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ABSTRACT

A network which has redundancy in the design to to be setup for an organization.
The organization is currently having an internet connection, which is setup using a Cisco router.
The gateway addresses for users in the LAN is currently provided as an intermediate router
address, which would then forward all internet bound packets to the internet router.

The network has to be upgraded by having dual intermediate routers which would automatically
failover, and provide high availability access to the internet. HSRP is to be used for the deployment.

The project identifies the configurations required on Cisco routers to achieve the same.

- To implement LAN Network design with redundancy with HSRP.

- The organization's network has to be upgraded by having dual intermediate routers which would automatically failover, and provide high availability access to the internet.

- Network redundancy is a process through which additional or alternate instances of network devices, equipment and communication mediums are installed within network infrastructure. It is a method for ensuring network availability in case of a network device or path failure and unavailability.

- The concept of Network Redundancy is to provide alternate and efficient paths for data to travel along the network without any interruption.

INTRODUCTION

Why is redundancy important??

- Reducing chances of network failure: Your network is more likely to stay running and connected with a network redundancy plan.

- Optimizing time and money: Damage to your network can cost organizations in time, money and human resources. With network redundancy, you can direct your business's revenue, employees and time to more valuable pursuits.

- Raising network uptime: Network uptime refers to how long your business's network remains running. The greater your network uptime is, the more easily, quickly and reliably customers and employees can access your company's network.

- Improving company security: Network redundancy helps protect your company against physical damage to your network, such as from a natural disaster or theft. You can also better protect your organization from cybersecurity threats with network redundancy.

REQUIREMENTS

Project Scope:

A network which has redundancy in the design to to be setup for an organization. The organization is currently having an internet connection, which is setup using a Cisco router.

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address, which would then forward all internet bound packets to the internet router. The network has to be upgraded by having dual intermediate routers which would automatically
failover, and provide high availability access to the internet. HSRP is to be used for the deployment. The project identifies the configurations required on Cisco routers to achieve the same.

Networking requirements:

1.LAN IP network design.
2.Network Topology diagram.
3.Configurations required on the routers to setup high availability with HSRP.
4.Configurations required on the routers to setup appropriate IP address and internet packet
forwarding on the routers.
5.Configurations required on the LAN PC's for appropriate gateway parameters.
6.Verification and Testing Procedure

Hardware:

1.Cisco routers (2 nos)
2.Cisco switches (2 nos)
3.Internet router (Internet not mandatory)
4.PC (As per requirement)
5.Network cables.

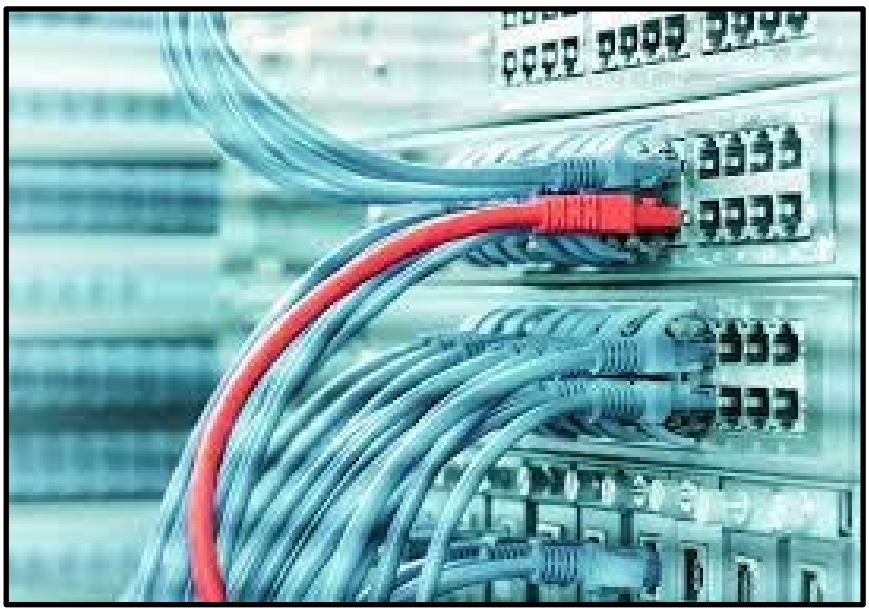
1.Internet router (Internet not mandatory)

2.Cisco routers (2 nos)

3.PC (As per requirement)

