Performance Analysis of HSRP in Provisioning Layer-3 Gateway Redundancy for Corporate Networks

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Abstract

The network functionaries incorporate and core networks aim to provide 99.999% reliability to their networks. The most preferred way to achieve this is to provide dynamic routing to the network. If the router gateway is disrupted by port failure, network administrator should manually configure the route in which packets are being forwarded. By using Hot Stand Routing Protocol (HSRP), it simultaneously adapts new route, which provides redundancy to the network with reduced packet loss. In this paper, our aim is to calculate the difference in number of packets lost when router with gateway is disrupted in the network by combining HSRP with Open Shortest Path First (OSPF) protocol. By using this combined technique, we can reduce the packet loss to maximum extent thereby increasing the reliability. The simulation results provide best route when HSRP is combined with OSPF than the existing technique without HSRP.

1. Introduction

Network administrator aims to provide maximum reliability to its clients round the clock. But sometimes default gateway for the given network will be disrupted due to IP traffic. In a network without Hot Stand Routing Protocol (HSRP), manual assistance is required to adapt alternative path for forwarding packets which leads to packet loss in that duration. In such circumstances, HSRP protocol provides redundancy to the network to minimize packet loss. Open Shortest Path First (OSPF) is used as a dynamic routing protocol in this paper as it has high convergence rate and designate shortest path using Dijkstra's algorithm.

2. Hot Stand Routing Protocol

Routers

Hot Stand Routing Protocol (HSRP) protocol involves two types of routers:

2.1 Active Router

Active router is the one which is forwarding IP packets to the virtual router in first place. It shares same IP and Medium Access Control (MAC) address with the standby router.

2.2. Standby Router

Standby group acts as backup to the active router. If active router was disrupted due to planned are unplanned rea-

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sons, standby will provide gateway redundancy thereby providing robustness to the network.

3. Working

Even though many routers are available, only single router can forward the IP packets and rest of routers will form standby group. Both active and standby share same IP and MAC address. Standby group periodically sends hello messages to active router. If active router fails, standby will undertake duty of forwarding IP packets. During this transition, one of the routers from HSRP group will act as standby router.

4. Features

4.1 Preemption

Every router possesses priority number. If active router was disrupted, then router with highest priority will immediately undertakes duty of active router.

4.2 Preempt Delay

Preemption process will be delayed for specific time period in order to configure the router with routing table before becoming active router.

4.3 Interface Tracking

It enables another interface on the router for HSRP process to monitor the specified interface and to alter the given group priority if it goes down. If given interface goes down due to disrupted router, then it reduces priority of given group so that highest priority group will become active and undertakes duty of forwarding IP packets.

4.4 Advantages

- Easy to configure, the protocol does not affect the routing tables or hosts configuration.
- Traffic due to HSRP is minimal.

4.5 Limitations

- From security point of view, HSRP is very weak.

4.6 Dynamic Routing Protocol

Some IP hosts use dynamic routing protocols such as Routing Information Protocol (RIP) and Open Shortest Path (OSPF) in order to discover routes for forwarding IP packets. In this paper, we prefer OSPF to RIP as it has high convergence rate. Main advantage OSPF is that it only enter changes occurred in the routing table but not update entire routing table again and again.

5. OSPF

OSPF (Open Shortest Path First) is a link state routing protocol. It is an open standard and is implemented by a variety of network vendors. OSPF will run on most routers that don't necessarily have to be Cisco routers. Routers using OSPF have to establish neighbour relationships before exchanging routes. As OSPF is a link state routing protocol, it exchanges network topology instead of routing tables. Using SPF algorithm, it calculates best path and add them to the routing table

6. OSPF Routers

6.1 Backbone Routers

In Area 0, Backbone routers has one or more interfaces.

6.2 DR and BDR

Based on the network type, OSPF router can elect one router (BDR). These router acts as central point for exchanging OSPF information. Each non DR or non BDR will exchange information only with DR or BDR instead of exchanging updates with every router. DR then distributes information about topology there by reducing OSPF traffic. Router with highest priority acts as DR. if DR fails or disrupted, BDR will act as DR.

6.3 Area Border Router

ABR is located near the border between one or more OSPF areas making it arrival and departure point to distribute information to other area or backbone area itself thereby establishing a connection between them.

7. OSPF Authentication

OSPF provide authentication to every OSPF message. This is usually done to prevent false routing information from rogue router and therefore causing a Denial-of-service-attack. Two types of authentication can be used:

Clear text authentication: clear text passwords are used.

MD5 authentication.

8. OSPF Areas

OSPF areas are used to impose a hierarchy structure to flow of data over a network. Network using OSPF should have backbone area. It is a two level hierarchy consists of backbone area and all other areas. Areas are used to minimize OSPF traffic. Routers present in same area exchange information locally but summarize that routing information when advertising routes externally. Area Border Routers (ABR) are used to connect the areas. Each area has two routers Designated Router (DR) and Backup Designated Router (BDR)

8.1. Backbone Area

It is main area in network using OSPF and it is always area 0. All others directly connected with Backbone Area. Network should ensure that there is zero possibility for backbone area to be separated by any router. If it splits, Areas with more size can be unreachable.

8.2 Totally Stub Area

This area has only connection with backbone area. The only route it receives is a default route from external area it must be backbone area. It allows totally stub area to communicate with rest of the network.

