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Design of Dual Homing Backup Link on Routing Border Gateway Protocol WithMethod Hot-Swap Routing Protocol

Heri Bani Jumawan[1], Subhanjaya Angga Atmaja[2], Firmansyah[3], Suminar[4], Tuti Rohayati[5]
[1,2,3,4,5]*Sistem Informasi, STMIK LIKMI, Bandung, Indonesia*
heribj@gmail.com, id.an99a@gmail.com, firmanhxc1@gmail.com, suminar0905@gmail.com, tutirohayati27@gmail.com

Abstract

The importance of the role of the network at this time makes companies and organizations look for ways to keep data flows running without downtime. Application of link backup is one way to overcome this. The need for the use of backup links at this time is expected to ensure the smooth running of the company is running its business. In this study, a design that will use BGP routing as well as using the methods HSRP and VLAN (Virtual Local Area Network) on the switch as supporters. The results obtained from the tests that have been carried out have resulted in the application of a backup link using BGP routing with the method HSRP can provide network availability of almost 0 percent in overcoming interference.

Keywords
Bgp; backup link; HSRP; method; failover; dualhoming

I. Introduction

Information and Communication Technology (ICT) networks play an important role in today's modern world of communication. A company or organization or even an individual depends on a reliable and trusted computer network. Where the computer network involves hardware and software components where both of them contribute greatly and are interrelated with each other in the success of a communication network. According to Njoka et al (2020) ICT greatly fosters cultural integration of people who hail from different cultural backgrounds. Advancement in ICT enables teachers to access and acquire extensive knowledge, best practices and experience at the mere touch of a button within the convenience of their offices or houses. Adoption and integration of technology in schools is largely dependent upon the availability and accessibility of ICT resources comprising of hardware, software and communications infrastructure.

Currently, information and communication technology has become a major requirement for the implementation of operations in companies or organizations. The larger an organization or company, the greater the need for technology, especially for the smooth flow of the organization's or company's business wheels. The more branches and data a company has, it becomes a special concern that must be considered, especially how to keep the flow of data communication, especially those with many organizational branches, so that the flow of the business wheel in question continues to run as it should. It is most feared by the organization or company is a constraint on data communication lines or commonly referred to as downtime, especially if the organization has a branch much so that the reliability of the data communication must remain vibrant and awake

As for who will be appointed, the formulation of the problem in this journal is to minimize downtime, especially in terms of inter-branch communication lines. Usually, to be able to communicate with every organization that has multiple branches, data communication lines are rented through a third party, be it intranet or internet. The

technique that will be discussed is to use the method HSRP (Hot-Swap Routing Protocol) wherein this technique is analogous to having two links which are assumed to be an active link which is used as the link main for data communication lines where between branches can send data while the other link is made as a standby link. which will work as a backup link for data communication when the link main downtime and when the main link returns to normal, the backup link will return to standby (inactive) This is specifically for networks wan on existing providers owned by an organization or company using BGP routing with the method HSRP (hot-swap routing protocol). If clarified, the aims and objectives of this study are as follows:

1. Network architecture design using BGP routing.
2. Design of method Hot Standby Router Protocol.
3. The design of a new topology is expected to be better than the previous topology for smooth data communication in minimizing downtime.

II. Research Method

2.1 Computer Network System

A system consisting of a computer designed to be able to share resources (printers, CPUs), communicate, and be able to access information (Yudianto, 2007). A computer network system is a collection of autonomous computers that are interconnected with each other, by using a single communications protocol so that all of the computers that are connected to them to share information, programs, resources and also use each other hardware devices simultaneously, such as printers, hard drives, and so forth (Kris, 2003). From the opinion of the experts, the authors conclude that a computer network is a system that connects more than one computer, printer, or other device designed to be able to share resources, communicate and access information.

2.2 Definition of a Router

A router is one of the equipment in a network whose function is to connect a network to a network another one. Routers are almost similar to bridges, only routers are smarter than bridges. Routers work based on a routing table that will be stored in memory where it will be used to make decisions about where and how packets of data will be sent. The router can also decide which route is the best that a data packet can take. (Sofana, 2013) A router is a piece of hardware whose function is to connect several networks, both in *the same network (local) or in different networks*.

a. Routing

Routing is used for the process of taking a packet from a device and sending it across the network to another device on a network different (Lammle, 2005) Routers learn how to study networks in two ways, namely:

1. *Routing* Statis

The purpose of routing statistics is that the user must enter or type allocations network into the routing table.

