Network-Level Redundancy for Campus LAN

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1. INTRODUCTION

The sole concept of network redundancy is to provide alternate and efficient paths for data to travel along in case a lop source fails [6]. Another term used to describe redundancy is cable is broken or a connector accidentally unplugged. Ethernet as standard does not have rings or loops in the network because it will cause broadcast storms and can ultimately cause the network to stop functioning. To withstand with redundancy, network building structure mainly the switches and routers [6] used in the network must support redundancy protocols designed to avoid the usual problems of putting loops into a network.

Today, business requires reliable network connectivity and access to corporate resources. Connections to and from business units, vendors and SOHOs are all equally important to keep the continuity when needed. Business runs all day, every day and even in off hours. Most companies run operations around the clock, seven days a week so it's important to realize that to keep a solid business continuity strategy, redundancy technologies should be considered and should be implemented [3].

Network redundancy is a simple concept to understand. If you have a single point of failure and it fails you, then you have nothing to rely on. If you put in a secondary (or tertiary) method of access, then when the main connection goes down, you will have a way to connect to resources and keep the business operational [5].

The purpose of this system is to build the redundancy system. Redundancy means that there are backup components in place to ensure that if a networking card, power supply, or Ethernet cable fails, your business will not

ABSTRACT

A network redundancy is a key factor to consider for maintaining network reliability. Redundancy is one of special importance in industrial process applications and in safety-critical system where network, down time could cause serious problems and production could stop. So, redundancy will be needed to consider to ensure that hosts maintaining network connectivity in the event of failure of one device serving. In this system, campus A and campus B connected point to point link. In the campus A, ether channel and the redundancy protocol is running, and the campus B is running VoIP service. Between the two campuses used Open Shortest Path Fast (OSPF) routing protocols for the routing among different networks. In the campus A, the Vlan Trunking Protocols (VTP) is used and Rapid Per Vlan Spanning Tree+ (RPVST+) is also used to avoid the loop among switches. Ether channel is used to get load balancing and VoIP is also running. The two routers at the edge of core layer are running the Network Address Transition (NAT) to connect the outside world. This system designed, built DHCP, HSRP, GLBP, Ether channel, OSPF, NAT, STP, VLAN, RPVST+, VTP, VoIP and simulated using Cisco Packet Tracer. The results showed that network design is viable and implementation.

KEYWORDS: Network Protocols, Network Redundancy, Cisco Packet Tracer

suffer because a source is in place to take over if the primary high availability, because of the increased availability to your resources. We have achieved redundancy by ensuring your server has everything that it needs (including power and network source). So in the case of networking, a redundant connection would include two Ethernet cables going to two separate routers from two separate network cards connecting to our backbone ISP providers.

The more common approach a highly available directory service is to use redundant server components. Redundant solutions are usually less expensive, easier to implement, and easier to manage. During a failure, a redundant system might provide poor availability. Imagine, for example, an environment in which the load is shared between two redundant server components. The failure of one server component might put an excessive load on the other server, making this sever respond more slowly to client requests.

A slow response might be considered a failure for clients that rely on quick response times. In other words, the availability of the service, even though the service is operational, might not meet the availability requirements of the client.

2. PROPOSED SYSTEM

Figure 1 shows infrastructure design for campus buildings. The campus A is running ether channels and redundancy protocols. At the upper edge routes are running NAT and they can connect to the outside internet. In the campus B, we use the VoIP phones and it can communicate with the other networks in the redundancy campus.

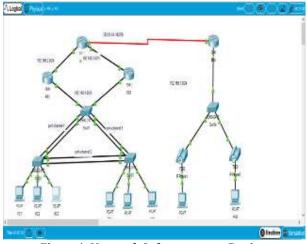


Figure 1. Network Infrastructure Design

3. IMPLEMENTION

In this design, four Cisco 1900 series routers, four Cisco 2960 series switches, personal computers (PCs), two IP phones are used as main networking components. Gateway Load Balancing Protocol (GLBP) is used for redundancy. Ether channel is a form of link aggregation used in switched networks. It also provides redundancy because the overall link is viewed as on logical connection by Spanning Tree Protocol (STP). If one physical link within channel goes down, this does not cause a change in the topology and does not require STP recalculation. RPVST+s support 802.1g and works as IEEE 802.1w. Vlan VTPs and RPVST+ are used to avoid the loop among switches. In this system OSPF protocol is used to route and to get connections between the different networks. NAT is also used the system to connect with outside network.

