Automated Alignment of Microwave Antenna of Base Transceiver Station by Utilizing Hybrid Sources

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Abstract: This technical paper illustrates the concept of automatic alignment of microwave antenna of base transceiver station using renewable or hybrid energy sources. In getting desired LOS of microwave antenna, electromagnetic rays show hazardous effect on rigger. Telecom or GSM operators can implement this document in telecom field, an automated microwave antenna can align itself without human intervention and can get desired LOS. The RFS antenna designer company has been working for making an auto adjustable antenna since September 2013 by using 3 robots and dedicated machines based on CNC spinning, central punching and automatic reverting process's [1]. This paper depicts the auto alignment of MW antenna using a renewable source (vertical axis wind turbine) for generating sufficient power for antenna alignment and with lithium –ion battery for storage purpose.

Keywords- *vertical axis wind turbine, parameters of microwave antenna, The Path Align-R™*

I. INTRODUCTION

In mobile communication, antenna is the main part which converts the electronic signals into Electromagnetic waves. Classification of antenna depends upon some factors such as Frequency, Apertures, Polarization; Radiation .Different types of antennas based on frequency are (1).VLF antenna (2) LF antenna (3).HF antenna (4).VHF antennas (5) Microwave antenna [10]. Antenna can be directional, omni directional, highly directional [11]. For better communication the main thing is to install a microwave point to point link having proper directional antenna system. Any misalignment of microwave antenna will terminate the whole operation and parameters i.e link budget and reliability will be decreased or affected. Microwave antenna is a major system component which transmits a desired frequency and wavelength of signal from radome (radar +dome) to make proper line of sight and optimal link performance with another base station. The alignment of microwave antenna can be done by manual (rigger) and automatically (rcx robotics). But manually alignment method is not reliable, so automatically method is preferred over that. Several steps are involved in the process of antenna alignment in a microwave communications system like .Azimuthal, transmission path, RSL (received signal level), SNR, Side lobe to main lobe response. Once the parameters are established, the antenna is elevated for optimum elevation and maximum response is obtained.

II. LITERATURE SURVEY

[1] Exalt Communications

This paper focus on alignment of antennas used in terrestrial microwave radio systems by using different techniques. Installation professionals can use this idea for antenna alignment. Pre-alignment or coarse-tuning and final alignment or fine-tuning are two phases for alignment of antenna pair for a terrestrial microwave radio system. In Pre-alignment phase, setting of antenna is done before the installation and/or turn-on of the radio electronics. After pre-alignment phase, all steps are completed for alignment after the radio electronics have been installed and turned on, which comes in final alignment phase. Misalignment causes the lower system gain which directly affects the availability of the microwave link.

[2] Hassan, Ahmad Kamal Hoque , Ahsanul (2011)

In this paper, the solution for microwave antenna alignment has discussed for some applications like point to point links with small wavelength to maximize the network availability at all times by means of an automation system and modeled loop antennas. Automated alignment of antennas allows its subscribers to communicate without a break. An automated antenna alignment can decrease the down time and ensure a reliable communication between the near ends and far end terminals of the Base Transceiver Station (BTS). In this paper Lab VIEW design and RCX Robotics Kit is used so that the system can work autonomously. Interference reduction is examined by making use of deep nulls between two nodes.

[3] Chaitali Ingale, Trupti Ingale, Anand Trikolikar (2013)

In this paper, the function of microwave antenna is defined. Basically microwave antenna which is operated at microwave frequency to transmit and receive the data from other microwave sites. Televisions and telephone communications are the applications of microwave antenna. This paper represents the different types of antenna and its applications in wireless communication.

III. PROBLEM FORMULATION

- Misalignment of microwave antennas causes the gradually decreases the system gain. Because of this subscribers have to face many problems while communicating.
- HAWTs (horizontal axis wind turbines) are less efficient as compare to VAWTs (vertical axis wind turbines).
- Non-renewable resources for power generation required to maintain line of sight of microwave antennas is less reliable as compared to Renewable resources like windmill.
- Lack of power storage system (required for alignment of antennas).

IV. PROPOSED METHOD

The purpose of this paper is to make auto adjustable microwave antenna which will work on renewable or hybrid power source. This can be done by designing an automated MW alignment system in which a transceiver receives a certain RSL at Far End station. A closed loop system makes the basis of Logic for Microprocessor [2]. Assuming that design parameters are set at -45dBm, so if the received RSL is in this range, it will consider the antennas to be in their appropriate directions else alignment will start. In wireless system due to natural sources and other users, Interference occurs [11]. Discrimination characteristic of antenna reduces the interference and align itself to the line of sight [2]. It is ensured by manufacturer that the Lithium ion batteries have life time approximate 5 years if it is used properly [6]. In these batteries, there is no need of memory and scheduled cycling to extend the battery's life [10].Yaw mechanism is not required while using VAWTs (vertical axis wind turbines). They can tolerate if wind speed is greater than 64 mph; there is no need to shut down [8].