2. *Routing* Dinamis

While the definition of routing dynamic is a protocol on one router that can communicate with the same protocol that works on routers neighboring and then exchange with each other about all existing networks on each router and then place the information into the table router.

2.3 Border Gateway Protokol (BGP)

According to Rahmat Rafiudin. R (2004) Border Gateway Protocol (BGP) is an inter-Autonomous system routing protocol that has the main function of exchanging information networks that can be reached by BGP systems which include information in the AS (Autonomous System) list. BGP runs over a transport protocol called TCP. While the purpose of the existence of BGP is how to introduce it to the public outside our network.

2.4 Autonomous System

Autonomous System (AS) is a collection of a network that has policy routing the same. Usually, this network collection consists of one or more IP-Prefixes that are interconnected under a network operator where one routing policy is clearly defined. Functions Autonomous System (AS) is required if a network has a connection or is connected to one or more AS that has policy routing a different. To route packets between AS internally is required Interior Gateway Protocol (IGP) while the opposite to route packets to AS others we require Exterior Gateway Protocol (EGP) Examples: The network is connected to the open IIX or so.

2.5 Hot Swap Routing Protokol (HSRP)

HSRP is a method applied to Cisco network devices, where the concept used is to create a virtual IP gateway address on two devices so that the two devices have virtual gateway the same with each other. (Geraldi, 2020). HSRP is a Cisco standard redundancy protocol that defines a router that automatically takes over if another router fails (Purwanto, 2018). From the understanding of the journal above, it can be concluded that HSRP (Hot-Swap Routing Protocol) is a method used on routers (Cisco) where its function is to automate routing in case of interference on one of the links.

2.6 Switch

The switch is a device in existing components on a computer network where its function is to connect two or more computers based on addresses MAC (Media Access Control). Types of switches are divided into 2, among others:

1. *Switch Layer 2*

Layer 2 switches in the OSI model are found in the data link layer that works to forward data packets by looking at the destination as seen from the MAC address (Media Access Control), can also operate to perform other functions such as bridges between segments on a LAN (Local Area Network), because the switch is in charge of sending data packets by looking at the destination address by looking at the MAC regardless of the protocol of the network used.

2. *Switch Layer 3*

Switches at the OSI Layer layer can also be placed at the Network layer. Because layer 3 switches can forward data packets using IP addresses. Layer 3 switches can also function as routers even though their features are not the same as routers.

a. Virtual LAN (VLAN)

VLAN is a logical grouping of users and resources on component the network that connects to a port that has been determined administratively if on a switch (Lammle, 2005) VLAN can be analogous to a LAN is only virtual.

b. Routing between VLAN

Hosts in a VLAN live in their broadcast domain and can communicate freely. The VLAN can create a shared network and perform traffic separation on data in a network. If there is more than one VLAN on a switch to be able to communicate between VLANs, a needed router is.

2.7 Device Requirements

In this study, the design process required hardware and software support tools, including:

a. Hardware Requirements

Minimum Spec

Jenis	Spesifikasi Perangkat
Operating System	Windows 7 (64 bit) or later
Processor	2 or more Logical cores
Virtualization	Virtualization extensions required. You may need to enable this via your computer's BIOS.
Memory	4 GB RAM
Storage	1 GB available space (Windows Installation is < 200 MB).

Recommended Spec

Jenis	Spesifikasi Perangkat
Operating System	Windows 7 (64 bit) or later
Processor	4 or more Logical cores - AMD-V / RVI Series or Intel VT-X / EPT
Virtualization	Virtualization extensions required. You may need to enable this via your computer's BIOS.
Memory	16 GB RAM
Storage	Solid-state Drive (SDD) with 35 GB available space.

