Analysis of Measuring Drive Test Result 4g LTE Network Telkomsel Operators Using Tems Pocket and Tems Discovery Software

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Abstract— The high-quality data transfer speeds of 4G LTE technology make people race to enjoy the technology. However, the reality is that there are still areas with Internet connections that are said to be less stable on Telkomsel operators in the area of 3 sites of the Lubuk Begalung. It is also supported by population density data from the Central Statistical Authority of Padang Cities. So, it is necessary to carry out measurements and analyses to know the methods of verification and measurement of signals as well as know the coverage of the area of 4G LTE network in the depth of the Lubuk Begalung on Telkomsel operators. Using Node B data from the associated company, then measurement and analysis can be done. The measurement of the signal quality is done using the drive test method, i.e. by circling the area to be measured. The application used to carry out a drive test is TEMS Pocket that is embedded in the smartphone. Where the result of the record logfile of the measurements will be imported into the TEMS Discovery software for analysis. Then the coverage area will be analyzed on the atoll application. Forecasting coverage area will be analyzed on the basis of RSRP parameters. Based on the value of the test drive results of the known RSRPs parameters, the signal quality at the accuracy of the Lubuk Begalung is normal because it is dominated by the yellow color with a strong signal of -100 dBm to -80dBm. The normal RSRP consists of 297 samples or as much as 81.15%.

Keywords— 4G LTE, Drive Test, Telkomsel, TEMS Pocket, TEMS Discovery, coverage area, Atoll.

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I. INTRODUCTION

Wireless telecommunications nowadays are growing very rapidly. Starting from the first generation (1G), then the second generation (2G), the third generation (3G), 4G generation until what is now implemented in Indonesia is the fifth generation (5G). However, for now the majority still use the fourth generation (4G) network called LTE (Long Term Evolution). This 4G LTE network itself supports the performance of mobile internet services introduced in the 3G era. This is where popular mobile gaming services, including HD TV, Video Conference, 3D TV, and other features that can be accessed on smartphones with superfast internet. All work is getting smoother with 4G. Besides, the maximum downlink service speed in the 4G network reaches 100 Mbps and the maximum uplink speed reaches 50 Mbps. [3] As the development of 4G networks especially in a time of pandemic that demands all sectors to work and study from home, then the quality of the 4G network has a huge role in achieving the smoothness and convenience of Internet access for users for the sake of business, education, government and so on. According to data from the Central Statistical Authority of the City of Padang in 2021, the geographical depth of the Lubuk Begalung is at 100° 21' 11" Eastern/East Longitude and 00° 58' 4" South Latitude with an area of 30.91 km2 and the height of the area is 8 – 400 Mdpl with a total population of 15 with a population of 122.593 people [2]. Based on the population density and the need for Internet access, which is so much needed during the pandemic as it is now, it is necessary to check and measure the signal in this area to find out the quality of the signal and the facts that cause the signal quality to be worse in future. Therefore, a method of measurement and verification of signals is necessary, namely drive test based on the network parameters used using the necessary tools and software. Where the results of this measurement process will be analyzed to determine the quality of the signal as well as its inhibitory factor.

II. THE MATERIAL AND METHOD

In this research, planning is an important part of the process of determining the coordinate point and the location of the site that has a sectoral antenna that leads to the direction of the gravity of the Lubuk Begalung. From the data site of Telkomsel operators there are several nearest sites that are in the area of Lubuk Begalung and the measurement using a mobile phone in which the application TEMS Pocket has been installed. Method used in measuring signal quality with drive test. The equipment in the planning process is mobile phones, laptops, dongles.

A. 4G LTE signal verification activities planning

Before conducting a 4G LTE signal check, first plan the activities that we will do to facilitate data retrieval.

