

Network Design Planning for Very Small Aperture Terminal (VSAT) in Nagari Rangkiang Luluh, Solok Regency

Roni Saputra^{1*}, Uzma Septima², Herry Setiawan³

^{1,2,3} State Polytechnic of Padang, Electrical Engineering Department,

¹ronisaputra3070@gmail.com, ²uzmaseptima@gmail.com, ³herysetiawan88@gmail.com



***Corresponding Author**

Article History:

Submitted: 20-09-2024

Accepted: 25-12-2024

Published: 25-02-2025

Keywords:

VSAT, BTS, Parameter Value

JATAED: Journal of Appropriate Technology for Agriculture, Environment, and Development is licensed under a Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0).

ABSTRACT

The public truly needs technological advancements, particularly internet networks, in order to access information such as phone, data, and video services, all of which are growing in volume. This requirement also holds true for isolated places without internet connectivity, like Nagari Rangkiang Luluh. The primary barrier to building telecommunications infrastructure, such as Base Transceiver Stations (BTS), which are more expensive than BTS, is geographic conditions. For isolated Indonesian locations without access to a telecommunications network, such as Rangkiang Luluh, VSAT technology offers a practical alternative in the form of dependable and constant internet connections. VSAT provides greater coverage and increased dependability by acting as a repeater for satellite communications. greater than BTS, particularly in regions with challenging topography. When compared to BTS technology, the design findings demonstrate that VSAT is a more cost-effective and efficient option. Planning the VSAT network design in Nagari Rangkiang Luluh yielded optimal parameter values for internet access services in the Tigo Lurah District, Solok Regency, and the hilly, forested, and valleyous remote areas. These values included an average delay of 34.08 ms, a throughput of 379.66 bps, a jitter of 10.58 ms, and a packet loss of 0%.

INTRODUCTION

West Sumatra Province is home to Solok Regency. This region is separated into 74 Nagari, the Tigo Lurah District's Nagari Rangkiang Luluh being one of them. In 2022, Nagari Rangkiang's area was approximately 93 km², and its population was 11,088 (BPS Solok Regency, 2022). Rangkiang Luluh's terrain is varied, ranging from mountains to valleys, but it is still primarily composed of hills with big trees, rice fields, and forests. In a number of locations, notably Nagari Rangkiang Luluh, this results in low signal reception levels (Budiman, E. 2021).

The public truly needs technological advancements, particularly internet networks, in order to access information such as phone, data, and video services, all of which are growing in volume. This requirement also holds true for isolated places without internet connectivity, like Nagari Rangkiang Luluh. The primary barrier to the development of expensive telecommunications infrastructure like Base Transceiver Stations (BTS) is geographic location (Hardjono et al., 2020). While planning a network for a VSAT (very small aperture terminal), cost and location are also crucial variables. Compared to BTS, VSAT installation and maintenance expenses are comparatively low. Remote Indonesian locations without access to a telecommunications network can benefit from VSAT technology, which offers a dependable and persistent internet. in order for Rangkiang Luluh and other remote locations to have a dependable and constant internet connection through VSAT (Sari, M. R., & Saputra, H. K. 2022). Compared to BTS, VSAT offers more coverage and greater dependability by using satellite communications as a repeater, particularly in regions with challenging topography. Additionally, networks for satellite communications are more resilient to disturbances brought on by bad weather or natural calamities (Yadnya, 2023).

The community in Nagari Rangkiang Luluh stands to gain a great deal from the VSAT network, most notably increased access to information. Information has become a valuable resource in the contemporary digital era and is easily accessible for the inhabitants of Rangkiang Luluh, benefiting a number of facets of community life, including the social, political, educational, and economic spheres in Nagari Rangkiang Luluh (Sultan, S., et al. 2023).

METHOD

The VSAT network planning flow is shown in Figure 1 and is as follows.



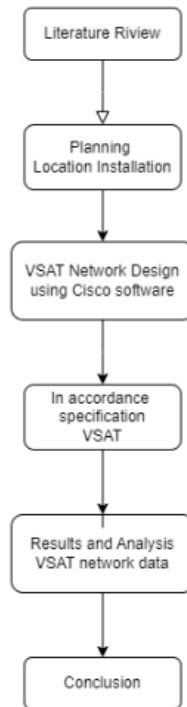


Figure 1. VSAT network design planning flow

Review of Literature

to gather data on the study topic in order to determine the first steps that will be planned. In order for you to comprehend the features of VSAT, the technology that it employs, applications, and ideas that come from journals and papers.

