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OPTIMIZATION OF 4G LTE NETWORK BAD SPOT AREA USING AUTOMATIC CELL PLANNING METHOD

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ABSTRACT

The 4G LTE technology is widespread in almost all regions in Indonesia, including Solok City in West Sumatra, where this study was conducted. Based on the results of the 1800 MHz frequency drive test, the RSRP value was in the good category (81.44%), but the SINR value was in the poor category (56.96%). Furthermore, the results of the 2100 MHz frequency drive test showed that the RSRP value was in the poor category (58.11%), and the SINR value was also in the poor category (54.62%). These results indicate that the area had poor network quality. Therefore, this study aimed to optimize the Bad Spot Area in Solok City using the Automatic Cell Planning (ACP) method. The ACP method optimization results show that at the 1800 MHz frequency, the value of the ten cells is in the interval -127.84 ≤ RSRP ≤ -99.34. Meanwhile, at the 2100 MHz frequency, the value of the seven cells is in the poor category, which is in the interval -136.39 ≤ RSRP ≤ -111.03. In the 2100 MHz frequency, there is a decrease in RSRP value in the poor category from 43.27% to 41.85%. SINR parameter optimization results of 2100 MHz frequency, the percentage of a very good category is higher with a value of 51.40% than 44.16% at 1800 MHz frequency.

***Keywords**: 4G LTE, automatic cell planning, drive test, RSRP, SINR.*

I. INTRODUCTION

THE need for internet technology, especially 4G LTE cellular networks, has now become the main requirement of all communities. The rapid development of internet technology has led to changes in the network model to be more efficient and provide the best service for high traffic. The use of heavy data applications such as video streaming, video calls, and social media has caused a significant increase in data traffic. 4G LTE networks can provide the high speed and capacity required for high-speed data exchange processes.

4G LTE technology is widespread in various regions and cities in Indonesia, encouraging internet service providers to compete in improving network quality to meet user needs. Until now, the 4G LTE network implementation is still not fully optimized according to KPI standards. Based on the research of Ferdiansah *et al.*, "Simulation of 1800 MHz Network Optimization Using Physical Tunning Method in Sukaharjo City", there is a significant increase in KPI of 70.08% on RSRP parameters and 78.13% on SINR parameters [1]. Another study that discusses "Analysis and Optimization of Bad Coverage on 1800 MHz 4G network" successfully improved network performance from initial conditions, with RSRP deployment increasing from 71.8% to 92.77% [2]. In addition, in the research "Sector 3 Bad Spot Optimization in 2300 MHz LTE Network Using Physical Tunning Method at Site Gondangslamet Boyolali", the optimization results after physical tuning and electrical tuning in scenario 3 show that the RSRP value still does not reach the provider's KPI target of 69.577% for RSRP values greater than or equal to 100 dBm. On the other hand, the SINR parameter has met the KPI target with an achievement of 96.112% for SINR values ≥0 dB [3].

The research area is in Solok City, located in the central part of West Sumatra Province, Indonesia, with a population of around 74.469,00 people in 2021. Solok City area is a sub-urban category area [4]. To identify the condition of the internet in Solok City, it is necessary to check the signal with the Drive

TABLE 1
THE TARGET VALUE OF KPIS FOR NETWORK PERFORMANCE

Objective	Parameter	Target
Integrity	Mean Throughput	>2 Mbps
Coverage	RSRP	90% >-90 dBm
Network quality	SINR	80% ≥ 0 dB

TABLE 2
THE RSRP PARAMETER FOR XL OPERATOR

Legend	Range
Excellent	RSRP ≥ -85
Very Good	-90≤RSRP<-85
Good	-100≤RSRP<-90
Fair	-105≤RSRP<-100
Poor	-115≤RSRP<-105
Very poor	-140≤RSRP<-115

TABLE 3
THE SINR PARAMETER FOR XL OPERATOR

Legend	Range
Excellent	20>SINR ≥ 50
Very Good	10≤SINR<20
Good	3≤SINR<10
Fair	0≤SINR<3
Poor	-5≤SINR<0
Very poor	-20≤SINR<-5

test and optimization using Atoll software. The parameters of this study are RSRP and SINR. With the application of the ACP Method, optimization parameters can be calculated automatically to improve network quality based on coverage and capacity. This approach takes advantage of the existing site infrastructure [5]. Therefore, the authors seek to overcome areas with poor signal on 4G LTE networks in Solok City by applying the ACP method.

II. RESEARCH METHOD

In this study, network quality and bad spot areas covered by the XL operator were analyzed using the Drive Test method. The aim was to obtain actual data and identify problems with each 4G LTE parameter directly at the research location. Before measuring the signal quality of the XL operator in Solok City, we designed the Drive test to map the area to facilitate the measurement process. After that, drive test data was collected using TEMS Pocket, while Drive test measurements were using TEMS Discovery software.

The data processed is the XL operator's existing site data, which will be transferred to the Atoll software. The required parameters are longitude, latitude, azimuth, antenna height, antenna power, and mechanical tilt. The ACP optimization method aims to maximize the performance of the existing eNodeB, and the ACP optimization results will change the azimuth angle, and antenna tilting (antenna pattern), which will affect the mechanical tilt and electrical tilt values of the eNodeB.