Optimal Spec

Jenis	Spesifikasi Perangkat
Operating System	Windows 7 (64 bit) or later
Processor	Core i7 or i9 Intel CPU / R7 or R9 AMD CPU / 8 or more Logical cores - AMD-V / RVI Series or Intel VT-X / EPT
Virtualization	Virtualization extensions required. You will need to enable this via your computer's BIOS.
Memory	32 GB RAM
Storage	Solid-state Drive (SDD) with 80 GB available space

Figure 1. *Optional specifications for hardware requirements*
Source GNS3. (2021). *https://docs.gns3.com/docs/getting-started/installation/windows/.* GNS3

b. Software Requirements

In this study, the author uses software that helps the author in the design process, including:

1. GNS3 is software used for network simulation that will be designed
2. Putty is a terminal used for CLI (Command Line Interface) which is used to configure simulation devices such as routers or switches.
3. IosV is a virtual OS used for designing this simulation for routers and switches

III. Results and Discussion

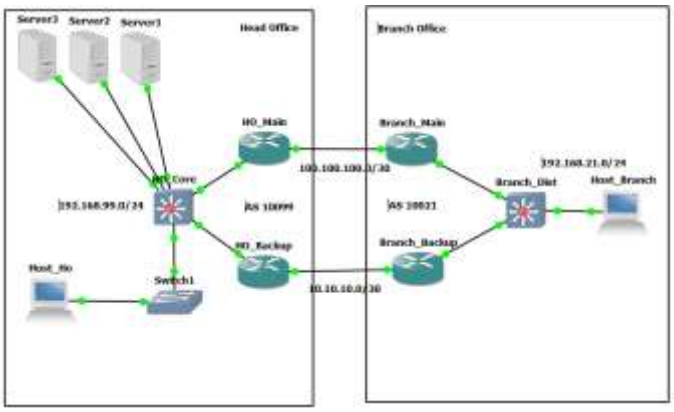

Figure 2. *Planning the topology of the method HSRP*

In Figure 2, a centralized network model is illustrated where all servers are located in the head office and all branch offices carry out the process of input, edit or delete directly to the head office. Both the head office and the branch office must have 2 communication lines which will later function if there is downtime on the mainline, it will automatically move to the line backup, and when the mainline is normal, it will automatically return to the mainline. This is where the method HSRP performs its function.

3.1 Configure HSRP on a Router

a. Configuration Head Office Router

The first thing to do is to give the WANIPs and LAN to the router, create a loopback IP, and then install the BGP routing, only after that the configuration HSRPis made on each router.

1) Main Head Office Router

```
HO_Main(config-if)#description WAN_Main
HO_Main(config-if)# ip address 100.100.100.1 255.255.255.252
HO_Main(config-if)#
```

Figure 3. *Assignment IP on the Wan Head Office interface*

```
HO_Main(config)#int fa0/0.10
HO_Main(config-subif)#description LOKAL
HO_Main(config-subif)#encapsulation dot1Q 10
HO_Main(config-subif)#ip address 192.168.99.2 255.255.255.0
HO_Main(config-subif)#int fa0/0.5
HO_Main(config-subif)#encapsulation dot1Q 5
HO_Main(config-subif)#ip add 11.11.11.1 255.255.255.252
HO_Main(config-subif)#desc P2P_ROUTER
```

Figure 4. *Provision IP interface Lan Head Office*

Additionsconfiguration BGP in the route around the head office

```
HO_Main(config)#router bgp 10099
HO_Main(config-router)# no synchronization
HO_Main(config-router)# bgp router-id 1.1.1.1
HO_Main(config-router)# bgp log-neighbor-changes
HO_Main(config-router)# network 192.168.99.0
HO_Main(config-router)# timers bgp 15 20
HO_Main(config-router)# redistribute connected
HO_Main(config-router)# neighbor 11.11.11.2 remote-as 10099
HO_Main(config-router)# neighbor 11.11.11.2 next-hop-self
HO_Main(config-router)# neighbor 11.11.11.2 soft-reconfiguration inbound
HO_Main(config-router)# neighbor 100.100.100.2 remote-as 10021
HO_Main(config-router)# neighbor 100.100.100.2 soft-reconfiguration inbound
HO_Main(config-router)# neighbor 100.100.100.2 route-map LOCALPREF in
```

Figure 5. *Configuring Routing BGP routers Head Office*

Making HSRP in IP Lan Head Office

```
HO_Main(config)#int fa0/0.10
HO_Main(config-subif)#encapsulation dot1Q 10
HO_Main(config-subif)#description LOKAL_MAIN
HO_Main(config-subif)#ip address 192.168.99.2 255.255.255.0
HO_Main(config-subif)#standby 10 ip 192.168.99.1
HO_Main(config-subif)#standby 10 priority 120
HO_Main(config-subif)#standby 10 preempt
```

Figure 6. *Configuring HSRP in head office*

In addition to the IP LAN, we need 3 IPs because we use 2 routers to play and backup, where the 3 IPs are used for 2 physical IPs, then 1 IP for virtual.