Planning for Installation Location

The study will be conducted in Nagari Rangkiang Luluuh, Solok Regency, West Sumatra Province, which has 11,088 residents in 2022 and a 93 km² area.

Simulation of VSAT Network Pointing

The Google Earth application is used to perform the pointing simulation. In order for data to be transferred and received efficiently, VSAT must be able to communicate with the appropriate satellite through the pointing process. This is crucial for VSAT networks, which are utilized for VOIP and the internet among other things.

Design of VSAT Networks

Designing a VSAT network with Cisco Packet Tracer software. Packet Tracer is used in VSAT network design to simulate and test the network prior to physical implementation. This enables you to maximize VSAT network performance and create, deploy, and maintain computer networks that meet your demands.

Findings and Information Analysis

The process of data analysis will be completed, yielding optimal outcomes that will be presented in the final assignment.

Concluding remarks

After all of the steps have been completed, the conclusion stage is the last one.



RESULT

VSAT Network Design Using Cisco

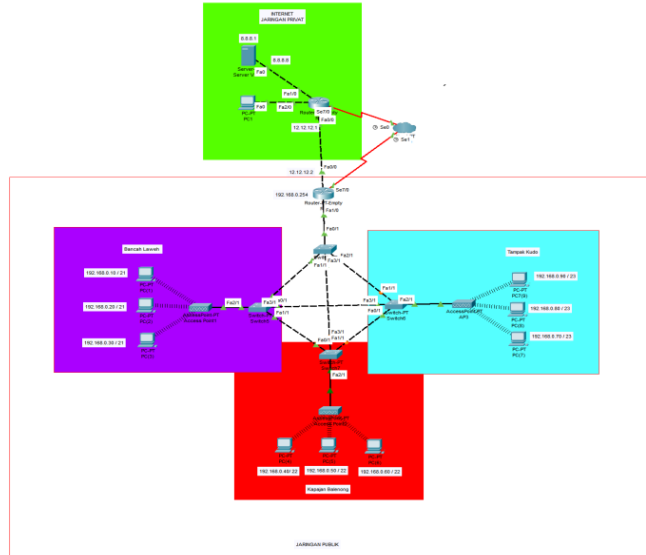


Figure 2. VSAT Network Topology

A star topology called the VSAT network topology was employed in the Final Project's research. A computer network with a star topology has every device linked to a hub or router, or other central device. Every VSAT terminal in a star topology will communicate via an earth hub station. It is possible to guarantee distinct access from every terminal in this way. A banking application, for example, might use this concept as a data transmission application if every VSAT terminal points to an earth station. This allows network permission and data points to be ensured in one location, and allows each data transmission to be managed at a single hub station.

Internet Protocol (IP)

Table 1. Use of IP Servers and Routers on private networks

NO		Server	Router Privat	Subnets mask
1	Fastethernet ke pc Administrator	8.8.8.1	10.10.10.2	255.255.255.0
2	Fastethernet0/0		12.12.12.1	255.255.255.0
3	Fastethernet1/0		8.8.8.8	255.0.0.0
4	Serial 7/0		30.30.30.1	255.0.0.0

The Fastethernet0/0, Fastethernet1/0, and Serial 7/0 IP addresses that the VSAT network uses to configure the Fastethernet device are listed in Table 1.

Table 2. Use of Static IP on Local/Public Network Routers and Servers

NO		Server	Router Publik	Subnest Mask
1	Fastethernet0/0	8.8.8.1	12.12.12.2	255.255.255.0
2	Fastethernet1/0		192.168.0.254	255.255.255.0
3	Serial 7/0		30.30.30.2	255.0.0.0

The IP address used to configure Fastetherner0/0, Fastethernet1/0, and Serial 7/0 devices on the local/public network of the VSAT network is listed in table 2.

Table 3. IP usage for private network users

PC ADMINISTRATOR	Internet	Subnest mask
10.10.10.2	8.8.8.8	255.0.0.0

Table 3 shows the PC IP used on a private VSAT network with subnet mask 255.0.0.0 and IP 10.10.10.2.