A. *Key Performance Indicator* (KPI)

Key Performance Indicator (KPI) is an indicator that allows operators to measure network performance quality according to its parameters. KPI is used as a benchmark for optimizing network conditions so that if the parameter value obtained is close to the range of KPI values, the network performance will be better [6] – [9]. The target value of KPIs is shown in Table 1 [6].

B. RSRP *(Reference Signal Received Power)*

RSRP is the linear power average of the source elements carrying reference signal information, covering some frequency range of the bandwidth being used [10] – [13]. Multiple symbols have the reference signal on a single subcarrier in the source block, so the evaluation is performed on the source element having the cell-specific reference signal information [14]. RSRP provides information about the signal intensity in a particular cell [13], [14]. RSRP has a range of values from -140 to -85 dBm, as can be seen in Table 2 [2].

TABLE 4
THE MEASUREMENT RESULTS OF RSRP PARAMETER ON 1800 MHZ

Legend	Value (dBm)	Sample	Percentage
Excellent	RSRP ≥ -85	396	28.59%
Very Good	-90≤RSRP<-85	277	20.00%
Good	-100≤RSRP<-90	455	32.85%
Fair	-105≤RSRP<-100	177	12.78%
Poor	-115≤RSRP<-105	79	5.70%
Very poor	-140≤RSRP<-115	1	0.07%
Total		1385	100%

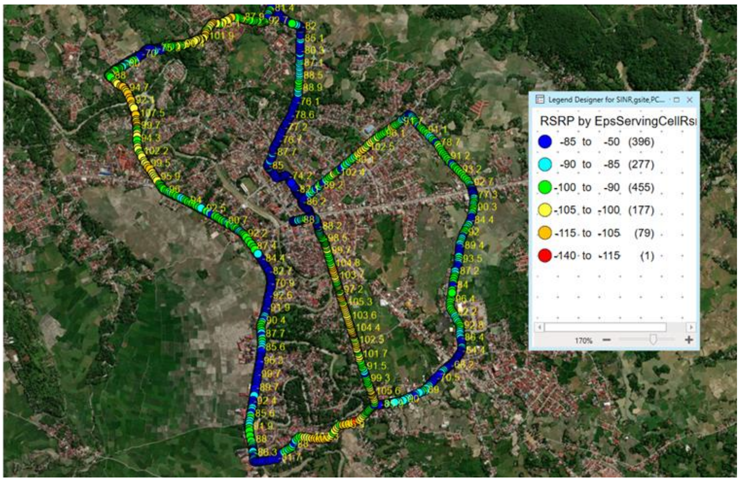


Figure 1. Data Processing Results of RSRP Parameter on 1800 MHz

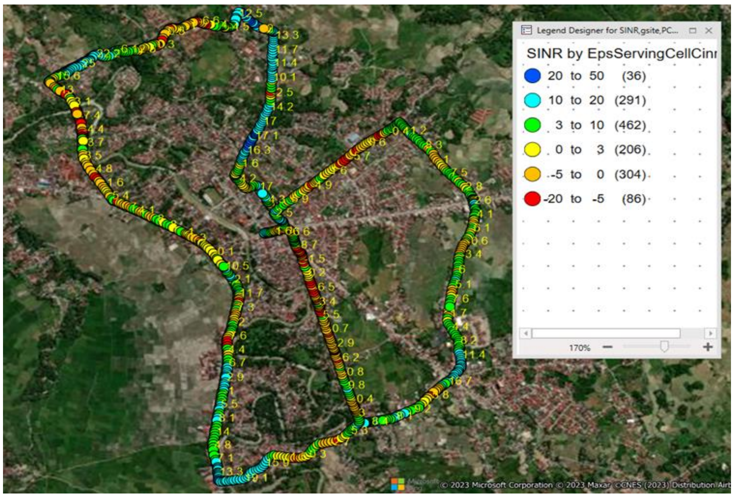


Figure 2. Data Processing Results of SINR Parameter on 1800 MHz

C. SINR *(Signal to Interference Noise Ratio)*

SINR is the ratio between the received signal power and the interference received by the user [5][12][15][10]. The SINR parameter indicates signal quality, although it is not used as a standard specification by 3GPP[3]. The XL operator has six indicators for the SINR parameter, as shown in Table 3.

III. RESULT AND DISCUSSION

A. RSRP Drive Test Results on 1800 MHz Frequency

The measurement results drive test of RSRP parameter on the 1800 MHz frequency can be seen in Figure 1 and Table 4. Based on Table 4 and Figure 1, in the 1800 MHz frequency, there are 1,128 samples from a total of 1385 samples (81.44%) with RSRP values of ≥ -100 dBm. This result indicates that the signal quality in this area based on RSRP parameter for the 1800 MHz is classified as good, as in this area may have no geographical obstacles so that the signal transmission from the eNodeB is not

TABLE 5
THE MEASUREMENT RESULTS OF SINR PARAMETER ON 1800 MHZ

Legend	Value (dB)	Sample	Percentage
Excellent	20>SINR ≥ 50	36	2.60%
Very Good	10≤SINR<20	291	21.01%
Good	3≤SINR<10	462	33.36%
Fair	0≤SINR<3	206	14.87%
Poor	-5≤SINR<0	304	21.95%
Very poor	-20≤SINR<-5	86	6.21%
Total		1385	100%