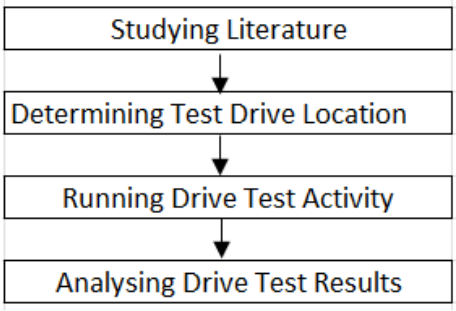

Figure 1. Signal Verification Activity Planning Stream

B. 4G LTE Technology

The Third Generation Partnership Project (GPP) has released a long-term evolutionary radio access network called Long Term Evolution (LTE). This technology has data transfer speeds of up to 100 Mbps on the downlink side and 50 Mbps at the uplink side. [8]

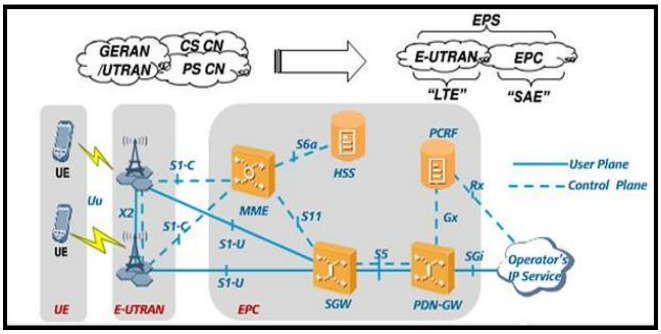

Figure 2. 4G Network Architecture

C. Data retrieval location and time

The 4G LTE signal verification of Telkomsel operators with the Drive Test method is carried out in the district of Lubuk Begalung, the city of Padang Data collection in this area is due to in this region there are complaints from active users that the quality of the 4G telkomsel signal is poor and often suffer failures for internet access. After setting up the location map, the data will be collected using the Drive Test method.

D. Drive Test

Drive test is a part of the work in radio network optimization. Drive Test aims to gather network information in real field. The information gathered is the actual Radio Frequency (RF) condition on an eNodeB. Software and Devices used for Drive Test:

1. TEMS Pocket is a commonly used tool for maintenance, and troubleshooting of cellular networks. TEMS Pocket can measure the performance of data transmission at both downlink and uplink. Temps Pocket collects measurements and events and displays them on the device screen. The results of these measurements can be stored for analysis in other products such as TEMS Discovery and TEMS Investigation.
2. TEMS Discovery is the most comprehensive wireless network analysis and optimization solution in the industry based on cellular network testing data. It gives unparalleled insight into the network performance as perceived by customers at the device, application, and network levels. In addition to supporting the complete TEMS Suite, TEMS Discovery also supports log files from other network testing vendors so it can benefit from its advanced analytics, regardless data collection methods.

E. Data retrieval

In carrying out the measurement using a mobile phone in which the application TEMS Pocket has been installed and on such measurements performed data capture at several coordinate points. The method used in the measurement of signal quality with drive test. Data collection using the application TEMS Pocket with the drive test method is performed as many as 5 times in the specified area. In the measurement process data processing was taken using drive test methods from the area of Bandar Buat, Cangkeh Nan XX, to Putra Indonesia University YPTK Lubuk Begalung, Padang city. After the drive test is measured, the next stage of data processing is performed using TEMS Discovery software. The data to be processed is a drive test logfile with TEMS Pocket aimed at displaying the plotting results of all parameters.

F. Parameters to be measured

1. RSRP (Reference Signal Received Power)

RSRP is an LTE power signal that is received by the user at a certain frequency. The farther the distance between the site and the user, the smaller the RSRPs that the user receives.

Category	RSRP Range
Very Good	-80
Good	≤ -90, <-80
Normal	≤ -100, <-90
Poor	≤ -120, <- 100

Very Poor	< -120

Figure 3. RSRP Strength Value Standard

RSRP can be calculated using the following formula:

RSRP = RSSI – 10 logs (12*N)..... (1)

- The RSSI (Received Signal Strength Indicator) is the power signal received by the user within a certain frequency range including noise and interference (dBm).
- N is the Number of resource block used by OFDMA.

2. RSRQ (Reference Signal Received Quality)

RSRQ is a parameter that determines the quality of the received signal.

Category	RSRQ Range
Very Good	-9
Good	$-10, \leq -9$
Normal	-15, ≤ -10
Poor	-19, ≤ - 15
Very Poor	< -20

Figure 4. RSRQ Strength Standard

3. SINR (Signal to Interference Noise Ratio)

SINR is the ratio of the primary signal emitted to the interference and noise generated. The range of SINR values can be seen in Figure 5, whereas the distinction between interference and noise can be found in Fig. 6.

