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Dynamic Time Sync Reference Load Balancing In Virtual Router Redundancy Protocol

Mr. Augustine Praveen Raja Ilango[*1], Dr. T.V.U. Kiran Kumar[2], Ms. A. Geetha[3]
[*1,2,3]Department of ECE, Bharath University, Chennai 600 073
173 Agharam Road, Selaiyur Chennai, Tamil Nadu 600073, India
prawin22012@gmail.com

Abstract

In this paper, we discuss on Dynamic Time Sync Reference Load Balancing technique to enhance the Virtual Router Redundancy Protocol with Dynamic load balancing feature to utilize the redundant VRRP Backup device, inorder to share the traffic load. Virtual Router Redundancy Protocol acts as default gateway for the hosts on the shared Ethernet segment. VRRP protocol does not support the feature of load balancing for both the incoming and outgoing traffic. In this case, the Master VRRP device monitors the duration of the incoming traffic from a particular Virtual Local Area Network (VLAN) segment and redirects the traffic to the Backup VRRP device incase if the Master VRRP device still has the existing session based on the duration of the flow of traffic and the number of session through the Netflow cache database. While implementing Dynamic time sync reference Load Balancing mechanism, the Master VRRP device redirects the traffic to Backup VRRP device through the ICMP Redirect message, incase there is an current session going through the Master VRRP device by dynamically monitoring the Active Flow per Second parameter information through the Netflow cache information through the Layer 3 switch thereby achieving the Dynamic Load Balancing feature with the use of existing Active Flow per Second timers to dynamically share the traffic load between the Master VRRP device and the Backup VRRP device.

Keywords: Virtual Router Redundancy Protocol (VRRP), Netflow Cache parameter - Active flow per second.

Introduction

The phase starts with identifying business goal, technical requirements and optimizing the utilization of redundant devices. The effective and efficient use of infrastructure’s redundant device in the network environment so that failure of the single unit does not impact the network service provide by the LAN/WAN requests. Existing VRRP protocol is used by various vendors but the feature that is not supported is the load balancing feature, due to which the traffic from the User segment will be processed only by the Master VRRP device and the Backup VRRP device process the traffic only if the primary Master VRRP device fails so that the gratuitous ARP message is sent to the end machine to update the Virtual MAC Address of the Backup VRRP device that has taken over the role as the Master VRRP Device. The enhancement of the existing working of VRRP protocol to incorporate the load balancing feature to utilize the redundant Backup device to process the traffic until the Master VRRP device process the existing client connection request that will considerably improve the performance of the Master VRRP device and reduce the CPU utilization. During the logical network design phase, the size of the network and traffic characteristics has to be considered as the topology of the network design can vary from simple to complex base on the number of VLAN Segments within the infrastructure and number of users connected in the VLAN Segment.

VRRP Traffic Flow Method

The Virtual Router Redundancy Protocol is implemented in the environment that has the redundant device in the distribution layer. The distribution layer switches that support the VRRP Protocol is Cisco 6500 series, 4500 series. VRRP configured with the IP Address is used as the gateway for the end user machine amongst the redundant device. The active device is called the Master VRRP device, whereas all others devices in the group are in the Backup state. The master device is selected on the basis of the device with the highest device IP address in the VRRP group, incase if a particular device should be elected as the Master VRRP device priority in the VRRP group, then the priority is altered with the highest priority to influence the election of the Master VRRP device. The end user computing device or the server uses the VRRP IP address as the default gateway to reach the external network. VRRP protocol are also being used at the Core layer of the Three-tier Hierarchical network design model for the primary path selection to the Internet Service Provider (ISP), incase the primary path of the ISP has failed due to link issues or due to internal network outage in the ISP network then the VRRP dynamically identifies the presence of the interesting traffic to fall back to the redundant or secondary ISP to have the connection to the external network or the VRRP is also used at the distribution layer of the Three-tier Hierarchical network design so that the Server/User Vlan segment uses the VRRP IP address as the gateway to route the traffic to the intended destination. The VRRP protocol advertisements are sent every 1 seconds to poll the VRRP Devices to determine the traffic is taken via the Master VRRP device and the backup device are online or if they have gone down. The LAN segment implementation of the VRRP is taken into the consideration inorder to demonstrate the newly incorporation of load balancing feature within the VRRP protocol.

