

Network Performance Analysis of 4G LTE in Marumpa Village, Maros Regency

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ARTICLE INFORMATION	ABSTRACT
Received : 10 – 06 – 2024 Revised : 05 – 03 – 2025 Published : 25 – 04 – 2025	Communication technology continues to evolve rapidly, one of which is the implementation of 4G LTE (Long Term Evolution) networks that offer high-speed internet and reliable performance. Based on preliminary data obtained through interviews conducted during this study, it was found that several areas in Marumpa Village still experience 4G signal quality that does not meet network standards. Therefore, signal strength measurements for 4G LTE in Marumpa Village need to be re-evaluated. This study aims to provide relevant information for the local community in Marumpa Village who utilize 4G LTE network services. The research was conducted using the Drive Test method with the G-NetTrack Pro application. The results indicate that the parameters RSRP, RSRQ, and SNR fall within good to excellent categories. Specifically, the RSRP value of -83.7 dBm at the Afiat Building is categorized as good, the RSRQ value of -8.5 dB at Cinranae Housing is classified as excellent, and the SNR value of 23 dB at the Afiat Building is also in the excellent category. On the other hand, poor performance for RSRP and RSRQ was recorded in the Babul Jannah area, with an RSRP value of -107.7 dBm and RSRQ value of -15.4 dB, both classified as poor. However, SNR values across all seven tested locations were found to be in the good to excellent categories, indicating stable signal-to-noise ratios overall.
Keywords: 4G LTE G-NetTrack Pro RSRP RSRQ SNR	

I. Introduction

Telecommunication technology continues to experience rapid development, one of which is the implementation of 4G LTE (Long-Term Evolution) networks that offer high-speed internet access and reliable performance. Telecommunication service providers have undoubtedly undertaken service quality optimization to meet customer demands [1]. Maros Regency, which currently consists of 14 districts and 103 villages or urban wards—including Marumpa Village—has embraced this development through the adoption of 4G LTE technology, primarily via the Telkomsel network.

However, based on initial interview data conducted in this study, several locations within Marumpa Village were found to have 4G signal strength below standard, indicating the need for signal re-evaluation in the area. This is important to ensure that the public's connectivity needs are met and that the Telkomsel network operates optimally in the region. The aim of this study is to provide accurate and practical information for residents of Marumpa Village who rely on 4G LTE for internet services.

Previous research has discussed the analysis of 4G LTE network quality, with a case study at PT. Ramayana Sudirman Pekanbaru. 4G technology is known to deliver data access speeds ranging from 100 Mbps to 1 Gbps [2]. However, in deploying this technology, many factors must be considered to ensure high-quality network performance [3]. In that study, the walk test method was used, and the results showed poor network performance in several test locations [4]. It was noted that weak internet connections are not only caused by poor signal quality, but also by network congestion due to a high number of users [5]. Additionally, dense and tall vegetation and weather conditions were found to contribute to signal degradation [6]. A limitation of the previous study was that it only employed the walk test method, without utilizing a drive test approach.

In contrast, the drive test method offers broader coverage and gathers real-time network data under dynamic conditions, using a vehicle to conduct measurements while in motion [7]. The data collected from this method is then analyzed to support improvements in network quality [8].

Based on these previous findings, further research is necessary using the drive test method in Marumpa Village, Maros Regency. Therefore, the present study is titled: "Network Performance Analysis of 4G LTE in Marumpa Village, Maros Regency."

II. Method

A. Drive Test Method

The drive test is a method used to collect real-time field data directly from the environment. This data collection requires the use of specialized equipment. A drive test must be supported by digital maps, GPS, and dedicated software designed for network performance measurement [9]. In technical terms, a drive test refers to signal measurements conducted to evaluate the performance of a specific cell site or Base Transceiver Station (BTS) [7].

The primary objective of a drive test is to assess the network quality in the direction of the Mobile Station (MS) by analyzing wireless signals transmitted or received from the BTS, and to collect field data accordingly. These measurements can be conducted using specially configured smartphones [10].

