

Analysis the Expansion of Base Station's Coverage for Gsm Cellular Network Using Solar Cell at Gadog Village, West Java, Indonesia

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Abstract: The presence of Global system for Mobile technology provides opportunities for the development of information and communication technology towards more valuable automation. One of the benefits that become the backbone to support today's communication activities is high-speed internet access which has reached the 4G version. However, this version upgrade is not necessarily evenly distributed in all regions in Indonesia, Gadog village located in the West Java ,Cianjur region is one area that can be called an isolated area from GSM telecommunication signals, this is due to the topology of the area which is between the hills. Therefore, a GSM signal amplification system is needed to support the use of GSM-based telecommunications and the use of the internet as a gateway for information exploration.

Keywords: GSM, 4G Technology, Signal Amplification

1. Introduction

The availability of Cellular Communication Network in industry 4.0 become a backbone for all the equipment that is using computer so that they can send data from one location to another location or from one machine to another machine. In Indonesia at this time have already operated 4G Cellular Network and some area have already operated 5G ,but the signal quality not the same for all area in Indonesia , because maybe are influenced by many factors, and one of them is the geographic condition of that area. Gadog Village is an area in Cianjur, West Java. Geographically this area is located 500 m over surface of the sea. The height is lower than the area around it ,so that it can be said that this village is located in the valley and is surrounded by high hills with the height around over 650 m over the surface of the sea. The position of the BTS tower is located at the back of the hills make more worst that condition so that the quality of the received signal of cellular network become very low at that village. On this research we do experiment to get the area become better in receiving cellular signal. The goal of the research is to build a system for improvement in the strength of the received cellular signal at that area so that the received signal at that area is fulfilled the standard for communication cellular and the development of the technology that based on internet of things in monitoring electrical energy[1].

2. Research Planning

2.1 Research Flowchart

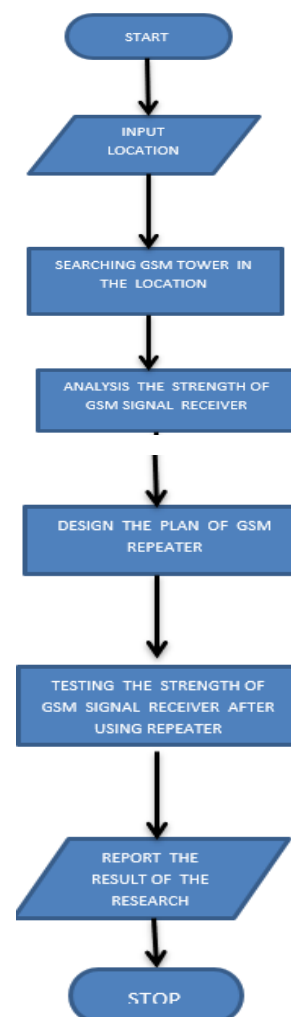


Fig 1. The Flow Chart of the Research

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2.2 Research Configuration

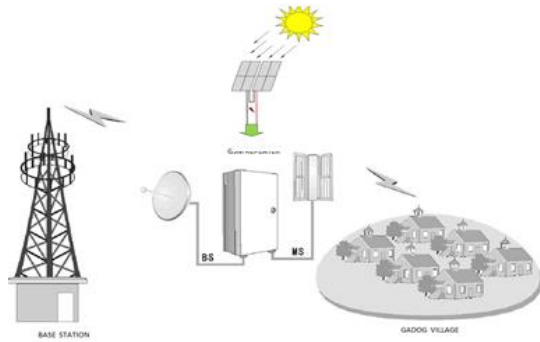


Fig 2. The Diagram of the research

2.3 The Steps of The Research

The Research is divided by four session, the sequence of the session are as follows:

- Investigation
- Analysis
- Design
- Testing

The goal of The Investigation is to get the initialization data for the coordinate of the Research Location, the place of Base Station(BTS)'s Tower and the strength of the signal on the research location. The Second Step is Analysis, this activity is used for mapping between the point of the location that is used with the place of the Base Station's Tower to calculate the line of sight distance between the two sites. The Third step is Design the System which is used for making the plan of The GSM Signal Repeater on the research location. The Last Step is the Testing of the Strength for the received cellular signal and the strength of the relaying signal from The GSM Repeater.