TABLE 6
THE MEASUREMENT RESULTS OF RSRP PARAMETER ON 2100 MHZ

Legend	Value (dBm)	Sample	Percentage
Excellent	RSRP ≥ -85	162	16.63%
Very Good	-90≤RSRP<-85	135	13.86%
Good	-100≤RSRP<-90	269	27.62%
Fair	-105≤RSRP<-100	105	10.78%
Poor	-115≤RSRP<-105	232	23.82%
Very poor	-140≤RSRP<-115	71	7.29%
Total		974	100%

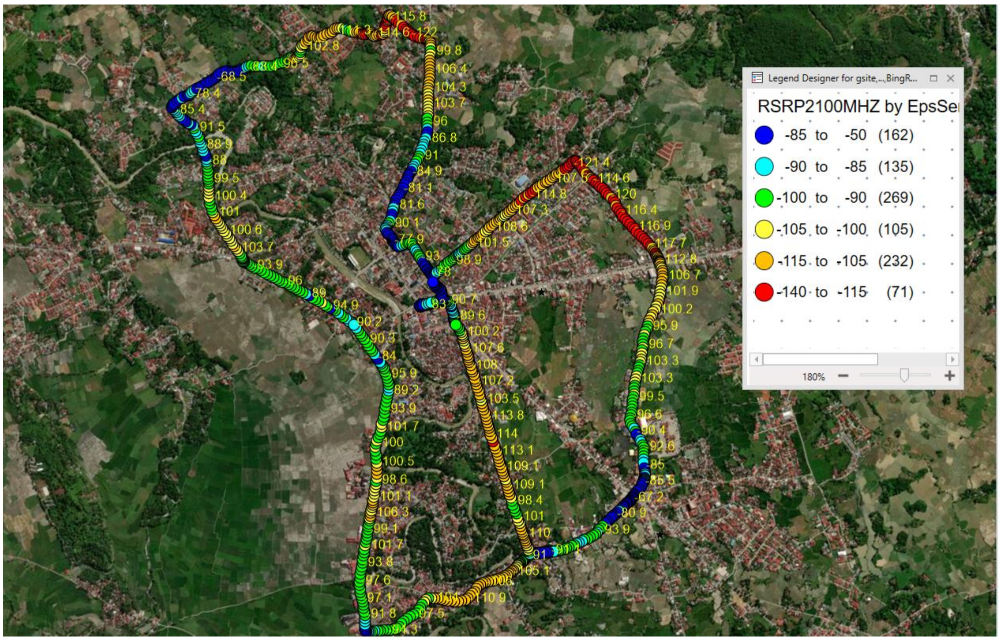


Figure 3. Data Processing Results of RSRP Parameter on 2100 MHz

obstructed to the user. However, it still does not meet the target of coverage set by the Indonesian Ministry of Communication and Informatics (Kominfo) [6], which is at least 90%.

B. SINR Drive Test Results on 1800 MHz Frequency

The measurement results drive test of SINR parameter on the 1800 MHz frequency can be seen in Figure 2 and Table 5. Based on Table 5 and Figure 2, in the 1800 MHz frequency, there are 789 samples from a total of 1385 samples (56.96%) with SINR values of ≥ 3 dB. However, this result indicates that the 4G LTE network quality based on SINR parameter on 1800 MHz does not meet the target set by the Kominfo [6], which is at least 80%.

C. RSRP Drive Test Results on 2100 MHz Frequency

The measurement results of RSRP parameter on the 2100 MHz frequency can be seen in Figure 3 and Table 6. Based on Table 6 and Figure 3, in the 2100 MHz frequency, there are 566 samples from a total of 974 samples (58.11%) with RSRP values of ≥ -100 dBm. This result indicates that the 4G LTE network quality based on RSRP parameter on 2100 MHz does not meet the target set by the Kominfo [6], which is at least 90%.

TABLE 7
THE MEASUREMENT RESULTS OF SINR PARAMETER ON 2100 MHZ

Legend	Value (dB)	Sample	Percentage
Excellent	20>SINR ≥ 50	43	4.41%
Very Good	10≤SINR<20	215	22.07%
Good	3≤SINR<10	274	28.13%
Fair	0≤SINR<3	142	14.58%
Poor	-5≤SINR<0	229	23.51%
Very poor	-20≤SINR<-5	71	7.29%
Total		974	100%

TABLE 8
THE DATA OF BAD SPOT AREA ON 1800 MHZ

Location	Obstacle	Total (km)
Jl. Tandikat	Trees and high school building	0.959
Jl. Tunas Bangsa	High geographic conditions, vocational school, and inclusive school buildings	0.3012
Jl. Syeh Kukut	Shop building	0.663
Jl. Lubuk Sikarah	Long site distance and interference due to PCI originating from a remote site	0.1401
Jl, Letnan Jamhur	Shop building	0.889
Jl. By Pass Ktk	Shady trees	0.209