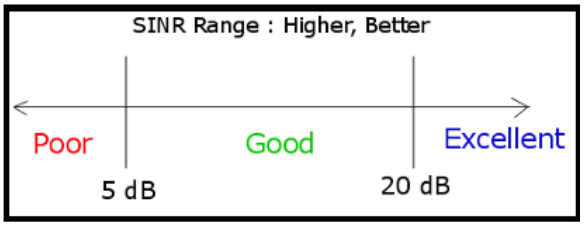

Figure 5. SINR Range

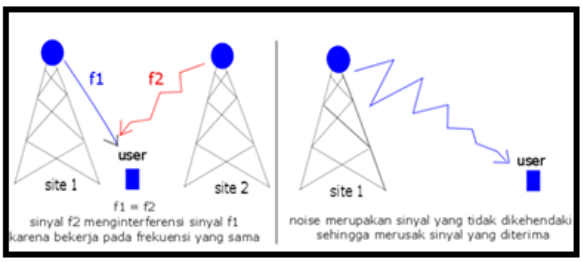

Figure 6. Difference between Interference and Noise

The formula for calculating SINR is as follows:

SINR = P / I + N..... (2)

Description:

- SINR=Signal to Noise Ratio (dB)
- P = Power received at a certain distance
- I = Interference received P due to other sites working at the same frequency
- N = Noise received P

III. RESULTS AND DISCUSSION

a. RSRP (Reference Signal Received Power)

RSRP or strong signal is one of the parameters used in 4G LTE network test drives. The relationship between RSRP parameters and coverage areas in software atolls is to get predictions of areas covered by sites or covered with RSRP parameters themselves. After conducting a drive test measurement and analyzing the drive test results.

As shown in Figure 4, the results of the measurement of the RSRP drive test parameters show that the signal strength in the area of intensity is normal because it is dominated by yellow with strong signal values of -100 dBm up to -80 dBm. The normal RSRRP consists of 297 samples or as much as 81.15%. Whereas the smallest sample is red that is very poor with a strong signal with a value of -120 to -100dBm.The very poor RSRPs consist of 14 samples, or as many as 3.83%. And for the good RSRPS with strong signals of -80 to -60 dBs. The good quality RSRP consist of 55 samples. For a clearer percentage of its quality can be seen in Fig. 7.

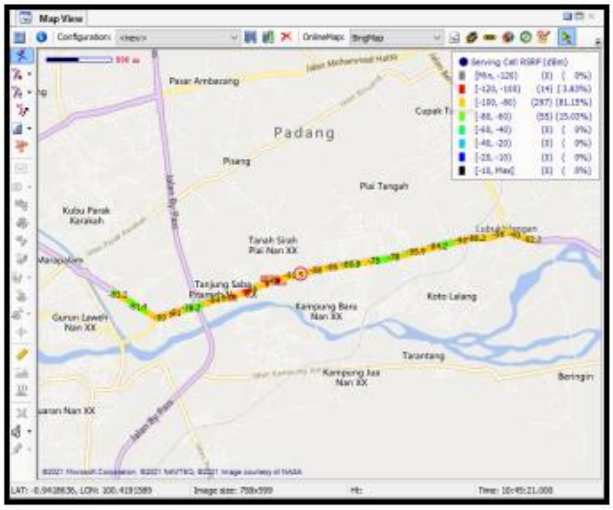

Figure 7. Map View RSRP.

As shown in Figure 7, the results of the measurement of the RSRP drive test parameters show that the signal strength in the area of intensity is normal because it is dominated by yellow with strong signal values of -100 dBm up to -80 dBm. The normal RSRRP consists of 297 samples or as much as 81.15%. While the smallest sample of the RRP is red that is very poor with a strong signal with a value of -120 to -100dBm.The very poor RSRPs are comprised of 14 samples, or as many as 3.83%. And for the good RRPs with strong

signals of -80 to -60dB m. The good quality of this RSRPS is comprising of 55 samples. For a clearer percentage of its quality, see Figure 3.8.

