

# 4G LTE Network Quality Comparison Provider Telkomsel and Tri In Pariaman City

Irvandito Pondri<sup>a</sup>, Miftahul Hamdi<sup>b,\*</sup>, Afrizal Yuhane<sup>f</sup>, Dikky Chandra<sup>b</sup>

<sup>a</sup> Telecommunication Engineering , Politeknik Negeri Padang, 25166 , Indonesia,  
Corresponding author:miftahulhamdi67@gmail.com

**Abstract**— Along with the development of the current era of globalization, human needs for telecommunications are also increasing, especially in the telecommunications sector. A technology called Long Term Evolution (LTE) was introduced, which is a fourth generation (4G) cellular network technology. LTE is capable of providing data transfer speeds of up to 100 Mbps on the downlink side and 50 Mbps on the uplink side. The growth in the number of telecommunications service users in Pariaman City has caused a decline in network quality, especially 4G LTE technology. Benchmarking (Comparison) of the quality of 4G LTE operator services is carried out by measuring, comparing, and analyzing the network quality (performance) of two 4G LTE operators in Pariaman City. The measurement process uses the drive test method with the G-Net Track Pro application to measure RSRP, RSRQ, SINR and Throughput in Pariaman City. The comparison results were obtained in Pariaman City for Telkomsel operators having network quality parameters RSRP with a percentage of 48.71%, RSRQ with a percentage of 61.11%, SINR with a percentage of 84.25% and Throughput with a percentage of 68.48% while Tri operators have RSRP values with a percentage of 59.74%, RSRQ with a percentage of 50.38%, SINR with a percentage of 85.68% and Throughput with a percentage value of 66.63%. In general, it can be concluded that Tri operators are included in the good category in terms of signal quality and integrity while Telkomsel operators are in the good category in terms of Coverage.

**Keywords**— 4G LTE; Drive Test; Benchmarking; Telecommunication

*Manuscript received 22 Sep. 2024; revised 17 Oct. 2024; accepted 16 Jun. 2025. Date of publication 21 Jun. 2025.  
International Journal of Wireless And Multimedia Communicatios is licensed under a Creative Commons Attribution-Share Alike 4.0  
International License.*



## I. INTRODUCTION

The increasing use of cellular technology has a rapid impact on technological developments, especially in the field of information and telecommunications. Thus, consumer needs are also increasing with high mobility. This has triggered the emergence of a broadband era that can support consumer needs with optimal performance.

4G technology or LTE(Long Term Evolution) is a term for service technology that has high capabilities in mobile communication systems. LTE is a development of the previous generation, LTE is designed to be able to communicate data such as sending images, graphics, and multimedia content to faster video communication compared to the previous generation, where LTE provides a

level of capability for UE (User Equipment) or user devices that can support downlink data rates from 10 Mbps to 300 Mbps, and uplink from 5 Mbps to 75 Mbps[1].

It is undeniable that the large amount of 4G network usage data must be in line with the availability of the network that must be provided by the internet service provider. Therefore, an important part of implementing a 4G network is the availability of a Coverage area or region with optimal signal-quality services. Optimal coverage areas must also be supported by the capacity and optimal Throughput value. To measure and analyze the comparison of internet service quality on the 4G LTE network from Telkomsel and Three, an accurate and objective method is needed, one of the methods used is the drive test method[2].

*Drive test* is an activity that aims to collect real radio frequency network information in the field, in order to

determine network performance and upload and download speeds and is also called a measurement technique that is carried out by driving along a certain route while collecting data from the measurement device installed in the cellphone[3].

Based on this research, it will conduct an analysis of 4G LTE network parameters, namely, RSRP (Reference Signal Received Power), RSRQ (Reference Signal Received Quality), SINR (Signal to Interference Noise Ratio), and Throughput on the Telkomsel 4G LTE network with the drive test method using the G-NetTrack Pro application. As well as speed measurements by looking at the results on the MapInfo application [4].

The Internet has become a part of life. Therefore, it is very important to conduct a drive test on eNodeB sites by implementing 4G LTE technology because by doing so, we can find out the performance of the 4G LTE network in the Pariaman City area so that we can find out the quality of the 4G LTE network, of course, based on parameters in the form of RSRP, RSRQ, SINR, and Throughput parameters which will be carried out later.

comparison and benchmarking of data obtained from drive test results using the G-NetTrack Pro application managed by Mapinfo.

Based on this background, the author chose the title of the assignment of "COMPARISON OF SIGNAL QUALITY ON 4G LTE NETWORKS OF TELKOMSEL AND TRI PROVIDERS IN PARIAMAN CITY"

## II. METHOD

The process of checking the comparison of 4G LTE network quality and bad spots on Telkomsel and Tri operators uses the Drive Test method which aims to see the comparison of the quality of the existing network in Pariaman City with the route from Jalan Syekh Burhanuddin to Jalan Tuanku Naali which has been taken real data and to find out the influence and causes that occur in the 4G LTE parameter problem [25].

Signal strength measurements in writing this Final Assignment were carried out by drive test, using Android-based software. The software used in the measurement is G-Net TrackPro [26].

In addition to signal measurements in writing the thesis, thematic maps and BTS plots were also made during the drive test. In making thematic maps, MapInfo Profesional software was used, so a comparative analysis of network quality was carried out so that the parameter values of the specified route could be seen. Which time for data collection was carried out on July 21, 2024.

### A. Data collection technique

*Test Drive aims* to find out the actual quality and coverage in the field to find out the strength of the 4G signal of Telkomsel and Tri providers on Jalan Syekh Burhanuddin in Pariaman City. Before conducting a drive test, a planning process was carried out to facilitate the drive test process[27].

The process carried out is to create a drive test route/path for directions on which roads will be passed. After the planning process is carried out, the next step is to carry out

the data-checking process (drive test) to measure the quality of the network in the area[28].