4. Cisco switches (2 nos)

5.Network cables



ARCHITECTURE AND DESIGN

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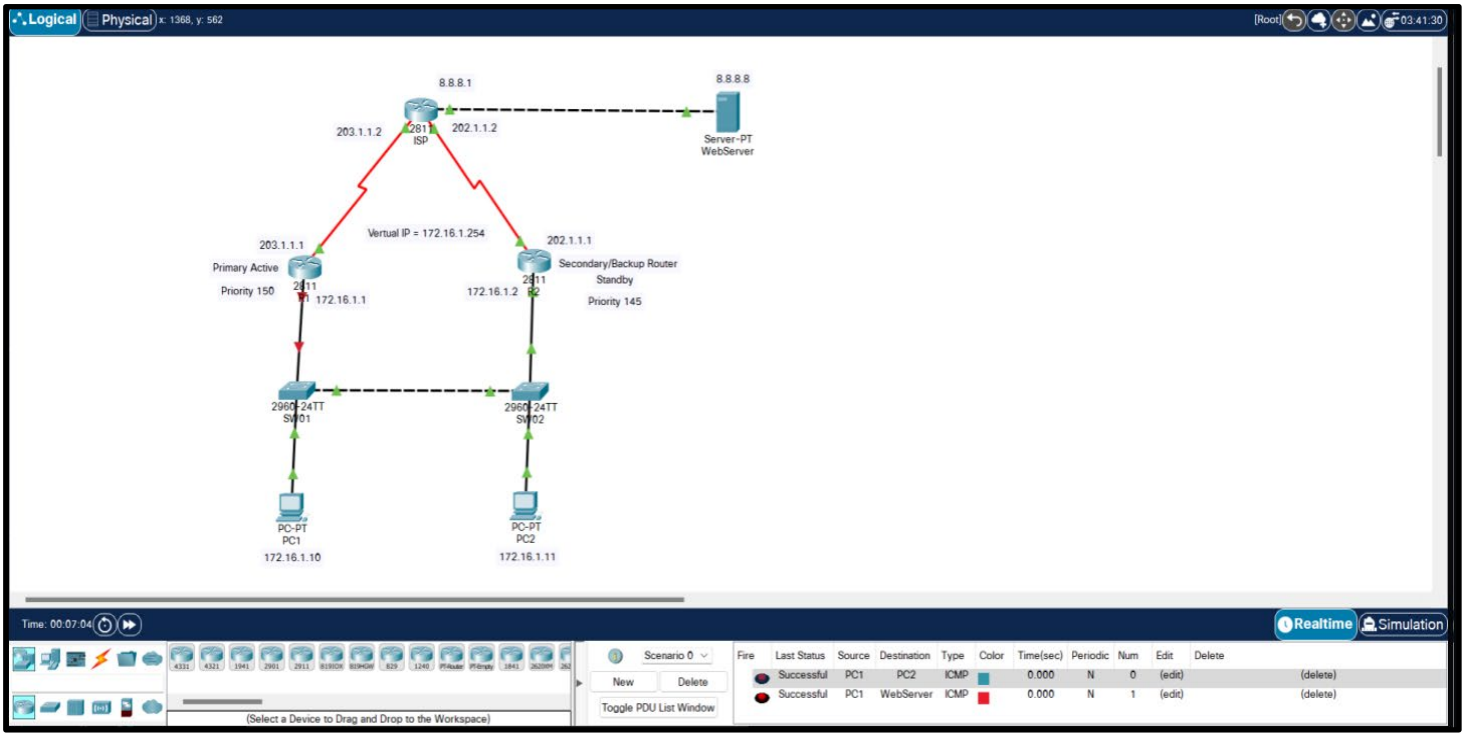
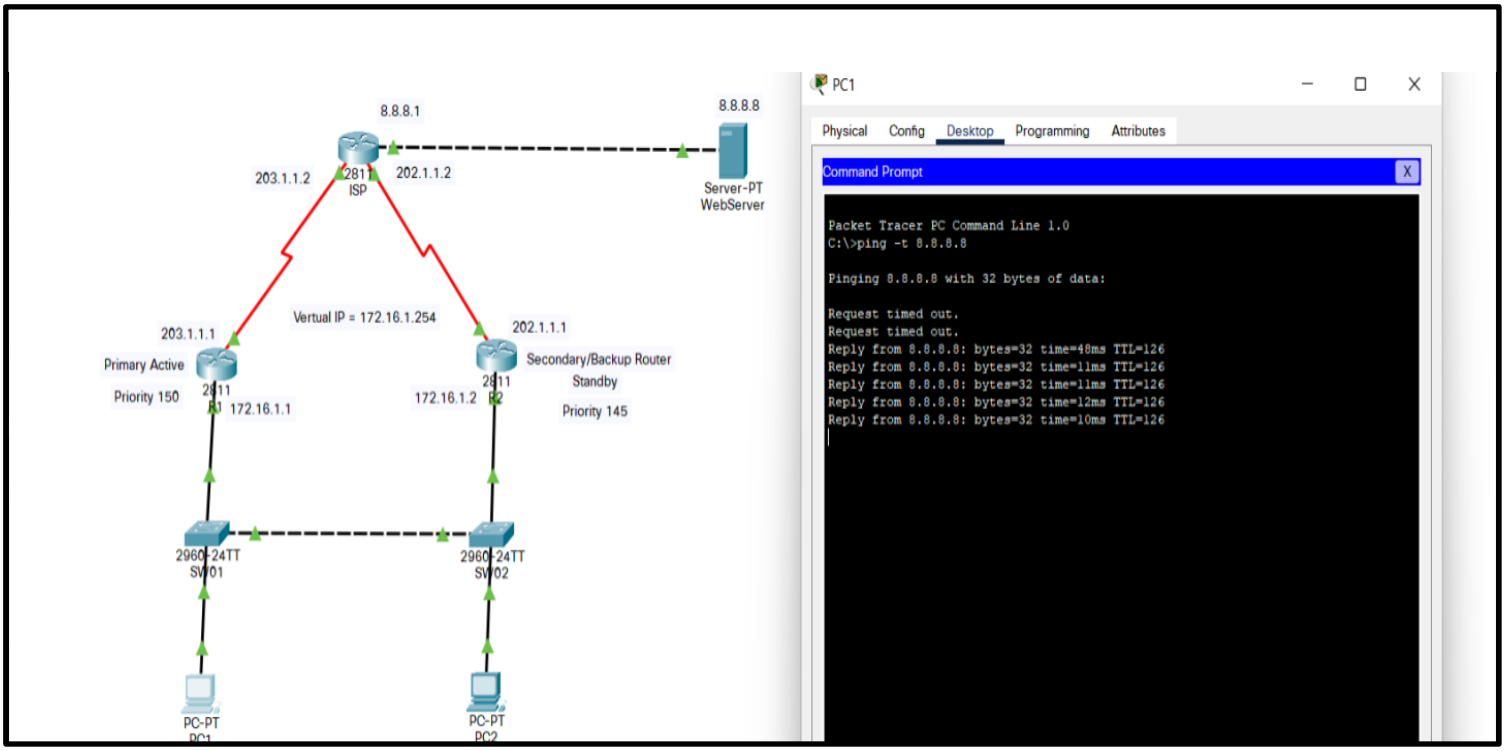

Logical
Physical
8.8.8.1
8.8.8.8
203.1.1.2
202.1.1.2
ISP
Server-PT
WebServer
Vertual IP = 172.16.1.254
203.1.1.1
202.1.1.1
Primary Active
Priority 150
Secondary/Backup Router
Standby
Priority 145
172.16.1.1
172.16.1.2
2960-24TT
SW01
SW02
PC-PT
PC1
PC2
172.16.1.10
172.16.1.11
Realtime
Simulation
Scenario 0
New
Delete
Toggle PDU List Window
(Select a Device to Drag and Drop to the Workspace)
Fire
Last Status
Source
Destination
Type
Color
Time(sec)
Periodic
Num
Edit
Delete
Successful
PC1
PC2
ICMP
0.000
N
0
(edit)
(delete)
WebServer
1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SW01
SW02
PC-PT
PC1
PC2
PC1
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Packet Tracer PC Command Line 1.0
C:\>ping -t 8.8.8.8
Pinging 8.8.8.8 with 32 bytes of data:
Request timed out.
Request timed out.
Reply from 8.8.8.8: bytes=32 time=48ms TTL=126
Reply from 8.8.8.8: bytes=32 time=11ms TTL=126
Reply from 8.8.8.8: bytes=32 time=11ms TTL=126
Reply from 8.8.8.8: bytes=32 time=12ms TTL=126
Reply from 8.8.8.8: bytes=32 time=10ms TTL=126

