A COMPARATIVE ANALYSIS, THROUGH DIFFERENT CASE STUDIES, OF TWO ROUTING PROTOCOLS, RIPv1 AND RIPv2, REGARDINGRUOTE SUMMARIZATION

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Abstract

Nowadays the data transmission networks, that we use daily, spread in a range form small and local networks to big and global ones. Therefore, network architecture is becoming more and more complex and requires more advanced mechanisms to be administered. The dynamic routing protocols are used in networks relatively large and attempt to minmimize the administrative and operational overhead that is injected through static routes.

The Routing Information Protocols (RIP) are some distance-vector routing protocols, which employ the hop count as a routing metric. RIP prevents routing loops by implementing a limit on the number of hops allowed in a path from the source to a destination. Theese routing protocols, RIPv1 and RIPv2, are two important dynamic routing protocols because of the simplicity they offer. In this paper we have presented a comparative analysis for these protocols that are related with a mechanisnm called route summary. It is important to highlight that we are concentrated pretty much in the RIPv1 protocol whereas about RIPv2 we have introduced the advantages that it has against RIPv1.

The survey in question makes e general presentation of the two protocols as well as handles some network topologies composed from Cisco routers and switches. Also, the correspoding configurations are made based on the Cisco IOS operating system. In these topologies are given some concrete case studies regarding the RIPv1's attribute to aggregate the different routes basing in the classes of IP addresses.

Finally the necessary comparative conclusions regarding these two protocols have been given.

Keywords: *dynamic routing protocols, RIP, distance vector, route summarization, Cisco IOS*

1. Introduction of dynamic routing protocols

A routing protocol consists in a set of processes, algorithms and messages that are used to exchange routing information and to populate the router's routing tables, in order to choose the best paths.

The dynamic routing protocols are used to facilitate the exchange of routing information between the routers. They allow to the routers that, in a dynamic context, to share the information about the remote networks and automatically to put this information in the routing tables.

The routing protocols define the best path toward every networks which, then, is added in the routing table. One of the most important advantages of using routing protocols is that the routers exchange routing information every time there are changes in the topology. This exchange let the routers to learn about any new network and also to find the best alternative paths in case of any failure in any actual network connection.

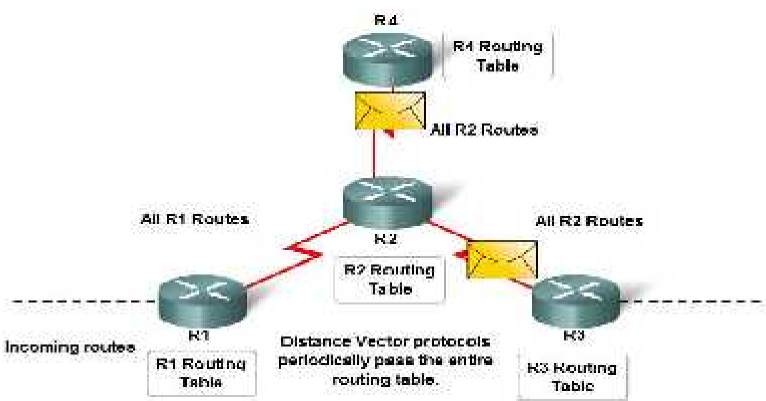
Comparing with the static routing, the dynamic routing protocols require less administrative overhead. However the cost of using e dynamic routting protocol is in consuming the router's resources: CPU time and the network bandwith. Regardless of the benefits of the routing protocols, the static routing has its own advantages: minimal processing from the CPU, simple configuration, etc. So, there are some cases when the static routing is more suitable then the dynamic routing, but there are cases when the dynamic routing protocols are required. However the most frequent case is the combination of static routing and dynamic routing protocols.

1.1 The Distance-Vector protocols

The term distance-vector means the the routes are advertised as e vector of distance and direction. The distance is defined in the terms of a certain metrics such as the hop-count whereas the direction is simply the next-hop router or the outbound interface. Usually, the distance-vector protocols use the Bellman-Ford algorithm to define the best path.