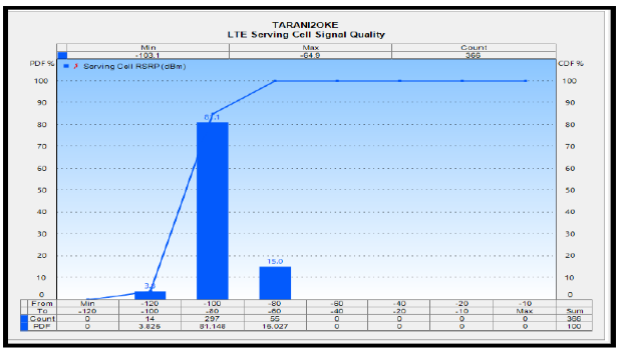

Figure 8. RSRP Histogram

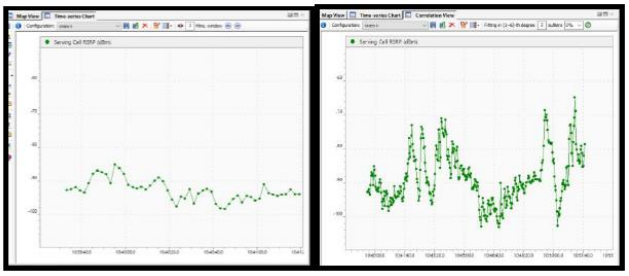

Figure 9. Time Series Chart & Correlation View Serving Cell RSRP (dBm)

To see the quality of the RSRP signal (dBm) at a certain time can be seen in Figure 8. Where the signal quality is best with values between -90 dBm to -80 dB m that is at 10:40:00 pm. RSRP with normal and good values are strong signals with normal categories. Based on the histogram above, it can be seen that strong signal in the area of intensity of the Beagle Basin is dominated by normal and Good values. In other words, the 4G LTE network RSRP of Telkomsel operators in the Lubuk Begalung is already normal. A possible way to fix the low RSRP area, which is to increase the dominance of cells coverage on this mobility route, is that in turn will improve channel quality and increase SINR for better downlink channel capability.

b. RSRQ (Reference Signal Received Quality)

RSRQ is the quality of the signal received by user equipment (UE). The aim is to see how the relationship between RSRP and RSRQ. RSRQ is influenced by traffic data and load in a cell. In practice, the channel quality and the ability of the receiver to decode data depends not only on data traffic from the cell itself, but also data traffic and interference from neighbor cells. Therefore, the measurement of RSRQ is a good representation of the signal quality of the serving cell, but it is not necessary for channel quality. Then, based on the drive test activities carried out, logfile processing results were obtained on TEMS Discovery as in Figure 3.10.

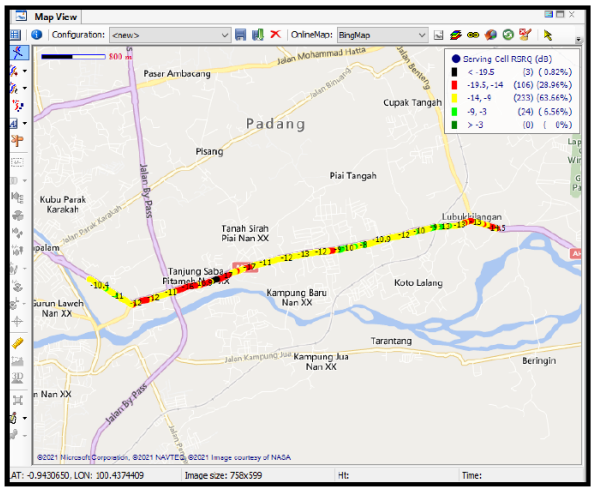

Figure 10 RSRQ in the Lubuk Begalung district (dB)

Based on Figure 10 above, the RRQ is dominated by a strong yellow normal signal with values of -14 dB to -9 dB. This normal value consists of 233 samples or as much as 63.33%. While the least RRK is black or very poor with a value of <-19.5dB. The very bad value is composed of 3 samples, or as many as 0.82%. Then for a poor value marked with a red color is 106 Samples or so 28.96 %. Then for good or good quality is -9 to -3 dB consisting of 24 samples. For the ratio of RSRQ signal quality (dB) can be seen in Figure.11 below.