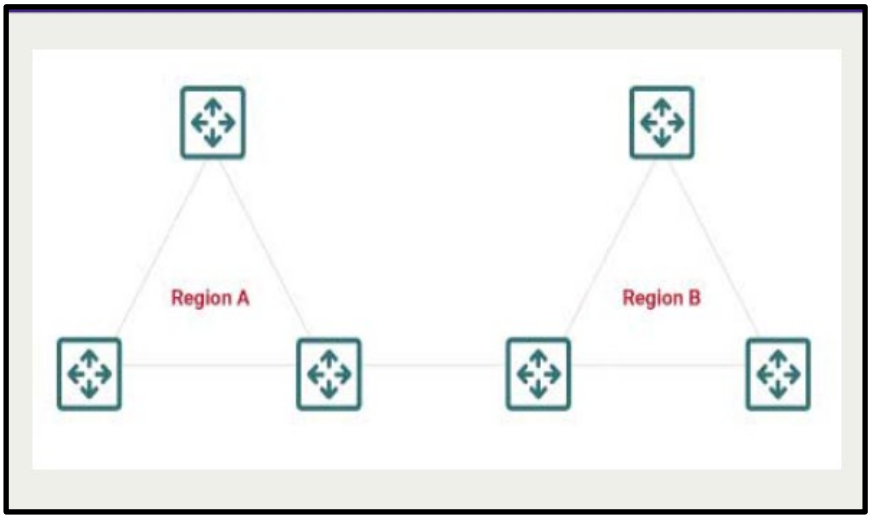
IMPLEMENTATION

First, we need to look into the different types of network redundancies and decide the one that fits well according to our requirements.

- Multiple Spanning Trees (MST)
- Ring Networks
- Diverse Trunking
- Multi-Protocol Label Switching (MPLS)

Multiple Spanning Trees (MST)

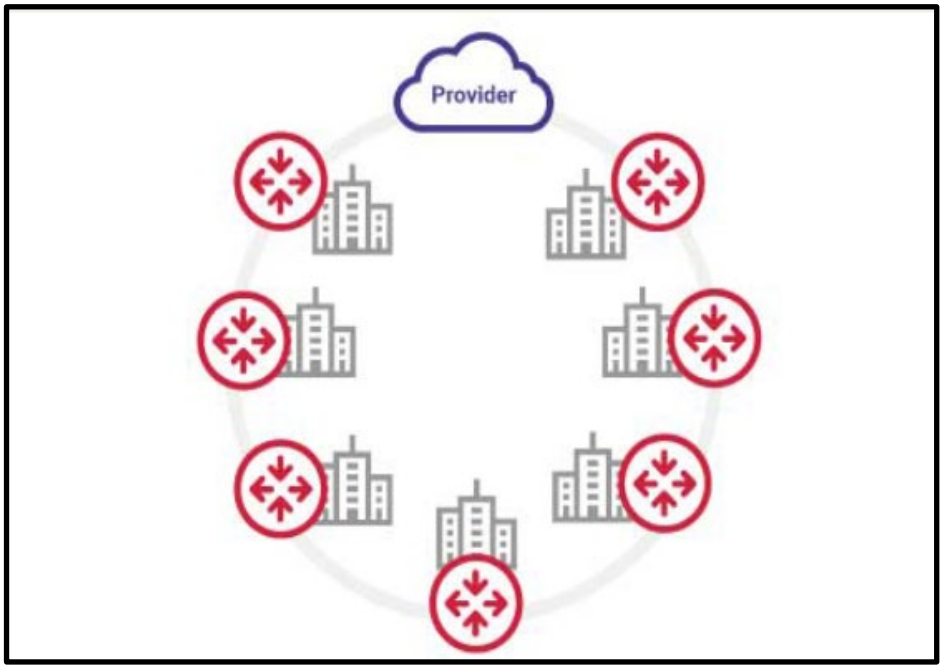
- MST supports load-balancing capability while still allowing for scalability. It enables the designated administrator to plan out a random number of VLANs to one MST instance. As a result, there are the least number of instances essential to satisfy a design.



Ring networks

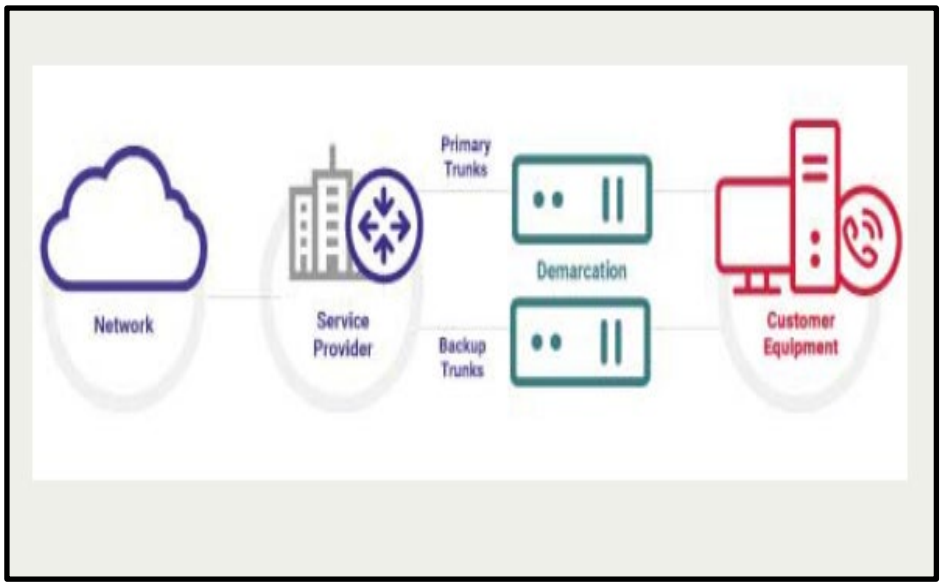
- A ring network is a type of topology in which nodes are connected in a closed loop (ring) configuration. Similar to a bus network, a ring network has one extra link connecting the last switch to the first switch and where each switch supports a redundancy protocol. Ring protocols typically disable one link to stop messages from circulating the network. If the link in the ring fails, then the backup link is enabled to

restore the network.



