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Backcup Router Network Optimization to Prevent Link Failure Using the Virtual Router Redundancy Protocol (VRRP) Method

Adjie Santoso [1], Moh.Iwan Wahyuddin [2], Andri Aningsih[3]

Informatika,
Universitas Nasional, Jl. Sawo Manila, Jakarta Selatan, Jakarta, Indonesia 12520

Email: Santosoadjie161297@gmail.com, iwan_wyd@yahoo.com, andrianingsih@civitas.unas.ac.id

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ABSTRACT

The internet network runs without stopping as its usage increases, if the Router experiences a problem of downtime then the internet cannot be used. To minimize these problems, the Backcup Router can be applied using the VRRP method. Testing in this study will use packet loss and throughput parameters. From the results of tests that have been done show that the application of the VRRP method can provide optimal network availability by providing a Router Backcup and produces an average packet loss value of 0.39%, and an average throughput of 279 Bps is said to be very good, with the results of applying the method VRRP is able to provide solutions when the main router is experiencing problems and still maintaining the quality of the internet network.

1. Introduction

The internet network runs without stopping as its usage increases, if the Router experiences a problem of downtime then the internet cannot be used. To minimize these problems, a backcup router can be used using the VRRP (Vitrual Router Redundancy Protocol) method, which is a method where there is an active link that is useful as the main link to forward packets and a backcup link that is useful as a backcup When the main link experiences problems and When the main link is back to normal, the backcup link will become backcup (inactive). [1] - [2].

Previous research by I Gede Made Surya tested the Virtual Router Redundancy Protocol backcup link method without combining it with the VLAN Method and resulting in Delays, with 80ms Delay values and 16-18% Package Loss. Delay values are calculated according to TIPHON Standards [3]. According to Indra Chaidir From the results of tests conducted, Virtual Router Redundancy Protocol (VRRP) can be used to overcome device failures that occur on one network and can improve network performance. By implementing the VRRP protocol when the Router load is increased and the network experiences link failure, it is known that VRRP can work well, so that all data transmission processes continue as they should, and VRRP can be a solution of telecommunications network design that requires network reliability from broken links [4]. Based on this research, this research will apply the VRRP (Virtual Router Redundancy Protocol) method combined with the VLAN (Virtual Local Area Network) method which is expected to get better results.

2. Research Methods

2.1. VVRP (Virtual Router Redundancy Protocol)

Topology (VRRP) is a selection protocol that dynamically assigns responsibility for one or more Virtual Routers for VRRP Routers on a LAN, which allows multiple Routers on a Multiaccess Link to utilize the same Virtual IP address. A VRRP Router is configured to run the VRRP protocol in

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conjunction with one or more other Routers attached to the LAN. In the VRRP configuration, one Router is selected as the Master Router with another Router acting as a Backcup [5].

Table 1
Terms in the VRRP Method

Terms in the VRRP Method	Definition
Router Master	Router The main task is to send packets
Backcup Router	as a backup Router that is ready to function When the master Router experiences a dead / problem
Priority 1 - 254	Priority is the priority value that we can give to the Router to determine the Router to be the main Router / Backup Router

2.1 VLAN (Virtual LAN)

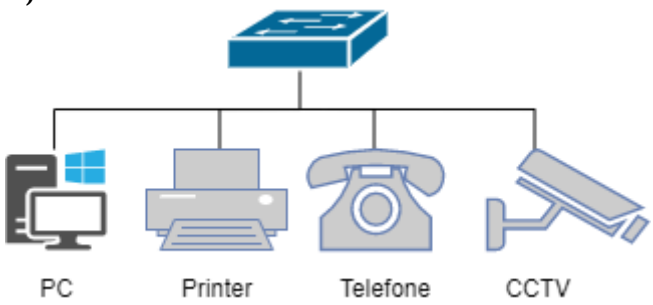

Fig 1. Virtual LAN (V-LAN)

A VLAN is a group of devices on one or more LANs, which are configured (using Virtual devices) so that they can communicate as if they were connected to the same line physically, when in fact the device is in a different LAN segment [6].

2.2 DHCP

Method Dynamic Host Configuration Protoocol (DHCP) is a service that automatically gives an IP address to the computer requesting it [7].

