IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 4, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 4, April 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1204095 |

Mobile Network Booster

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ABSTRACT: The major objective of the mobile signal booster is to enhance the reach of the signal to remote areas such as regions with thick walls, hilly terrains etc. The function of the mobile phone signal booster is to take an existing cell signal, typically found outside your home, office or vehicle, amplify the signal and then broadcast it to an area which has weak or no signal. A mobile phone signal enhancer system consists of an external antenna, a signal boosting amplifier unit and an internal antenna, with cables connecting all of the components. A GSM mobile phone signal booster basically consists of a bidirectional amplifier created to boost weak cell phone signals in remote or hard-to-reach areas. The purpose of boosting signals is to promote clearer reception for cellular phone users in difficult locations. It is meant to solve the problem of bad network in offices, camps, recreational centers, homes and in vehicles. The device brings improved network signal to a relatively poor network area. This work intends to develop a device which can provide users with relatively high signal strength in a poor network area and at a lower cost. This is done in order to provide them with seamless, uninterrupted and reliable communication and in the final analysis, make GSM network available everywhere irrespective of height, terrain and location. To effect this, three major components are utilized, they include: an external antenna to capture the weak signal, a signal amplifier to boost the captured signal and an internal antenna to redistribute the signal for users around the area where enhanced signal is required.

KEYWORDS: Amplifier, Antenna, Base Station, GSM, Mobile Phones and Signal Booster

I. INTRODUCTION

The Network Booster Circuit basically helps the service provider to rectify the poor signal service. It can be operated according to the user's convenience and requirement. This cellular repeater is economical as all the components used are of low cost and hence total cost has been integrated. It is user-friendly and ecofriendly. These are similar to the cellular broadcast towers used by the network providers for broadcasting, but are much smaller in size and are recommended to use for a particular building only. Modern cellular repeater amplifiers rebroadcast cellular signals inside the building. The systems usually use an external directional antenna to collect the best cellular signal, which is then transmitted to an amplifier unit which amplifies the signal, and retransmits it locally, providing significantly improved signal strength. The GSM mobile phone signal booster is a bidirectional amplifier created to boost weak cell phone signals in remote or hard-to-reach areas. It is a system, which takes mobile phone signal from one area where the signal is active, and repeats (or amplifies) it to an area where the signal is poor. The purpose of boosting signals is to promote clearer reception for cellular phones users in difficult locations [6]. In order for GSM services to be made available everywhere to subscribers with GSM compliant phones, antennas are mounted on masts so that they can transmit and receive radio waves. Radio base stations are sites that enable mobile phones to work. It is composed of several antennas mounted on towers with electronics in it at the base. They can equally be mounted on existing building, rooftops etc. Without base stations, mobile phones will not work. As mobile phone users move away from these base stations, the radio signal also weakens. This is where the need for a signal booster became necessary. The radio link must be made available so that mobile phones can connect to it for the purpose of making calls and harnessing other data services. It is meant to solve the problem of bad network in offices, homes, schools, camps, hospitals, stadiums, rural areas and in vehicles on transit. The device brings improved network capability to relatively poor network areas. Many things contribute to poor network signals, among them are: i. The concentration of commercial centers and houses in most rural locations are too low. It is unlikely that the service provider will do anything to improve reception, due to the high cost of erecting a new tower. ii. Attenuation, a process that leads to weakening of signal strength increases when they come in contact with lead used for roofing material, thick concrete, energy efficient windows and metal window. iii. Urban areas, which usually have strong cellular signals throughout, often experience dead zones caused by destructive interference of waves which have taken different paths caused by the

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signal bouncing off buildings. This is referred to as Multipath interference. iv. The longer wavelengths have the advantage of being able to diffract to a greater degree, so are less reliant on line of sight to obtain a good signal, but still attenuate significantly [7]. It is no longer news that GSM subscribers have occasional trouble with their services, such as dropped calls or no service which can inevitably lead to loss of useful calls, loss of lives and business opportunities. Rural dwellers, travelers, campers and drivers sometimes find it difficult to make calls due to obstructions posed by mountains, hills, valleys, foliage and other natural obstructions. The result is slower data speeds and connectivity problems. These problems are properly addressed using a mobile phone signal booster. Installing a signal booster will help to maximize cellular phone customer satisfaction. The device consists of an external antenna which serves to capture the low signal from a base station. The amplifier then repeats or boosts the signal and transfers it to an internal antenna. The internal antenna takes the repeated signal and redistributes it so the mobile phones in the vicinity can make calls and explore other data services. In this development, a weak signal (not a stronger signal, is amplified). More often than not, the external antenna is placed in an area particularly in the direction or line of sight with a base station. This work also delved into areas having a significant relevance on the GSM evolving trends and architecture bearing in mind that the entire field of telecommunication is dynamic.