Redundancy Configuration 3.1

R02(config)#interface g0/1 R02(config-if)#glbp 1 ip 192.168.1.254 R02(config-if)#glbp 1 preempt R02(config-if)#glbp 1 priority 150 R02(config-if)#glbp 1 load-balancing round-robin R03(config)#interface g0/0 R03(config-if)#glbp 1 ip 192.168.1.254 R02(config-if)#glbp 1 load-balancing round-robin

3.2 EtherChannel Configuration on Switches

SW01(config)#interface range f0/3-4 SW01(config-if)#shutdown SW01(config-if)#channel-group 1 mode desirable SW01(config-if)#no shut SW01(config-if)#interface port-channel 1 SW01(config-if)#switchport mode trunk SW01(config)#interface range f0/5-6 SW01(config-if)#shutdown SW01(config-if)#channel-group 3 mode desirable SW01(config-if)#no shut SW01(config-if)#interface port-channel 3 SW01(config-if)#switchport mode trunk

SW02(config)#interface range f0/3-4 SW02(config-if)#shutdown SW02(config-if)#channel-group 1 mode desirable SW02(config-if)#no shut SW02(config-if)#interface port-channel 1 SW02(config-if)#switchport mode trunk

SW02(config)#interface range f0/1-2 SW02(config-if)#shutdown SW02(config-if)#channel-group 2 mode desirable SW02(config-if)#no shut SW02(config-if)#interface port-channel 2 SW02(config-if)#switchport mode trunk

SW03(config)#interface range f0/1-2 SW03(config-if)#shutdown SW03(config-if)#channel-group 2 mode desirable SW03(config-if)#no shut SW03(config-if)#interface port-channel 2 SW03(config-if)#switchport mode trunk SW03(config)#interface range f0/5-6 SW03(config-if)#shutdown SW03(config-if)#channel-group 3 mode desirable SW03(config-if)#no shut SW03(config-if)#interface port-channel 3 SW03(config-if)#switchport mode trunk

OSPF Configuration on Routers 3.3

R01(config)#router ospf 10 R01(config-router)#router-id 1.1.1.1 R01(config-router)#log-adjacency-changes R01(config-router)#network 192.168.3.0 0.0.0.255 area 0 R01(config-router)#network 192.168.2.0 0.0.0.255 area 0 R01(config-router)#network 192.168.10.0 0.0.0.255 area0 R01(config-router)#network 192.168.11.0 0.0.0.255 area 0 R01(config-router)#network 192.168.12.0 0.0.0.255 area 0 R01(config-router)#network 203.81.64.192 0.0.0.7 area 0

R02(config)#router ospf 10

R02(config-router)#router-id 2.2.2.2 R02(config-router)#log-adjacency-changes R02(config-router)#network 192.168.2.0 0.0.0.255 area 0 R02(config-router)#network 192.168.4.0 0.0.0.255 area 0 R02(config-router)#network 192.168.10.0 0.0.0.255 area 0 R02(config-router)#network 192.168.11.0 0.0.0.255 area 0 R02(config-router)#network 192.168.12.0 0.0.0.255 area 0

R03(config)#router ospf 10 R03(config-router)#router-id 3.3.3.3 R03(config-router)#log-adjacency-changes R03(config-router)#network 192.168.3.0 0.0.0.255 area 0 R03(config-router)#network 192.168.4.0 0.0.0.255 area 0 R03(config-router)#network 192.168.10.0 0.0.0.255 area 0 R03(config-router)#network 192.168.11.0 0.0.0.255 area 0 R03(config-router)#network 192.168.12.0 0.0.0.255 area 0