8.3 Stub Area

Stub areas are only connected with backbone areas. It don't receive information from outside of autonomous system but it receives information within autonomous system

8.4 Virtual Links

These links are used when you have a network to make connection with existing OSPF system, but cannot be physically connected directly with routers in backbone area. OSPF virtual link can be established by making direct virtual connection with routers in backbone area.

8.5 Metrics

OSPF uses cost as metrics means it provides best path for forwarding packets in accordance with cost. Path that requires low cost will be selected in first place. It uses 100 Mbps as reference bandwidth for cost calculation. For example,
10 Mbps cable will cost 10.

9. Convergence Scheme

OSPF converge route from to another in fraction of seconds and it is faster when compared to other protocols; this was one of the main features included within its initial design. To keep this desirable feature fully functional in your network, you need to consider the three components that determine how long it takes for OSPF to converge:

- The time period needed by OSPF to detect a link or interface failure.
- The length of time it takes the routers to exchange routing information via Link State Algorithms (LSAs), rerun the Shortest Path First algorithm (SPF) and build a new routing table.

9.1 Advantages

- It will run on more routers as it is a open standard.
- It provides loop free topology by using SFP.
- It provides high convergence rate.

9.2 Disadvantages

- It is complex to configure and to troubleshoot.
- It requires heavy CPU processing to run SPF.

10. Topology

We use CISCO PACKET TRACER for simulation purpose. By using topology, we will calculate amount of packet loss in particular interval of time. We compare results by using HSRP in one case and without HSRP

in another. By using ping command we can evaluate the amount of packet loss occurred and by using tracert command we can find the route in which packets are forwarded.

10.1 Without HSRP

We constructed topology without using HSRP as shown in Figure 1 and ping result is given in Figure 2.

In the Figure 3, one of gigabit Ethernet connection of R4 is disconnected and we will find out packet loss percentage due to change in topology.

We run Figure 3 by using ping command the result is shown in Figure 4.

It is observed from Figure 4, when default gateway is disrupted in network topology, packet loss is more as it can't designate another route without manual assistance. Figure 3 topology provides single route for forwarding packets and it can be traced using tracert command as shown in Figure 5.

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10.2 With HSRP

Topology with HSRP is constructed as shown in Figure 6. When we ping Internet Service Provider (ISP), the result is shown in Figure 7.

In the Figure 8, R1 acts as active router and R2 is standby router. R1 will forward packets and R2 acts as backup to R1. If R1 is disrupted, packet loss will not occur as R2 acts as a backup router.

In the Figure 8 HSRP topology, gigabit Ethernet connection of R1 router was disrupted. User can still possess connection with ISP through R2 router. In this instant, R1 will be a standby router and R2 will be a active router. By using HSRP, network will provide redundancy to default gateway thereby user can forward packets through R2.

In the ping result shown in Figure 9, no packet loss occurred as HSRP replace disrupted active router R1 with R2.

OSPF will change route for packet forwarding and it can be traced by using tracert command as shown in Figure 10.

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Table 1. Performance comparison with HSRP and without HSRP

Operation	No of packets sent	Loss (%)
Without HSRP	20	100
With HSRP	16	0

Above table is made in reference with Figure 4 and Figure 9. It is clear that if a gateway is disrupted, packet loss is accountably high when compared with result obtained by using HSRP in topology.

11. Conclusion

Most of the corporate network administrators aim to provide maximum reliability to their clients. Manual assistance is required to alter the route if default gateway is interrupted. HSRP reduces network congestion and ensures soft operation. We use OSPF dynamic routing protocol as it has high convergence rate. With features of pre-emption and pre-empt delay, HSRP provide robustness to the default gateway thereby reducing packet loss. Even though many routers are available in HSRP group, only one router will forward packets and other router acts as standby router in order to reduce IP traffic. Without HSRP, when topology of network changes, packet loss is almost close to 100% and zero possibility for packets to reach destination. Meanwhile, by using HSRP along with OSPF reduce packet loss to almost negligible percentage which is expected by many sections of community nowadays. By using CISCOPACKET TRACER, we simulate topology with HSRP and without HSRP separately and successfully achieved perfect results as shown in figure 9.

12. Reference

1. Persis DJ, Robert TP. Ant based multi-objective routing optimization in Mobile Ad-Hoc Network. Indian Journal of Science and Technology. 2015 May; 8(9):875–88.
2. Abdulsaheb GM, Khalaf OI, Sulaiman N, Zmezm HF, Zmezm H. Improving ad hoc network performance by using an efficient cluster based routing algorithm. Indian Journal of Science and Technology. 2015 Nov; 8(30):1–8.

3. Anand V, Sairam N. Methodologies for addressing the performance issues of routing in Mobile Ad hoc Networks: A Review. Indian Journal of Science and Technology. 2015 Jul; 8(15):1–10.

4. Yesodha R, Amudha T. A study on bio-inspired meta-heuristics for solving vehicle routing problem. Indian Journal of Science and Technology. 2015 Oct; 8(25):1–9.

5. Park HW, Yeo IY, Jang H, Kim NG. Study on the impact of big data traffic caused by the unstable routing Protocol. Indian Journal of Science and Technology, 2015 Mar; 8(S5):59–62. Doi no: 10.17485/ijst/2015/v8iS5/61480.

6. Available from: https://en.wikipedia.org/wiki/Open_Shortest_Path_First