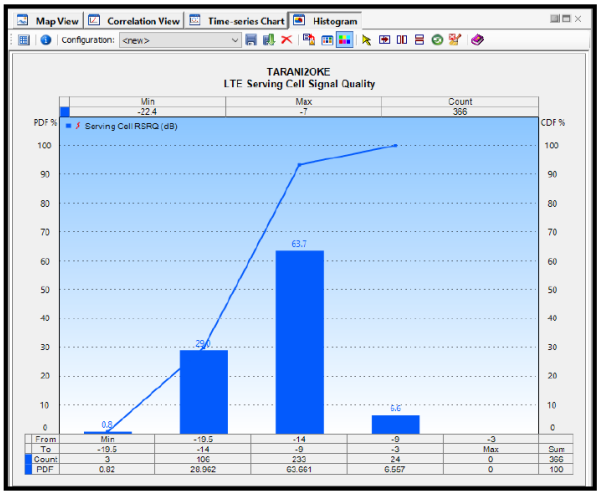

Figure 11. RSRQ Histogram in Lubuk Begalung (dB)

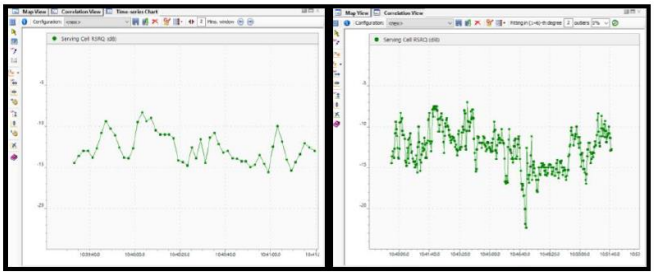

Figure 12. Time Series Chart & Correlation View RSRQ (dB)

Based on the histogram above, it can be seen that the quality of the RSRQ signal in the Beagle depth is dominated by the normal category with a percentage of 63.7% and the poor category with 28.96%. For category 54 very good with a value of -3 dB not visible because the number of samples consists of zero or as much as 0%. For the signal quality in the good or good category is with a rating of 6.56%. Although the quality signal of the 4G LTE network operators Telkomsel in the beagles depth has not reached the excellent category but the quality signals on the Lubuk Begalung depth are already good enough because more than half of the samples of the signal Quality in the Lubuk Begalung district are normal values.

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

SINR is the ratio of the primary signal emitted to the interference and noise generated. (mixed with the first signal). Based on Figure 4.7 Map View of the Lubuk Begalung District (dB), the SINR is dominated by the red color poor with a signal quality of -10 dB. This poor score consists of 151 samples or 41.26%. As for the lowest SINR value is by the old concentrated blue color is very excellent with a value of 25-30 dB consisting of 1 sample or as much as 0.27%. Then for the very poor quality with the value of -10 dB consists of 3 samples or as many as 0.82%. For more clarity can be seen in the figure 13 below.