Some distance-vector routing protocols send, periodically, full routing tables toward neighbors that are directly connected with the the router in question. In the large networks, these routing updates can become pretty large causing the traffic to increase in the connection.

Figure 1. Distance-Vector operation



We must highlight that, although the Bellman-Ford algorithm accumulates pretty capacity to maintain the database of the networks, this algorithm does not allow the router to recognize exactly the topology of a internetwork. The router simply recognizes the routing information that receives from its neighbors. The only information that the router knows about a remote network is the distance or the metric that is needed to reach that network as well as the path or the interface that is used to go there.

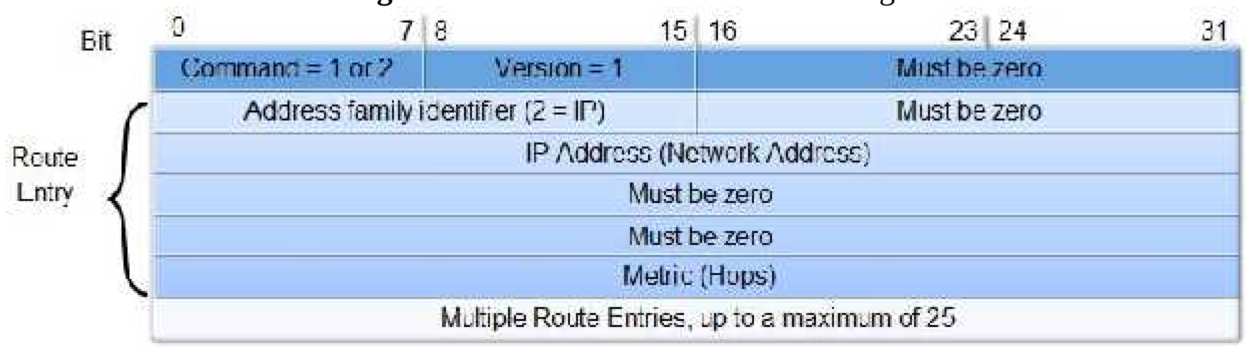
2. RIPv1 (Routing Information Protocol version 1)

The RIPv1 protocol is the oldest distance-vector protocol. Although the RIPv1 does not have advanced attributes, its simplicity and the the large use have affected in its longevity.
RIPv1 has these important attributes:

- RIPv1 is a distance-vector protocol
- RIPv1 uses the hop-count as e mteric to choose the best path
- The advertised routes, that have the hop-count greater than 15, are considered as unreachable
- The mesagges are sent as broadcast every 30 seconds

In the figure 2 we have shown the format of the RIPv1 mesagge

Figure 2. The format of the RIPv1 message



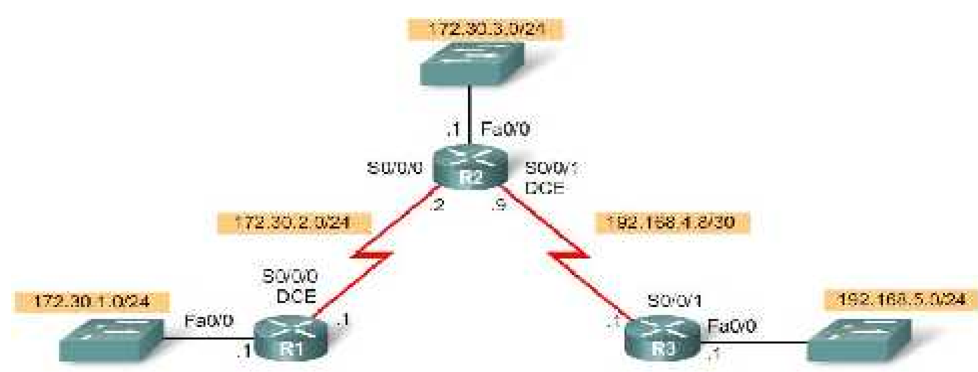
It is important to emphasize that RIPv1 is a classful routing protocol. This means that RIPv1 does not send subnet mask information in its updates. In the figure 2 we see notice that there is no subnet mask information included in the mesagge. Therefore, the router uses the subnet mask configured locally in an interface or applies the default subnet mask basing in the address class. Because of this limitation, the networks that use RIPv1 can not implement the VLSM (variable-length subnet mask).