Table 4. IP usage for local/public network users

NO	Jaringan Publik	Internet	IP PC	Subnest mask
1	Bancah Laweh	8.8.8.8	192.168.0.10- 192.168.0.30/21	255.255.248.0
2	Kapujan		192.168.0.40- 192.168.0.60/22	255.255.252.0
3	Tampak Kudo		192.168.0.700- 192.168.0.90/23	255.255.254.0

Table 4 lists the IP addresses that users in each area use, which range from 192.168.0.10 to 192.168.0.90. The subnet mask utilized varies based on the population density of each location. For example, Jorong Bacah Laweh, which has a subnet of 21 and a population of about 750. With a population of about 850, Jorong Kapujan has a subnet of 22, and the subnet mask is 255.255.248.0. The subnet mask is 255.255.252.0, and Jorong Tampak Kudo is a soul with a subnet of 21 and a population of about 512. The mask that is subnet is 255.255.254.0.

VSAT Network Parameters

1. Delay

Standard delay values are important to ensure good service quality in various applications. By understanding different delay standards, you can choose the right technology and network infrastructure for your needs. Delay is an important factor that must be considered in data communications. If the delay is too long, it will disrupt the data transmission process. The delay on the VSAT IP network is quite high, because the transmission medium uses satellite (Dian Hakim, T. 2018).

The following is the formula for delay:

$$\text{Average Delay} = \frac{\text{Total Delay}}{\text{Total Packages received}}$$

Table 5. Delay standardization

Category	Large Delay
Very good	<50 ms
Good	150-300 ms
Currently	300-450 ms
Bad	>450 ms

Source: THIPON

2. Throughput

The total number of packet arrivals that arrive at their destination safely and on schedule is known as throughput. Since throughput can also be referred to as bandwidth in practical situations, throughput and bandwidth are typically linked (Sula, A., et al. 2021). The equation is used to calculate the Throughput value.

$$\text{Throughput} = \frac{\text{received data packets}}{\text{observation time}}$$

Table 6. Throughput Categories

Category	Large Throughput (bps)
Very good	100
Good	75
Currently	50
Bad	<25

Source: THIPON

3. Jitter

Latency and jitter, also referred to as delay variation, are closely related concepts. The first step in overcoming jitter is to gather incoming packets in the jitter buffer and hold onto them for as long as necessary to ensure that they are received at the receiving end in the proper order (Sula, A., et al. 2021). The equation is used to calculate the Jitter value.

$$\text{Jitter} = \frac{\text{Total Delay Variation}}{\text{Total Package Received}}$$



Table 7. Standardization of Jitter Values

Category	Large jitter (ms)
Very good	0 ms
Good	1ms-75 ms
Currently	76 ms-125 ms
Bad	>126 ms

Source: THIPON

4. Lost Package

The total amount of packets that are sent and never arrive at their intended destination is known as packet loss. Network traffic overload, network collisions, and physical media faults can all result in packet loss (Sula, A., et al., 2021). The following equation is used to calculate the PacketLoss value:

$$\text{Lost Package} = \frac{\text{Packets sent} - \text{Packets received}}{\text{Packets sent}} \times 100\%$$

Table 8. Standardization of Package Loss values

Category	Large Paket Loss (%)
Very good	0
Good	3
Currently	15
Bad	25

Source: THIPON

VSAT Network Test Data Results

Following the data processing using the Cisco program, the outcomes displayed in Figures 3 through 5 were attained.