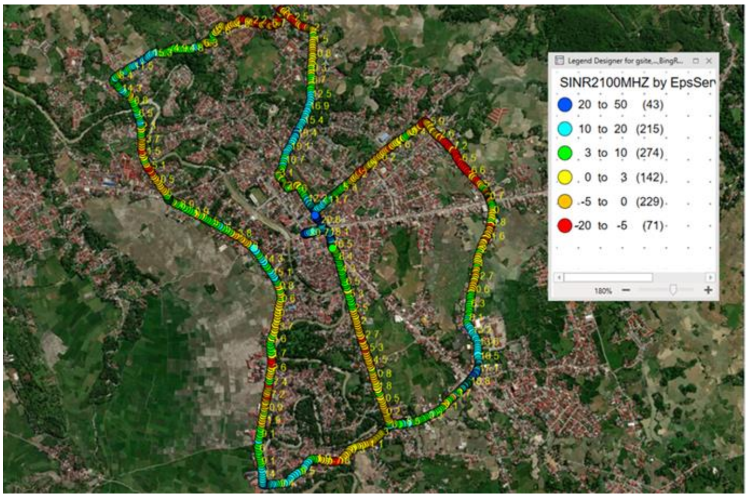


Figure 4. Data Processing Results of SINR Parameter on 2100 MHz

D. SINR Drive Test Results on 2100 MHz Frequency

The measurement results drive test of SINR parameter on the 2100 MHz frequency can be seen in Figure 4 and Table 7. Based on Table 7 and Figure 4, in the 2100 MHz frequency, there are 532 samples from a total of 974 samples (54.62%) with SINR values of ≥ 3 dB. This result indicates that the 4G LTE network quality based on SINR parameter on 2100 MHz does not meet the target set by the Kominfo, which is at least 80%.

E. Bad Spot Analysis on 1800 MHz Frequency

In Figure 5, six locations have bad spots that affect the signal quality in the area. The location details are described in Table 8. Based on Table 8 and Figure 5, bad spots are caused by obstacles of school buildings, trees, and long site distances.

F. Bad Spot Analysis on 2100 MHz Frequency

Figure 6 shows that seven locations have bad spots that affect the 4G LTE network quality on 2100 MHz frequency in the area. The location details are described in Table 9.

Based on Table 9 and Figure 6, bad spots are caused by obstacles of school buildings, trees, long site distances, and there are no sectors pointing to the location. The 2100 MHz frequency has a better building penetration ability compared to the 1800 MHz frequency [9][11]. This is evident along Letnan Jamhur road, where the 2100 MHz frequency demonstrates a smaller dead zone length of 0.35 km, as opposed to 0.89 km at the 1800 MHz frequency, as illustrated in Tables 8 and 9.

TABLE 9
THE DATA OF BAD SPOT AREA ON 2100 MHZ

Location	Obstacle	Total (km)
Jl. Tunas Bangsa	High geographic conditions, vocational school, and inclusive school buildings	0.835
Jl. Tandikat	Trees and high school building	0.959
Jl. Patimura	There are no sectors pointing to the location	0.741
Jl. Syeh Kukut	There are no sectors pointing to the location	0.58
Jl, Letnan Jamhur	Shop building	0.35
Jl. By Pass Ktk	Shady trees	0.29
Jl. Lubuk Sikarah	Distance and governmental building	0.123