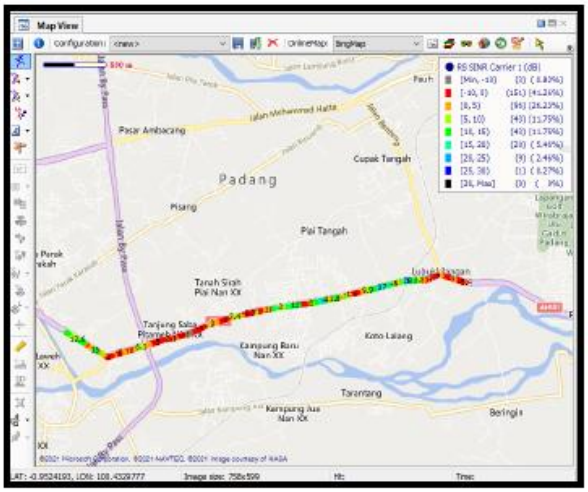

Figure 13 Map View SINR

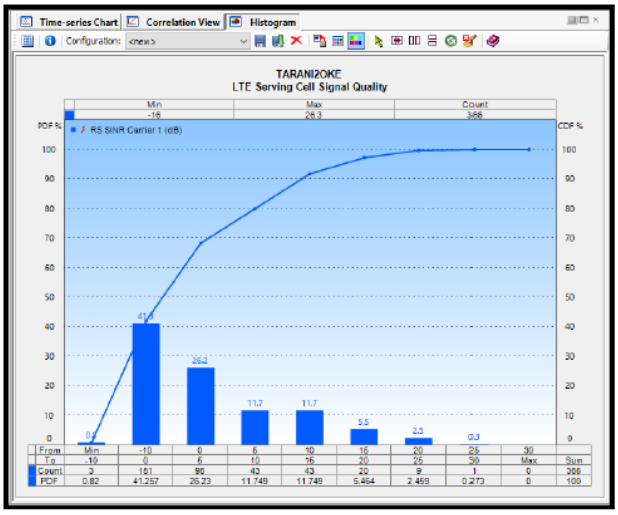

Figure 14 SINR Histogram (dB)

Based on the histogram in Figure 13 above is obtained the SINR area of the intensity of the Lubuk Begalung dominated by the red color that is poor with a signal quality of -10 dB. The value of this poor consists of 151 samples or as much as 41.26%. That means the value of poor has not reached half of the total sample quality of SINR. Then the quality of SINR in this area can be said to be normal.

d. Analysis of Coverage Area on Atoll

Figure 15 Coverage of the RSRP area on the Lubuk Begalung

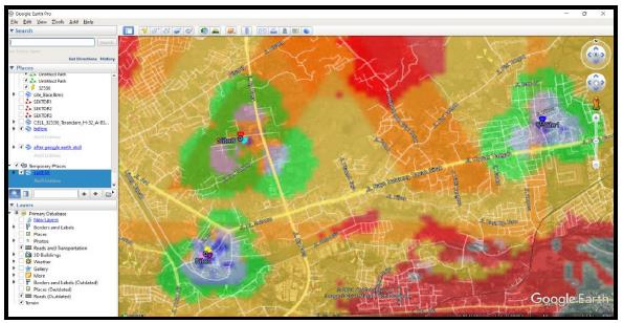

Figure 16 Coverage Area on Google Earth

Based on Figure 15 and Figure 16 above, after a prediction of the coverage area of the RSRP on the atoll software, it is known that there are three nearest sites with drive test tracks

not covering sufficiently the area or route that 57 were measured. So it's done on the atoll software using the ACP method. (Automatic Cell Planning).

After the ACP method is automatic cell planning which is a method to improve the quality of the 4G LTE network that can be done by setting the physical tunning sectoral antenna by changing the height of the antenna, azimuth, and tilting antenna. The changes in the coverage area that occurred can be seen in Figure 17 and 18 below.

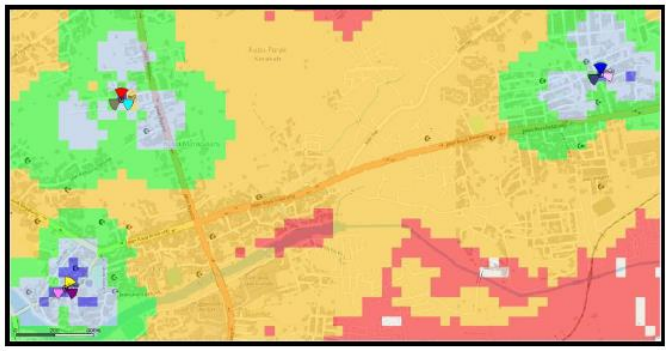

Figure 17. Coverage area before ACP

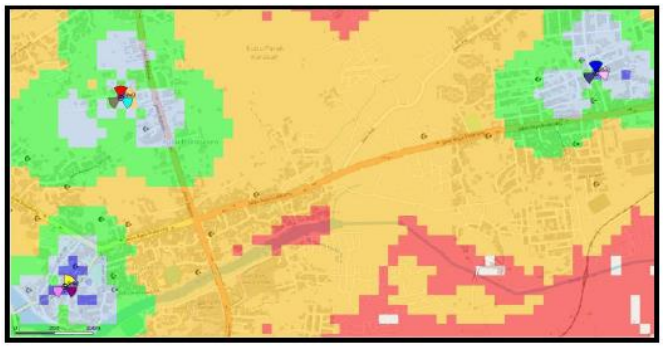

Figure 18. Coverage Area after ACP

Based on Figures 17 and 18, after the ACP coverage area method on the 4G LTE network Telkomsel operators in the Lubuk Begalung district are still not optimal and have not covered the area or route of the drive test measurement. Here are the reconfiguration data of ACP method in Figure 19.

