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LTE OPTIMIZATION USING THE ELECTRICAL TILT METHOD AT THE MANDAU SITE

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ABSTRACT
LTE provides data rates of up to 100 Mbps on downlink and up to 50 Mbps on uplink. The Duri-Bengkalis area is one example of the large number of LTE users, but because the location is surrounded by densely populated settlements, especially in the Mandau area. based on the results of the drive test conducted, a problem was found, namely throughput quality which was in very bad condition. Therefore, a network optimization simulation was carried out using the Electrical Tilt method to overcome the problem of very poor throughput conditions. This implementation method is carried out using Software Atoll. This study aims to get better quality and network performance and to get an analysis of the effect of optimization on throughput parameter values on LTE networks. The throughput results obtained after optimization at the Mandau site with a value on Jalan Obor 2 from 1000 kbps increased to 19,000 kbps, Jalan Torch 1 from 1000 kbps increased to 50,000 kbps, on Jalan Bandes from 5000 kbps increased to 50,000 kbps, Jalan Swadaya from 5000 kbps increased to 50,000 kbps and on Jalan Hangtuah from 1000 kbps increased to 50,000 kbps.

Keywords: *Drive test, Electrical tilt, LTE, Optimize, Throughput*

1. Introduction

The development of telecommunications technology is very rapid, so it is very important for users to obtain communication and information quickly and easily (Arin Anjani, 2015; Ulfah & Sri Irtawaty, 2018; Yuliana et al., 2021) Long Term Evolution (LTE) is the name of the Third Generation Partnership Project (3GPP) Project to raise the bar for 3rd generation (4G) mobile phones (Hardiyanto, 2020; Panjaitan et al., 2018; Ulfah et al., 2018; Yuliana et al., 2019) provides data rates of up to 100 Mbps on the downlink side and up to 50 Mbps on the Uplink side (Kusumo et al., 2015; Rahmania, 2020; Warsika et al., 2019). LTE networks are advanced communications for accessing GSM/EDGE and UMTS/HSPA based wireless data and LTE technology can provide 300 Mbps downloads and 75 Mbps uploads (Gemiharto, 2015; Rahmat & Chandra, 2022; Sahala & Sirait, 2018; Suparyanto, 2020) .

LTE has the advantage of being able to meet the needs of operators for high-speed data and media access from the previous generation. LTE can also provide greater service coverage and capacity, reduce operational costs, support the use of multiple antennas, be flexible in the use of operational bandwidth and can also be combined with existing technologies (Haq et al., 2018; Yuliana et al., 2020).

As a result, the deployment of LTE in Indonesia is still constrained in order to maintain network performance. Many people live in Duri-Bengkalis, but they rarely get better service. One of them is in the Mandau area, namely in the Duri-Bengkalis area. Network users often voice their dissatisfaction with the weak LTE signal they receive, which results in slow data access and disrupts business and communication activities. Optimization of the LTE network in the area is needed to improve network quality.

Based on this research, a network optimization was carried out at one of the providers. From the results of the drive test conducted, a problem was obtained, namely the quality of network throughput which was in a very poor condition. This drive test was conducted on the Mandau site. Therefore, researchers simulated network optimization using the Electrical Tilt method. The use of this method can solve the problem of throughput value conditions that arise.

2. Literature Review

There are a variety of methods that can be utilized to optimize LTE quality. In the analysis in this study, a comparison of previous studies, namely (Larasati & Rizkiatna, 2017) with the title "LTE Network Optimization in the Cigadung Bandung Area" was optimized in the Cigadung area by reazimuth the antenna, it was found that the throughput value increased from 512 kbps to 14 Mbps so that the network in the Cigadung area of Bandung became better.

The following study is entitled (Wahyu et al., 2017) With the title "Optimizing Data Services on LTE Networks with Genex Assistant in Delanggu Klaten," optimized the network using Electrical Tilt and Mechanical Tilt, resulting in an increase in throughput from 2674.47 kbps to 6713.13 kbps.