### B. Drive test Measurement method

#### 1. Drive test Idle Mode

Measurement of the signal quality received by MS (Mobile Station) in an idle state or not performing the download/upload process. This mode is only used to find out the signal strength of an area indicated as low signal/no service[19].

#### 2. Drive test DedicateMode





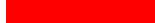
Signal quality measurement is performed during the upload/download process. To measure and identify voice and data quality. Test dedicated mode is used to obtain throughput, RSRP, and SINR value[20]. In the Drive test process, G-NetTrack Pro software is used, which is software for measuring the parameters and performance of a telecommunications network, be it 2G, 3G or 4G networks[21]

### C. 4G LTE Parameters

#### 1. RSRP(Reference Signal Receive4 Power)

It is an LTE power signal received by the user at a certain frequency. The further the distance between the site and the user, the smaller the RSRP received by the user. RS is a Reference Signal or RSRP at each coverage point. Users who are outside the range will not get LTE services as in Table 1[22].

TABLE I  
STANDAR RSRP VALUE

Signal Strength – RSRP (dBm)		
Exelent		$\geq -75$ RSRP $< 0$
Very Good		$\geq -85$ RSRP $< -75$
Good		$\geq -100$ RSRP $< -85$
Fair		$\geq -110$ RSRP $< -100$
Poor		

#### 2. SINR (Signal to Interface Noise Ratio)

SINR is the ratio of the comparison between the main signal transmitted with the interference and noise that arises or is mixed with the main signal. The greater the SINR value, the better the signal quality and vice versa with the KPI (Key Performance Indicator) standard as in Table 2.[24]






TABLE II  
STANDAR SINR VALUE

Quality-SINR (dB)		
Exelent		$\geq 20$
Good		$\geq 20$ SINR $< 20$
Fair		$\geq 0$ SINR $< 13$
Poor		$< 0$

#### 2. SINR (Signal to Interface Noise Ratio)

*Throughput is* the average number of bits received by the UE in a network. Downlink Throughput is the actual or true bandwidth, measured in a certain time unit and under certain network conditions. certain used to perform *transfer* data with a certain size

TABLE III  
STANDAR THROUGHPUT VALUE

Throughput-DL (Kbit/s)		
Excellent		$\geq 1400$
Very Good		$\geq 7000$ Throughput $< 1400$
Good		$\geq 1000$ Throughput $< 7000$
Fair		$\geq 512$ Throughput $< 1000$
Poor		$< 512$

III. RESULT AND DISCUSSION

After measuring the quality of the 4G LTE signal on Telkomsel and Tri operators using the RSRP, RSRQ, SINR, and Throughput parameters according to the KPI (Key Performance Indicator) KPI standards. The Drive Test result data is processed and then analyzed using MapInfo to see the network quality of Telkomsel and Tri operators in Pariaman City with a path length of 16.5 km

A. Telkomsel Data Result

1. Received Signal Reference Power (RSRP)



Fig 1 Telkomsel RSRP Measurement Result

As seen in Figure 1, the quality of the RSRP network that occurred in Pariaman City with data collection using the Drive Test method by obtaining 11,162 samples with 5 categories (very bad, bad, quite good, good and very good).

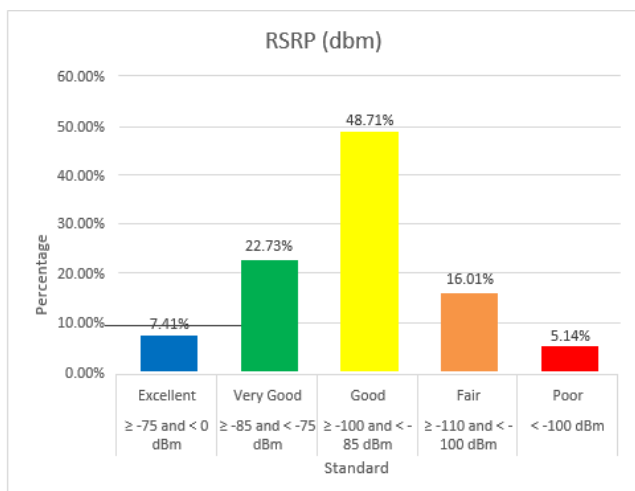


Fig 2 Percentage Graph of Standar RSRP Telkomsel

In Figure 2, it can be seen that the very bad or poor category ( $< -100$  dBm) obtained 574 samples with a percentage of 5.14%, the bad or fair category ( $\geq -110$  dBm RSRP  $< -100$  dBm) obtained 1787 samples with a percentage of 16.01%, for the fairly good or good category ( $\geq -100$  dBm RSRP  $< -85$  dBm) there were 5437 samples with a percentage of 48.71% while the good or very good category ( $\geq -85$  dBm RSRP  $< -75$  dBm) with 2537 samples with a percentage of 22.73% and the very good or excellent category ( $\geq -75$  dBm RSRP  $< 0$ ) obtained 827 samples with a percentage of 7.41%.

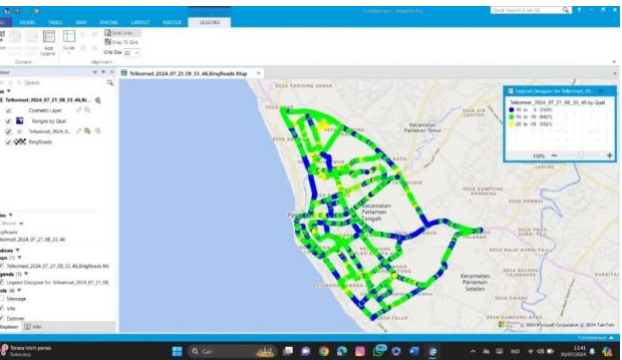


Fig 3 Telkomsel RSRQ Measurement Result

As seen in Figure 3, the quality of the RSRQ network that occurred in Pariaman City with data collection using the Drive Test method by obtaining 11,162 samples with 3 categories (very good, good, quite good).