2) Router Backup Head Office

```
HO_Backup(config)#int fa0/1
HO_Backup(config-if)#description WAN_Backup
HO_Backup(config-if)#ip address 10.10.10.1 255.255.255.252
HO_Backup(config-if)#
```

Figure 7. *Assignment IP on the Wan Head Office interface (backup router)*

```
HO_Backup(config)#int fa0/0.5
HO_Backup(config-subif)#description P2P_ROUTER
HO_Backup(config-subif)# encapsulation dot1Q 5
HO_Backup(config-subif)# ip address 11.11.11.2 255.255.255.252
HO_Backup(config-subif)#int fa0/0.10
HO_Backup(config-subif)#description LOKAL_BACKUP
HO_Backup(config-subif)# encapsulation dot1Q 10
HO_Backup(config-subif)# ip address 192.168.99.3 255.255.255.0
HO_Backup(config-subif)# standby 10 ip 192.168.99.1
```

Figure 8. *Assignment IP on the Lan Head Office interface (backup router)*

Addition of configuration BGP on the main head office router

```
HO_Backup(config)#router bgp 10099
HO_Backup(config-router)# bgp router-id 2.2.2.2
HO_Backup(config-router)# bgp log-neighbor-changes
HO_Backup(config-router)# network 192.168.99.0
HO_Backup(config-router)# timers bgp 15 20
HO_Backup(config-router)# redistribute connected
HO_Backup(config-router)# neighbor 10.10.10.2 remote-as 10021
HO_Backup(config-router)# neighbor 10.10.10.2 soft-reconfiguration inbound
HO_Backup(config-router)# neighbor 10.10.10.2 route-map Localpref in
HO_Backup(config-router)# neighbor 11.11.11.1 remote-as 10099
HO_Backup(config-router)# neighbor 11.11.11.1 soft-reconfiguration inbound
```

Figure 9. *Configuration BGP on head office router (backup router).*

Making HSRP on IP Lan Head Office

```
HO_Backup(config)#int fa0/0.10
HO_Backup(config-subif)#description LOKAL_BACKUP
HO_Backup(config-subif)# encapsulation dot1Q 10
HO_Backup(config-subif)# ip address 192.168.99.3 255.255.255.0
HO_Backup(config-subif)# standby 10 ip 192.168.99.1
```

Figure 10. *Configuration HSRP on head office router (backup router)*

b. Adding VLANs to the Head Office Switch

For the configuration of the switch in the head office, only 2simulated, VLANs are including VLAN 10 for local and VLAN 5 for p2p connections router main and backup in the head office.

```
HO_Core(vlan)#vlan 10 name LOKAL
VLAN 10 added:
    Name: LOKAL
HO_Core(vlan)#vlan 5 name P2P
VLAN 5 added:
    Name: P2P
HO_Core(vlan)#
```

Figure 11. *Configuration of VLANs in the head office switch*

```
HO_Core(config-if)#int fa1/0
HO_Core(config-if)#description ROUTER_MAIN
HO_Core(config-if)#switchport mode trunk
HO_Core(config-if)#switchport trunk allowed vlan add 5,10
HO_Core(config-if)#
```

Figure 12. *Configuration on the head office switch*

For the configuration on the side backup router in the head office the same as the main router, the difference is only on the side neighbor according to the router opposing or partner.

c. Configuring the Branch Office Router

The configuration for the side branch office concept is almost the same as in the head office. It is just the same with the backup router on the side of the head office. We have to look on the side of the router his opponent. Similarly, the side branch office switch in the simulation used only two VLANs is VLAN 10 and VLAN 5.

3.2 Results of testing methods HSRP

In this testing phase will be tried interest a ping from a PC in the branch office (192.168.21.100) to a PC and Server in the head office with IP 192.168.99.100 (PC) and 192.168.99.10 (Server) to ensure that packet delivery runs without any problems. Then proceed with doing a traceroute whose purpose is to see the hops passed from the PC in the branch office to the address IP in the head office (PC/Server) to ensure whether the process is failover running correctly, and use the show standby command on the putty terminal at the location. main routers and backup to determine the functioning status of HSRP the created, then testing deliberately to create a link down on the main cable line (main link) to find out whether the transfer link can move automatically or not.