Change set Table

Change Orde	Enable	Change Type	Name (Site/Txt/Cell)	Initial	Final	Quality Improvement	LTE RSRP	LTE PDSCH CINR
1	TRUE	Electrical Tilt	Site0_1	6	2	17.35	23.42	30.53
2	TRUE	Antenna	Site2_2	65deg 17-18dBi	33deg 21dBi	33.4	24.43	33.53
3	TRUE	Electrical Tilt	Site1_2	6	2	49.38	26.03	35.93
4	TRUE	Mechanical Tilt	Site0_2	0	2	59.05	25.14	39.24
5	TRUE	Electrical Tilt	Site2_3	6	2	68.38	26.3	40.41
6	TRUE	Electrical Tilt	Site1_1	6	0	73.94	27.3	40.8
7	TRUE	Azimuth	Site1_2	90	110	78.94	27.57	41.78
8	TRUE	Azimuth	Site0_3	240	260	82.03	27.76	42.36
9	TRUE	Mechanical Tilt	Site1_1	0	2	84.5	28.24	42.5
10	TRUE	Azimuth	Site2_3	240	220	86.49	28.14	43.1
11	TRUE	Azimuth	Site0_1	0	20	88.13	28.11	43.55
12	TRUE	Azimuth	Site0_2	120	140	90.47	28.09	44.15
13	TRUE	Mechanical Tilt	Site2_1	0	3	91.7	27.4	45.14
14	TRUE	Azimuth	Site2_2	120	110	93.55	27.37	45.64
15	TRUE	Mechanical Tilt	Site1_3	0	1	96.23	26.96	46.72
16	TRUE	Electrical Tilt	Site0_3	6	4	98.15	28.21	45.95
17	TRUE	Azimuth	Site2_1	30	10	99.11	28.29	46.11
18	TRUE	Azimuth	Site1_3	240	245	100	28.35	46.28

Figure 19. Data Reconfiguration on ACP

Based on the above data, it is known that the changes or configurations that have been made are the adjustment of azimuth, mechanical, and electrical tilt. Once done but not reached the expected KPI standard and the changes that have occurred are not very significant. The percentage of change can be seen in Figure 20 and the quality can be found in Figugre. 21.