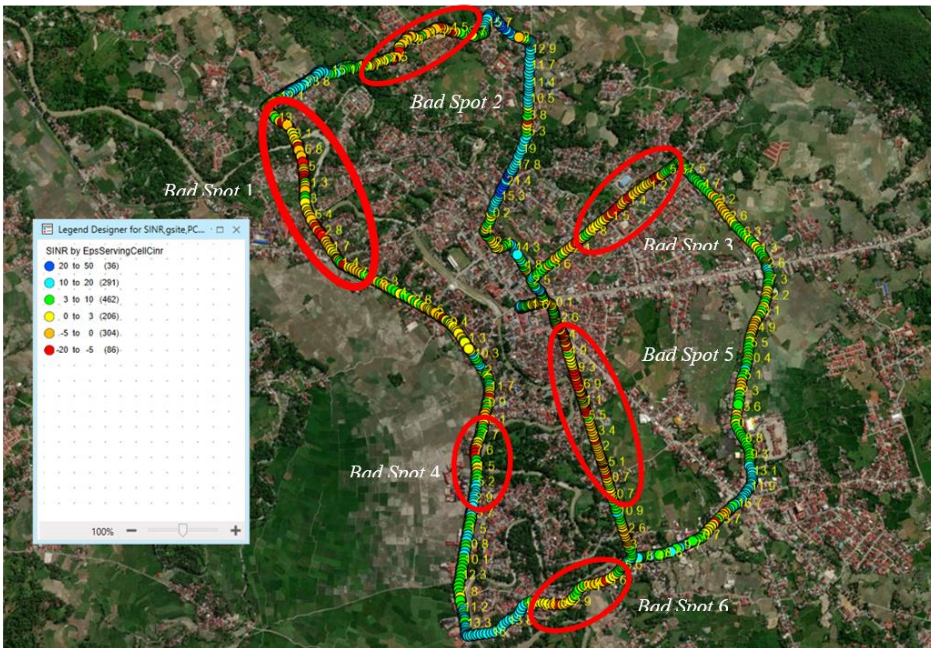


Figure 5. Bad Spot Area on 1800 MHz

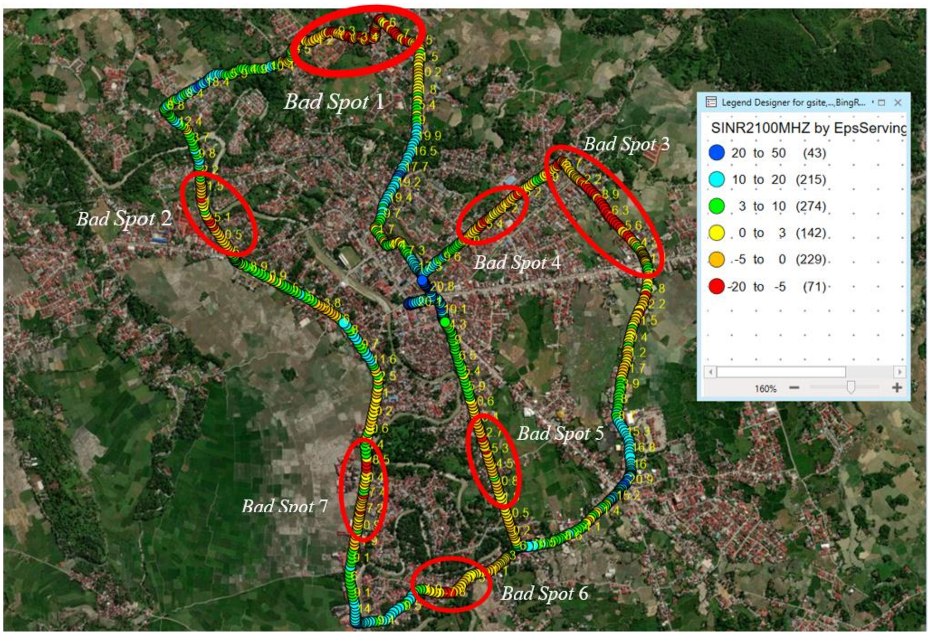


Figure 6. Bad Spot Area on 2100 MHz

G. Optimization Result on 1800 MHz Frequency

After the optimization process, there was a significant increase in the success rate of the RSRP parameter when the threshold exceeded -91 dBm. The percentage increase rose from 61.8% to 81.1%. Simultaneously, the percentage below -91 dBm decreased from 38.2% to 18.9%. This improvement was achieved through readjusting the antenna configuration using the ACP method. The optimization results

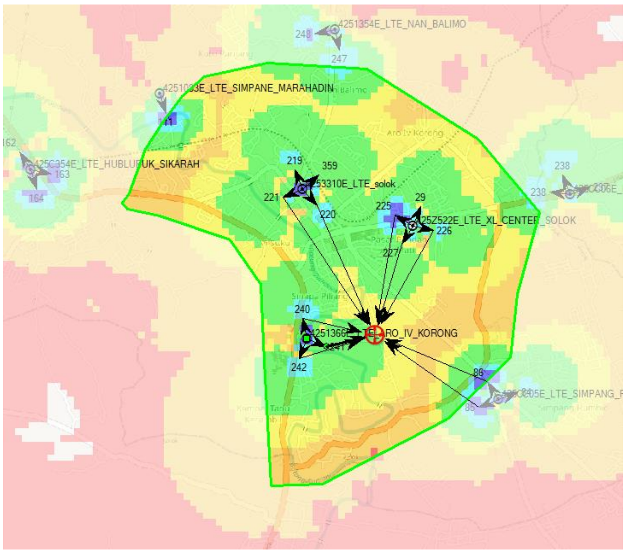


Figure 7. Optimization Result on 1800 MHz

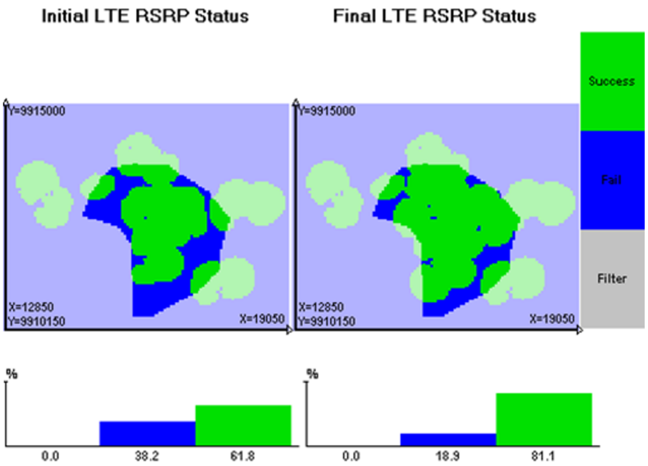


Figure 8. Statistic Scheme of ACP Method on 1800 MHz

are presented in Figure 7, and a statistical representation of the optimization using the ACP method is depicted in Figure 8.

Based on Table 10, six sectors underwent a change in antenna pattern. A steep slope angle can reduce the coverage area, making it more susceptible to signal blockage from tall buildings. Conversely, if the tilt angle is too shallow, the coverage area will expand, but the signal strength will decrease [11][16][17][18]. Therefore, adjusting the antenna tilt angle and azimuth can effectively enhance the network coverage area.

Using Atoll point analysis feature, the RSRP values for the ten cells were in the interval of -127.84 ≤ RSRP ≤ -99.34 in areas experiencing bad spots. The details are described in Table 11.