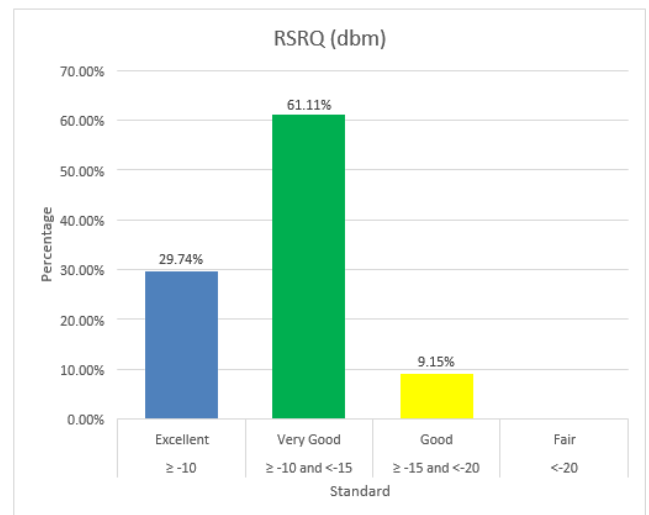


Fig 4 Percentage Graph of Standar RSRQ Telkomsel

In Figure 4, it can be seen that the very bad or poor category ( $< -20$  dBm) obtained 0 samples with a percentage of 0%, the good or good category ( $\geq -15$  dBm RSRQ  $< -20$  dBm) obtained 1021 samples with a percentage of 9.15%, for the good or very good category ( $\geq -10$  dBm RSRQ  $< -15$  dBm) there were 6821 samples with a percentage of 61.11% while the good or excellent category ( $\geq -10$  dBm) had 3320 samples with a percentage of 29.74%.

3. Signal to Interference and Noise Ratio (SINR)

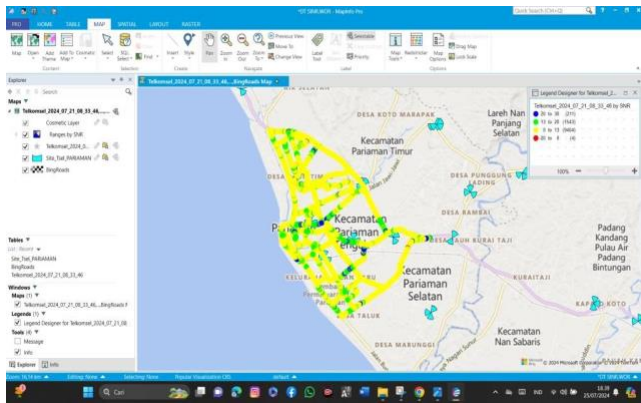


Fig 5 Telkomsel SINR Measurement Result

Figure 5, the SINR quality of the data retrieval results using the Drive Test method which took place in Pariaman City with the Telkomsel operator obtaining 11,162 samples with 4 categories (very bad, quite bad, good and very good).

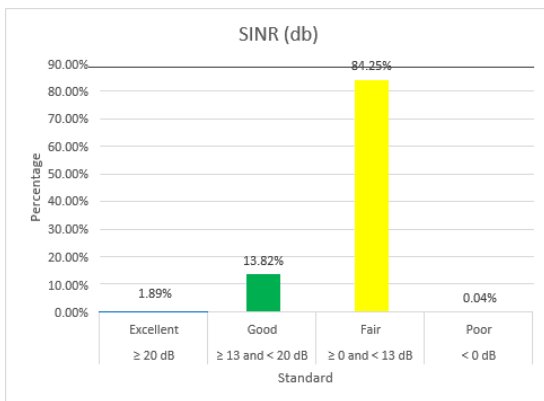


Fig 6 Percentage Graph of Standar SINR Telkomsel

In Figure 6, it can be seen that the very bad or poor category ( $< 0$  dB) obtained 4 samples with a percentage of 0.04%, the bad or fair category ( $\geq 0$  dB SINR  $< 13$  dB) obtained 9404 samples with a percentage of 84.25%, for the good category ( $\geq 13$  dB SINR  $< 20$  dB) there were 1543 samples with a percentage of 13.82% while the good or very good category ( $\geq 20$  dBm) with 211 samples with a percentage of 1.89%.

4. Throughput

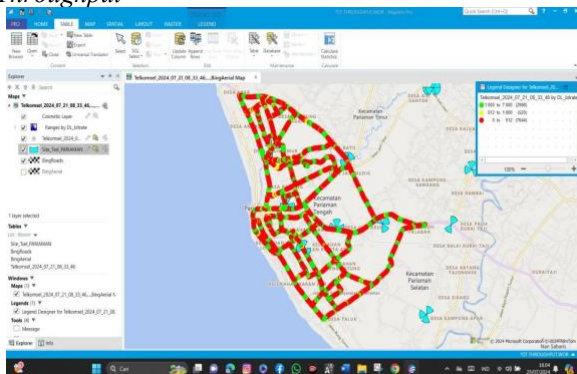


Fig 7 Telkomsel Throughput Measurement Result

In Figure 7, the quality of the Downlink Throughput parameter against the results of data collection using the Drive Test method that occurred in Pariaman City. For this Throughput sampling, it was done by streaming YouTube with 1080p quality which aims to check the downlink speed of the Telkomsel operator along the route, getting 11,162 samples with 5 categories (very good, very good, good, quite bad, and very bad).