2.3 QOS parameter

The Quality of Service parameter is a calculation parameter about the quality of a network in which there are Package Loss, Delay, Jitter, Bandwidth, Througput.

a) Package Loss

Is a parameter that describes a condition that shows the total number of packets lost, Manual Package Loss Calculation Formulas

$$PL = () \times 100\% \frac{PK - PT}{PK}$$

Information:

PL = Package Loss data
PK = Data Packages sent
PT = Data Packages received [8]

Table 2
Standardization of Packet Loss Based on TIPHON

Category	Package Loss
Very good	0%
Good	3%
Ugly	15%
Very ugly	25%

Table 2 refers to TIPHON Standardization the results of testing Package Loss on the Network say Very Good if the value of Package Loss of 0%, Good 3%, Medium 15% and Bad 25% [8].

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Jurnal Mantik
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b) Throughput

Is the rate of successful data transfer rate and is measured in units of Bps (Bits per Second),Manual Througputh Calculation Formulas

$$\text{Througputh} = ()\frac{TP}{TWP}$$

Information :
TD = Package Total
TP = Total Delivery Time [8].

Table 3
Througputh standardization according to TIPHON

Throughput Category	Througputh (Bps)
Very good	> 100
Good	75
Is	50
Ugly	<25

In Table 3. TIPHON Standardization in determining the quality of Througputh in the network with values <25 Bps Poor, 50 Bps Medium, 75 Bps Good,> 100 Bps Very Good

2.4 Research Framework

This study applies the VRRP (Virtual Router Redundancy Protocol) method in network design created and simulated using the GNS-3 (Graphical Network Simulator-3) application.

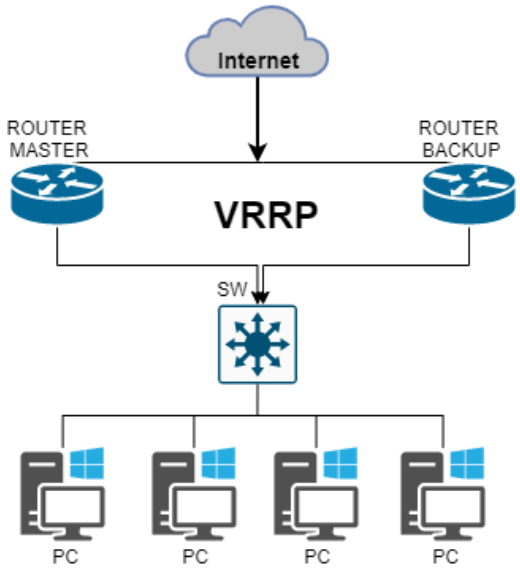

Fig 2. VRRP Topology Design

Figure 2 is a topology design that will be applied in the network design process in this study, by implementing the VRRP (Virtual Router Redundancy Protocol) method, so that there is a backup link on the network with the VRRP method.

3. Results and Discussion

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Jurnal Mantik
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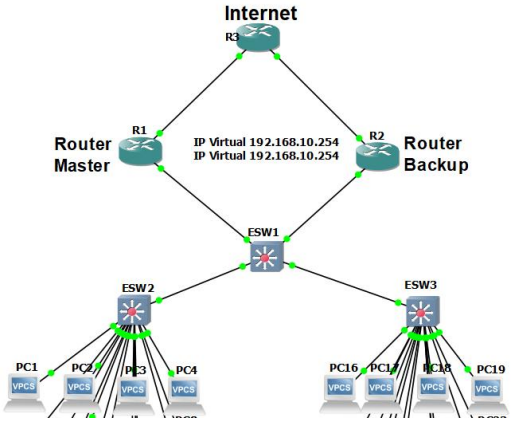

Fig 3.VRRP Method Network Topology

The topology in Figure 3. When a PC client accesses the internet, there is no need to worry about sending package failures if a link failure occurs on the main cable transmission line, because it will automatically use Router backup. In this topology the router has configured the Virtual Router Redundancy Protocol method, so that this method will have a backup link

3.1 Testing the Virtual Router Redundancy Protocol Method

At this stage, it will be pinged from the PC Client to IP 11.11.11.1 (IP ISP) aims to ensure that packet delivery is running properly and normally, and by using the VRRP command show on the Solar-Putty terminal to find out the VRRP status on the Router, then testing the Link Failure intentionally on the Master Router to find out whether the link transfer from the main path to the backcup link takes place automatically. This is very important to ensure the availability of backcup links to the network as a whole without having to do the transfer manually. As an example of the flow of the VRRP method, it will be explained in the figure below.

a. Active Router Status Check

```
R1#show vrrp
FastEthernet0/0.10 - Group 1
  State is Master
  Virtual IP address is 192.168.10.254
```