H. Optimization Result on 2100 MHz Frequency

After the optimization process, the rate of success for the RSRP parameter with a threshold above -91dBm has increased from the previous value of 31.8% to 43.3%. In addition, the percentage of values below -91 dBm decreased from a high failure rate of 68.2% to 56.7%. The optimization result on the 2100 MHz is shown in Figure 9 and the statistic scheme of the optimization using the ACP method on the 2100 MHz is shown in Figure 10.

Changes in network coverage occur after optimizing the antenna configuration using the ACP method. Details of the adjustments are in Table 12. From the Figure 11-14, it can be seen that four sectors have experienced changes in antenna patterns. If the azimuth does not match the desired direction, then the coverage area will change, and the signal will be more difficult for users to receive the signal [11][16]. If the azimuth is in the desired direction, the coverage area will be optimal, and the signal will be stronger and more stable.

TABLE 10
THE RESULT OF ANTENNA CONFIGURATION ON 1800 MHz

Cell/Tx Name	Use			Antenna Pattern		Azimuth (*)		Mechanical Tilt (*)	
	Ant	Azi.	MTilt	Initial	Final	Initial	Final	Initial	Final
4251366EE_LTE_ARO_IV_KORONG_1(0)	√	√	√	65deg 17dBi 0Tilt 1800MHz	65deg 17dBi 0Tilt 1800MHz	10	350	3	5
4251366EE_LTE_ARO_IV_KORONG_2(0)	√	√	√	65deg 17dBi 2Tilt 1800MHz	65deg 17dBi 2Tilt 1800MHz	90	110	4	0
4251366EE_LTE_ARO_IV_KORONG_3(0)	√	√	√	65deg 17dBi 6Tilt 1800MHz	65deg 17dBi 0Tilt 1800MHz	180	200	4	4
4253310E_LTE_SOLOK_1(0)	√	√	√	65deg 17dBi 6Tilt 1800MHz	65deg 17dBi 0Tilt 1800MHz	0	340	4	4
4253310E_LTE_SOLOK_2(0)	√	√	√	65deg 17dBi 0Tilt 1800MHz	65deg 17dBi 0Tilt 1800MHz	140	140	4	4
4253310E_LTE_SOLOK_3(0)	√	√	√	65deg 17dBi 6Tilt 1800MHz	65deg 17dBi 0Tilt 1800MHz	260	250	4	2
4253310E_LTE_SOLOK_4(0)	√	√	√	65deg 17dBi 0Tilt 1800MHz	65deg 17dBi 0Tilt 1800MHz	70	50	5	2
425ZS22E_LTE_XL_CENTER_SOLOK_1(0)	√	√	√	65deg 17dBi 6Tilt 1800MHz	65deg 17dBi 0Tilt 1800MHz	80	100	3	3
425ZS22E_LTE_XL_CENTER_SOLOK_2(0)	√	√	√	65deg 17dBi 6Tilt 1800MHz	65deg 17dBi 0Tilt 1800MHz	230	210	2	2
425ZS22E_LTE_XL_CENTER_SOLOK_3(0)	√	√	√	65deg 17dBi 6Tilt 1800MHz	65deg 17dBi 6Tilt 1800MHz	300	300	4	4
425ZS22E_LTE_XL_CENTER_SOLOK_4(0)	√	√	√	65deg 17dBi 0Tilt 1800MHz	65deg 17dBi 0Tilt 1800MHz	0	20	1	1

TABLE 11
THE RESULT OF RSRP POINT ANALYSIS AFTER OPTIMIZATION ON 1800 MHz

Cell	Distance (m)	PCI	RSRP (dBm)
4251366E_LTE_ARO_IV_KORONG_2(0)	527	241	-99.34
425Z522E_LTE_XL_CENTER_SOLOK_2(0)	898	227	-105.69
4253310E_LTE_solok_2(0)	1,262	220	-109.82
4251366E_LTE_ARO_IV_KORONG_1(0)	527	240	-119
425CC05E_LTE_SIMPANG_RUMBIO_3(0)	1,074	86	-122.84
425CC05E_LTE_SIMPANG_RUMBIO_2(0)	1,074	85	-123.28
4251366E_LTE_ARO_IV_KORONG_3(0)	527	242	-123.32
425Z522E_LTE_XL_CENTER_SOLOK_1(0)	898	226	-125.69
4253310E_LTE_solok_3(0)	1,262	221	-127.25
425Z522E_LTE_XL_CENTER_SOLOK_3(0)	898	225	-127.84

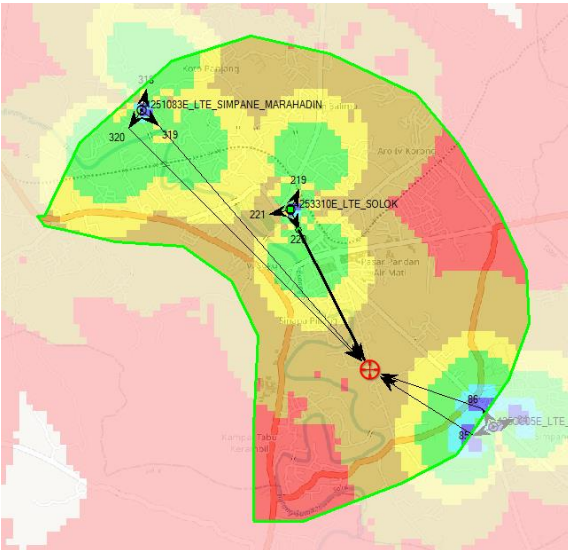


Figure 9. Optimization Result on 2100 MHz

Table 12 shows that after optimization using the ACP method on the RSRP parameters at a frequency of 2100 MHz, results were obtained that exceeded the simulation results. Previously, there were seven cells in the poor category, with RSRP values ranging from $-136.39 \leq RSRP \leq -111.03$. By implementing optimization using the ACP method, the RSRP values were significantly improved compared to previous conditions.