II. RELATED WORKS

2.1 The Design and Construction of Wi-Fi Antenna Booster. The research work introduced a new design to a device which can provide Wi-Fi users with high signal strength and at a lower cost in order to enable them have a seamless, uninterrupted and reliable communication. To implement this, a biquad antenna, a booster circuit and a USB connector were constructed and a Wi-Fi booster system was formed by interconnecting these three circuits together [2]. The project was aimed at designing and constructing a device which will trap and boost received wireless signals. It is known that wireless devices that receive and transmit wireless signals such as wireless cards, routers, access points etc already exists. In fact Wi-Fi antenna boosters also exist. The devices, according to the researcher have their limitations: i. The wireless signal antennas in a laptop computer are enclosed in the laptop case. This enclosure leads to a bad reception. ii. The wireless network cards that come inbuilt in laptops, routers, or access points have limited power and range. The solution then lies in getting a wireless card with higher power or attaching an antenna booster to the computer. The function of the Biquad was to receive signals; these signals were then sent to the booster for amplification. After amplification the signals passed through to the USB connector circuit which is plugged into a computer. Using software to analyze the throughput and signal strength showed a repeated 12dB gain. Further test showed that signals which could not be captured by the in-built wireless card of a computer system were captured with this device. The researcher defined the antenna booster as a device which is designed to amplify reception or received signals so that a marginal signal can be utilized. According to him, the way the antenna booster works is that it expands the area of the antenna, allowing it to pick up more of a weak signal and then translate it into a stronger signal for the device that the antenna is attached to. Antenna boosters can be used to improve radio signals in any frequency band be it the Very Low Frequency (VLF) band or the Extremely High Frequency (ELF) band. The researcher also opined that the booster finds suitable application in many areas which include but are not limited to the following areas: Cell phones: Areas which have poor network coverage require a signal booster (also called an antenna booster or an antenna amplifier). Although it is difficult to attach an antenna booster to a cell phone without making the phone hard to use, an antenna booster works effectively for cell phones (This is the focus of this work). Television sets: This also requires an antenna booster for us to be able to receive a variety of channels. Depending on the kind of television, the dipole or half-dipole (also known as rabbit ears antenna) which comes with the television is often not used these days by consumers of electronic products. Boosting of Wi-Fi (Wireless Fidelity) signals: Wi-Fi is a popular technology that allows an electronic device to exchange data wirelessly (using radio waves) over a computer network, including high-speed Internet connections. For instance devices such as a personal computer, video game console, smart phone, tablet, or digital audio player some of which do not have an Ethernet port, most of the times the signals present are not strong enough, in such cases an antenna booster will do [2]. Satellite communication: This uses a form of Low Noise Amplifiers (LNA). Here an LNA having a very low noise figure is required. He concluded by making it clear that the Wi-Fi booster system was able to trap wireless signals through the biquad antenna which has a gain of 12dBi and was amplified by the booster resulting in an overall gain of 24dBi. 2.2 In-Car Cellular Signal Boosters A white paper Prepared for Wilson Electronics and delivered by Andrew M. Seybold, CEO and Principal Consultant at Robert P. O'Hara Partner, in July 2010 (7) explained the problems that may be encountered while designing an In-Car Cellular Signal Boosters: "Cars with their metal bodies do a great job of blocking radio waves. Thus dropped and missed calls or slow data rates are all too common. The solution to this problem is to boost or amplify the signal between the phone and the cell site. An in-car or mobile cellular signal booster consists of two components: a booster that is placed inside the car (perhaps incorporated into a cradle for the cell phone) and an antenna that is placed outside of the car. The

