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Predicting Dual-WAN Failover Using a Variant of the RNN Algorithm for High-Availability Internet Networks

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Failover dual;
WAN;
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ABSTRACT
The availability of the Internet network is very necessary for daily activities and in the business world. The need for the internet has been very massively used both with cell phones, personal computers and network computers using network hardware. One of the network hardware used in this study is a microtia router as load balancing. Failover prediction analysis with dual WAN to obtain Internet network availability using the RNN variant algorithm method to support stability performance in using the internet. Internet Service Provider (ISP) is an internet provider service used in this study, ISP Indihome 20 Mbps and ISP Telkomsel Modem Orbit GSM model HKM0130 use 4G prepaid cards as internet service providers. The purpose of this study is to predict the redirection of the internet from dual WAN to support the availability of the Internet network. With the stability method using algorithm support, this research provides convenience and algorithms in network reliability configuration. The results show that load balancing with PCC and ECMP methods combined with failover mechanisms significantly improves network performance. For 100 users, throughput increased from 90 Mbps to 180 Mbps, response time decreased from 150 ms to 70 ms, and packet loss dropped from 5% to 2%. The failover mechanism successfully maintains connectivity when one ISP line fails. In conclusion, the dual-WAN failover system with RNN-based prediction effectively ensures high-availability internet networks with proven reliability. The application of research results can be carried out by companies and education providers as well as for other needs.

INTRODUCTION

The development of technology is currently accelerating, both information and communication technology causing the need for internet access to use is urgently needed. Traffic stability and speed are very important, both in the environment of education providers, companies, and internet service providers. Generally, every operational activity related to communication access, data transfer of internet needs uses one Internet Service Provider (ISP) line. For example, a manufacturing company that makes production from raw materials into a product requires a very long process. The organizational structure requires the Internet as a means of digitizing company operations (Haq et al., 2023). The internet integration system manages the network of all organizational structures that must have (Shafiq et al., 2022).

Operational activities such as online information systems, cloud-based data exchange services, video conferencing, with various real-time applications availability demand high-speed internet networks and minimize Internet network delays. This makes load balancing as a balancing factor for the existence of dual WAN in one Internet Service Provider. This research occurs when the problem of a one-line internet service provider is often disconnected. Failover backs up the Internet to one of the Internet service providers, transmission failure, communication between computers does not work. A limited bandwidth traffic load of 20 Mbps makes the network Computer Down (Amalia et al., 2023; Jayadi & Sadamaputra, 2023).

The load balancing model with dual WAN applies the distribution of simple traffic load sharing routing techniques for indihome internet service providers (ISP 1) and Orbit Telkomsel Gsm internet service providers (ISP 2) equally. The configuration in the mangle firewall only implements Action accept, chain prerouting. Meanwhile, the PCC Model Distribution (Per connection Classifier) applies a balanced distribution of internet traffic load for internet service provider Indihome (ISP 1) and Internet service provider Orbit GSM (ISP 2) configuration firewall mangle applies Action mark connection, mark routing, while chain prerouting, Ethernet output is adjusted to needs. The main goal is to distribute evenly, optimize bandwidth, improve network performance (Saharuna et al., 2020; Tantoni et al., 2022).

To maintain the stability of access, the bandwidth capacity was increased to 50 Mbps from ISP 2. The number of gateway ISPs used is two ISPs 1 bandwidth of 20 Mbps and ISP 2 of bandwidth of 50 Mbps. The approach used by the RNN variant algorithm for the configuration of failover settings logs. The device has a check gateway and ping feature for Public IPs, 8.8.8.8 for ISP1 and 1.1.1.1 for Public IP ISP2.

The purpose of this recursive failover load balancing main research is to: Ensure that the internet connection remains running automatically by switching the main path to the backup path in the event of ISP1 and ISP2 failures. Ensure to maintain the stability of the speed of both ISP1 and ISP2 to maintain network reliability. The benefits of this research are expected to be available to the public to use the reserve function of this system for operational continuity and have an impact on keeping services active and increasing trust (Khaerudin et al., 2025).

METHOD

Types of Research

The research methodology used by the case study with a qualitative method approach. The purpose of the research is to have an in-depth understanding of microtics, in load balancing, the failover feature can be explored and developed according to the needs of companies and institutions in the field. Internet service providers (ISPs) with more than one or multiple ISPs can be applied with this microtic device.