Current state of load balancing includes configuring the VLAN with two different VRRP group so that first VRRP group has a higher priority in Switch A when compared to the priority in the Switch B while the second VRRP group has the higher priority in Switch B compared to the priority in the Switch A, so that the end user nodes gets registered with the first received ARP message from the VRRP group 1 or group 2 based on the Layer 3 device that receives the request. So that the end user/server node gets the corresponding Virtual MAC Address associated with the VRRP IP address. In VRRP there is no tracking mechanism incorporated into the system in-order to detect the failure of the link or the interesting traffic.

Figure (1) is the generic representation of VRRP protocol being used in the network infrastructure:-

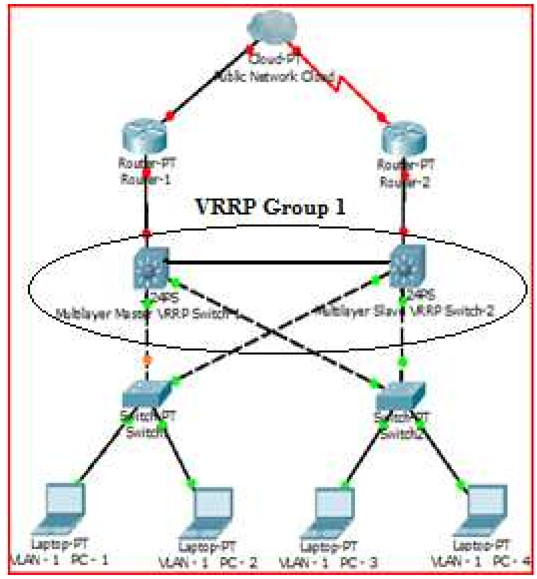

Figure 1. Generic VRRP representation

Integration of VRRP and Active Flow Per Second Timer to Perform Dynamic Time Sync Load Balancing

Virtual Router Redundancy Protocol is the redundancy protocol that do not support the load balancing, due to which the source vlan segment that wants to initiate a session to the destination network segment will use the Master VRRP Layer 3 switch as the single point of communication node inorder to reach the destination. The end nodes of the particular VLAN segments populates with the default gateway IP & MAC address of the Master VRRP device as 0000.5e00.01XX, where xx belonging to the group number. Incase of the Master VRRP device fails, the Backup VRRP takes about 3 seconds + Skew timer to take over the role of the Master VRRP device and the newly changed Master VRRP device sends a gratuitous ARP message to update the MAC address so instead of forwarding the traffic to the old Master VRRP device.

VRRP also does not support the tracking command hence addition of tracking feature is incorporated with the VRRP protocol to monitor the Netflow Cache parameter (Active Flow Per Second) so that the dynamic load balancing will be performed for the incoming traffic. The length of the traffic session is continuously monitored and tracked by the Master VRRP Layer 3 device to dynamically load balance in synchronous with time for the traffic flow. Incase, there is a session that is already in progress with the Master VRRP device the next incoming traffic session from the source is sent to the Master VRRP device, the Master VRRP device check if there is already existing session and the duration of the session that persist with the Master VRRP device, incase if the session is already existing, the Master VRRP device send the ICMP redirect message to the source machine that is originating the to re-direct the traffic to Backup VRRP device. So that the traffic session now persist with the Backup VRRP device until the traffic session gets terminated and the new session that is initiated from the source if there is already a longer duration through the Master VRRP Device.