TABLE 12
THE RESULT OF ANTENNA CONFIGURATION ON 1800 MHZ

Cell/Tx Name	Use			Antenna Pattern		Azimuth (*)		Mechanical Tilt (*)		LTE RSPR (%)		LTE PDSCH CINR (%)	
	Ant	Azi.	MTilt	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
4251083E_LTE_SIMPANE_MARAHADIN_1(0)	√	√	√	65deg 18dBi 4Tiltl 2100MHz	65deg 18dBi 4Tiltl 2100MHz	30	10	2	1	35.03	62.73	99.54	100
4251083E_LTE_SIMPANE_MARAHADIN_2(0)	√	√	√	65deg 18dBi 4Tiltl 2100MHz	65deg 18dBi 4Tiltl 2100MHz	110	130	3	0	29.14	50.18	89.17	100
4251083E_LTE_SIMPANE_MARAHADIN_3(0)	√	√	√	65deg 18dBi 4Tiltl 2100MHz	65deg 18dBi 4Tiltl 2100MHz	235	215	6	0	22.79	29.15	95.16	94.73
4253310E_LTE_SOLOK_1(0)	√	√	√	65deg 18dBi 4Tiltl 2100MHz	65deg 18dBi 4Tiltl 2100MHz	0	20	4	4	17.54	16.46	90.68	98.64
4253310E_LTE_SOLOK_2(0)	√	√	√	65deg 18dBi 4Tiltl 2100MHz	65deg 18dBi 4Tiltl 2100MHz	140	160	4	0	13.16	16.32	90.02	97.16

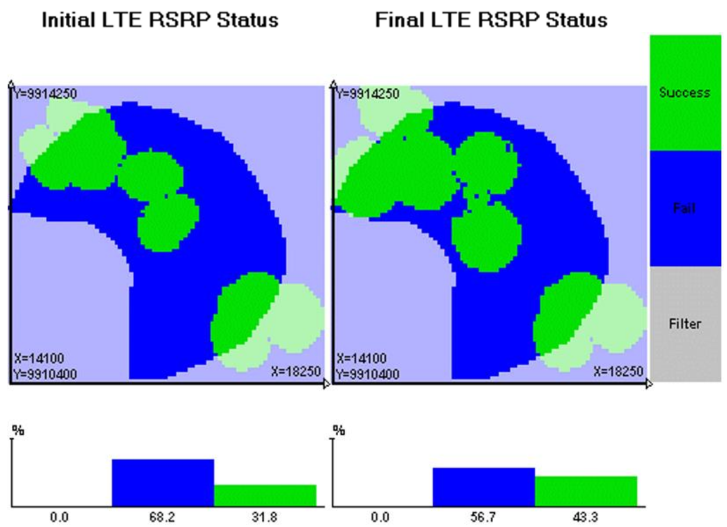
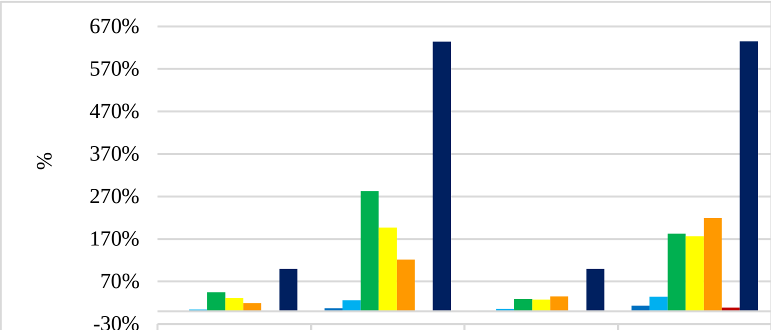


Figure 10. Statistic Scheme of ACP Method on 2100 MHz

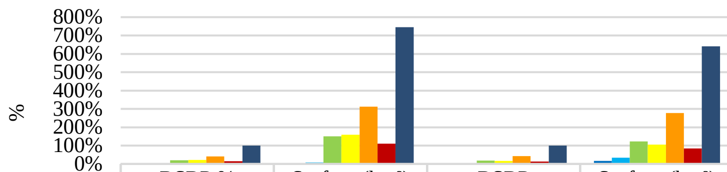


	RSRP %	Surface (km²)	RSRP	Surface (km²)
	1800 MHz Optimization		1800 MHz Before	
Excellent	1,15%	0,073	2,05%	0,13
Very Good	4,07%	0,258	5,40%	0,343
Good	44,52%	2,825	28,78%	1,827
Fair	31,05%	1,97	27,77%	1,763
Poor	19,20%	1,218	34,61%	2,197
Very Poor	0,05%	0,003	1,37%	0,087
total	100,00%	6,345	100,00%	6,348