Data Collection Methods

The data sources used for this study include interviews, supporting documents obtained from journals and field observations. Researchers actively interact directly in the processing of understanding microtics.

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Studi Literature

Table 1. Journal Article Review

No.	Title and Author	Method	Research Results
1	*LOAD BALANCING* WITH *ROUND ROBIN* METHOD FOR *WEB SERVER WORKLOAD SHARING Komaruddin sipitorini 2019*	*Load balancing* is a technology to distribute workloads to several *servers*	The results of the experiment show that the application *of the load balancing* technique with *the round robin* method on Nginx connected to 2 *Apache Web Server* machines can help regulate the workload sharing of Web Server.
2	Quality *of Service* Analysis on Computer Networks, Agung Eka Mandala Putra, Adnyana 2021	It is necessary to conduct a quality-of-service assessment on the Digital Agency company's computer network to determine the ability of network connections to fulfill company activities.	The results of the *Quality-of-Service assessment* at Kesato Digital Agency are in the satisfactory category, of course, there needs to be improvement efforts to achieve maximum results in the very satisfactory category.
3	ANALYSIS OF THE EFFECTIVENESS OF THE IMPLEMENTATION OF COMPUTER NETWORK MANAGEMENT STRATEGIES ON IMPROVING THE STABILITY, SECURITY, AND PRODUCTIVITY OF THE ECOLOGICAL SYSTEM INFORMATION ON XYZ COMPANY, Sinambela, Patria, Jon Tasrif 2025	The research methods used include case studies, direct observations, and interviews with the company's IT team**.**	The results of the study show that the application of management strategies network based on real-time monitoring, network segmentation, and policy implementation Structured security can improve system stability by up to 25%, reducing potential security threats by 30%, and increase network user productivity by 20%.
4	The Effect of Network Speed on the Performance of Google Cloud Applications Web-Based Drive, Widiyanto, Syamsudin 2025	The method that Used is a quantitative experiment with an inter-subject design, testing five levels speeds (5, 10, 25, 50, 100 Mbps) on three file sizes (10 MB, 100 MB, 500 MB), each repeated 30 times in a controlled environment using a network emulator.	The results showed that network speed significantly affected all indicators ($p < 0.001$), with R^2 values ranging from 0.87 to 0.96.
5	SIMPLE METHOD BANDWIDTH MANAGEMENT IMPLEMENTATION QUEUE ON THE INTERNET	The method used is the framework kerja NDLC (*Network Development Life Cycle*).	Research results provides a solution to perform network topology updates with Introducing *proxies* and implementing *the Simple*

	NETWORK OF SMP NEGERI 1 JAMANIS, Gunawan, Siti Sundari, Syahrul Anwar 2025		*Queue* method for management *bandwidth*.
6	BANDWIDTH MANAGEMENT WITH THE QoS (QUALITY OF SERVICE) SDN KEDAUNG Copyright © 2024 Copyright © 2024 Copyright © 2024 Copyright © 2024 Copyright © 2024 Copyright © 2024 Copyright © 2024 T	QoS is a method of measuring the quality of a network that attempts to define its functions and characteristics**.**	With a QoS bandwidth manager, all devices of any kind can access the internet with the same bandwidth capacity flat.
7	Intelligent Routing for IoT-Driven MANETs Using Computational Intelligence	the interlinkage of the internet of thinks (Iot) with mobile A Hoc networks creates an autonomous communication ecosystem, imperative for applications ranging from disaster recovery to smart agriculture. The interconnectedness between the internet of things (IoT) and mobile A-Hoc networks creates autonomous communication ecosystems, which are critical for a wide range of applications, from disaster recovery to smart agriculture.	
8	Computer Network Service Information System, Triwahyudi, Veritawati (2022)	The information system testing process is carried out using the blackbox testing method.	The results of this research are in the form of a web-based information system that can accommodate user needs, store service change request documents and make it easier to manage service change requests.
9	Analysis and Design of Load Balancing and Failover using GSM card links, Fauzi, Darmawan, Junaidi (2021)	Real-time and up-to-date communication, load balancing and failover methods have been developed so that users in branch offices can still communicate when there is a connection interruption and there are no delays on the user side or slow when exchanging data or sending data to the head office.	Using a connection from GSM card media is one of the options to create an internet network at the branch office of PT. SML with the help of Mikrotik OS.