The Technology that used for observation is 4G LTE (Long-Term Evolution) that is usually used for internet,



Fig 3. Cikalong Tower

.The Parameter that used is Reference Signal Received Power(RSRP) with decibel as measurement unit.

$$RSRP = RSSI - 10 * \log(12 * N) \text{ db} \quad (1)$$

Receive Signal Strength Indicator or RSSI is an indicator that shows the strength of the signal on the receiver with noise and interference.

$$RSSI = \text{Powernoise} + \text{Powersignal} + \text{Powerinterference} \quad (2)$$

Based on the table 1 the strength indication of RSRP can be grouped as follows

Table 1. The Range of RSRP

Group	dBm
Very Good	<= -80
Good	<= -90 sd < -80
Normal	<= -100 sd < -90
Bad	<= -120 sd < -100
Very Bad	<= -120

According to the table, the best signal is on the range -100 dBm to -80 dBm .

3. Analysis and Result

There are two towers BTS that nearest from the result of the research(Table 2)

Table 2. The Location of the BTS Tower

Area	Coordinate(⁰)	height (mdpl)
Cikalong	-6.69147 107.16095	670
Sukaresmi	-6.73371 107.09435	823

The Measurement of the distance between the two BTS tower's location with research location use google maps software that are showed on figure 3 and figure 4 [4].

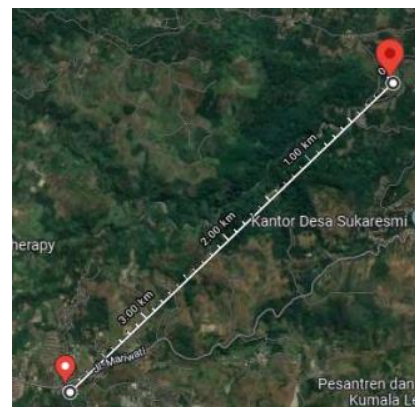


Fig 4. Sukaresmi Tower

The Distance between the BTS's tower with the research location using line of sight measurement around ± 4.8 km for Cikalong tower and ± 4 km for Sukaresmi tower. And the strength of the received signal is showed on figure 5.



Fig 5 Signal Measurement using Application Software[5]

The value that can be seen on display for the strength of the received signal is -118 dBm. This value is not good according to the table for communication voice or data.

To overcome the problem the specification for the repeater should be according to table 3 as follows.

Table 3. The Specification of The Repeater

Type	Specification
Grid Antenna high Gain	<ul style="list-style-type: none"> ▪ Frequency Range 890 to 2180 Mhz ▪ Gain 18 dB ▪ Vertical Beamwidth 18 degree ▪ Horizontal Beamwidth 12 degree ▪ Impedance 50 Ohm
Signal Processor	<ul style="list-style-type: none"> ▪ 2G/3G/4G LTE ▪ Uplink 890-2000 Mhz ▪ Downlink 930-2100 Mhz ▪ Gain 60 to 70 dB

The result for the received signal after installation repeater is showed on the figure 6 below:



Fig 6 The Result of The Testing

It can be seen that the strength of the received signal is around -93 dBm, it means that the signal can be said on the normal condition and stable. So that the chance for the development with new innovation using information technology and communication would be bigger.

4. Summary

1. GSM signal repeater system is a component that amplifying and relaying signal cellular. The signal from the tower BTS is relayed again to some area around it, This system depend on the capacity and the ability from cellular service provider.
2. The Strength of the receiving signal for cellular data and voice communication can be amplified and relayed using GSM repeater.
3. The Coverage of the receiving signal for data and voice communication can be extended using GSM Repeater

5. Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

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