This is important to ensure the availability of a complete backup link to the network without the need for manual transfers to increase the duration of downtime. Testing will be carried out in stages from the branch office to the head office, where later from the side, the branch office test will be carried out to the PC in the head office and the server as mentioned above.

a. HSRP Status on Routers Branch Main and Backup

```
Branch_Main#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Fa0/0.10    10   110   Active  local           192.168.21.3    192.168.21.1
```

Figure 13. *Status HSRP on the main branch office router*

```
Branch_Backup#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Fa0/0.10    10   100   Standby 192.168.21.2    local           192.168.21.1
```

Figure 14. *Status HSRP in branch office router backup*

It can be seen in the picture above that the status of the main router at the branch office is active, while the backup link status standby is in, this means a link that that is being used for data communication passes through the mainline on the branch office router.

b. Testing from PC Branch Office to PC Head Office (IP 192.168.99.100)

```
PC_Branch> ping 192.168.99.100 -c 10
84 bytes from 192.168.99.100 icmp_seq=1 ttl=62 time=62.706 ms
84 bytes from 192.168.99.100 icmp_seq=2 ttl=62 time=65.652 ms
84 bytes from 192.168.99.100 icmp_seq=3 ttl=62 time=47.930 ms
84 bytes from 192.168.99.100 icmp_seq=4 ttl=62 time=78.773 ms
84 bytes from 192.168.99.100 icmp_seq=5 ttl=62 time=53.404 ms
84 bytes from 192.168.99.100 icmp_seq=6 ttl=62 time=64.388 ms
84 bytes from 192.168.99.100 icmp_seq=7 ttl=62 time=59.512 ms
84 bytes from 192.168.99.100 icmp_seq=8 ttl=62 time=66.413 ms
84 bytes from 192.168.99.100 icmp_seq=9 ttl=62 time=58.318 ms
84 bytes from 192.168.99.100 icmp_seq=10 ttl=62 time=65.557 ms
```

Figure 15. *Results ping from PC branch office to head office*

```
PC_Branch> trace 192.168.99.100 -P 6
trace to 192.168.99.100, 8 hops max (TCP), press Ctrl+C to stop
 1   192.168.21.2    17.761 ms  8.056 ms  17.847 ms
 2   100.100.100.1   46.069 ms  45.600 ms  30.998 ms
 3   192.168.99.100   34.814 ms  48.712 ms  47.186 ms

PC_Branch>
```

Figure 16. *Results from Tracebranch office to head office*

Terlihat pada Hasil *trace* Dari *pc It* can be seen in the results trace from the branch office pc that data communication lines still pass through the main link on IP 100.100.100.1.

c. Terminate at the Main Link to the Head Office Deliberately

```
HO_Main#sh ip int brief
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            unassigned      YES unset  up                    up
FastEthernet0/0.5          11.11.11.1      YES manual up                    up
FastEthernet0/0.10         192.168.99.2    YES manual up                    up
FastEthernet0/1            100.100.100.1   YES manual up                    up
FastEthernet1/0            unassigned      YES unset  administratively down down
Loopback0                  1.1.1.1         YES manual up                    up
HO_Main#config t
Enter configuration commands, one per line.  End with CNTL/Z.
HO_Main(config)#int fa0/1
HO_Main(config-if)#shu
HO_Main(config-if)#
*Mar  1 03:40:31.083: %BGP-5-ADJCHANGE: neighbor 100.100.100.2 Down Interface flap
HO_Main(config-if)#
*Mar  1 03:40:33.051: %LINK-5-CHANGED: Interface FastEthernet0/1, changed state to administratively down
*Mar  1 03:40:34.051: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
HO_Main(config-if)#
```

Figure 17. *Termination of main link head office.*

As seen in the picture above to3:16 link play in head office attempted revived and the results obtained on a pc at locations branch office do not feel downtime back when the link is restored passes through play, the results of the trace of a branch office pc also returned passes through play.