B. 4G LTE Parameters

Network optimization is an activity aimed at enhancing the performance of cellular networks. This process is carried out to achieve the best possible network quality by efficiently utilizing the available data. Network optimization involves a set of parameters that must be closely monitored. Improvements in these performance parameters directly affect the overall network performance. Several key performance indicators used in 4G LTE networks include the following [11]:

1) Reference Signal Received Power (RSRP)

RSRP refers to the LTE signal power received by a user device at a specific frequency. The greater the distance between the user and the cell site, the lower the RSRP value received. This parameter is used by the device to determine the appropriate point for handover [12]. Telecommunication providers typically target optimal RSRP values above -95 dBm [13].

The working principle of RSRP is illustrated in **Figure 1**, and the standard classification of RSRP values is presented in **Table 1**.

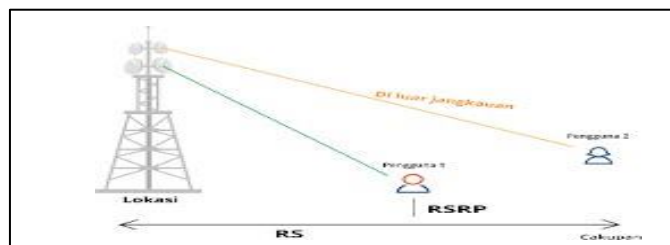


Figure 1. How RSRP Works

Table 1. RSRP Value Standardization [14]

Category	RSRP Value Range
Excellent	≥ -80 dBm
Good	-90 to -81 dBm
Fair (Normal)	-100 to -91 dBm
Poor	-120 to -101 dBm
Very Poor	< -120 dBm

The RSRP calculation equation can be seen in equation (1).

$$RSRP (dbm) = RSSI - 10 \log(12 \times N) \quad (1)$$

Where,

RSRP: Received Signal Received Power – the level of signal received by the user (dBm)

RSSI: Received Signal Strength Indicator – an indicator of signal power (dBm)

N : The number of resource blocks

2) Reference Signal Received Quality (RSRQ)

RSRQ is a parameter that defines the quality of the received signal. It reflects the signal quality as perceived by the User Equipment (UE). RSRQ is influenced by various factors, including signal strength, noise, and interference received by the UE [15].

To enhance the quality of a cellular network, the information obtained from the RSRQ parameter can be used as a reference for network improvements—such as antenna repositioning, increasing transmission power, or reducing interference from adjacent cells [10].

The RSRQ coverage range is illustrated in **Figure 2**, and the standard classification of RSRQ values is presented in **Table 2**.



Figure 2. RSRQ Reach

Table 2. RSRQ Value Standardization [14]

Category	RSRQ Value Range
Excellent	> -9 dB
Good	-10 to -9 dB
Fair (Normal)	-15 to -11 dB
Poor	-19 to -16 dB
Very Poor	> -9 dB

The RSRQ calculation equation can be seen in equation (2).

$$RSRQ = \frac{RSRP \times N}{RSSI} \quad (2)$$

Where,

$RSRP$: Received Signal Received Power – the level of signal received by the user (dBm)

$RSSI$: Represents noise or interference, which are conditions related to user activity detected within the current frequency range (dBm)

N : The number of resource blocks in OFDMA (Orthogonal Frequency-Division Multiple Access)

3) Signal to Noise Ratio (SNR) Parameter

SNR is an indicator that expresses the ratio between the transmitted signal and the level of noise or interference that occurs during the transmission process to the user [4]. The standard classification of SNR values can be found in **Table 3**.

Table 3. SNR Value Standardization [14]

Category	RSRP Value Range
Excellent	15 to 30 dB
Good	0 to 14 dB
Fair (Normal)	-5 to -1 dB
Poor	-11 to -6 dB
Very Poor	-20 to -12 dB

The SNR calculation equation can be seen in equation (3).

$$SNR = \frac{S}{I + N} \quad (1)$$

Where,

S : Average signal strength (dB)

I : Average interference power (dB)

N : Noise power (dB)

C. Research Stages

The research was conducted through the following stages:

1) Problem Identification

This stage begins with identifying the problem based on the background previously explained. The problem identified is that several areas in Marumpa Village experience 4G signal quality that does not meet network standards, thus requiring a re-measurement of 4G LTE signal strength in the area.