Fig 4. Router 1 is active as a Router Master

At this stage, the Router 1 will check whether the active status can be seen in the picture above the status of Router 1 is the master means the main Router is active.

```
R1#configure t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int f0/0
R1(config-if)#shu
R1(config-if)#shutdown
R1(config-if)#
*Mar  1 02:28:34.123: %VRRP-6-STATECHANGE: Fa0/0.10 Grp 1 state Master -> Init
*Mar  1 02:28:34.135: %VRRP-6-STATECHANGE: Fa0/0.20 Grp 2 state Master -> Init
```

Fig 5. The Router Master is turned off

At this stage, we will turn off the main Router to make it change the status from master to init in the sense that the master router is dead and all of its tasks are delegated to the Router backcup.

```
*Mar  1 02:28:43.007: %VRRP-6-STATECHANGE: Fa0/0.10 Grp 1 state Backup -> Master
R2#
*Mar  1 02:28:45.495: %VRRP-6-STATECHANGE: Fa0/0.20 Grp 2 state Backup -> Master
```

Fig 6. The Backcup Router process turns into a Master

In Figure 6. Is the stage of the process of moving the work of the backcup Router to Router master can be seen as shown above.

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Jurnal Mantik
Volume 4 Number 1 May 2020, pp. 276-282 E-ISSN 2685-4236
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```
PC1> ping 11.11.11.1 -t
84 bytes from 11.11.11.1 icmp_seq=1 ttl=254 time=47.763 ms
84 bytes from 11.11.11.1 icmp_seq=2 ttl=254 time=34.723 ms
84 bytes from 11.11.11.1 icmp_seq=3 ttl=254 time=34.887 ms
84 bytes from 11.11.11.1 icmp_seq=4 ttl=254 time=42.783 ms
84 bytes from 11.11.11.1 icmp_seq=5 ttl=254 time=40.368 ms
84 bytes from 11.11.11.1 icmp_seq=6 ttl=254 time=35.867 ms
84 bytes from 11.11.11.1 icmp_seq=7 ttl=254 time=39.742 ms
84 bytes from 11.11.11.1 icmp_seq=8 ttl=254 time=45.719 ms
84 bytes from 11.11.11.1 icmp_seq=9 ttl=254 time=42.924 ms
84 bytes from 11.11.11.1 icmp_seq=10 ttl=254 time=37.774 ms
```

Fig 7. Process before the occurrence of link failure

In Figure 7 is the Client stage successfully pinged the ISP IP Router through the Router R1 link