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booster amplifies both the signal that the phone receives from the cell site and the signal the phone transmits to the cell site. Thus the phone always has a strong signal (more "bars") and dropped calls are virtually eliminated" [7]. The white paper spelt out problems to overcome in the design of a booster. They include: i. Oscillation due to feedback must be avoided. If the external antenna is placed too close to the in-car cradle (which has its own internal antenna), oscillation due to feedback can occur, similar to when a microphone is placed too close to the speaker of a public address system and a howling whine comes out of the speakers. In a cell phone booster, feedback oscillation causes the system to generate noise that can interfere with nearby cell sites' ability to receive signals from other cell phones, causing disruption of service to other users. ii. Overload of the cell site with which the phone is communicating must be prevented. When you are far from the nearest cell site, the booster needs to transmit at the maximum allowable power. If you then drive close to the cell site, it must appropriately adjust itself so as not to overwhelm the cell site and to avoid any type of network overload or potential interference. iii. Interference to adjacent cell sites must not occur. A more subtle variation of the previous problem occurs when your cell phone is communicating with a distant cell site, but there is another cell site (operated by a different provider) close by. If the booster transmits a strong signal in order to reach the distant site, it could potentially interfere with the nearby cell site. This must not happen. The solution proffered by Wilson Electronics include: i. Avoiding oscillation due to feedback. If the external antenna is placed too close to the in-car cradle (which has its own internal antenna), oscillation due to feedback could occur similar to when a microphone is placed too close to the speaker of a public address system and a howling whine comes out of the speakers. ii. Preventing overload of the cell site with which the phone is communicating. When you are far from the nearest cell site, the booster needs to transmit at the maximum allowable power. If you then drive close to the cell site, it must appropriately adjust itself so as not to overwhelm the cell site. Avoiding interference to adjacent cell sites. A more subtle variation of the above occurs when your cell phone is communicating with a distant cell site, but there is another cell site (operated by a different service provider) close by. There is a possibility that the booster could cause interference to the other network operators' cell site. If the booster transmits a strong signal in order to reach the distant site, it could potentially interfere with the nearby cell site [7]. Thus a booster must be designed to avoid transmitting broadband noise that would cause a problem to nearby cell sites. 1. Dead Zone: A mobile phone signal (or reception) is the signal strength (measured in dBm) received by the mobile phone from the cellular network (on the down link). Depending on various factors, such as proximity to a tower, obstructions such as buildings or trees, etc., the signal strength will vary. Most mobile devices use a set of bars of increasing height to display the approximate strength of the received signal to the mobile phone user. Areas where mobile phones cannot transmit to a nearby mobile site, base station, or repeaters are known as dead zones. In these areas, the mobile phone is said to be in a state of outage. Dead zones are usually areas where mobile phone service is not available because the signal between the handset and mobile site antennas is blocked or severely reduced, usually by hilly terrain, dense foliage, or physical distance. A number of factors can create dead zones, which may exist even in locations in which a wireless carrier offers coverage, due to limitations in cellular network architecture (the locations of antennas), limited network density, interference with other mobile sites, and topography. Since cell phones rely radio waves, which travel though the air and are easily attenuated (particularly at higher frequencies), mobile phones may be unreliable at times. Like other radio transmissions, mobile phone calls can be interrupted by large buildings, terrain, trees, or other objects between the phone and the nearest base station. 2. Antenna: The following antennas are most suitable for mobile communication: I. Directional and Omnidirectional GSM antennas will be either directional or omnidirectional. Omni-directional antennas, also known as helical antennas, can receive signals from any direction. Directional antennas usually have more gain, that is, more sensitivity to signal, than omnidirectional antennas. Directional antennas accomplish this greater sensitivity because they are able to focus their energy patterns onto a smaller area than omnidirectional antennas. However, to receive signal, directional antennas must be pointed in the specific direction from which the signal is emanating. I. Monopole Antennas Monopole antennas consist of a small pole placed upon a planar piece of metal or a series of wires radiated out from the pole. Monopole antennas are omni-directional in nature and have equal gain in all directions so that we can use it outdoor. II. Yagi-Uda Antennas Yagi-Uda antennas, more often referred to simply as Yagi antennas, are directional antennas made up of a dipole element, a reflector dish and one or more director elements. Yagi antennas are much more complicated in design than most other types of GSM antennas. III. MULTIBAND ANTENNAS Multiband antennas can also be used to pick up GSM signals. They are able to pick up many sorts of different signals, including the GSM frequency, which is usually the 800 MHz or 1900 MHz bands. Multiband antennas can come in many different models. Tri-band antennas can be tuned to pick up three different bands, while duo-band antennas can pick up two different bands. B. Description The major advantage of this system is that it enhances the applicability of mobile phones. Although mobile phones have got greater reach in today's world, the lack of cell phone signal still remains its major short coming. This Signal enhancer circuit will be useful in overcoming this demerit. In times of disasters, the cell phone signals become very weak. This system would enable communication even in times of crisis. CELL REPEATER A cell repeater can also help in boosting reception. Made up of a few more parts than a femto cell, a cell repeater includes an antenna, an amplifier, and a coaxial cable that connects them. The antenna is placed either outside

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|| Volume 12, Issue 4, April 2024 ||

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your building or on a window and then you can string the coaxial cable to the most convenient spot to place the amplifier. Some cell repeaters include an additional indoor antenna, but many of them integrate that into the amplifier.