3.4 VoIP Services Configuration

R04(config)#telephony-service R04(config-telephony)#max-ephones 5 R04(config-telephony)#max-dn5 R04(config-telephony)#ip source-address 192.168.1.1 port 2000 R04(config-telephony)#auto assign 1 to 9 R04(config)#ephone-dn 1 R04(config-ephone-dn)#number 100 R04(config)#ephone-dn 2 R04(config-ephone-dn)#number 200

3.5 **NAT Configuration**

R01(config)# ip nat inside source list 1 interface Serial0/1/0 overload R01(config)# ip route 0.0.0.0 0.0.0.0 Serial0/1/0

R01(config)# access-list 1 permit 192.168.0.0 0.0.255.255 R01(config)# interface GigabitEthernet0/1 R01(config-if)# ip address 192.168.3.1 255.255.255.0 R01(config-if)# ip nat inside R01(config)# interface GigabitEthernet0/0 R01(config-if)# ip address 192.168.2.1 255.255.255.0 R01(config-if)# ip nat inside R01(config)# interface Serial0/1/0 R01(config-if)# ip address 203.81.64.193 255.255.255.248 R01(config-if)# ip nat outside R04(config)# interface GigabitEthernet0/0 R04(config-if)# ip address 192.168.1.1 255.255.255.0

R04(config-if)# ip nat inside R04(config)# interface Serial0/1/0

R04(config-if)# ip address 203.81.64.194 255.255.255.248

Testing Result 3.7

The following figures show the result for the system.

R04(config-if)# ip nat outside

R04(config)# ip nat inside source list 1 interface Serial0/1/0 overload

R04(config)# ip route 0.0.0.0 0.0.0.0 Serial0/1/0 R04(config)# access-list 1 permit 192.168.1.0 0.0.0.255

3.6 RPVST+ Configuration on Switches

SW01(config)# spanning-tree mode rapid-pvst SW01(config)# spanning-tree vlan 10 root primary SW01(config)# spanning-tree vlan 11-13 root secondary SW02(config)# spanning-tree mode rapid-pvst SW02(config)# spanning-tree vlan 11 root primary SW02(config)# spanning-tree vlan 10,12,13 root secondary SW03(config)# spanning-tree mode rapid-pvst SW03(config)# spanning-tree vlan 12 root primary SW03(config)# spanning-tree vlan 10,11,13 root secondary

Physical	Config CLI	Attributes	2004					
		115	IOS Comm	and Line Interface	1			
⊐ SW01‡sh	Dog(SD) Pod(SD) d therchannel D - dewn I - stand-al. H - Hot-stam R - Layer3 U - in use u - unsutab w - ositing d - default;	Summary P - in one s - sus dby (LACP - S - Lay E - fer le for bunc to be aggre	spended mly) per3 lled to all iling	1=1	gatos			0
	of channel-gr of aggregator		2:8 3					
	Port-channel		Forte					
		ANTITZ						
2	Pol (SU) Pol (SD)	-	Fa0/8(P)					100
3 SW014	Po3 (50)	PAGP	Fa0/8(P)	Fa0/6(P)				~
Ctri+F6 to c	wit CLJ focus					Copy	P	aste
7211 (0.17)								
Sw02			r channe	el Testing	in Switch	n SW01	-	0
Sw02	Figur					i SW01	7	
5w02				el Testing		i SW01	77	•
SW02>en SW02‡eh SW02‡eh SW02‡eh Flags:	<pre>config clu ether etherchannel etherchannel</pre>	Attributes sumary P - in ne s - sus by (LACP o s - Lay f - fal e for bund o be aggre	DS Comma port-chann pended nly! er3 led to all ling	Ind Line Interface		1 SW01		-
SwO2 hysical SWO22en SWO22en SWO22en SWO22en Flags:	Config CU ether etherchannel b- down I - stand-alc H - Hot-stand J - Layer3 U - in use u - unsuitabl w - waiting t	Attributes summery P - in ne s - sus by (LACP o S - Lay c - for bund o be aggre ort ups in use	DS Comma port-chann pended nlyi er3 led to all ling gated	Ind Line Interface		i SW01		-
SW02>=n SW02>=n SW02p=h SW02p=h Flags: Number o Group E	<pre>config CL ether etherchannel getherchannel b - down I - stand-alc H - Not-stand A - Layer3 U - in use u - unsuitabl w - waiting t d - default p of chennel-geo</pre>	Attributes Attributes summary P - in ne s - sus by (IACP o s - Lay c - for bund o be aggre ort ups in use Protocol	DS Comma port-chann pended nly! er3 lid to all ling gated . 2 2 Fort.	Ind Line Interface		1 SW01	-	
Sw02 hysical SW022=n SW025=h SW025=h Flags: Number o Swmber o Group F	<pre>config CL *ther *therchannel stherchannel D - down I - stand-alc H - Not-stand R - Layer3 U - in use u - unsuitabl w - waiting t d - default p of channel-group f channel-group f channel-group f channel-group</pre>	Attributes Attributes SUMMATY P - In ne 5 - SUS by (IACP o 5 - Lay 5 - Sat c for bund ore ore ups in use - Protocol PAgP	DS Comma port-chann pended nly! er3 lid to all ling gated . 2 2 Fort.	nd Line interface nel .occate aggre		i SW01	-	