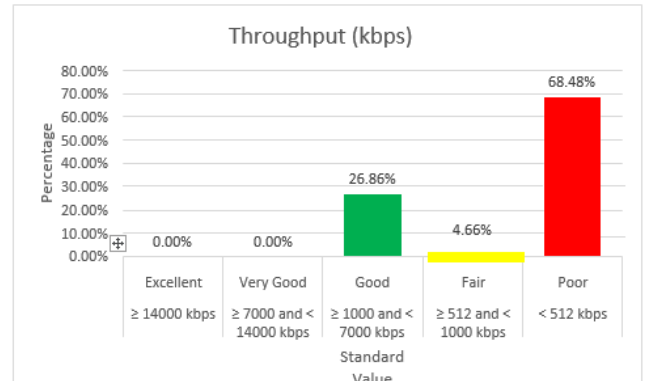


Fig 8 Percentage Graph of Standar Throughput Telkomsel

In Figure 8, it can be seen that the very bad or poor category ( $< 512$ ) obtained 7644 samples with a percentage of 68.48%, the bad or fair category ( $\geq 512$  Throughput  $< 1000$ ) obtained 512 samples with a percentage of 4.66%, for the fairly good or good category ( $\geq 1000$  Throughput  $< 7000$ ) there were 2998 samples with a percentage of 26.86% while the good or very good category ( $\geq 7000$  Throughput  $< 14000$ ) with 0 samples with a percentage of 0% and the very good or excellent category ( $\geq 14000$ ) obtained 0 samples with a percentage of 0%.

B. Tri Data Result

1. Received Signal Reference Power (RSRP)

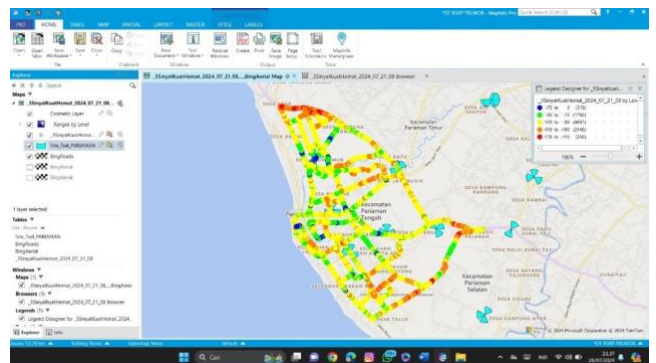


Fig 9 Tri RSRP Measurement Result

As seen in Figure 9, the quality of the RSRP network against the results of data collection using the Drive Test method in Pariaman City using the Tri operator, there are 11,210 samples with 5 categories (very bad, bad, quite good, good and very good).

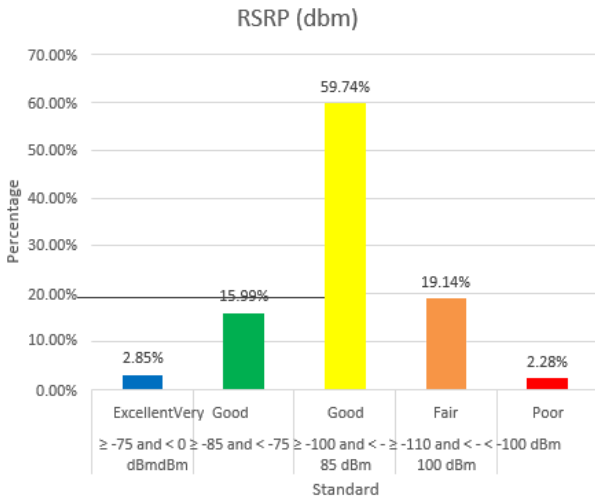


Fig 10 Percentage Graph of Standar RSRP Tri

In Figure 10, it can be seen that the very bad or poor category ( $< -100$  dBm) obtained 256 samples with a percentage of 2.28%, the bad or fair category ( $\geq -110$  dBm RSRP  $< -100$  dBm) obtained 2146 samples with a percentage of 19.14%, for the fairly good or good category ( $\geq -100$  dBm RSRP  $< -85$  dBm) there were 6697 samples with a percentage of 59.74% while the good or very good category ( $\geq -85$  dBm RSRP  $< -75$  dBm) with 1792 samples with a percentage of 15.99% and the very good or excellent category ( $\geq -75$  dBm RSRP  $< 0$ ) obtained 319 samples with a percentage of 2.85%.

2. Reference Signal Received Quality (RSRQ)

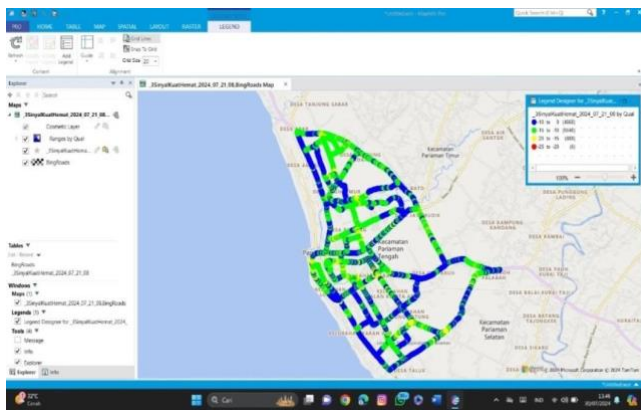


Fig 11 Tri RSRQ Measurement Result

As seen in Figure 11, the quality of the RSRQ network that occurred in Pariaman City with data collection using the Drive Test method by obtaining 11,162 samples with 4 categories (very good, good, bad and very bad).

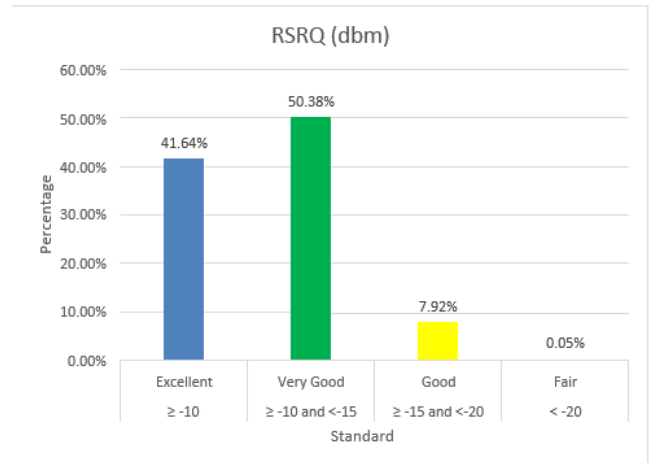


Fig 12 Percentage Graph of Standar RSRQ Tri

In Figure 12, it can be seen that the very bad or poor category ( $< -20$  dBm) obtained 6 samples with a percentage of 0.05%, the bad or fair category ( $\geq -15$  dBm RSRQ  $< -20$  dBm) obtained 888 samples with a percentage of 7.92%, for the good category ( $\geq -10$  dBm RSRQ  $< -15$  dBm) there were 5648 samples with a percentage of 50.38% while the good or very good category ( $\geq -10$  dBm) with 4668 samples with a percentage of 41.64%.