Further research by (Firdaus Rofiansyah, Hafidudin, ST., MT, Ichwan Saputro, S.Pd., 2018) with the title "LTE Network Optimization on the Main Road of the North Balikpapan Area" where this researcher used the Electrical Tilting and Mechanical Tilting methods, to improve network performance so that it has better network quality. The results of the study obtained were throughput values before optimization = 440 kbps (bad) while after optimization the throughput value = 10 Mbps (normal).

Further research by (Laksana et al., 2020) with the title "LTE Network Optimization Using the Electrical Tilt Method in Karet Kuningan". This researcher used the electrical tilt method to overcome network problems. The results of the study obtained were throughput values before optimization = 512 kbps (bad) and after optimization of throughput values = 10 Mbps (normal).

3. Research Methods

3.1. Research Flow

In this study, it used the Electrical Tilt method because it was able to overcome the problem of unstable throughput conditions. From the research flowchart that can be shown in fig. (1) so that a system is formed that becomes a goal, then the work data obtained in the analysis so that a conclusion can be drawn

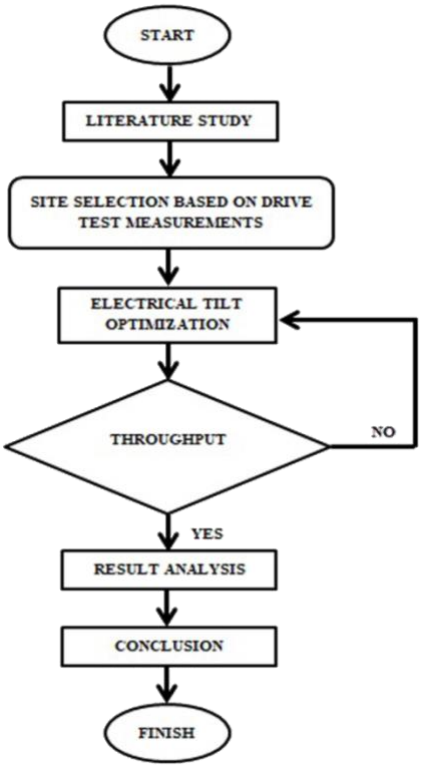

Fig. 1. Flow of Research

3.2. Literature Study

In this stage, a literature discussion of a study was carried out, namely LTE optimization on throughput parameters with the Electrical Tilt method at the Mandau site, where the author

collected data and managed research materials including previous related studies. The reviews conducted relate to the performance analysis and optimization of LTE networks.

3.3. Drive Test Measurement Location Selection

Location and route data are influenced after conducting a site survey. The area that was the target of the study was an area that was reported to have poor network throughput quality in the Mandau site area. The reason is because, the Mandau-Duri area, Bengkalis has a population of 150,806 people with high activity (Anonim, 2021). Therefore, a drive test and optimization were carried out in the area to improve the quality of data services from tri providers.

Drive test is a technique used to collect information about the quality of a network signal to improve network quality. The information collected is the RF (Radio Frequency) status in the context of BTS (Base Station) and BSS (Base Station Subsystem) (Karo Karo et al., 2020). The trip is equipped with digital maps, GPS, handsets and test drive software. This allows engineers to obtain RF coverage and identify problems in the field (Makkatang & Nugroho, 2019; Simanjuntak et al., 2020). Drive test are carried out to find out the latest condition of an operator's cellular network by getting radio parameter values and knowing the latest problems experienced in the field.

3.4. Electrical Tilt Optimization

Electrical tilt is changing antenna coverage using changing the antenna phase as a result of changes in the antenna beamwidth. The electrical tilt setting is usually at the bottom of the antenna (Fajar & Devia, 2017) For tilting is shown in Eqn. (1) using the following formula:

$$A_{dt} = tan^{-2}\left(\frac{Ht-Hr}{Distance(m)}\right)+\frac{Bw}{2} \quad (1)$$

The tilt of the antenna is carried out to reduce the coverage of a certain area, as a result of which the antenna will only serve the synchronous area using its initial design. In this explanation, it can be seen in Fig. (2), namely the measurement on the tilting antenna,