1. Testing in the Bancah Laweh area

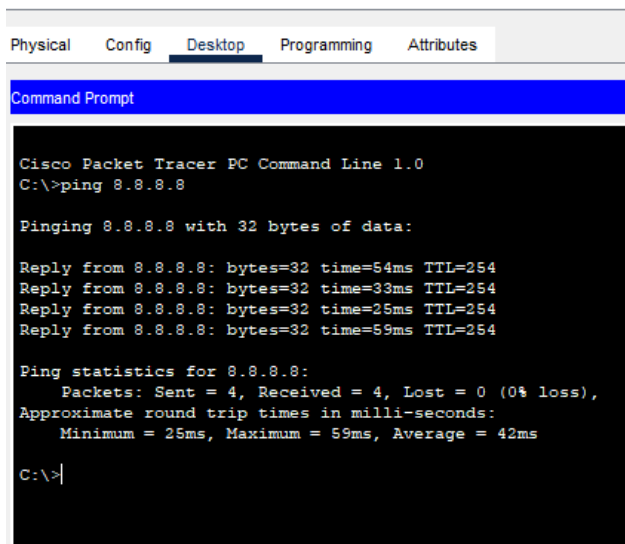


Figure. 3 Testing in the Bancah Laweh area

The testing on Bancah Laweh is described in Figure 3, which displays a ping simulation of the PC that was utilized in the simulation and had the IP address 192.168.0.10 with a subnet mask. The purpose of this command is to check the PC and server's connectivity. An ICMP (Internet Control Message Protocol) 255.255.248.0 packet is sent by this command. This indicates that the PC is connected to the 192.168.0.10-192.168.0.30/21 network. Ping 8.8.8.8 is the command that is utilized. Make a request to the destination IP address and watch for the response from the ICMP.

The PC can successfully connect to the server, according to the ping results. Four ICMP Reply packets that were received from the server attest to this. Ping Bytes Results Details: The packet size for an ICMP request and reply is 32 bytes. Between 25 and 59 milliseconds are needed for the ICMP Request and Reply packets to exchange. 42 ms is the

average journey time. Every time a packet travels through a router, the Time to Live (TTL) number is lowered by one. 254 is the initial TTL value and 254 is the final value. This suggests that the packet only traveled through a few routers before arriving at the server. Four ICMP packets Four ICMP reply packets were received after request packets were submitted; no packets were lost in the process.

2. Testing in the Kapujan area

```

Physical  Config  Desktop  Programming  Attributes
-----
Command Prompt

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.8

Pinging 8.8.8.8 with 32 bytes of data:

Reply from 8.8.8.8: bytes=32 time=73ms TTL=254
Reply from 8.8.8.8: bytes=32 time=29ms TTL=254
Reply from 8.8.8.8: bytes=32 time=24ms TTL=254
Reply from 8.8.8.8: bytes=32 time=9ms TTL=254

Ping statistics for 8.8.8.8:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 9ms, Maximum = 73ms, Average = 33ms

C:\>
C:\>|
    
```

Picture. 4 Testing in the Kapuja area

The testing on Bancah Laweh is described in Figure 4, which displays a ping simulation from the simulation's PC, which has an IP address of 192.168.0.40 and a subnet mask of 255.255.252.0. This indicates that the PC is connected to the 192.168.0.40-192.168.0.60/22 network. Ping 8.8.8.8 is the command that is utilized. The purpose of this command is to check the PC and server's connectivity. This command waits for an ICMP Reply reply after sending an ICMP Request packet to the specified IP address. The PC can successfully connect to the server, according to the ping results. Four ICMP Reply packets that were received from the server attest to this.

Details of Ping Bytes Results The ICMP Request and Reply packets are 32 bytes in size. Time Between 8 and 73 milliseconds are needed for the ICMP Request and Reply packets to exchange. 33 ms is the average journey time. Each time a packet travels through a router, the value (TTL) is lowered by one. 254 is the initial TTL value and 254 is the final value. This suggests that the packet only traveled through a few routers before arriving at the server. Packets: There were no lost packets; four ICMP request packets were issued and four ICMP reply packets were received. This ping simulation demonstrates that the PC and server may establish a successful connection. Network communication between a PC and server is reliable and strong.

3. Testing in the Tampak Kudo area

```

Physical  Config  Desktop  Programming  Attributes
-----
Command Prompt

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 8.8.8.8

Pinging 8.8.8.8 with 32 bytes of data:

Reply from 8.8.8.8: bytes=32 time=52ms TTL=254
Reply from 8.8.8.8: bytes=32 time=25ms TTL=254
Reply from 8.8.8.8: bytes=32 time=28ms TTL=254
Reply from 8.8.8.8: bytes=32 time=29ms TTL=254

Ping statistics for 8.8.8.8:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 25ms, Maximum = 52ms, Average = 33ms

C:\>
C:\>|
    
```

Figure 5. Testing in the Kapuja area

In figure. 5 explained about testing on Bancah Laweh, which showed that the ping simulation of the PC used in this simulation had an IP address of 192.168.0.40 with a subnet mask of 255.255.252.0. This means the PC is on the network 192.168.0.40-192.168.0.60/22. The ping command used is ping 8.8.8.8. This command is used to test connectivity between the PC and the server. This command sends an ICMP Request packet to the destination IP address and waits for an ICMP Reply reply. The ping results show that the PC can connect to the server successfully. This is proven by 4 ICMP Reply packets received from the server.