3. Signal to Interference and Noise Ratio (SINR)

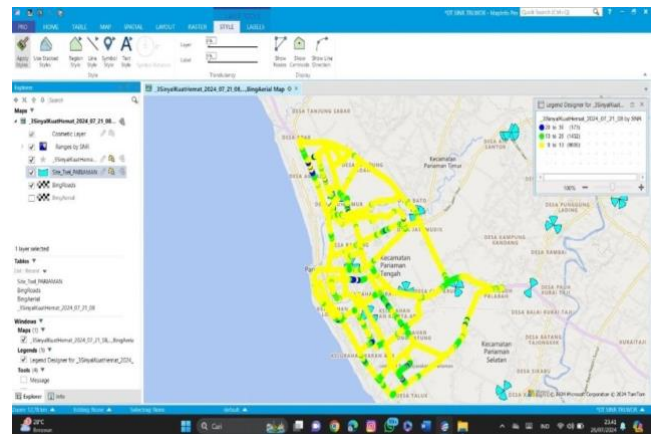


Fig 13 Tri SINR Measurement Result

Based on Figure 13, the quality of SINR against the results of data collection using the Drive Test method that occurred in Pariaman City with the Telkomsel operator obtaining 11,211 samples with 4 categories (very bad, bad, good and very good).

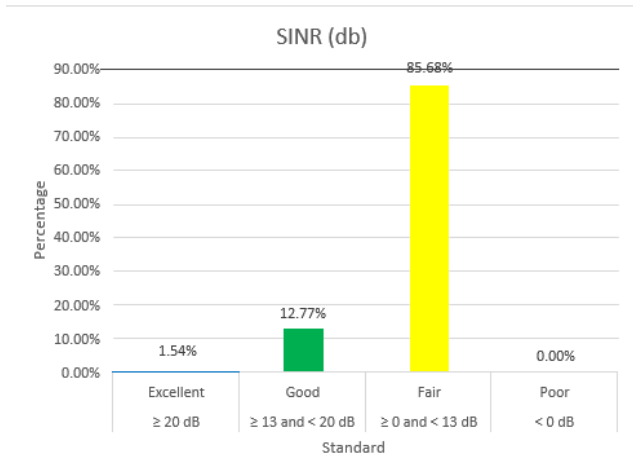


Fig 14 Percentage Graph of Standar SINR Tri

In Figure 14, it can be seen that the very bad or poor category (< 0 dB) obtained 0 samples with a percentage of 0%, the bad or fair category (≥ 0 dB SINR <13 dB) obtained 9605 samples with a percentage of 85.68%, for the good category (≥ 13 dB SINR < 20 dB) there were 1432 samples with a percentage of 12.77% while the good or very good category (≥ 20 dBm) had 173 samples with a percentage of 1.54%.

#### 4. Throughput

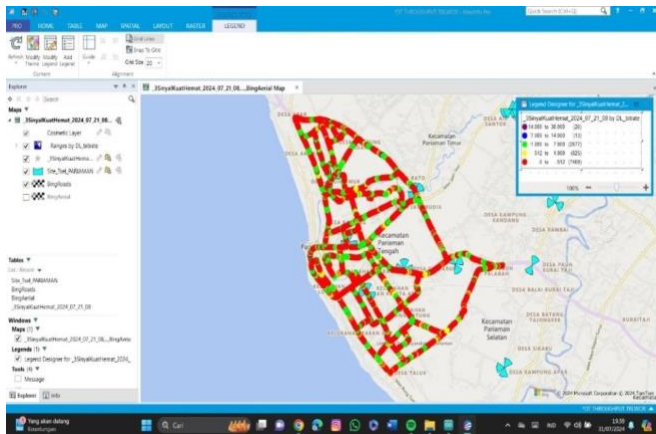


Fig 15 Tri Throughput Measurement Result

In Figure 15, the quality of the Downlink Throughput parameter against the results of data collection using the Drive Test method which was carried out by streaming YouTube with a resolution of 1080p which was carried out in Pariaman City with the aim of checking the downlink speed of the Telkomsel operator along the route, obtaining 11,210 samples with 5 categories (very good, very good, good, quite bad, and very bad)

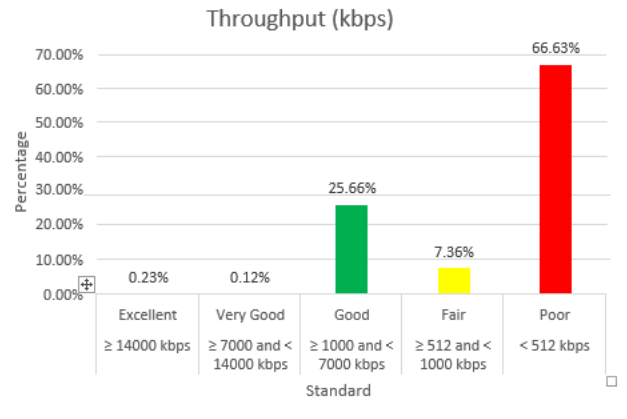


Fig 16 Percentage Graph of Standar Throughput Tri

In Figure 4.24, it can be seen that the very bad or poor category (<512) obtained 7469 samples with a percentage of 66.68%, the bad or fair category (≥512 Throughput <1000) obtained 825 samples with a percentage of 7.36%, for the fairly good or good category (≥1000 Throughput <7000) there were 2877 samples with a percentage of 25.66% while the good or very good category (≥7000 Throughput <14000) with 13 samples with a percentage of 0.12% and the very good or excellent category (≥14000) obtained 26 samples with a percentage of 0.23%.