2.1 Automatic Summarization – case study 1

Let consider the topology shown in the figure 3, where are used three classful networks:

- 172.30.0.0/16
- 192.168.4.0/24
- 192.168.5.0/24

Figure 3. A topology used for the study of the automatic summarization– case study 1



The network 172.30.0.0/16 is divided in three subnetworks

- 172.30.1.0/24
- 172.30.2.0/24
- 172.30.3.0/24

The devices that take part in 172.30.0.0 are all interfaces in R1 and interface Fa0/0 and S0/0/0 in R2

As we know, RIPv1 is a routing protocol which automatically summarizes the classful networks through major network boundaries. In the above scenario, we see that the router R2 has interfaces in more than one classful network. This thing makes the R2 to be a boundary router i RIPv1. The intefaces s0/0/0 and Fa0/0 in R2 are all inside the 172.30.0.0 boundary. The interface s0/0/1 is inside the 192.168.4.0 boundary. Since the boundary routers aggregate the RIP subnets form one major network to the another, the updates for 172.30.1.0, 172.30.2.0 and 172.30.3.0 will be aggregated automatically in the 172.30.0.0 when sent in s0/0/1 interface of R2.

It is important to highlight that the RIP updates are governed from these rules

1. If one routing update and the inteface from which comes this update belong the same major (classful) network, then the netmask of the interface will be applied in the network that is in the update
2. If one routing update and the interface from which comes this upate belong different major networks, then the classful subnet mask will be applied in the network that stands in the routing update.

In the figure 3, R2 receive an update form the R1 and put this network in the routing table. So, in the R2's routing table will appear this output:

```
R    172.30.1.0 [120/1] via 172.30.2.1, 00:00:18, serial 0/0/0
```

How does R2 know that this subnet has a netmask /24 (255.255.255.0)?

R2 knows this because:

1. R2 receives this information in an interface that belongs to the same classful network (172.30.0.0)
2. The IP address for which the R2 router received the message (172.30.1.0 in 1 hop) was 172.30.2.2/24
3. R2 uses its own subne mask in this interface and applies it in all networks 172.30.0.0 that come in this interface.
4. The network 172.301.0/24 is added in the routing table

So, we can say that when an update is sent, the router R2 (boundary) will include the network address and the corresponding metrics. If any route entry is for one update that is sent outside a different major network, then the network address in the route will be aggregated in the classful or major network. This is exactly what the R2 router does for 192.168.4.0 and 192.168.5.0.

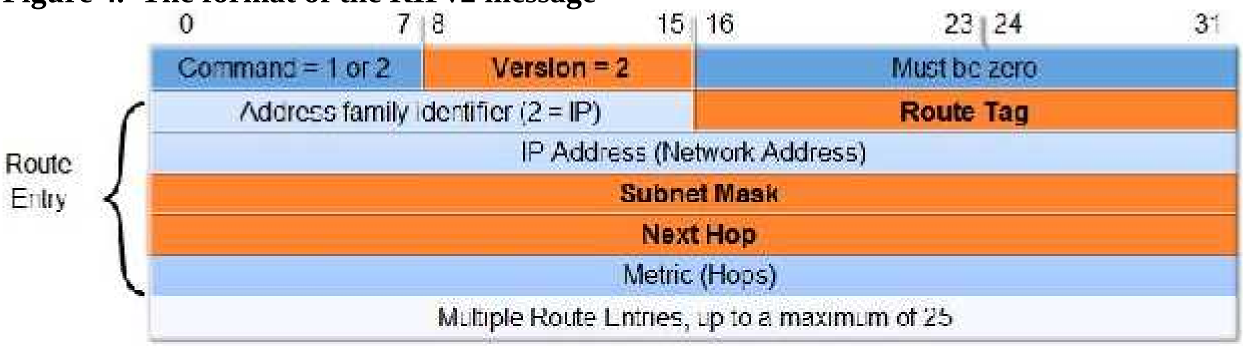
3. RIPv2 – an improvement of RIPv1

RIPv2 i a protocol defined in the RFC1723. As though RIPv1, RIPv2's basic features are similar; for example it is encapsulated in a UDP segment that uses the 520 port and can send up to 25 routes. However RIPv2 has two additive elements.