Specifics of Ping Bytes Findings: The packet size for an ICMP request and reply is 32 bytes. Between 25 and 52 milliseconds are needed for the ICMP Request and Reply packets to exchange. 33 ms is the average journey time. Each time a packet travels through a router, the value (TTL) is lowered by one. 254 is the initial TTL value and 254 is the final value. This suggests that the packet only traveled through a few routers before arriving at the server. Pakete: No packets were lost in the exchange of 4 ICMP Request and 4 ICMP Reply packets. This ping simulation demonstrates that the PC and server may establish a successful connection. The PC's network connectivity and the server is good and stable.

VSAT Parameter Calculation Results

1. Bancah Laweh

a. Delay

$$\text{Rata - rata Delay} = \frac{54\text{ms} + 33\text{ms} + 25\text{ms} + 29\text{ms}}{4}$$

$$\text{Rata - rata Delay} = \frac{141\text{ms}}{4}$$

$$\text{Rata - rata Delay} = 35,25 \text{ ms}$$

b. Througput

$$\text{Througput} = \frac{128\text{byte}}{0,35\text{s}}$$

$$\text{Througput} = 365,714 \text{ bps}$$

$$\text{Througput} = 365 \text{ Kbps}$$

c. Jitter

$$\text{Jitter} = 59\text{ms} - 25\text{ms}$$

$$= 34\text{ms}$$

$$\text{Jitter} = \frac{34\text{ms}}{4}$$

$$\text{Jitter} = 8,5\text{ms}$$

d. Paket Loss

$$\text{Paket Loss} = \frac{4}{4} \times 100\%$$

$$\text{Paket Loss} = \frac{(0)}{4} \times 100\% = 0\%$$

2. Kapujan

a. Delay

$$\text{Rata - rata Delay} = \frac{73\text{ms} + 29\text{ms} + 24\text{ms} + 8\text{ms}}{4}$$

$$\text{Rata - rata Delay} = \frac{134\text{ms}}{4}$$

$$\text{Rata - rata Delay} = 33,5\text{ms}$$

2. Througput

$$\text{Througput} = \frac{128\text{byte}}{0,33\text{s}}$$

$$\text{Througput} = 387,878\text{bps}$$

$$\text{Througput} = 387\text{Kbps}$$

3. Jitter

$$\text{Jitter} = 73\text{ms} - 8\text{ms}$$



$$= 65\text{ms}$$

$$\text{Jitter} = \frac{65\text{ms}}{4}$$

$$\text{Jitter} = 16,25\text{ms}$$

4. Paket Loss

$$\text{Paket Loss} = \frac{4}{4} \times 100\%$$

$$\text{Paket Loss} = \frac{(0)}{4} \times 100\% = 0\%$$

3. Tampak Kudo

a. Delay

$$\text{Rata - rata Delay} = \frac{52\text{ms} + 25\text{ms} + 28\text{ms} + 29\text{ms}}{4}$$

$$\text{Rata - rata Delay} = \frac{134\text{ms}}{4}$$

$$\text{Rata - rata Delay} = 33,5\text{ms}$$

b. Througput

$$\text{Througput} = \frac{128\text{byte}}{0,33\text{s}}$$

$$\text{Througput} = 387,878\text{bps}$$

$$\text{Througput} = 387\text{Kbps}$$

c. Jitter

$$\text{Jitter} = 52\text{ms} - 24\text{ms}$$

$$= 28\text{ms}$$

$$\text{Jitter} = \frac{28\text{ms}}{4}$$

$$\text{Jitter} = 7\text{ms}$$

d. Paket Loss

$$\text{Paket Loss} = \frac{4}{4} \times 100\%$$

$$\text{Paket Loss} = \frac{(0)}{4} \times 100\% = 0\%$$

The computation results from the VSAT network testing are shown in table 9 below.