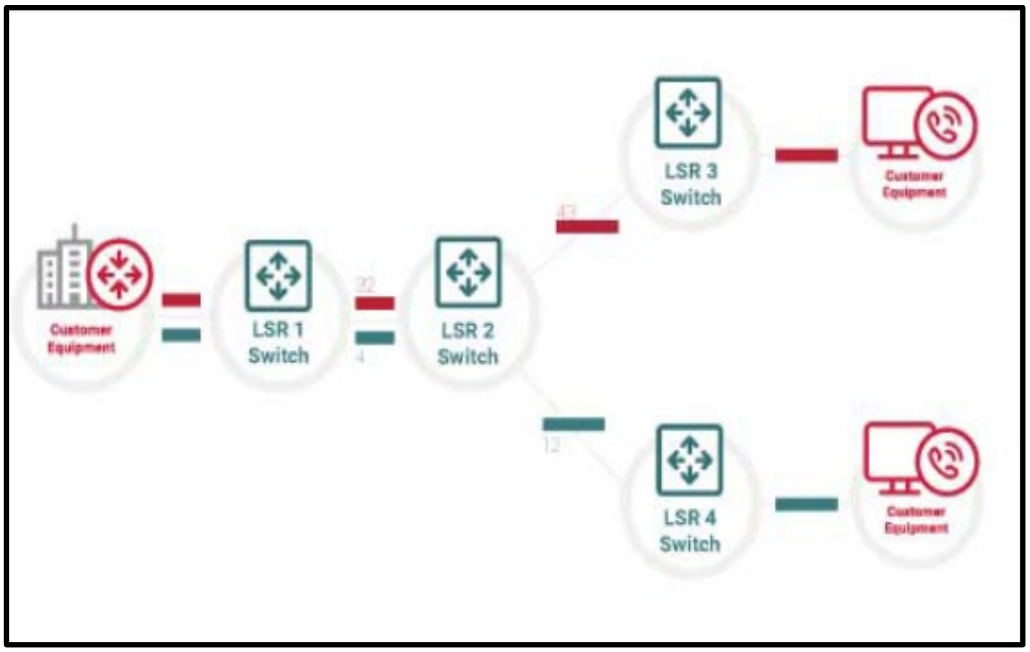
Diverse trunking

- Diverse trunking provides communications and network access between two switching centers. A trunk can consist of multiple wires, cables, or fiber optic strands bundled together in a single physical sheath. Typically, network redundancy is accomplished through the addition of substitute network paths from a secondary physical cable which are implemented through redundant standby routers and switches. When the primary path is unavailable, the alternate path can be instantly deployed to ensure minimal downtime and continuity of network services.



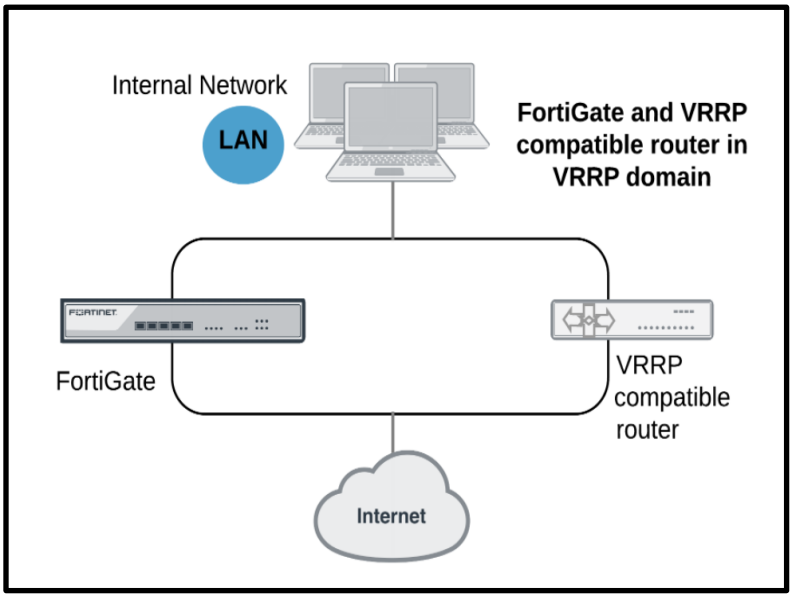
Multi-Protocol Label Switching (MPLS)

- A MPLS cloud is a meshed and redundant network in which data packets are assigned labels that specify the paths or routes for transmission across the network. Label Switch Routers (LSRs) read these short labels and forward the data packets according to these instructions. This enables very high-speed packet switching and redundancy through the core MPLS network.



Next we decide which protocol to follow up and since our experiment is regarding the Hots Standby Routing Protocol we have followed HSRP . Where as there as other methods such as VRRP and GLBP:

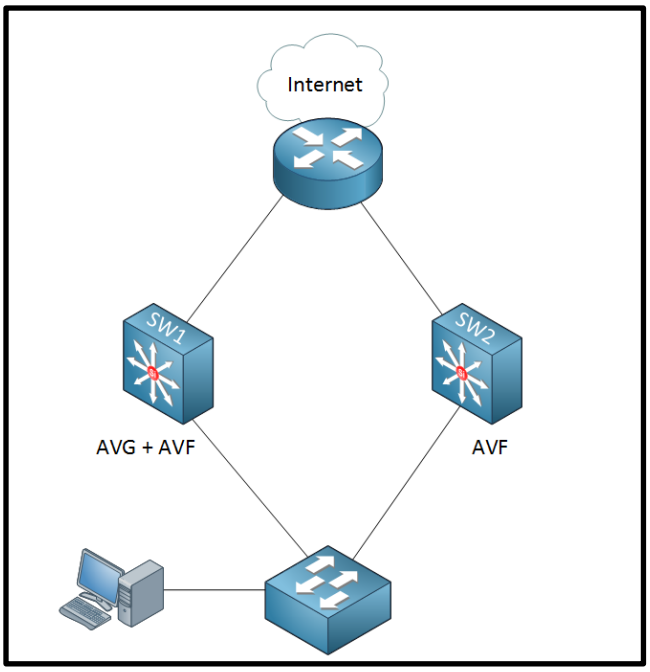
VRRP:



The Virtual Router Redundancy Protocol (VRRP) eliminates the single point of failure inherent in the static default routed environment.