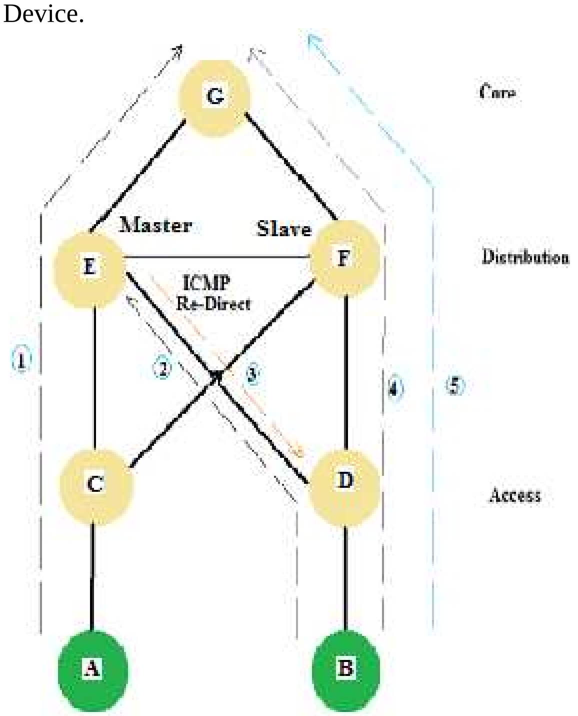

Figure 2. Generic Dynamic Time Sync Load Balancing traffic flow in VRRP

The figure (2) illustrates the traffic between the source and destination between the Master and Backup VRRP device through dynamic load balancing. The first traffic that has been initiated from the source (Node A) to the destination (Node G), passes through the access layer switch C inorder to reach the Master VRRP device E for the traffic initiated from the source to reach the destination (Node G). The information such as Source IP address, Source Interface, Destination IP address, Destination Interface, Protocol, Active Flow per second that are populated in the Netflow Cache database are used inorder to monitor the duration session flow.

So incase there is another session initiated from the source (Node B) to the destination (Node G), the packet is first forwarded to Master VRRP Device (Node E), through the access layer switch (Node D). The Master VRRP device first checks its Netflow Cache database to confirm if there is any existing session in the Master VRRP device, since there is already a current session through Master VRRP Device (Node E), the re-direct message is sent to the access layer switch (Node D) inorder to take the session from Node B to the Backup VRRP device (Node F), ultimately to reach the destination (Node G). This helps in utilizing the idle Backup VRRP device through dynamic load balancing in Sync with time.

Incase of the duration of traffic session initiated from source (Node A) to the destination (Node G) is longer than the traffic between the source (Node B) to the destination (Node G) that has got ended with brief transfer. Once again, if there is been another traffic that has been initiated from the Source (Node B) to the destination (Node G) for a different network service. The traffic is again taken to the Master VRRP Device (Node E) which in-turn checks for the existing session in the cache flow database for the current session and since the first session is still live and the session persist with the Master VRRP device. The Master VRRP Device (Node E) redirects the traffic again to the Backup VRRP device (Node F), thereby achieving the dynamic time sync load balancing between the source and the destination network segment.

VRRP incorporated with the Netflow parameter such as Active Flow per Second to perform the Dynamic Time Sync Load Balancing for the traffic without any additional installation of hardware, utilization of the existing parameter from the already populated data, also it will reduce the CPU utilization of the Master VRRP device by performing the dynamic load balancing and to utilize the idle Backup VRRP device to reduce the risk of single point of failure and also reduce the number of existing connection handled by the Master VRRP device.

Conclusion

Combining the existing feature from the Cisco device with the VRRP protocol helps to achieve the dynamic load balancing with respect to the current traffic session flowing through the device helps to alleviate the CPU overload on the Master VRRP Device, effectively utilize the idle Backup Device through load balancing and bandwidth. The dynamic time sync load balancing overcomes the disadvantages of static Round-Robin and Ratio type of load balancing that will never consider the duration of the traffic flow from the source and destination and the performance of the device. VRRP with the enhancement of tracking feature to monitor the Netflow parameter to implement the dynamic time sync load balancing feature will help to alleviate the disadvantage of CPU overload of Master VRRP device, single point of failure and bandwidth choking. The selection of Active Flow per second parameter from the Netflow is to ensure the maximum availability of network service through dynamic time sync load balancing of various application related traffic and optimized utilization of redundant device to the maximum advantage.

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