```
PC1> ping 11.11.11.1 -t
84 bytes from 11.11.11.1 icmp_seq=1 ttl=254 time=47.763 ms
84 bytes from 11.11.11.1 icmp_seq=2 ttl=254 time=34.723 ms
84 bytes from 11.11.11.1 icmp_seq=3 ttl=254 time=34.887 ms
84 bytes from 11.11.11.1 icmp_seq=4 ttl=254 time=42.783 ms
84 bytes from 11.11.11.1 icmp_seq=5 ttl=254 time=40.368 ms
84 bytes from 11.11.11.1 icmp_seq=6 ttl=254 time=35.867 ms
84 bytes from 11.11.11.1 icmp_seq=7 ttl=254 time=39.742 ms
84 bytes from 11.11.11.1 icmp_seq=8 ttl=254 time=45.719 ms
84 bytes from 11.11.11.1 icmp_seq=9 ttl=254 time=42.924 ms
84 bytes from 11.11.11.1 icmp_seq=10 ttl=254 time=37.774 ms
11.11.11.1 icmp_seq=11 timeout
84 bytes from 11.11.11.1 icmp_seq=12 ttl=254 time=24.534 ms
84 bytes from 11.11.11.1 icmp_seq=13 ttl=254 time=30.501 ms
84 bytes from 11.11.11.1 icmp_seq=14 ttl=254 time=33.272 ms
```

Fig 8. The router master process died and was replaced by the backcup router

In Figure 8, is the ping test process from Client to ISP Router, the Client is pinged to IP 11.11.11.1 is the ISP Router IP and looks successful and When the main Router is turned off there will be a timeout for 1 second it is the process of switching Links from the Router Master to the backcup router.

3.2. Testing Scenarios

Test scenarios performed on the Backcup Link system include:

a. Testing for Package Loss on the network from the Active Start Router to Backcup with 5 stages of testing are:
   1) PING testing to ISP using the ICMP Protocol for 10 Minutes
   2) PING testing to ISP using the ICMP Protocol for 15 minutes
   3) PING testing to ISP using ICMP Protocol for 20 Minutes
   4) PING testing to ISP using the ICMP Protocol for 25 Minutes
   5) PING testing to ISP using ICMP Protocol for 30 Minutes

b. Througput Testing
   1) PING testing to ISP using the ICMP Protocol for 10 Minutes
   2) PING testing to ISP using the ICMP Protocol for 15 minutes
   3) PING testing to ISP using ICMP Protocol for 20 Minutes
   4) PING testing to ISP using the ICMP Protocol for 25 Minutes
   5) PING testing to ISP using ICMP Protocol for 30 Minutes

3.3. Test Result Graph

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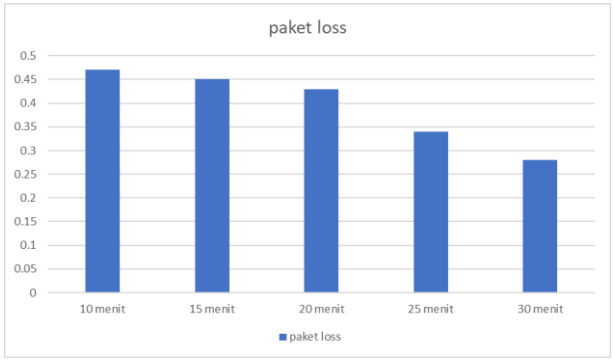

Fig 9. Package Loss Test results

Table 4
Loss package testing results

Package received	Missing ackage	Duration of testing	Package Loss
1142	6	10 minutes	0.47%
2361	8	15 minutes	0.45%
3458	10	20 minutes	0.43%
4608	10	25 minutes	0.34%
5815	10	30 minutes	0.28%
Amount Average		10-30 minute	0.39%

In Table 5 is the result of the packet loss calculation process obtained from the capture software Wireshark and calculated manually using a calculator to produce an average yield of packet loss tested 10-30 minutes by 0.39% according to the TIPHON standardization the number of packet loss below 3% can be said good.

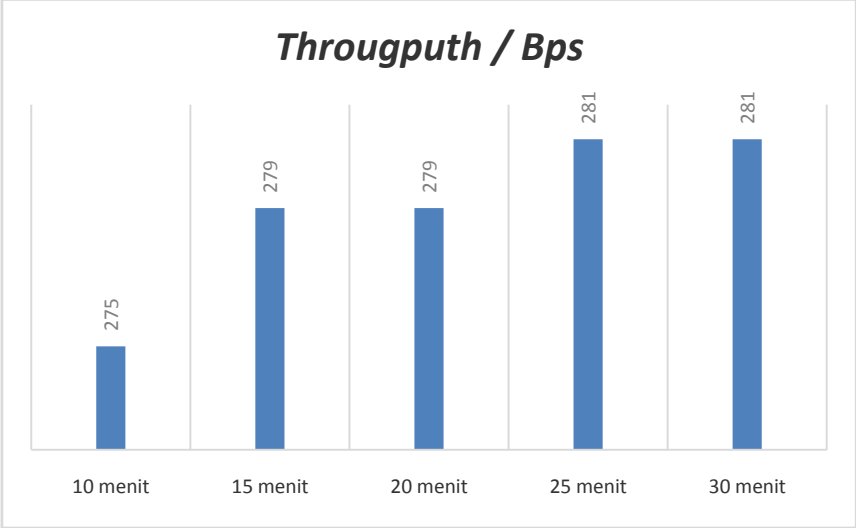

Fig 9. Throughput Test results

Table 5
Througput Test Results

Router Situation	Number of packages	Duration of testing	Througputh
The master router turn off	191255	10 minutes	275 Bps
Router Master turn off	260577	15 minutes	279 Bps
Router Master turn off	340299	20 minutes	279 Bps
Router Master turn off	427005	25 minutes	281 Bps
Router Master turn off	511532	30 minutes	281 Bps
amount		0 - 30 minutes	279 Bps
Average			

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Jurnal Mantik
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In Table 6. The results of the Througputh testing process for 0 - 30 minutes produce an average Througputh value of 279 Bps based on the TIPHON standardization that 279 Bps can be said to be very good for its network quality.

4. Conclusion

Based on the results of the method testing process (VRRP) and also Virtual LAN network availability at layer 3 network is guaranteed because there is an active link and backcup link from the application of the Virtual Router Redundancy Protocol method, as evidenced by the results of tests that have been carried out using a PC for 10 - 30 minutes only there is an average of 39% packet loss, while the value of Througputh produces an average value of 279 Bps on testing for 30 minutes according to the TIPHON standardization can be said to be Very Good.

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