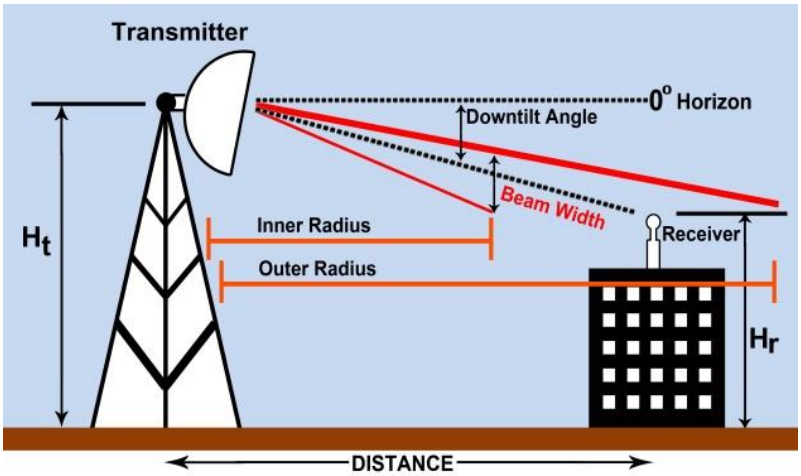

Fig. 2. Tilting Antenna

3.5. Throughput

Throughput is the actual data rate based on the information sent. In addition, throughput can be interpreted using the number of pieces of information that are successfully transmitted per unit of time. Throughput is a value based on EU to EnodeB. There are two types of throughput, download and upload and the LTE network unit is Mbps. In Table (1) It shows the range of throughput, The range of this value is based on existing conditions, including:

Table 1 - Throughput Value Range

Range (kbps)	Information	Color
41.000 s/d 50.000	Excellent	

31.000 s/d 40.000	Good	
21.000 s/d 30.000	Normal	
11.000 s/d 20.000	Bad	
0 s/d 10.000	Very Bad	

At this stage of the study, observe and collect data on the condition of the site. The condition of this site includes antenna tilt figures, antenna transmitting power, longitude and latitude. On this site with eNodeB ID 204131 after searching and collecting data and getting the site name, namely: SITE_MANDAU_4G. Therefore, the site data can be seen in Table (2).

Table 2 - Plotting site

ITEM NAMES	ITEMS CONDITION		
Name eNodeB	SITE_MANDAU_4G		
City Site	Duri		
Frequency Bands	LTE-2100 MHz		
Longtitude	101.19162		
Latitude	1.27126		
Beam Power	25 dB		
Height	28 m		
Mechanical Down Tilt (MDT)	SEC 1	SEC 2	SEC 3
	2°	2°	3°
Electrical Down Tilt (EDT)	SEC 1	SEC 2	SEC 3
	4°	4°	4°
Azimuth	SEC 1	SEC 2	SEC 3
	30°	120°	240°