VRRP specifies an election protocol that dynamically assigns responsibility for a virtual router to one of the VPN Concentrators on LAN.

GLBP:



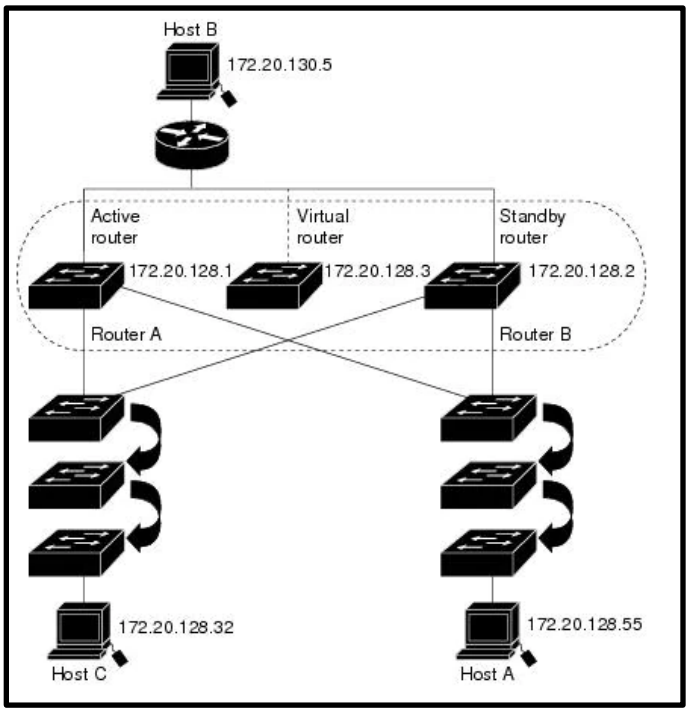
GLBP stands for Gateway Load Balancing Protocol and just like HSRP / VRRP it is used to create a virtual gateway.

One of the key differences of GLBP is that it can do load balancing without the group configuration.

HSRP:

Hot Standby Router Protocol or HSRP is Cisco's standard method of providing high network availability by providing first-hop redundancy for IP hosts configured with a default gateway IP address.

HSRP routes IP traffic without relying on the availability of any single router. One of the routers is selected to be the active router and another to be the standby router which assumes control of the group MAC address and IP address should the designated active router fail.



HSRP or Hot Standby Routing Protocol was primarily designed for providing layer two redundancy for default gateways (DG) failures on LAN segments. Understandably, for most networks out there if the default gateway is lost (may be by a router crash or by a interface disconnect or …) LAN looses the ability to communicate with the external networks, HSRP offers some layer 2/3 redundancy for such failures by providing a virtual IP and a virtual MAC address and binding interfaces on two or more routers to the same virtual IP address (VIP).

Any one router can be active at a time. A router that is chosen to be active would attend to

the requests that come in for the VIP, should the active router go inaccessible the standby router/s assumes the role of servicing the requests for the VIP. Note that to benefit from HSRP, default gateways on the PC's should be configured with the VIP instead of interface addresses of the routers. With that in mind let's actually design a network that does this for us. Our goal here is to create a HSRP group with R3 as an active router and R2 as a standby router.

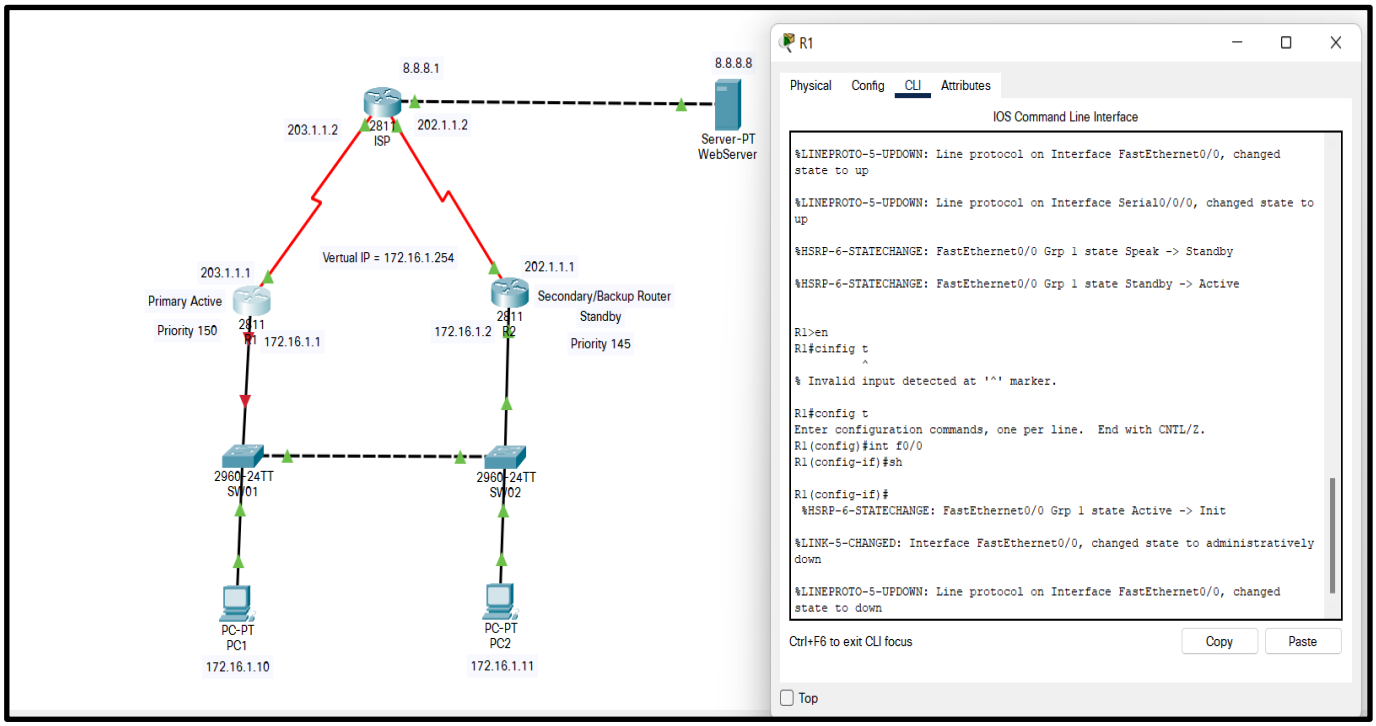
We would further set the VIP to 192.168.1.100 and R3 to preempt (give it the capability to assume the active role should it go inaccessible and come back up). Further we would like to set a tracking on the interface between R3 and R4, so that if the serial interface goes