Figure 11. Percentage of RSRP Focus Zone on 1800 MHz

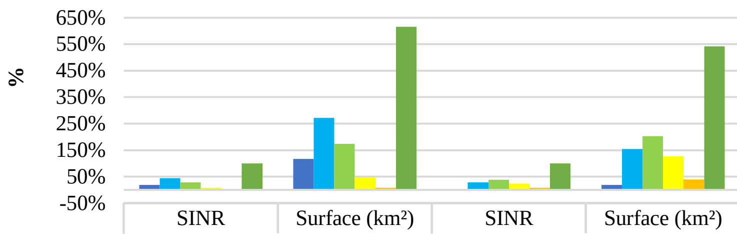
I. Comparison of RSRP Parameter Optimization Results

Based on Figure 11, in the Focus Zone area, there was an increase in coverage dominated by the good category with a percentage of 44.52%, previously 28.78%, and fair with a value of 31.05%, from the previous 27.77%. In addition, the poor category experienced a very significant decline from 34.61% to 19.20%.



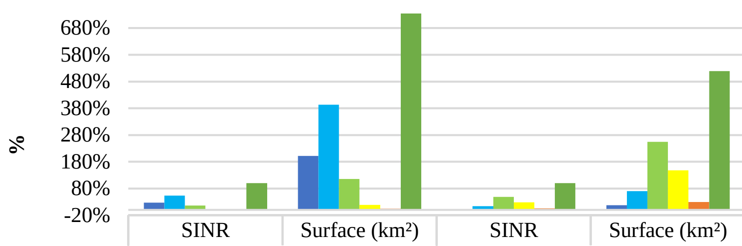
	RSRP %	Surface (km²)	RSRP	Surface (km²)
	2100 MHz Optimasi		2100 MHz Before	
Excellent	0,60%	0,045	2,62%	0,168
Very Good	1,14%	0,085	5,34%	0,343
Good	20,16%	1,503	19,24%	1,235
Fair	21,44%	1,598	16,28%	1,045
Poor	41,85%	3,12	43,27%	2,777
Very Poor	14,82%	1,105	13,24%	0,85
total	100,00%	7,455	100,00%	6,418

Figure 12. Percentage of RSRP Focus Zone on 2100 MHz



	SINR	Surface (km²)	SINR	Surface (km²)
	1800 MHz Optimization		1800 MHz Before	
Excellent	0,18961	1,168	0,03506	0,19
Very Good	0,44156	2,72	0,28376	1,538
Good	0,28133	1,733	0,37509	2,033
Fair	0,07516	0,463	0,23395	1,268
Poor	0,01266	0,078	0,07251	0,393
total	1	6,16	1	5,42

Figure 13. Percentage of SINR Focus Zone on 1800 MHz



	SINR	Surface (km²)	SINR	Surface (km²)
	2100 MHz Optimization		2100 MHz Before	
Excellent	0,27543	2,023	0,03317	0,172
Very Good	0,53547	3,933	0,13558	0,703
Good	0,15725	1,155	0,48987	2,54
Fair	0,02587	0,19	0,28447	1,475
Poor	0,00613	0,045	0,05689	0,295
total	1	7,345	1	5,185

Figure 14. Percentage of SINR Focus Zone on 2100 MHz

Referring to Figure 12, the graph on the right depicts the conditions before the optimization process was carried out, while the graph on the left depicts the optimization results. Specifically, it displays the Focus Zone area, which shows the extent of coverage in the good category. This resulted in an increase in the percentage from the previous value of 19.24% to 20.16%, and for the fair category it increased from 16.28% to 21.44%. Specifically for optimization results at the 2100 MHz frequency, the poor category decreased from 43.27% to 41.85%.

J. Comparison of SINR Parameter Optimization Results

Examining Figure 13, the graph on the right represents conditions prior to the optimization process, while the left graph illustrates the outcomes of the optimization. Notably, the SINR parameter has experienced an increase, reaching 44.16% in the very good category. Initially, it was dominated by two categories, with the fair category at 36.15% and the good category at 30.97%.

Referring to Figure 14, the graph on the right depicts the conditions before the optimization process was carried out, while the graph on the left displays the optimization results. The SINR value at 2100 MHz is mostly in the very good category, namely 53.55%, exceeding the value at the 1800 MHz frequency (44.16%). One of the factors that influences the SINR value is the frequency bandwidth allocated by the cellular operator [18]. Specifically, the bandwidth for the 2100 MHz frequency is 60 MHz, while for the 1800 MHz frequency it is 75 MHz. In addition, the 2100 MHz frequency bandwidth is divided into six separate blocks, while for 1800 MHz it is divided into ten separate blocks [16]. This means that the 2100 MHz frequency has a narrower bandwidth and fewer separate blocks than the 1800 MHz frequency. As a result, the SINR value at the 2100 MHz frequency is higher than at the 1800 MHz frequency because the spectrum is narrower so there is less interference from other channels.

IV. CONCLUSION

Implementation of the ACP method results in significant improvements in RSRP coverage. In the good category, coverage increased from 1,827 km to 2,825 km at the 1800 MHz frequency and from 1,235 km to 1,503 km at the 2100 MHz frequency. Likewise, the quality of the focus zone coverage area has increased, from 5,173 km to 6,033 km at the 1800 MHz frequency and increasing from 5,185 km to 7,345 km at the 2100 MHz frequency.

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