4. Results and Discussions

4.1. Drive Test

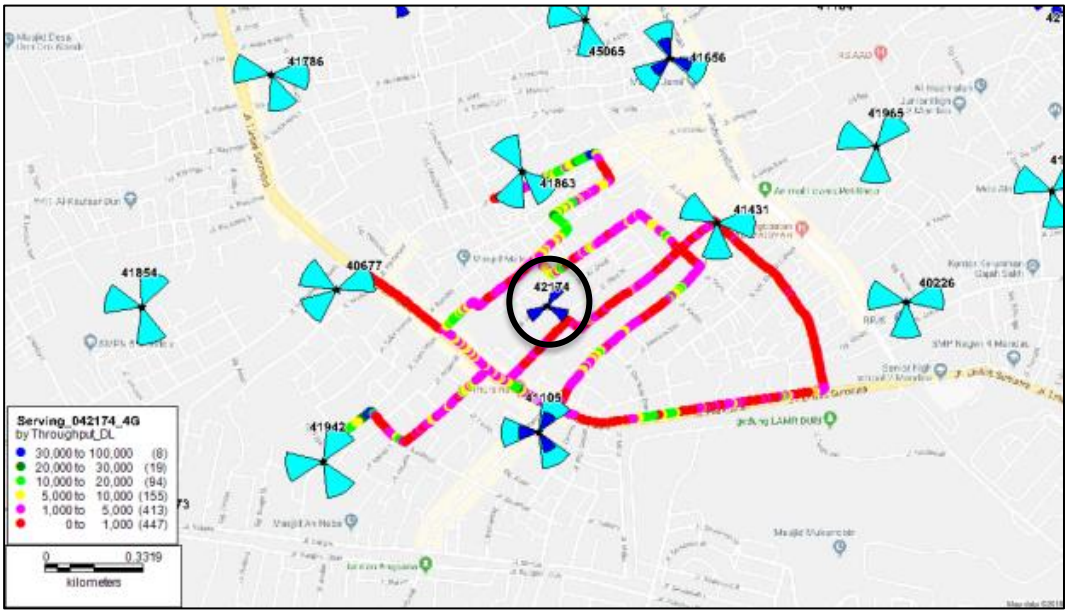

Fig. 3. Report Drive Test Site Mandau

In Fig. (3) is a display of the results of the Mandau drive test coverage site for throughput parameters. For the Mandau site in the picture above, it is a site that is in a dark circle. It can be seen that the coverage area of the site is generally at the red and purple levels. From the color caption in this image, the area that has red and purple colors has a value of Red (0 kbps to 1000 kbps) while for purple (1000 kbps to 5000 kbps). And for both colors this indicates that the throughput in the area is in poor condition and very poor.

4.2. Optimization Results

In this network optimization, as explained in the previous research methods section, it is using the Electrical Tilt method. In the use of this method, the main purpose is to change the value or condition of the Electrical Tilt value on the sectoral site antenna. This change can be made by lowering or increasing the previous Electrical Tilt value, in the hope of improving the quality and coverage of the site area. The changes in the Electrical Tilt value can be seen from Table (3).

Table 3 - Antenna EDT Value Reconfiguration

No	Name Cell	Initial Value	Last Score
1	SITE_MANDAU_4G_1	4°	3°
2	SITE_MANDAU_4G_2	4°	3°
3	SITE_MANDAU_4G_3	4°	3°

Table (3) shows the results of the antenna EDT reconfiguration with the Electrical Tilt Antenna Sectoral value at the initial condition at 4°. After reconfiguring the Antenna EDT value of 3°. This indicates that optimization is getting better. After the optimization simulation, the results were obtained as shown in fig. (4) below.

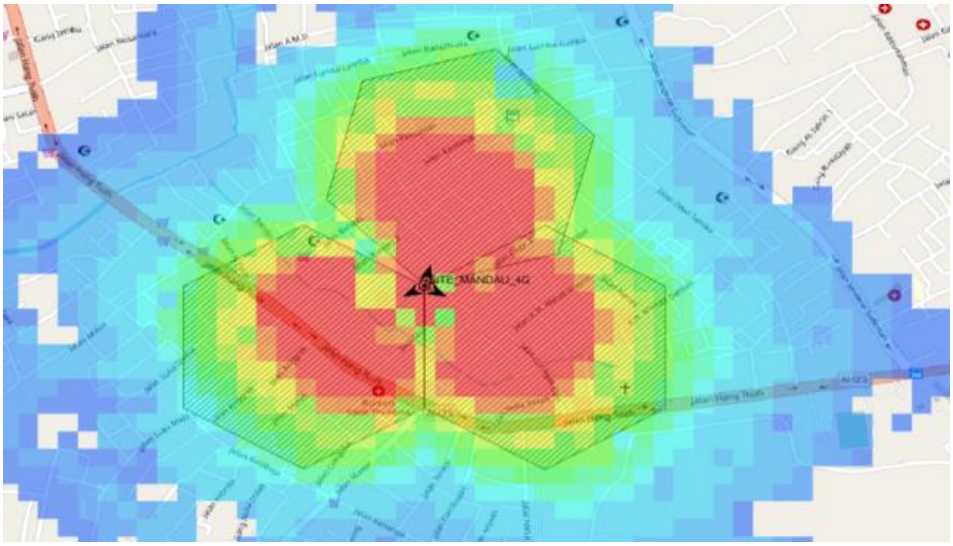

Fig. 4. Optimization Simulation Results

In Fig. 4 above, the kineja site quality for throughput parameters. On the site, a throughput condition with a value of 41,000 kbps - 50,000 kbps (red condition) was found. This indicates that at the Mandau site, a stable throughput value is obtained.