#### C. Comparisom of Telkomsel and Tri Operatoes

##### 1. Comparison of Telkomsel and Tri RSRP

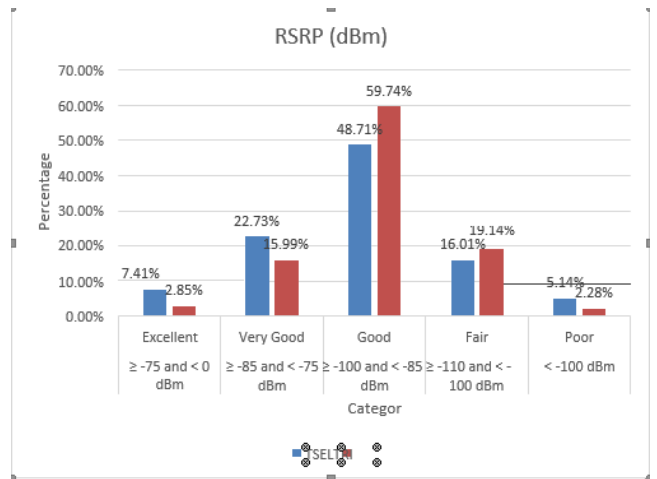


Fig 17 Comparison of Telkomsel and Tri RSRP Percentages

As seen in Figure 1, the quality of the RSRP network that occurred in Pariaman City with data collection using the Drive Test method by obtaining 11,162 samples with 5 categories (very bad, bad, quite good, good and very good).

##### 2. Comparison of Telkomsel and Tri RSRQ

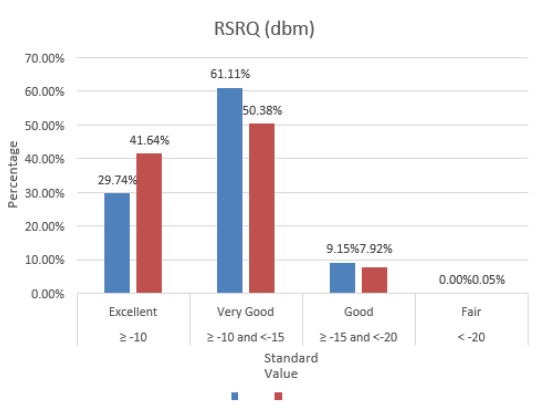


Fig 18 Comparison of Telkomsel and Tri RSRQ Percentages

As seen in Figure 1, the quality of the RSRP network that occurred in Pariaman City with data collection using the Drive Test method by obtaining 11,162 samples with 5 categories (very bad, bad, quite good, good and very good).

### 3. Comparison of Telkomsel and Tri SINR

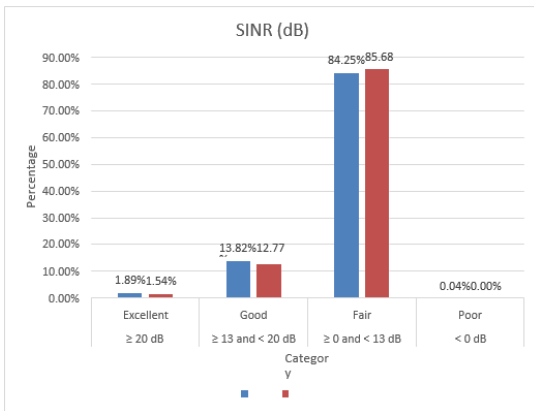


Fig 19 Comparison of Telkomsel and Tri SINR Percentages

As seen in Figure 1, the quality of the RSRP network that occurred in Pariaman City with data collection using the Drive Test method by obtaining 11,162 samples with 5 categories (very bad, bad, quite good, good and very good).

### 4. Comparison of Telkomsel and Tri Throughput

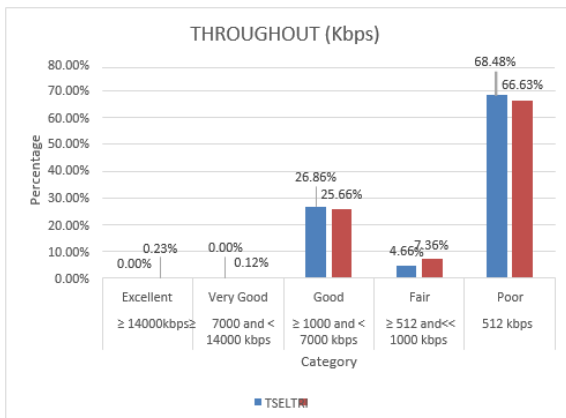


Fig 20 Comparison of Telkomsel and Tri Throughput Percentages

As seen in Figure 1, the quality of the RSRP network that occurred in Pariaman City with data collection using the Drive Test method by obtaining 11,162 samples with 5 categories (very bad, bad, quite good, good and very good).

### 5. Comparison of Percentage Telkomsel and Tri Operator

TABLE IV  
Comparison of Percentage Telkomsel and Tri-Operator

Parameter	Telkomsel	Tri
RSRP	48.71%	59.74%
RSRQ	61.11%	50.38%
SINR	84.25%	85.68%
Throughput	68.48%	66.63%

Table IV shows the results of the percentage comparison between Telkomsel and Tri operators, where Telkomsel is better than Tri in terms of RSRQ, while Tri is better than Telkomsel in terms of RSRP, SINR, and Throughput.