The first element in the message format of RIPv2 is the field of subnet mask that allows one 32-bit mask to be included in the RIP route entry. As a result, the receiving router does not depend anymore from dhe interface's netmask or classful netmask when defining this one for a route

The second significant element in the format of the RIPv2 message is the next-hop router address. This address is used to identify a better next-hop address (if there is one) than the address of the sender router. If we pit to this field only 0.0.0.0, then this means that the sender router is the best next-hop address. The format of the message of RIPv2 is hsown in the figure 4:

Figure 4. The format of the RIPv2 message



4. Conclusions and recommendations: advantages and disadvantages of Automatic Summarization

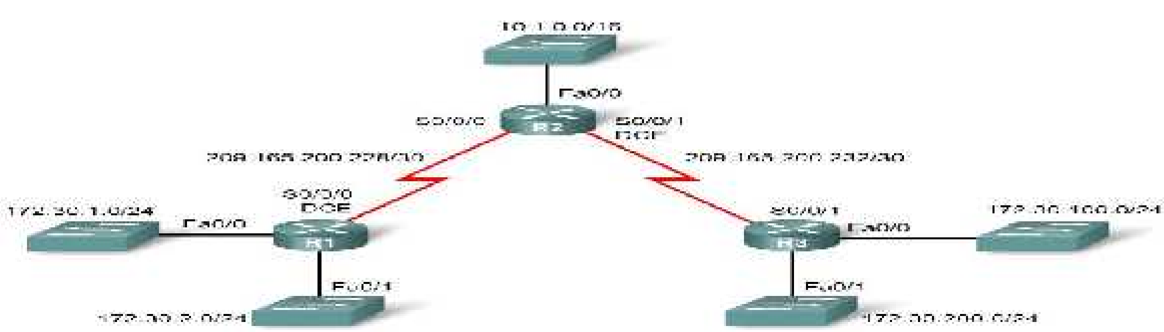
In the section 3, we already have seen that in the router R2 in the figure 3, RIPv1 automatically summarizes the updates between classful networks. Since the update 172.16. 0.0 is sent outside of an interface (s0/0/1) in another classful network (192.168.4.0), the router R2 sends an update for the all classful network, instead of one route for every different subnet.

Basing in the figure 3 we can say that the advantages of summarization are:

- There are smaller updates that are exchanged and consequently there is fewer usage of the bandwith.
- The router R3 has only one route for the network 172.30.0.0/16, regardless how many subnets there are ose how they are subnetted. The usage of only one route results in a faster process of lookup in the routing table for the router R3.

At the other side to observate the disadvantages let consider the topology below:

Figure 5. Topology for studying the disadvantages of auto-summarization – case study 2



As we can see, the addressing scheme has changed beside to the topology of the figure 3. This topology will be used to show 1 important disadvantage of the classful routing protocols such as RIPv1 (the lack of support for the discontiguous networks). The classful routing protocols does networks, since the receiving router is not capable to define the router's subnet mask. This happens because the receiving interface can have a different mask from the subneted routes.

We must emphasize that the routers R1 and R3 have both 2 subnets from the major network 172.30.0.0/16, whereas the router R2 does not. Essentially the routers R1 and R3 are boundary routes for the network 209.165.200.0/24. This division is called *discontiguous network.* So, the group 172.30.0.0/16 is a discontiguous network

However, we can say that these protocols that we analyzed such are that can't be implemented in very huge networks because there is a lack of enabling scalability. Also, another important factor is the performance of these protocols as well as their skill to utilize efficiently the data processing structures. In fact, these protocols are part of a very studied and consumed generation and consequently other protocols are recommended which offer scalability as well as maximal utilization of the data processing systems. Therefore, when it comes about relatively big networks we can recommend another types of protocols such as link-state protocols: OSPF (Open Shortest Path First), IS-IS, etc.

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