2) Literature Review

In this stage, the researcher collects references and theoretical foundations related to 4G LTE network concepts from various sources relevant to the issues discussed in the study.

3) Determining the Operator and Drive Test Routes

The operator selected for signal measurement is Telkomsel. Data collection routes were established in several points across Marumpa Village.

- Route 1: Includes Trans Jaya Flight School (0.3 km from the BTS), Afiat Building (0.17 km), and Griya Batas Kota Housing Complex (0.12 km), all with minimal visual obstructions such as trees.
- Route 2: Covers Cinranae Housing Complex (0.05 km from the BTS) and Mandai Train Station (0.68 km), also with minimal visual obstructions.
- Route 3: Includes Babul Jannah Islamic Boarding School (0.9 km from the BTS) and Aulia Mart (0.3 km), both with significant visual obstructions such as buildings and trees.

4) Drive Test

The drive test was conducted to collect field data using the G-NetTrack Pro application. Measurements were taken throughout Marumpa Village, Maros Regency.

5) Analysis

Once the data from the drive test is obtained, the next step involves analyzing the results to evaluate signal performance at each location

6) Conclusion and Recommendations

Conclusions are drawn based on the analysis results. This section provides a concise summary of the findings along with recommendations for future research and potential improvements.

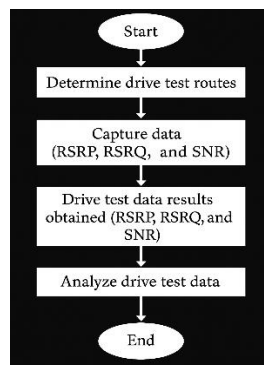


Figure 3. Research flow

The explanation of Figure 3 is as follows:

- The first stage is to determine the drive test route, which is selected as the data collection area, located in Marumpa Village, Maros Regency.
- The second stage involves data collection based on selected parameters. The parameters used in this study are RSRP, RSRQ, and SNR.
- The third stage, after conducting the drive test using the G-NetTrack Pro software, is that the collected data will be automatically saved by the application.
- The fourth stage is to process the data obtained from the drive test for further analysis.

III. Results and Discussion

A. Research Results

The drive test measurement conducted in Marumpa Village, Maros Regency, on March 18, 2024, was carried out in seven locations, namely: Trans Jaya Flight School, Afiat Building, Griya Batas Kota Housing Complex, Cinranae Housing Complex, Mandai Train Station, Babul Jannah Islamic Boarding School, and Aulia Mart Area. Measurements were taken under various conditions that influence the strength of the received signal, such as geographical characteristics, surrounding buildings or obstacles, weather conditions, and road traffic density. The drive test was performed using the G-NetTrack Pro application installed on a smartphone, with data collection conducted while in motion (on a moving vehicle).

1) Average Measurement Values at Each Location in Marumpa Village, Maros Regency

a. RSRP Parameter

Table 4. Average RSRP value

No	Point	RSRP (dBm)	Category
1	<i>Trans Jaya Flight School</i>	-89,7	Good
2	<i>Gedung Afiat</i>	-83,7	Good
3	<i>Komp. Griya Batas Kota</i>	-88,4	Good
4	<i>Komp. Perumahan Cinranae</i>	-90,3	Good
5	<i>Stasiun Kereta Api Mandai</i>	-88,8	Good
6	<i>Pesantren Babul Jannah</i>	-107,7	Bad
7	<i>Aulia Mart</i>	-90,8	Fair

b. RSRQ Parameter

Table 5. Average RSRQ value

No	Point	RSRQ (dBm)	Category
1	<i>Trans Jaya Flight School</i>	-9,3	Good
2	<i>Gedung Afiat</i>	-9,8	Good
3	<i>Komp. Griya Batas Kota</i>	-9,1	Good
4	<i>Komp. Perumahan Cinranae</i>	-8,5	Very Good
5	<i>Stasiun Kereta Api Mandai</i>	-9,7	Good
6	<i>Pesantren Babul Jannah</i>	-15,4	Bad
7	<i>Aulia Mart</i>	-11,9	Fair

c. SNR Parameter

Table 6. Average SNR value

No	Point	SNR (dBm)	Category
1	<i>Trans Jaya Flight School</i>	17,1	Very Good
2	<i>Gedung Afiat</i>	23	Very Good
3	<i>Komp. Griya Batas Kota</i>	19,4	Very Good
4	<i>Komp. Perumahan Cinranae</i>	14,6	Very Good