Source: Author's literature review (2026)

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Analysis Method

Equal Cost Multi Path (ECMP) Method

The ECMP method was a load balancing technique to unite two or more internet lines (ISPs) to increase bandwidth capacity and network performance simultaneously (Pakiding et al., 2021).

This method is often referred to as dividing connections based on primary address and destination. The initial setting is the same in general, only the internet connection with 2 rules NAT Masquerade, a very easy way to rule default gateway fill dst-address=0.0.0.0 and gateway=ISP 1, ISP 2 when unreachable or disconnected, check-gateway will disable ISP gateway 1 and ISP 2 will use the internet path that is still active (Manurung & Ula, 2023).

Configuration characteristics that use the ECMP method display on the screen of the winbox firewall mangle application Action-accept, chain prerouting, in-inter-ether3. Next Action-mark connection, chain-prerouting, in-inter-ether1, Action-mark connection, chain-prerouting, in-inter-ether2.

Metode Pre Connection Classifier (PCC)

The PCC method is a load balancing technique to group data traffic based on the source internet protocol connection to the destination by dynamically combining ISP 1 and ISP 2 loads, to prevent traffic overload (Pratama et al., 2024).

Internet connection by activating 2 rules NAT Masquerade, in IP routes we add route 0.0.0.0/0 to ISP 1 and ISP 2 gateways. (Wahid et al., 2024)

Configuration features that use the PCC method display on the application screen winbox firewall, mangle Action-accept, prerouting, ether3 made twice.

Firewall, mangle Action-Mark connection, chain-prerouting, in-inter, ether1 dan ether2,
Firewall, mangle Action-mark connection, chain-prerouting, in-inter, ether3 dan ether3,
Firewall, mangle Action-mark routing, chain-prerouting, in-inter, ether3 dan ether3,
Firewall, mangle Action-mark routing, chain-output,
Firewall, mangle Action-mark routing, chain-output,

Network Architecture

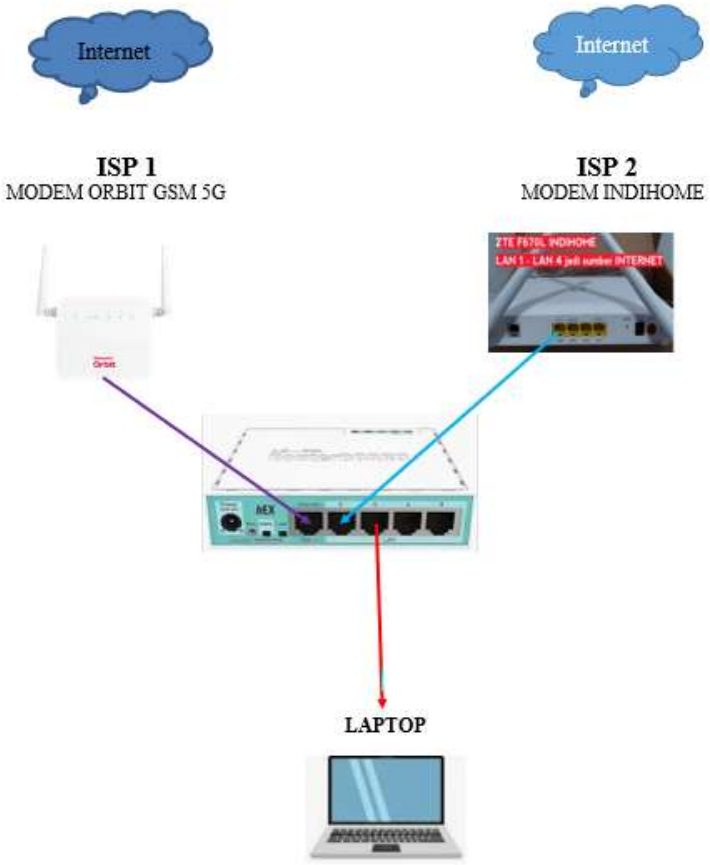

Figure 1. Network Topology
Source: Author's documentation (2026)

RESULT AND DISCUSSION

Parameters tested:

Throughput (ECMP)
Respond Time (PCC)
Packet Loss (FAILOVER)
CPU Server (DESCRIPTION)

Testing Without Load Balancing

Table 2. Network Performance Testing Without Load Balancing

Number of Users	Throughput	Response Time	Packet Loss	CPU Server
10	50 Mbps	20 Ms	0.5%	40%
50	80 Mbps	80 Ms	2%	75%
100	90 Mbps	150 Ms	5%	95%

Source: Author's testing results (2026)

Explanation

At first there was no significant change but after the user reached >50 then the server began to overload (Ramakrishnan & Soni, 2018).