Figure3. Ether channel Testing in Switch SW02

hysical Config	Attributes		
	IOS Command Line Interface		
I - stand H - Hot-s R - Layer U - in us u - unsul	nel summary P - in port-channel -alone s - suspended tandby (LACP only) S - Layer2	ator	
d - defau Number of channel Number of aggrega	groups in use: 2		
Group Port-chann	el Protocol Ports		
2 Po2(SU) 3 Po3(SU)	<pre>DAgP Fa0/1(P) Fa0/2(D) DAgP Fa0/5(P) Fa0/6(P)</pre>	************************	
swos≢ tri+F6 to exit CLI focus		Copy P	aste
		1 A 1	
R01	Figure4. Ether channel Testing in	Switch SW03	1
	∑ う of Trend in Scienti	ific i g y	Ĵ ŝ
	∑	ific i g y)
R01>en R01fsh ip route Codes: L - local, D - EIGRP, N1 - OSPF E1 - OSPF i - IS-TS, * - candid P - period Gateway of last r 192.168.2.0/ C 152.168.2 L 152.168.3.0/	C - connected, S - static, R - RIP, EX - EIGRP external, O - OSPF, IA - NSSA external type 1, N2 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 1, N2 - OSPF Starnal t L1 - IS-IS level-1, L2 - IS-IS level ate default, U - per-user static rout lc downloaded static route esort is 0.0.0.0 to network 0.0.0.0 4 is variably subnetted, 2 subnets, 0/24 is directly connected, Gigabitz 1/32 is directly connected, Gigabitz 24 is variably subnetted, 2 subnets,	<pre>H - mobile, B - BGP OSPF inter area external type 2 ype 2, E - EGP -2, ia - IS-IS inter area ex. o - ODR 2 masks thernet0/0 thernet0/0 2 masks</pre>	1
Physical Config R01>en R01#sh ip route Codes: L = local, D = EIGRP, N1 = OSPF i = IS-IS, * = candid P = period Gateway of last : 192.168.2.0/ C 152.168.2 192.168.3.0/ C 152.168.3 192.168.3.0/ C 152.168.3 203.81.64.0/ C 203.81.64 S* 0.0.0.0/0 is	C - connected, S - static, R - RIP, EX - EIGRP external, O - OSPF, IA - ISSA external type 1, N2 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 1, L2 - IS-IS level ate default, U - per-user static rout ic downloaded static route esort is 0.0.0.0 to network 0.0.0.0 24 is variably subnetted, 2 subnets, 0/24 is directly connected, Gigabitz 1/32 is directly connected, Gigabitz	<pre>H - mobile, B - BGP OSPF inter area external type 2 :ype 2, E - EGP -2, ia - IS-IS inter area e, o - ODR 2 masks thernet0/0 thernet0/0 2 masks thernet0/1 2 masks .0/1/0</pre>	
Physical Config R01>en R01#sh ip route Codes: L - local, D - EIGRP, N1 - OSPF E1 - OSPF 1 - IS-IS, * - candid P - period Gateway of last r 192.168.2.0/ C 152.168.2 192.168.3.0/ C 152.168.3 L 192.168.3 203.01.64.0/ C 203.81.64 L 203.81.64	C - connected, S - static, R - RIP, EX - EIGRP external, O - OSPF, IA - ISSA external type 1, N2 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 1, L2 - IS-IS level to default, U - per-user static rout lc downloaded static route esort is 0.0.0.0 to network 0.0.0.0 24 is variably subnetted, 2 subnets, 0/24 is directly connected, Gigabitz 1/32 is directly connected, Gigabitz 24 is variably subnetted, 2 subnets, 1/32 is directly connected, Gigabitz 24 is variably subnetted, 2 subnets, 1/32 is directly connected, Gigabitz 24 is variably subnetted, 2 subnets, 1/32 is directly connected, Gigabitz 24 is variably subnetted, 2 subnets, 1/32 is directly connected, Gigabitz 24 is variably subnetted, 2 subnets, 1/32 is directly connected, Serial	<pre>H - mobile, B - BGP OSPF inter area external type 2 ype 2, E - EGP -2, ia - IS-IS inter area e, o - ODR 2 masks thernet0/0 thernet0/0 2 masks thernet0/1 2 masks 0/1/0 0/1/0</pre>]