Table 9. VSAT test calculations

Daerah	Delay	Througput	Jitter	Paket Loss	Quality
Bancah Laweh	35,25ms	365bps	8,5ms	0%	Good
Kapujan	33,5ms	387bps	16,25ms	0%	Good
Tampak Kudo	33,5ms	387bps	7ms	0%	Good
Rata-Rata	34,08 ms	379,66 bps	10,58ms	0%	Good

Table 9 presents the calculation results for each area. It is clear that this design is implementable because the findings for packet loss, jitter, delay, and throughput are all of good quality. The average delay value of 34.08 ms, which is relatively low, suggests that the network is responsive. This is crucial for applications like online gaming and video calls that demand quick responses. All regions with consistent throughput figures show that the network's capacity is sufficient to handle user activity. Good data transmission quality is indicated by a low jitter value, particularly for real-time applications like audio and video. When the packet loss value is zero, all sent data has successfully reached its destination and there has been no data loss.

DISCUSSION

The author's approach for creating the VSAT network in this study is excellent since it adheres to a methodical planning flow that begins with a review of the literature, plans the installation site, uses Google Earth to simulate VSAT pointing, and then uses Cisco Packet Tracer software to create the VSAT network. The author can create a thorough and organized network design thanks to this technique. Given the features of the VSAT network, which involves



communication between every terminal and a ground station, the star network topology was chosen for the VSAT design.

This design makes network management easier by allowing access and control to be centrally guaranteed at the ground station. Both for devices in public and local networks as well as private networks, the author has utilized IP addresses appropriately and in compliance with standards. The number of local users is also considered while dividing the subnet mask. This guarantees that IP addresses are efficient. According to the simulation findings, the designed VSAT network parameters—an average delay of 34.08 ms, a throughput of 379.66 bps, jitter of 10.58 ms, and packet loss of 0%—have satisfied the "good" criterion and may thus successfully meet the community of Nagari Rangkiang Luluh's internet access needs. It is quite advantageous to have a VSAT network available in rural areas such as Rangkiang Luluh to increase the community's information access. This will undoubtedly have a positive impact on a number of social, educational, and economic factors.

CONCLUSION

The architecture of the VSAT network in Nagari Rangkiang Luluh, Tigo Lurah District, Solok Regency, demonstrates how well VSATs perform in isolated locations that resemble hills, valleys, and forests. The best values for the following parameters, according to the VSAT network architecture, are for internet access services in the Nagari Rangkiang Luluh region, Tigo Lurah District, Solok Regency: packet loss of 0%, average delay of 34.08 ms, throughput of 379.66 bps, and jitter of 10.58 ms.