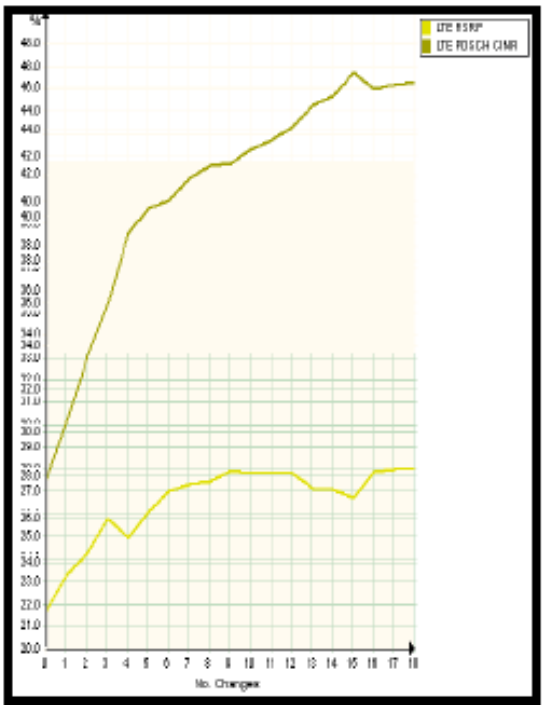

Figure 20. Percentage on Change Graph

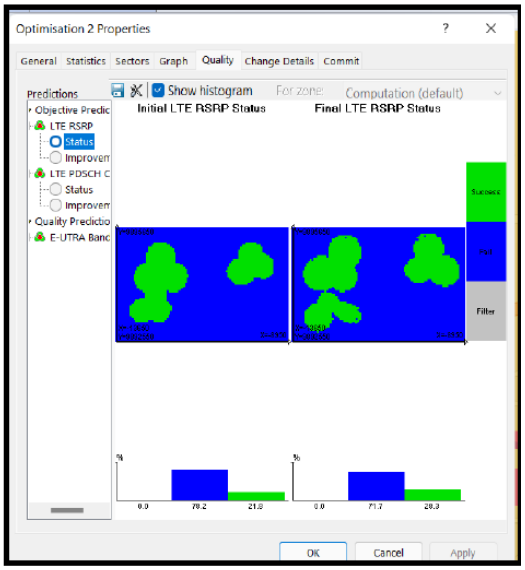

Figure 21. Quality

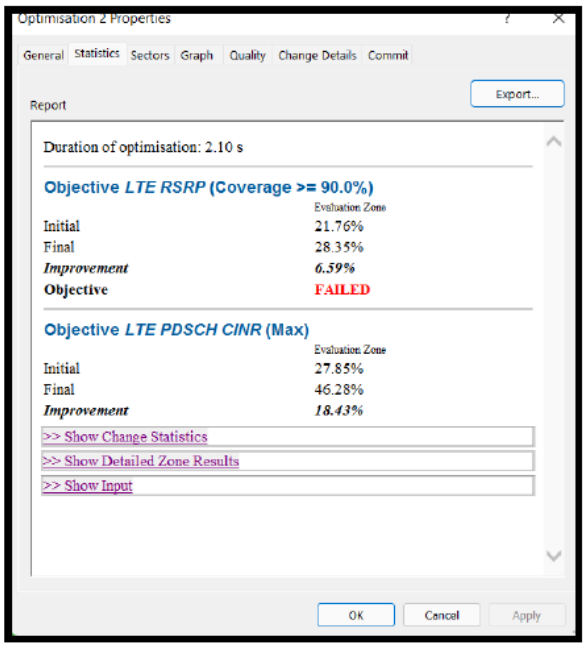

Figure 22. RSRP LTE Enhancement Statistics

Based on Figure 22, the RSRP LTE improvement statistics showed that there was only an improvement in quality from the initial 21.76% to the final 28.35%. This shows that the LTE quality improvement was only 6.59%. Therefore, in order for the 4G LTE network to cover the entire area or route measured and optimized it is considered necessary to plan a new site in the uncovered area in order to obtain a satisfactory quality of the Internet signal.

d. CONCLUSION

The 4G LTE signal verification method is one of the methods for verifying the accurate signal quality outdoors/outdoors by circling the area to be measured by driving with the aim of collecting measurement data related to the location of the user, where the data has been collected along the range of the desired RF coverage and will be processed on certain software including TEMS Pocket & TEMS Discovery to display the value of the 4G lte network parameters to be later analyzed or performed signal quality.

To determine the coverage area of the 4G LTE network operators Telkomsel then performed the forecast of the RSRP level area coverage (DL) with the setting of the range of RSRPs based on the value of Key Performance Indicator (KPI) and performed Automatic Cell Planning (ACP) method on the software atoll which is the method to improve the quality of the network 4GLTE that can be done by setting the physical tunning sectoral antenna by changing the height of the antenna, azimuth, and tilting antenna to get a more optimal coverage of the area.

Based on the value of the RSRP parameter test drive, the signal quality is normal because it is dominated by yellow with strong signals with values of -100 dBm up to -80dBm. The normal RRP consists of 297 samples or as much as 81.15%. Then according to the results of RSRQ test drive parameter it is that the quality of the RRQ signal in the rise of the Begalung is predominated by the normal category with a percentage of 63.7% and the poor category with 28.96%. Whereas for the SINR parameter, the red color is not dominated is poor with a signal quality of -10 dB. The poor value is 151 sample or 41.26%. This means that the poor value has not reached half the total of the overall SINR quality sample.

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