Figure 5. OSPF Testing on Cisco Router 01

Sw02					X
Physical Config CLI Attributes					
	IOS Command Line	Interface			
%LINEPROTO-5-UPDOWN: Line proto	col on Interfac	ce Port-channell, changed st	ate to	o up	*
SW02>en SW02#sh vlan bri					
SW02\$sh vian brief					
VLAN Name	Status	Ports			
l default	active	Fa0/8, Fa0/9, Fa0/10, Fa0, Fa0/12, Fa0/13, Fa0/14, Fa Fa0/16, Fa0/17, Fa0/18, Fa Fa0/20, Fa0/21, Fa0/22, Fa Fa0/24, Gig0/1, Gig0/2	a0/15 a0/19		
10 Teacher	active				
11 Student	active	and the second state of the second			
12 Staff	active				
1002 fddi-default	active				
1003 token-ring-default	active				-
1004 fddinet-default 1005 trnet-default	active active				
SW02#	accive				v
2041 2021 010 110 120 120 120 120 120		Сору		Paste	
Ctri+F6 to exit CLI focus					
Тор	e6. Testing Re	sult for VLAN			
Top Figure 1#Sh gibp abitEthernetO/1 - Group 1	Develop	esult for VLAN			33
Top Figure Hesh gibp abitEthernetO/1 - Group 1 tate is Standby	Develop	ment PB			
Top Figure 1#Sh gibp abitEthernetO/1 - Group 1	Develop	ment PB	and the		
Top Figure H#Sh gibp abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim	Develop tate change 168.4.3 me 10 sec	ment PB			
Top Figure SWSN glbp abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.964	Develop tate change 168.4.3 me 10 sec i secs	ment			
Top Figure SWSA glbp abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.984 edirect time 600 sec, for	Develop tate change 168.4.3 me 10 sec i secs	ment			
Top Figure SWSN glbp abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.964	Develop tate change 168.4.3 me 10 sec i secs t secs time	ment 3 9 9 00:07:52 put 14400 sec			
Top Figure SWSA glbp abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.984 edirect time 600 sec, for reemption disabled ctive is 192.168.4.1, pri	Develop	ment 3 9 9 00:07:52 out 14400 sec expires in 8.480 sec)			
Top Figure SASE GIDP abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.964 edirect time 600 sec, for reemption disabled totive is 192.168.4.1, pri tandby is local Priority 100 (default) Meighting 100 (default 100 Load balancing: round-robi Group members:	Develop tate change 168.4.3 me 10 sec i secs twarder times tority 150 (0), threshold in	ment 3 9 9 00:07:52 out 14400 sec expires in 8.480 sec)			
Top SPSN gibp abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.984 edirect time 600 sec, for reemption disabled ctive is 192.168.4.1, pri Standby is local Priority 100 (default) Seighting 100 (default 100 Load balancing: round-robi Scoup members: ccef.484f.Sa61 (192.168.	Develop	ment 3 9 9 00:07:52 out 14400 sec expires in 8.480 sec)			
Top SHSE GIDP abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.984 edirect time 600 sec, for reemption disabled ctive is 192.168.4.1, pri Standby is local Priority 100 (default) Weighting 100 (default 100 load balancing: round-robs Group members: ccef.484f.Sa61 (192.168. f872.ea57.e9a1 (192.168.	Develop	ment 3 9 9 00:07:52 out 14400 sec expires in 8.480 sec)			