### 6. Network Capacity on Telkomsel and Tri Operators

The available network capacity affects data speed and connection stability. The larger the bandwidth allocated by the operator, the better the network quality. Telkomsel, as a state-owned operator with the widest network coverage throughout Indonesia, has a total bandwidth capacity of 52.5 MHz. The total capacity consists of 15 MHz (frequency 2,100 MHz), 22.5

MHz (frequency 1,800 MHz), 7.5 MHz (frequency 900 MHz), and 7.5 MHz (frequency 800 MHz). 3 Hutchinson Indonesia has the lowest total band capacity, which is only 20 MHz divided into 10 MHz at the 1,800 MHz frequency and another 10 MHz at the 2,100 MHz frequency. In the research results, Telkomsel has the advantage in better area coverage (higher RSRQ) but Tri is superior in terms of signal quality (higher SINR). In terms of throughput (download and upload speeds), both operators showed less than optimal performance, with Telkomsel recording 68.48% in the "Poor" category, and Tri recording 66.63% in the same category. This indicates that the allocated spectrum may not be sufficient to handle the number of existing users, especially during peak usage periods.

## IV. CONCLUSION

From the results of the analysis and comparison, the following conclusions can be drawn:

1. Data collection of Telkomsel and Tri provider drive tests using 4 parameters obtained results on the Telkomsel provider, namely the RSRP parameter of 48.71% with a fairly good category, the RSRQ parameter of 61.11% with a fairly good category, the SINR parameter of 84.25% with a Fair category, the Throughput parameter of 68.28% with a bad category and on the Tri provider operator, namely the RSRP parameter of 59.74% with a fairly good category, the RSRQ parameter of 50.38% with a fairly good category, the SINR parameter of 85.68% with a fairly bad category, the Throughput parameter of 66.63% with a bad category.

2. Comparison of 4G LTE network signal quality, Telkomsel operator has a fairly good RSRP value with a percentage of 48.71%, a fairly good RSRQ value with a percentage of 61.11%, poor SINR with a percentage of 84.25% while the resulting Throughput is poor with a percentage of 68.28%. Based on data analysis and processing from the two operators, the network quality in the Pariaman City area can be stated that the Telkomsel operator is good in terms of RSRQ, compared to the Tri operator in terms of RSRP, SINR and Throughput.

3. Factors that affect the performance of 2 (two) 4G LTE operators in the Pariaman City area based on data that has been taken and analyzed, the RSRP, RSRQ, SINR and Throughput parameter values are very low due to network capacity (Bandwidth), user density (traffic load), interference, and limited spectrum.