REFERENCES

- Bayu Kurniawan1), Y. (2015). Perancangan Jaringan Pada Client – Server Menggunakan Aplikasi Cisco Paket Tracer. Bayu Kurniawan1), Yuyantofa2, 2.
- BPS Kabupaten Solok. (2023). Badan Pusat Statistik Kabupaten Solok Bps-Statistics of Solok Regency.
- Broto, W. (2016). DETEKSI DISASTER RECOVERY PLAN PADA SISTEM KOMUNIKASI SELULER MENGGUNAKAN VSAT FDMA BERBASIS KU-Band. V, SNF2016-CIP-89-SNF2016-CIP-94. <https://doi.org/10.21009/0305020118>
- Candra A.M, Jupriyadi, & Samsugi.S. (2021). Perancangan dan Implementasi Controller Access Point System Manager (CAPsMAN) Mikrotik Menggunakan Aplikasi Winbox. Journal of Telematics and Information Technology, 02(2), 26–32. <https://ejournal.teknokrat.ac.id/index.php/telefortech/article/view/1990>
- Gajah Mada, J., & Sei Ladi Batam, B. (2020). Analisis Keamanan Jaringan Local Area Network yang Menggunakan DHCP Server Berbasis Cisco dengan metode Penetration Testing. Journal of Information System and Technology (JOINT), 1(1), 100–124. <https://ojs.digitalartisan.co.id/index.php/joint/article/view/1386>
- Gani, A. G. (2014). Pengenalan Teknologi Internet Serta Dampaknya. Jurnal Sistem Informasi Universitas Suryadarma, 2(2). <https://doi.org/10.35968/jsi.v2i2.49>
- Ramdani, R., Lestari, M., & Parwati, N. W. (2020). Sistem Informasi Permintaan dan Pengadaan Barang untuk Instalasi VSAT di PT Telkomsat. Jurnal Riset Dan Aplikasi Mahasiswa Informatika (JRAMI), 1(01), 126–133. <https://doi.org/10.30998/jrami.v1i01.265>
- Gapo, L., Najoran, M. E. I., Sengkey, R., & Robot, J. R. (2012). Analisa Koneksi Jaringan Komputer Di Pti (Pusat Teknologi Informasi) Unsrat Dengan Vsat (Very Small Aperture Terminal). E-Journal Teknik Elektro Dan Komputer, 1(4), 1–10.
- Parabawa DWI, A. A. (2016). PERANCANGAN JARINGAN MENGGUNAKAN ROUTER SWITCH CISCO PADA PACKET TRACER PADA PT . TELKOMUNIKASI INDONESIA Tbk CABANG GIANYAR. 1–70.
- Hakim, T. D., & Dimiyati, A. (2018). Analisa Performansi Jaringan VSAT BRISAT Berdasarkan Delay, Packet Loss & Service Level. Jurnal Ilmiah Elektrokrisna, 6(3), 108–113.
- La Harnoko, S., & Alijoyo, F. A. (2023). Analysis of VSAT System Performance in Security and Communication Integrity of Indonesian Navy Headquarters. 13(03), 990–997.ka, G. Y. rugi, Rahayu, L. K., & Kusnadi, Y. (2015). Instalasi Dan Konfigurasi Jaringan VSAT Menggunakan Modem Gilat Pada PT. Indo Pratama Teleglobal Laka, G. Y. rugi, Rahayu, L. K., & Kusnadi, Y. (2015). Instalasi Dan Konfigurasi Jaringan VSAT Menggunakan Modem Gilat Pada PT. Indo Pratama Teleglobal Jakarta. Jurnal Techno Nusa Mandiri, XII(2), 66–76. Jakarta. Jurnal Techno Nusa Mandiri, XII(2), 66–76.
- Michael Ardita, Bima Romadhon P.D.P., I. S. F. (2023). Sistem Repeater Jaringan Internet Di Area Terpencil. Jurnal Sistem Dan Informatika, 6(1), 84–88.
- Mufadhol. (2012). Simulasi Simulation, T., Network, C., & Tracer, C. P. (n.d.). Simulasi jaringan komputer menggunakan cisco packet tracer (. jaringan komputer menggunakan cisco packet tracer (. Mufadhol.



- Parlin, A., & Rambe, A. H. (2014). Perbandingan Kinerja Jaringan Very Small Aperture Terminal Berdasarkan Diameter Antena Pelanggan Di Pasifik Satelit Nusantara Medan. *Singuda ENSIKOM*, 8(1), 45–50.
- Septiana, R., Sukiswo, S., & Z, A. A. (2019). ANALISIS JARINGAN VSAT TOPOLOGI STAR DENGAN NS2 yang didefinisikan oleh. *Transient*:
- Sula, A., Michael, A., & Rusman, J. (2022). Analisis Quality Of Service Pada Jaringan Internet Kampus 2 Universitas Kristen Indonesia Toraja. *Infinity*, 1(2). <https://doi.org/10.47178/infinity.v1i2.1517>
- Sugiharto, A. (2014). Penggunaan jaringan vsat untuk komunikasi jarak jauh. *Mitra Manajemen*, 6(2), 10–15.
- Wahyu Agung Laksono, & Jimmie. (2023). Simulasi Jaringan Komputer Sekolah Dengan Cisco Packet Tracer. *Kohesi: Jurnal Multidisiplin Saintek*, 01(07).
- Yadnya, M. S., Sultan, S., Muljono, A. B., Paniran, P., Sasongko, S., & Nrrartha, I. M. A. (2023). Program Perawatan Komunikasi Satelit (VSAT) Di Desa Tumpak Lombok Tengah. *Jurnal Gema Ngabdi*, 5(2), 210–214. <https://doi.org/10.29303/jgn.v5i2.351>
- Yulianto, A. (2016). Jaringan Satelit Sebagai Solusi Alternatif Layanan Multimedia Di Indonesia. *Jurnal Rekayasa Teknologi Nusa Putra*, 3(1), 27–33. <https://doi.org/10.52005/rekayasa.v3i1.174>