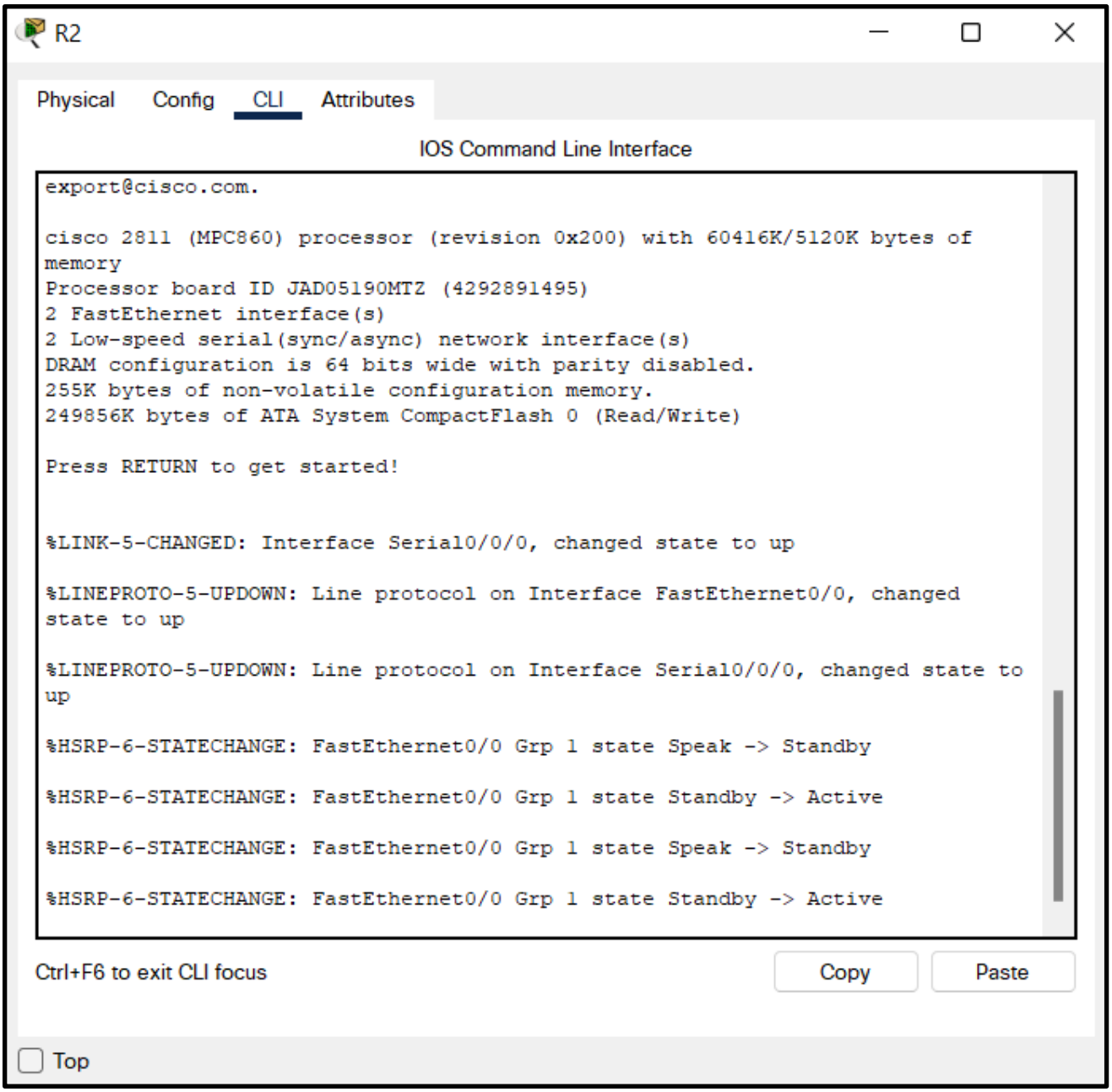
down, R3 loses its active status to R2 (note that if the serial interface goes down its useless to keep R3 active as it has no way to route the packets to the core) .

Also should R3 regain the serial interface it should switch back to active, we would use preempt statements to do that. Refer to the diagram mentioned below for further details.

By configuring R2 (refer to the snapshot mentioned below). Note that the VIP in this case

