Installation of Handphone Signal Booster Antennas at 900 MHz Frequency in Onggari Village Merauke Regency

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Abstract. The importance of cellular communication demands to improve the quality of good and quality services in all regions including rural areas. The limitations of BTS signal propagation in Kumbe village have disrupted cellular communication services in Onggari village. By using the Yagi antenna 13 elements as a cellular signal amplifier that is modified by using a repeater so that the handphone signal can be accessed at a greater distance from the BTS location. The results obtained after mounting the signal amplifier antenna is very good where the signal increase is at 4 Barr, the signal strength is -75 dBm at a distance of 1 meter with ”excellent” sound quality, while the results of the measurement of signal strength and signal quality for sunny weather are better than when it rains.

1. Introduction
Communication technology using handphone (HP) is currently experiencing progress and very rapid development. Mobile is a communication tool that is needed right now to facilitate us in communicating directly without face to face. Handphone is an electronic telecommunications device that has the same basic capabilities as a conventional telephone, but can be carried everywhere (portable / mobile) [1][2].

Global System For Mobile Communication (GSM) is a standard that is used globally for digital cellular communication [3]. Cellular communication technology has become very important for Indonesian people both in rural and urban areas. The importance of cellular communication requires operators to improve the quality of good service and quality [4]. But in reality it was found that the suburbs (rural areas) were not well served.

Nowadays, many Onggari villagers already have a handphone but cannot communicate properly, because the quality of the received handphone signal is very poor, this is due to the distance of Onggari Village to the nearest BTS located in Kumbe Village quite far around 28.8 km, causing a weakening handphone signal (only 1 Barr is obtained on HP signal) in Onggari village. Distance of Onggari Village to BTS in Kumbe Village can be seen in Figure 1.

Based on these problem, it is necessary to installation of handphone signal booster antenna, which operate at 900 MHz frequency [5] in the Onggari village hall, as a supporter of community activities, especially those related to telecommunications needs.
Figure 1. Distance of Onggari village to the nearest BTS in Kumbe village. (Source: Google Maps)

2. Implementasi Methods and Models
2.1. Method of implementation
The main target of the implementation of this program is the installation of handphone signal booster antenna to support the community activities of Onggari village, especially related to telecommunications needs using mobile phones (voice and SMS). Research methods can be seen in Figure 2.

Figure 2. Flow method of implementation.
2.2. Antenna Model
Installation of signal booster antenna in Onggari village, using yagi antenna 13 elements as signal receiver from BTS [6][7], can be seen in figure 3. The antenna is mounted at a height of 4 meters from the ground. Repeater are placed inside the Onggari village hall building, with a height of 2 meters from the ground surface, the Installation of HP Signal Booster Antennas (GSM) can be seen in Figure 4.

To activate the repeater, connect the repeater adapter to a 220 Volt voltage source, then the repeater (Barr) signal light will be on. Barr on the repeater shows the signal quality, the best quality is 5 Barr and the signal quality on the HP 4 Barr (full Barr), the sound received and sent is very clear when we communicate using a handphone. If the repeater lamp (Barr) blinks, indicating the quality of the received HP signal is still poor, it is necessary to adjust the position of the yagi antenna must point to the BTS (Base Transceiver Station) or the position of the Yagi antenna and the BTS must be Line of Side (LOS)[8].

![Figure 3. Yagi antenna 13 elements](image3.jpg)

![Figure 4. Installation of handphone signal booster antenna (GSM)](image4.jpg)

3. Measurement Results and Analysis results
3.1. Measurement Results before the antenna is attached
Before installing the HP signal booster antenna at Onggari Village Hall, the measurement results of the HP signal quality are very poor, namely 1 Barr, we can still receive calls and make calls using handphone, with very poor sound quality (the sound is not heard clearly), can be seen in Figure 5.

![Figure 5. Measurement Results](image5.jpg)
Figure 5. The quality of the HP1 Barr signal before installation the signal booster antenna

3.2. Measurement Results after antenna is attached
After signal booster antennas was installed, measurements were carried out in the room of the Onggari village hall. There are two methods of measurement, namely the quality of the received HP signal (Barr) and the measurement of the received signal strength (- dBm) using the Net Analyzer application with variations in the distance between the HP to the repeater which are 1 meter to 6 meters. Measurements are also taken when the weather is sunny and the weather is rainy. Results Measurement of the quality and signal strength received by HP can be seen in table 1.

3.2.1. HP signal quality measurement results
The measurement results of the HP signal quality received after mounting the signal booster antenna are very satisfying. Because the quality of the signal received on the handphone screen shows an increase in the signal to 4 Barr, with the distance of the cell phone to the repeater which is 1 meter to 5 meters. The measurement results can be seen in Figure 6.

Figure 6. The quality of the HP 4 Barr signal after installation the signal booster antenna

3.2.2. Results of measurement of HP signal strength using the Net Analyzer Application
The Net Analyzer application is installed on the cell phone which will be used to measure the signal strength received by HP. The measurement of the signal strength received by HP at a distance of 1 meter from the repeater is -75 dBm, very satisfying (the sound can be heard clearly). The measurement results in graphical form can be seen in Figure 7.

Table 1. Results of Measurement of Quality and Signal Strength that HP receives

| Distance from HP to Repeater (meters) | Sunny weather | Rainy weather |
|--------------------------------------|---------------|---------------|
|                                      | Signal quality (Barr) | Signal strength (-dBm) | Sound quality | Signal quality (Barr) | Signal strength (-dBm) | Sound quality |
| 1                                    | 4              | 75            | Very good      | 4              | 79            | Very good      |
| 2                                    | 4              | 76            | Very good      | 4              | 81            | Very good      |
| 3                                    | 4              | 79            | Very good      | 4              | 87            | Very good      |
| 4                                    | 4              | 82            | Very good      | 3              | 90            | Good           |
| 5                                    | 4              | 85            | Very good      | 2              | 95            | Not good       |
| 6                                    | 3              | 88            | Good           | 1              | 101           | Bad            |
Figure 7. Comparison graph of the signal strength received by HP when the weather is sunny and rainy

4. Comparative analysis

Based on Table 1 the results of the strong signal and the quality of the signal received by HP are:

The farther the distance of the repeater to the receiver (HP), the smaller the signal strength and the quality of the received signal, for example at a distance of 1 meter signal strength -75 dBm, the quality of the 4 Barr signal and the quality of the sound received and sent is very good (clearly audible), when the distance is 6 meters signal strength -88 dBm, signal quality is 3 Barr, the sound quality received and sent is good.

The results of the measurement of signal strength and signal quality received by HP when the weather is sunny is better than rainy weather, for example at a distance of 6 meters the signal strength is -88 dBm, signal quality is 3 Barr and sound quality is good, As for rainy weather At a distance of 6 meters, signal strength is -101 dBm, signal quality is 1 Barr and the quality of the received and sent sound is very poor (the sound received and sent is not heard clearly).

5. Conclusions

Yagi Antenna 13 elements that function as receivers of signals from BTS can work well, because by using a yagi antenna that is connected to a repeater can strengthen the signal 1 Barr to 4 Barr.

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The results of the measurement of signal strength and signal quality received by HP when the weather is sunny is better than rainy weather.
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