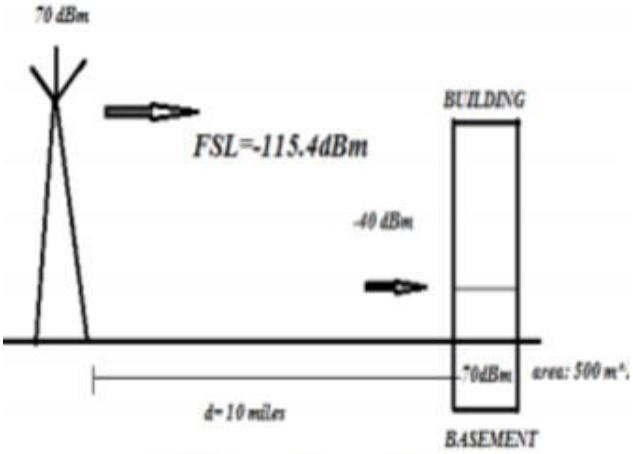

Fig1. Signal without enhancer

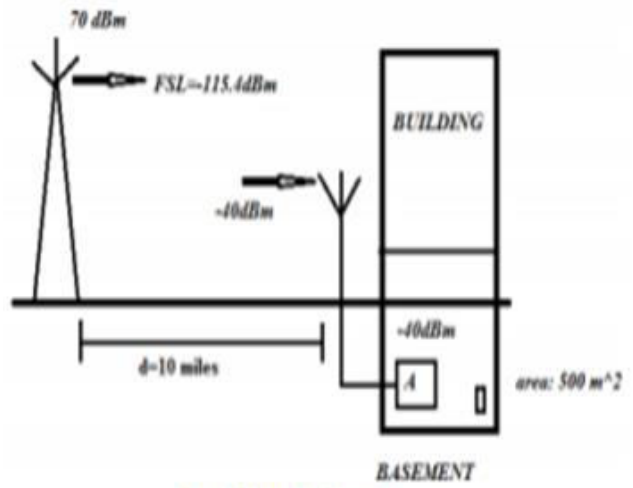

Fig2. Signal with enhancer

III. RESULTS AND DISCUSSION

The main aim is to increase the strength of signal by designing a network booster circuit and analyze the performance to improve the signal strength. To overcome drawbacks of existing technology such as: The High Cost of booster Antennas available in the markets. The booster antennas available in markets costs very high in dollars and are easily available in foreign countries. This adds to the cost of travelling or shipping the product to the user destination. The reduced Mobile Signal Strength for long distance. This aims at increasing the number of access points but inspite of these there are some locations where the range is not available because of which we receive weaker signal strength. We analyzed from our observations that signal can be enhanced in low coverage areas with the help of these boosters. We have observed the amplifications of Mobile Signal when booster is ON and OFF. Hence, practically also proved the importance of repeater in enhancing the signal. Finally, we conclude by saying that repeaters can improve the signal strength in low signal coverage areas to such an extent that everyone can receive signals without having any disturbances. Measuring the signal strength of a particular GSM service provider is not as simple as just viewing the number of service bars produced by a mobile phone network signal. There are two ways of measuring mobile signal on a cell phone. They include: i. Using the signal bars on your mobile device: The signal bars on your mobile device will offer a very basic interpretation of the mobile signal and also the signal quality. Each phone manufacturer calculates

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how many bars to display differently (see figure 9 below). The signal bars do not always mean you can make a call. It is possible to have signal bars and not be able to place a call due to network congestion. The bars on your phone are a representation of both signal strength and the quality of the signal. iPhone-iOS 7 takes into account the signal strength, signal quality and also the number of people using the base station to determine how many bars are displayed

IV. CONCLUSION

This paper aimed at designing and constructing GSM signal booster had the singular purpose of enhancing the signal level of most cells phones in a particular vicinity so as to make it easier for the mobile phones to make and receive calls without much hitch. The signal booster system was able to trap wireless signals through the antenna and amplify it resulting in an overall gain. This is to make GSM network available to everyone irrespective of height, terrain and location and in the long term facilitates business activities in small, medium as well as large scale enterprises in villages and cities and to take the radio link available in Base stations to areas where they are highly needed in order to make calls and use data in all terrains where mobile phones are used. With the GSM mobile booster device, users can now enjoy a seamless, uninterrupted and reliable data communication. They can also obtain/enjoy stronger signal strengths across longer ranges. This booster design is new and made from local components which are affordable.

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