#### REFERENCES

- [1] IP Indra Ully Widhi Nugraha, N. Gunantara, and I. Diafari Djuni Hartawan, "Analysis of Service Quality Measurement on 4G Network," *J. SPEKTRUM*, vol. 8, no. 1, p. 85, 2021, doi: 10.24843/spektrum.2021.v08.i01.p10.
- [2] D. Chandra, Zurnawita, S. Yusnita, D. Meidelfi, and AF Kasmar, "The Optimization of PCI Interference in the 4G LTE Network in Padang," *Int. J. Informatics Vis.*, vol. 5, no. 3, pp. 256–263, 2021, doi: 10.30630/JOIV.5.3.490.
- [3] Muhammad Harun Ashar and Dinda, "Analysis of Telkomsel 4G Network Performance Using Drive Test Method," *Bull. Comput. Sci. Res.*, vol. 3, no. 5, pp. 364–371, 2023, doi: 10.47065/bulletincsr.v3i5.273.
- [4] O. Yufiansa, P. Maria, and S. Yusnita, "Improving 4G LTE Network Performance Based on Signal Checking in Bukit Sundi District, Solok Regency," *Elektron J. Ilm.*, vol. 11, no. 2, pp. 49–55, 2019, doi: 10.30630/eji.11.2.129.
- [5] A. Akram, FH Melvandino, WY Bragaswara, and H. Ramza, "4G LTE Network Performance Analysis Using Drive Test Method in Kampung Rambutan Village, East Jakarta," *J. Inform. and Tech. Electro Terap.*, vol. 11, no. 3, 2023, doi: 10.23960/jitet.v11i3.3140.
- [6] Y. Rahmaddian and Y. Huda, "Analysis of 4G LTE Network Performance in the ITL Building, FT UNP, West Air Tawar Campus," *Voteteknika (Vocational Tech. Electron. and Inform.)*, vol. 7, no. 4, p. 40, 2020, doi: 10.24036/voteteknika.v7i4.106379.
- [7] R. Daffa, RR Saedudin, and M. Fathinuddin, "Analysis of 4G LTE Network Performance Using Drive Test Method at Xyz Building," *JUPI (Journal of Science, Research, and Learning Inform.)*, vol. 9, no. 2, pp. 548–557, 2024, doi: 10.29100/jupi.v9i2.4554.
- [8] F. Farida and S. Nurhaliza, "Analysis of 4G Network Quality Service in Pekanbaru City with G-Net Track," *ELECTROPS J. Ilm. Tech. Elektro*, vol. 1, no. 1, p. 30, 2023, doi: 10.30872/electrops.v1i1.9375.
- [9] FAI Nuari, UK Usman, and A. Hanuranto, "Application of Unmanned Aerial Vehicle (UAV) for Signal Strength Measurement (Drive Test) on 4G LTE Network," *Avitec*, vol. 3, no. 1, pp. 69–81, 2021, doi: 10.28989/avitec.v3i1.893.
- [10] A. Rahmi, JP Hapsari, and BP Jati, "Optimization of 4G Network at 1800Mhz Frequency with Re-Azimuth and Tilting Methods Using Atoll Simulation Software (Case Study: Pemalang City)," *Media Elektr.*, vol. 15, no. 1, pp. 1–11, 2022, doi: 10.26714/me.v15i1.7133.
- [11] D. Septiawan and D. Syamsuar, "Improving the Quality of 4G LTE Networks Using Traffic Sharing Technique Optimization Method," *J. Telecomun. and Comput.*, vol. 11, no. 3, p. 177, 2021, doi: 10.22441/incosmtech.v11i3.10612.
- [12] M. Fahrizal, I. Iskandar, NS H, and RM Candra, "Comparative Analysis of 4G Internet Network Quality at UIN Suska Riau Campus Using Quality of Service Method," *J. Ilm. Technol. and Engineering*, vol. 3, no. 6, pp. 806–812, 2023, doi: 10.30865/klik.v3i6.900.
- [13] P. Muliandhi, AE Jayati, and L. Hidayati, "Analysis of the 4G LTE Provider H3I Network Using Genex Probe 5.1 Software," *Elektrika*, vol. 15, no. 1, p. 55, 2023, doi: 10.26623/elektrika.v15i1.6013.
- [14] R. Ayubianto and M. Mulyono, "4G LTE Network Quality Analysis Case Study of PT. Ramayana Sudirman Pekanbaru," *Remik*, vol. 7, no. 1, pp. 246–258, 2023, doi: 10.33395/remik.v7i1.12040.
- [15] F. Labibah Amelia, A. Nurdin, and A. Info, "An Analysis of 4G Lite Signal Quality on Telkomsel XL Provider and Hutchison 3 Indonesia Using G- Nettrack Pro Application Via Android at State Polytechnic of Sriwijaya Published by Politeknik Piksi Ganesha Indonesia," vol. 6, no. 2, pp. 215–226, 2022, doi: 10.37339/e-komtek.v6i2.958.
- [16] F. Farida and AH Yunianto, "Analysis of 4G Network Performance of Telkomsel Operator in Tanjungpinang City using Drive Test Method," *J. Sustain. J. Has. Penelek. dan Ind. Terap.*, vol. 9, no. 1, pp. 1–7, 2020, doi: 10.31629/sustainable.v9i1.835.
- [17] FA Rahmat, "Performance Analysis of 4G LTE Network Quality in Singgalang Housing Area, Koto Tangah, Padang City," *Telekontran J. Ilm. Telekomun. Control and Electron. Terap.*, vol. 10, no. 2, pp. 106–115, 2022, doi: 10.34010/telekontran.v10i2.7904.
- [18] YR Yungka and DC Widiyanto, "4G LTE Network Walk Test Analysis Using Android Application G-Net Track on Swcu Fti Building," *J. Tek. Inform.*, vol. 4, no. 2, pp. 441–448, 2023, doi: 10.52436/1.jutif.2023.4.2.727.
- [19] EMDS Belo, "4G Long Term Evolution (LTE) Network Performance Analysis Based on Drive Test Data at PT. Indosat Kupang," *J. Media Elektro*, vol. X, no. 2, pp. 79–86, 2021, doi: 10.35508/jme.v10i2.5117.
- [20] U. Septima, D. Candra, R. Vitria, M. Alfarezi, and A. Yolanda, "Analysis of 2G and 4G Network Quality in Solok City," *Brill. Res. Artif. Intel.*, vol. 4, no. s1, pp. 208–222, 2024, doi: 10.47709/brilliance.v4i1.3870.
- [21] B. Alfaresi, MVE Satya, and F. Ardianto, "Analysis of Okumura-Hata and Cost-Hata Propagation Models in 4G LTE Wireless Network Communication," *J. Ampere*, vol. 5, no. 1, p. 32, 2020, doi: 10.31851/ampere.v5i1.4158.
- [22] A. Yuhaneef, S. Yusnita, and D. Gusvita, "The Effect of Overshoot on the Performance of the 4G LTE Network in the East Sawahan Region," *Brill. Res. Artif. Intel.*, vol. 4, no. 1, pp. 121–128, 2024, doi: 10.47709/brilliance.v4i1.3318.
- [23] H. Yuliana, NMD Putri, and S. Basuki, "Optimization of 4G LTE Network in Densely Populated Areas Using Multisectoral Antennas," *JTERA (Jurnal Teknol. Rekayasa)*, vol. 5, no. 1, p. 81, 2020, doi: 10.31544/jtera.v5.i1.2019.81-92.
- [24] A. Yuhaneef, S. Aulia, and OP Yaseva, "Comparison of 4G LTE Network Quality Between Three Operators Using Drive Test Method in Central Pariaman Beach," *JIKO (Journal of Inform. and Computer)*, vol. 7, no. 2, p. 301, 2023, doi: 10.26798/jiko.v7i2.886.
- [25] A. PURNAMA, ES NUGRAHA, and MA AMANAF, "Application of ACP Method for Optimization of Physical Tuning of Sectoral Antenna on 4G LTE Network in Purwokerto City," *ELKOMIKA J. Tech. Energy Elektr. Tech. Telekomun. Tech. Electron.*, vol. 8, no. 1, p. 138, 2020, doi: 10.26760/elkomika.v8i1.138.
- [26] J. Simanjuntak and J. Sitompul, "Analysis of GSM Network Performance in Urban and SubUrban Areas," *J. ELPOTECS*, vol. 4, no. 2, pp. 29–43, 2021, doi: 10.51622/elpotecs.v4i2.436.
- [27] RTS Simanjuntak, PH Rantellinggi, and K. Yulianawan, "Drive Test Method as Wireless Network Performance Monitoring in Buildings in the University of Papua Environment," *J. Technol. Inf. and Comput. Science.*, vol. 7, no. 6, p. 1245, 2020, doi: 10.25126/jtiik.2020762898.
- [28] EB Wagiu, A. Butar-butur, and JI Sihotang, "Analysis of QoS (Quality of Service) on Internet Network (Case Study: Adventist University of Indonesia)," *TeIka*, vol. 9, no. 01, pp. 31–41, 2019, doi: 10.36342/teika.v9i01.789.
- [29] E. Budiman and U. Hairah, "Performance of 4G LTE Network of Mobile Operators in the Capital of East Kalimantan during the Covid19 Pandemic," *Pekommas*, pp. 1–10, 2021, doi: 10.30818/jpkm.2021.

[30] S. Widodo et al., "Installation and Testing of Offline Drive Tester Around Tembalang Campus," *Orbith*, vol. 18, no. 3, pp. 271–278, 2022, doi:10.32497/orbith.v18i3.4371.