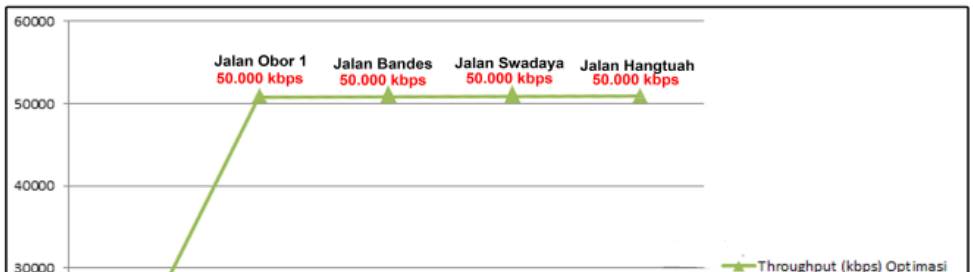

Fig. 5. Drive Test Throughput Comparison and Optimization

In Fig. (5) above, it can be seen how the comparison of the throughput value at the time of the test drive and the throughput value at the optimization time.

Table 4 - Drive Test Throughput Comparison and Optimization

Jalan	Throughput (kbps)	
	Drive Test	Optimization
Jalan Obor 2	1000 kbps	19.000 kbps
Jalan Obor 1	1000 kbps	50.000 kbps
Jalan Bandes	5000 kbps	50.000 kbps
Jalan Swadaya	5000 kbps	50.000 kbps
Jalan Hangtuah	1000 kbps	50.000 kbps

In Table (4) above, it is shown the previous drive test where on Obor 2 obtained the result that the network throughput quality was in a very bad condition, namely 1000 kbps (very bad). However, after network optimization, the condition has increased, where the quality is already at a value of 19,000 kbps (bad) but there has been an increase from the previous value.

In Obor 1, it was found that the quality of network throughput was in a very bad condition, namely 1000 kbps (very bad). However, after network optimization, the condition has increased, where the quality is already at a value of 50,000 kbps (very good) but there has been an increase from the previous value.

On Jalan Bandes, it was found that the quality of network throughput was in a very bad condition, namely 5000 kbps (bad). However, after network optimization, the condition has increased, where the quality is already at a value of 50,000 kbps (very good) but there has been an increase from the previous value.

On Jalan Swadaya, it was found that the quality of network throughput was in a very bad condition, namely 5000 kbps (bad). However, after network optimization, the condition has increased, where the quality is already at a value of 50,000 kbps (very good) but there has been an increase from the previous value.

On Jalan Hangtuah, it was found that the quality of network throughput was in a very bad condition, namely 1000 kbps (very bad). However, after network optimization, the condition has increased, where the quality is already at a value of 50,000 kbps (very good) but there has been an increase from the previous value.

5. Conclusion

The following are the findings of this study's calculations, simulations, and analysis: Based on the research that has been carried out, the following conclusions are obtained. After an

optimization simulation with the Electrical Tilt method, there was an improvement in network quality in several areas. Based on the results of optimization simulations that have been carried out, data on Obor 2 was obtained from 1000 kbps to 19,000 kbps, on Jalan Obor 1 from 1000 kbps to 50,000 kbps, on Bandes road from 5000 kbps to 50,000 kbps, on Jalan Swadaya from 5000 kbps to 50,000 kbps and on Jalan Hangtuah from 1000 kbps to 50,000 kbps. The results of the simulations showed that the effect of electrical tilt on coverage was acceptable, which led to an improvement in the network's quality and throughput. For additional examination, go to do it with the Use of the ACP Strategy for Actual Tuning Streamlining of Sectoral Radio wires on the 4G LTE Organization in Duri-Bengkalis

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