Top SPSN gibp abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.984 edirect time 600 sec, for reemption disabled ctive is 192.168.4.1, pri Standby is local Priority 100 (default) Seighting 100 (default 100 Load balancing: round-robi Scoup members: ccef.484f.Sa61 (192.168.	Develop	ment 3 9 9 00:07:52 out 14400 sec expires in 8.480 sec)			
Top Figure JASA GIDP abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.984 edirect time 600 sec, for reemption disabled ctive is 192.168.4.1, pri standby is local Priority 100 (default) Meighting 100 (default 100 Load balancing: round-robi Scoup members: ccef.484f.Sa61 (192.168. f872.ea57.e9a1 (192.168. There are 2 forwarders (1 "orwarder 1 State is Active	Develop tate change 168.4.3 pe 10 sec i secs warder times tority 150 (0 0), threshold in .4.1) .4.2) local active)	ment 3 C A 00:07:52 out 14400 sec expires in 8.480 sec) is: lower 1, upper 100			
Top SASH GIDP abitEthernetO/1 - Group 1 tate is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.984 edirect time 600 sec, for reemption disabled ctive is 192.168.4.1, pri ctandby is local Priority 100 (default) Neighting 100 (default 100 coad balancing: round-robi Scoup members: ccef.484f.Sa61 (192.168. f872.ea57.e9a1 (192.168. f872.ea57.e9a1 (192.168. f872.ea57.e9a1 (192.168. fbre are 2 forwarders (1 Orwarder 1 State is Active S state changes, last MAC address is 0007.b400	Develop tate change 168.4.3 pe 10 sec i secs warder times tority 150 (0 0), threshold 10 .4.1) .4.2) local active) state change 0.0101 (defa	ment 3 C A 00:07:52 put 14400 sec expires in 8.480 sec) is: lower 1, upper 100 e 00:08:22			
Top Figure Address is Active State is Standby 10 state changes, last s irtual IP address is 192. ello time 3 sec, hold tim Next hello sent in 1.984 edirect time 600 sec, for reemption disabled crive is 192.168.4.1, pri tandby is local Priority 100 (default) Heighting 100 (default 100 coad balancing: round-robis Group members: ccef.484f.Sa61 (192.168. f872.ea57.e9a1 (192.168. f872.ea57.e9	Develop tate change 168.4.3 pe 10 sec i secs cwarder times tority 150 (0), threshold in 4.1) 4.2) local active) state chang 0.0101 (defa Pal delay 30 se	ment 3 C () 00:07:52 put 14400 sec expires in 6.460 sec) ds: lower 1, upper 100 e 00:08:22 ult)			
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Figure7. Redundancy Protocol GLBP Testing

4. CONCLUSION

Redundant devices, such as multilayer switches or routers, provide the capability for a client to use an alternate default gateway when primary default gateway fails. First Host Redundancy protocols, such as HSRP, VRRP, and GLBP provide alternate default gateways for hosts in the redundant router or multilayer switched environment. In this system, a network redundancy is a key factor to consider for maintaining network reliability. So, Layer 3 redundancy will be needed to consider to ensure that hosts maintain connectivity in the event of link failure of one device serving as a default gateway for a VLAN or set of VLANs.

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