. Topology using Different Networking Devices

4.1. Configuration on Router Branch 1 Using RIPv2 Protocol

router rip
version 2
network 172.16.1.0
network 172.16.2.0
network 172.16.5.0
network 172.16.6.0
no auto-summary

4.2. Configuration on Router Branch 2 Using RIPv2 Protocol

router rip
version 2
network 172.16.3.0
network 172.16.4.0
network 172.16.5.0
network 172.16.7.0
no auto-summary

4.3. Configuration on Branch 1 Using EIGRP Protocol

router eigrp 1
network 172.16.1.0
network 172.16.2.0
network 172.16.5.0
network 172.16.6.0

4.4. Configuration on Branch 2 Using EIGRP Protocol

router eigrp 1
network 172.16.3.0
network 172.16.4.0
network 172.16.5.0
network 172.16.7.0

4.5. Configuration on Branch 1 Using OSPF Protocol

router ospf 10
router-id 1.1.1.1
network 172.16.1.0 0.0.0.255 area 0
network 172.16.2.0 0.0.0.255 area 0
network 172.16.5.0 0.0.0.3 area 0
network 172.16.6.0 0.0.0.3 area 0
passive-interface GigabitEthernet0/0

4.6. Configuration on Branch 2 Using OSPF Protocol

router ospf 10
router-id 2.2.2.2
network 172.16.3.0 0.0.0.255 area 0
network 172.16.4.0 0.0.0.255 area 0
network 172.16.5.0 0.0.0.3 area 0
network 172.16.7.0 0.0.0.3 area 0
passive-interface GigabitEthernet0/0

4.7. Configuration on Branch 3 Using OSPF Protocol

router ospf 10
router-id 3.3.3.3
network 172.16.6.0 0.0.0.3 area 0
network 172.16.7.0 0.0.0.3 area 0
network 172.16.8.0 0.0.0.255area 0
passive-interface GigabitEthernet0/0

4.8. Summary of Comparison

Routing plays an important role to determine the efficiency of network communication. The routing protocols operate the following steps:

- To receive and send information about the network.
- To find the best path to a destination and install the route in the routing table.
- To detect, react and inform to other devices about changes in the network topology.

CONCLUSION

In this work the network is demonstrated using the simulator Cisco packet Tracer, with various routing protocols. Routing protocols have a big role in network communication. Different protocols have different criteria and performance as we can see from the above comparison. RIPv2 protocol is suitable for small network and EIGRP is best for fast convergence, although it is a Cisco proprietary protocol. And OSPF is suitable for a very large network which does not have a maximum hop limit. After comparison we find that the best protocol is EIGRP because it provides better performance than RIPv2 and OSPF, in terms of fast convergence time. While comparing OSPF and RIP, OSPF dominates RIP in terms of average throughput and instant delay in different size of network. For the routing traffic the OSPF was the one with the most traffic sent and was the last one to send routing traffic on the other hand EIGRP was the first one to send traffic but RIP protocol had the least traffic as it sends only the number of hops.

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