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Response time has increased dramatically.
Packet Loss Tinggi

Testing with Load Balancing (Round Robin)

Tabel 3. Network Performance Testing with Load Balancing (Round Robin)

Number of Users	Throughput	Response Time	Packet Loss	CPU Server
10	55 Mbps	18 Ms	0.3 %	25 %
50	120 Mbps	40 Ms	1 %	50 %
100	180 Mbps	70 Ms	2 %	70 %

Source: Author's testing results (2026)

Explanation
The load is divided into multiple servers (Chen et al., 2021).
Response Time is more stable.
Throughput is improved.
Packet Loss

Load Balancing and failover testing

Table 4. Network Performance Testing with Load Balancing and Failover

Number of Users	Throughput	Response Time	Packet Loss	Remarks
100	55 Mbps	18 Ms	0.3 %	Normal
100	120 Mbps	40 Ms	1 %	1 server down

Source: Author's testing results (2026)

Explanation
The number of users >100 is normal
Through Put has increased (Deng et al., 2021)
Response Time Normal 18 Ms Normal condition
Packet Loss Stabil (Deo et al., 2024)
Failover serves as an Internet backup

Testing with the script algorithm as follows: (Park et al., 2020)

Gateway ISP1 10.112.0.1
Gateway ISP2 11.197.108.82
:local ip1 (“10.112.0.1”)
:local ip2 (“11.197.108.82)
:local ping1
:local ping2
:local U (“UP”)
:local D (“DOWN”)
:global ISP1;
:global ISP2;
:global MSG;
:set ping1 [/ping $ip1 count=2]

```
:if ($ping1=0) do={
		:set ISP1 “DOWN”;
		:put $ISP1;
} else={
		:set ISP1 “UP”;
		:put $ISP1;
}
:set ping2 [/ping $ip2 count=2]
:if ($ping2=0) do={
		:set ISP2 “DOWN”;
		:put $ISP2;
} else={
		:set ISP2 “UP”;
		:put $ISP2;
}
:if ($ISP1=$ISP2) do={
		:if ($ISP1=$U) do={
		:set MSG $U;
		:if (([:len [/ip route find where
comment=”ISP1” and disabled]] > 0)) do={
				/ip route { enable [find
comment=”ISP1”]};
			 }
			:if (([:len [/ip route find where
comment=”ISP2” and disabled]] > 0)) do={
				/ip route { enable [find
comment=”ISP2”]};
			}
			:if (([:len [/ip route find where
comment=”Main” and disabled]] > 0)) do={
				/ip route { enable [find
comment=”Main”]};
			}
			:log info ("1.ISP1 & 2=$MSG");
	} else={
		:set MSG $D;:log warning("1.ISP1 & 2=$MSG");
	}
} else={
		:if ($ISP1=$U) do={
		:set MSG "ISP1=$U & ISP2=$D";
		:if (([:len [/ip route find where
comment= “ISP1” and disabled]] > 0)) do={\\\5
```

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CONCLUSION

The implementation of failover with dual WAN on load balance using MikrtoTik was successfully implemented at Vocational high School Pancakarya2 with the aim of optimizing Internet Network Availability and creating a backup line if one of the ISP lines experiences problems or the connection is disconnected. For the use of firewall features, NAT, mangle, and route lists allow network administrators to maintain network stability from various web servers and other servers at all times. Future studies should compare RNN with LSTM, GRU, and Transformer models, test scalability with more users and ISPs, integrate IoT monitoring, conduct security testing, explore cloud deployment, and perform cost-benefit analysis. Organizations should adopt dual-WAN failover for business continuity. Administrators must regularly update configurations, backup routers, conduct failover tests, and train staff on MikroTik and network monitoring. System improvements include automated reporting, mobile monitoring, multiple backup lines, and State Elementary School integration. Policymakers should develop regulations, invest in infrastructure, and establish industry standards for high-availability networks.

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