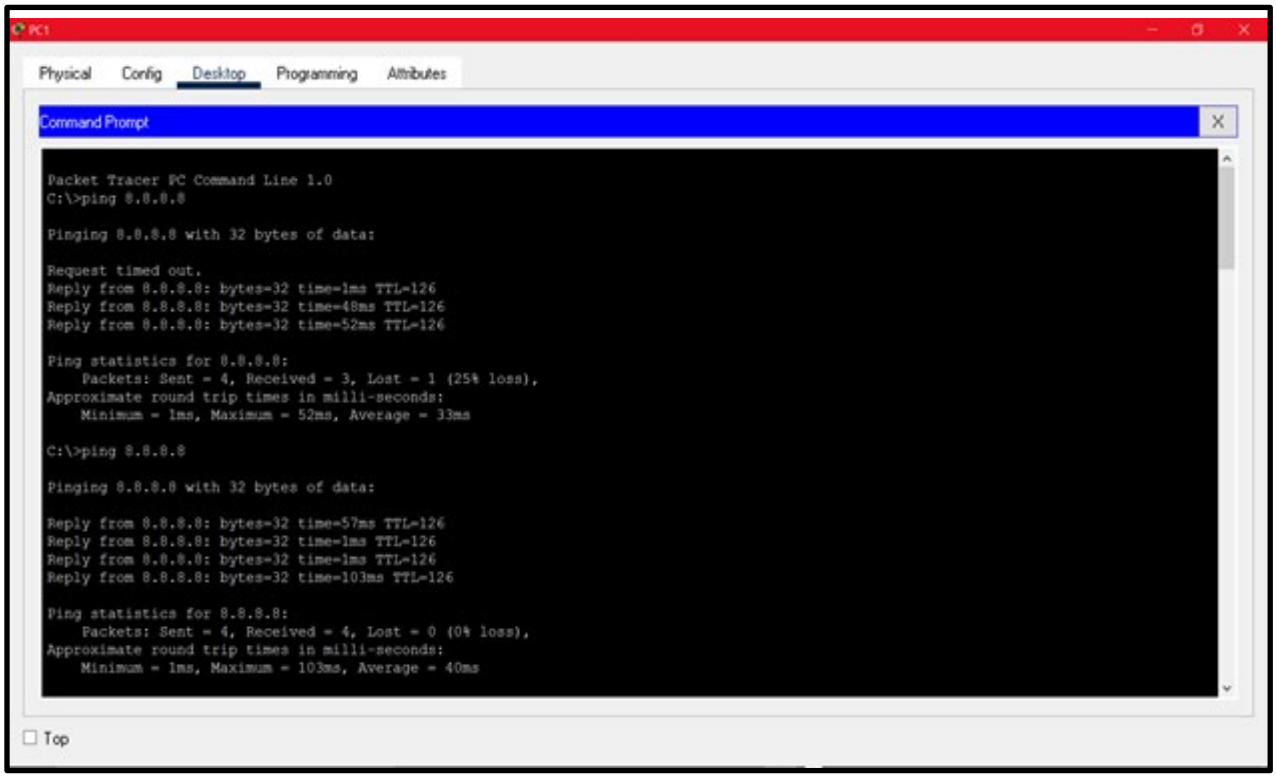
is 192.168.1.100 and R2 is given a priority of 101, also note that the preempt keyword enables R2 to kick the active router off and assume its role, should the priority of R2 increase to a better value.

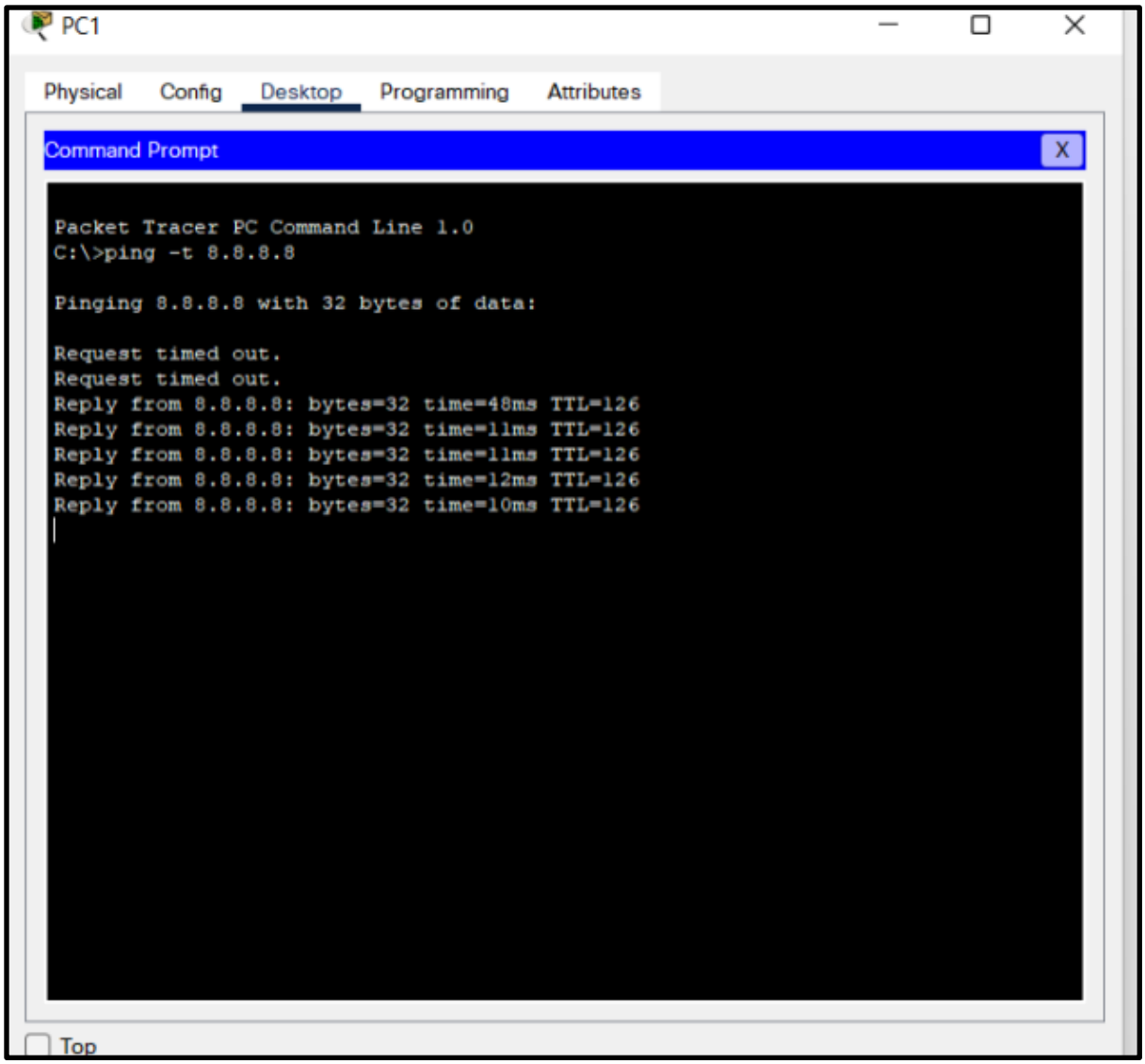




The configuration is almost the same on R3 except for increasing the priority to 255 (thereby making it an active router in the group) and adding a statement to indicate that serial 1/0 to be a tracking interface, with a priority negation of 155. In essence whenever serial 1/0 goes down; a priority of 155 is subtracted from 255 bringing the priority value to 100, thereby making R2 as the active router (remember R2′s priority value is 101). Again note that due to the preempt statement in the config, should the serial 1/0 come back on R3, it again returns to its original active state.