No	Point	SNR (dBm)	Category
5	<i>Stasiun Kereta Api Mandai</i>	7,7	Good
6	<i>Pesantren Babul Jannah</i>	4	Good
7	<i>Aulia Mart</i>	7	Good

B. Discussion

In **Table 4**, the average RSRP values indicate the quality of the Telkomsel network in Marumpa Village, Maros Regency. The highest RSRP values were recorded in five areas: Trans Jaya Flight School (-89.7 dBm), Afiat Building (-83.7 dBm), Griya Batas Kota (-88.4 dBm), Cinranae Housing Complex (-90.3 dBm), and Mandai Train Station (-88.8 dBm). These five locations fall under the "Good" category, mainly due to their proximity to the BTS. On the other hand, the lowest RSRP value was found at Babul Jannah Islamic Boarding School (-107.7 dBm), which is categorized as "Poor", primarily because this area is far from the BTS. In this case, RSRP values are significantly influenced by the distance between the user and the BTS.

In **Table 5**, the average RSRQ values show the network quality in the same area. The highest RSRQ value was recorded at Cinranae Housing Complex (-8.5 dB), which falls into the "Excellent" category. This result is likely due to the minimal visual obstructions, such as the absence of dense trees. In contrast, the lowest RSRQ value was observed at Babul Jannah (-15.4 dB), categorized as "Poor", which can be attributed to the presence of dense vegetation and multiple obstacles that interfere with the signal from the BTS. Thus, RSRQ is affected by signal quality and can be degraded by obstructions or unstable transmitters.

In **Table 6**, the average SNR values of Telkomsel's network performance show that the highest SNR was found in four areas: Trans Jaya Flight School (17.1 dB), Afiat Building (23 dB), Griya Batas Kota (19.4 dB), and Cinranae Housing Complex (14.6 dB). These values are categorized as "Excellent". Notably, none of the seven areas recorded poor SNR values. The SNR quality is influenced by the clarity of the main signal, meaning that the signal was not significantly affected by noise or unwanted interference. This indicates strong and clean transmission in the measured locations.:

IV. Conclusion

The results of the 4G LTE internet network performance measurement in Lompoloang Village, Wajo Regency, using the G-NetTrack Pro application, showed that several locations recorded values in the best range. The RSRP value of -74.5 dBm was found at the Lompoloang Village Office, -84.9 dBm at SD Negeri 189 Lompoloang, and -84.1 dBm at the Village Mosque. The RSRQ value of -7.4 dB was recorded at the Village Office, -8.2 dB at SMP Negeri 4 Pitumpanua, and -7.6 dB at SMA Negeri 14 Wajo. The SNR value of 20.2 dB was found at the Pustu (community health center) in Lompoloang Village, 25.5 dB at the Village Office, 8.9 dB at SD Negeri 189 Lompoloang, and 8.8 dB at SMA Negeri 14 Wajo.

Meanwhile, in the lowest signal range, the RSRP value of -104 dBm was recorded at the village church and -109.7 dBm at the Pustu. The lowest RSRQ value of -16.5 dB was also found at the Pustu in Lompoloang Village. However, the SNR values across all seven measured points were still in the good to excellent categories.

The factors contributing to the good quality of the 4G LTE network in several areas in Lompoloang Village, Wajo Regency—such as the Village Office, SD Negeri 189 Lompoloang, SMP Negeri 4 Pitumpanua, and SMA Negeri 14 Wajo—are due to the open area conditions, the absence of physical obstructions, and the relatively close distance to the BTS. On the other hand, the poor network quality in areas such as the Village Church and the Pustu in Lompoloang Village is caused by the presence of dense trees and numerous obstacles between the location and the BTS.

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