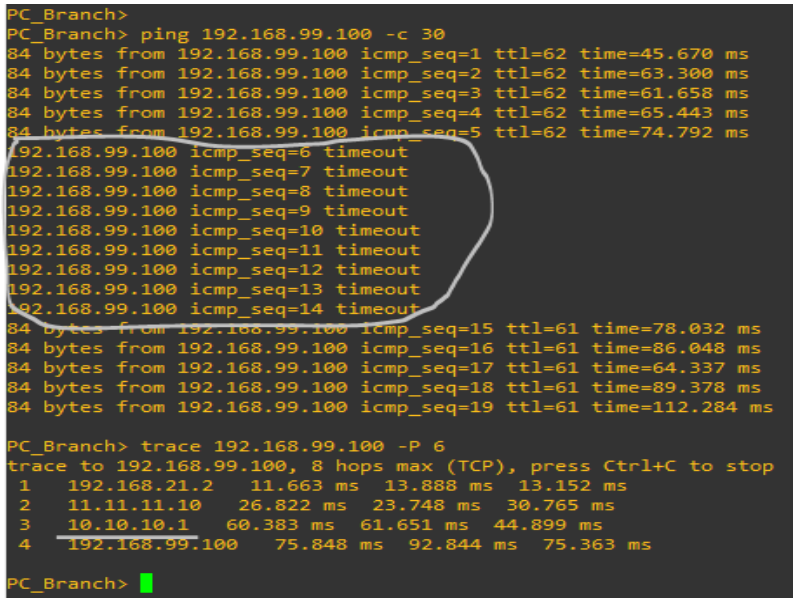

Figure 18. *The results of the ping and traceroute from the branch office when the main link at the head office is forcibly turned off*

And when the main link is turned on again, the results can be seen in the image below.

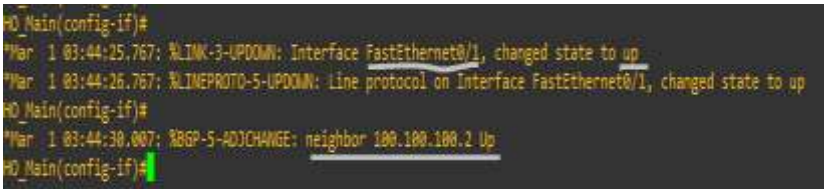

Figure 19. *The main link at the head office is revived*

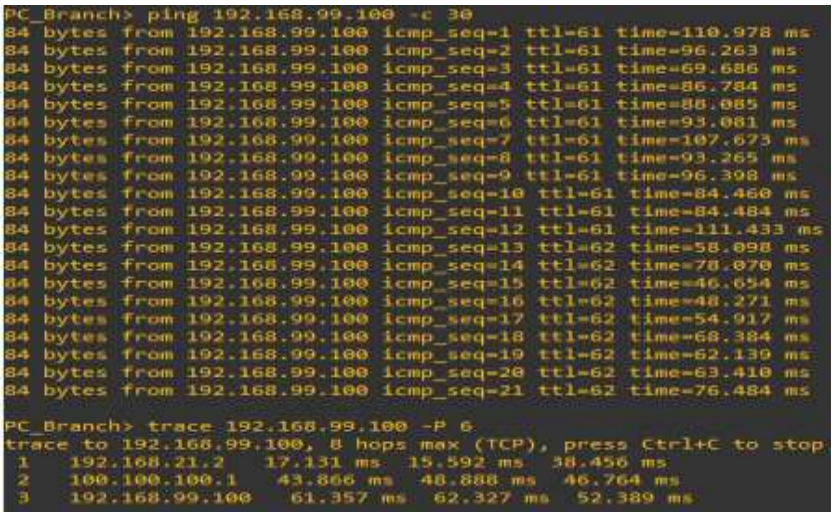

Figure 20. *Results Ping and traceroute from the branch office when the main link at the head office is restarted*

IV. Conclusion

After testing using BGP routing and methods, it HSRP can be concluded that network availability on the path is WAN guaranteed because of the implementation of main and backup on the link, so it can be proven that this method is very helpful, especially in dealing with disturbances, so that the duration of downtime will be longer lightly compared to the manual. From the above test, this is very useful, especially for companies or organizations that are engaged in the service sector because by using the BGP routing and method HSRP, the occurrence of disturbances can be guaranteed almost 100 percent.

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