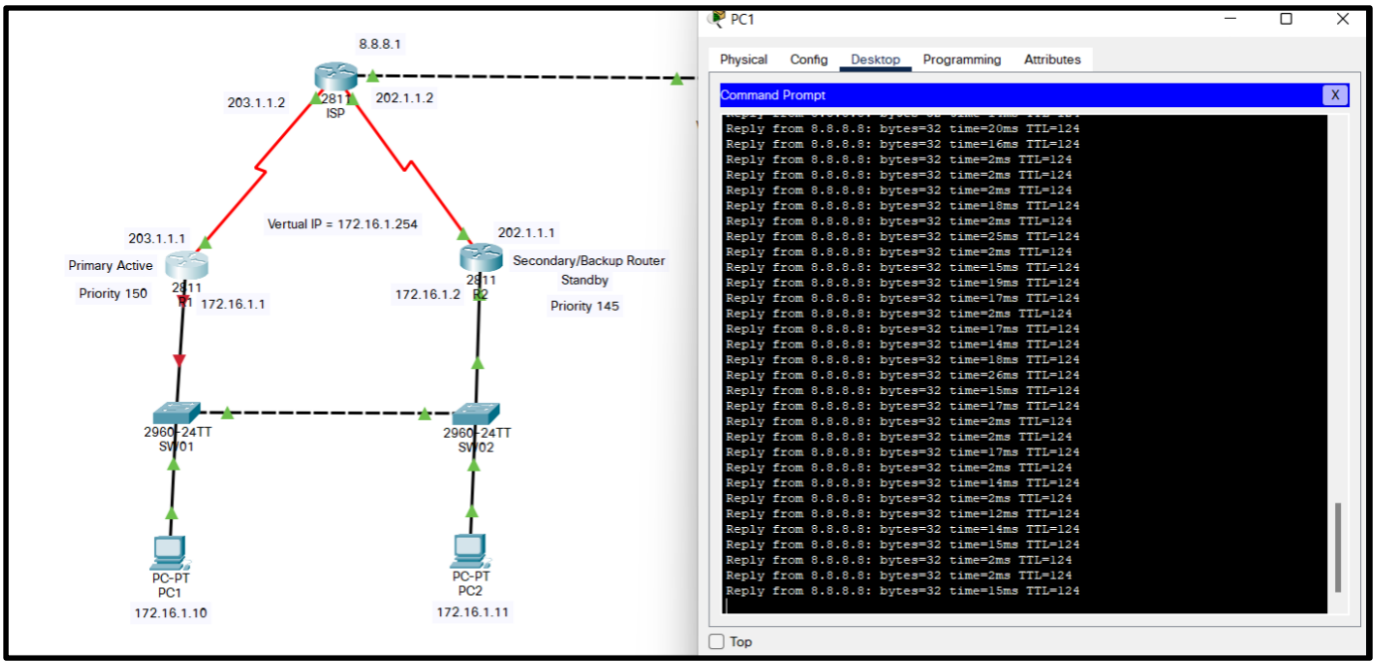
Also note that that R2 and R3 exchange the HSRP hello's between each other once every 3 seconds by default. A debug log on R3 below shows hello packets coming into R3 from R2 announcing that it's in standby mode and a hello packet leaving R3 announcing that it's active.





Taking a look at the arp table on router R1 mentioned below, note that the VIP now has a separate MAC address of 0000.0c07.ac0a, which is different from the individual BIA's of the routers R2 and R3. Note that the 0x0a on the last octet corresponds to the decimal 10, the HSRP group number that we created. Now that we are familiar with the inner workings of HSRP, let's see it in action. As a first test, I would unplug the Ethernet cable on R3.

As soon as this happens the router resigns itself of active role and goes into an Init state because it detects the change in the eth interface. R2 does not know what happened until the next few seconds until its hello/dead timers get expired, as soon as that happens it assumes an active role. Debug logs on R2 are mentioned below. Note that the virtual MAC address remains unchanged during the switch; hence R1 need not change its arp cache.



That's the advantage of using a Virtual mac, rather than router's BIA. A router reboot or any other connectivity loss also results in a similar outcome as above (not shown).As soon as I plug the Ethernet cable back, R3 leaps back to active status (not shown). As a last section, let's take a look at tracking interface in action. To illustrate this, let's unplug the serial cable from R3, note that as soon the serial 1/0 is unplugged from R3, its priority value changes to 100, which is one less than R2′s priority and hence it loses its active status.

6. EXPERIMENT RESULTS & ANALYSIS

6.1 Result:

We have successfully implemented our Network Design Proposal for a Local Internet Service Provider that has a main office which is located in Chennai

6.2 ANALYSIS:

1.We had done a practical project under the supervision of an University for the first time in our life.

2.Minor Project has taught us all the networking operations which are done in an organization.

3.Running Network programs in a stipulated time period makes any student perfect and updated.

6.3 CONCLUSION AND FUTURE WORK:

To conclude, we implemented the LAN Network design with redundancy with HSRP. The organization's network was upgraded by having dual intermediate routers which would automatically failover, and provide high availability access to the internet.

In future, the constraints of the design could be resolved. The constraints are:

a) Recovery time speed

b) Weak security

c) Cisco proprietary protocol

7. REFERENCES

- **Design and Simulation of a Lan Network Redundancy- ResearchGate**

https://ptgmedia.pearsoncmg.com/images/9781587133282/downloads/9781587133282%20_chapter_2.pdf

- **Lan Network Redundancy**

https://www.youtube.com/watch?v=gxsMuHXCOqg