(a) **Block diagram-**

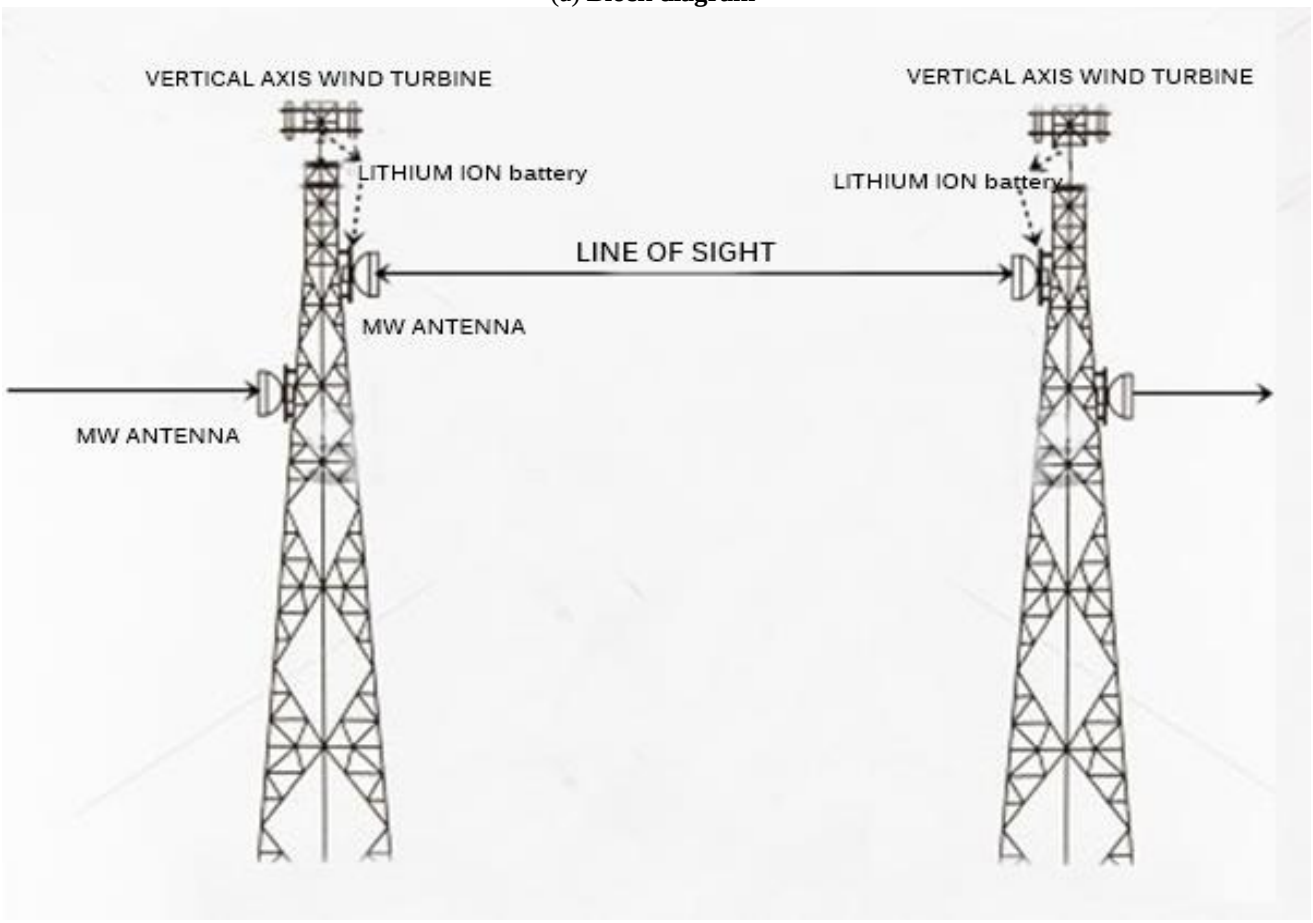


Fig.1. Proposed diagram

(b) Formula used

Radio signals generally losses his strength continually with distance. This gradual loss or reduction of Signal Power as the signal propagates from one BTS transmitting tower to another, as the distance increases is called Propagation Path Loss. In general Path Loss (Lp) is expressed as:

Lp = transmitted power/received power

Which in decibel (dB) is: Lp [db] =10 log [pt/pr] db [3]

Received Power: Pr (dBm) = Pt (dBm) – Ap (dB)

= Pt (dB) + Gt (dB) + Gr (dB) – Lp (dB)

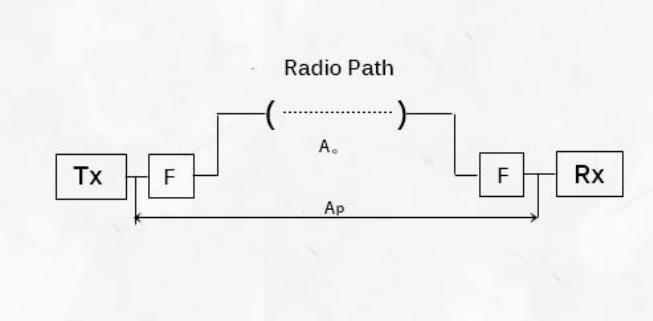


Fig.2. System assessment [3]

Signal to noise ratio (SNR) =Sv–Ap [3.2]

Where SNR = Signal to Noise Ratio in the Top channel of the Radio equipment, Sv = System Value, Ap = Transmission Path Loss (TPL)

Fresnel zone In microwave engineering, the radius of the first Fresnel zone is the parameter used to establish appropriate clearance of the link from different types of obstacles. The required formula to calculate the radius of the nth Fresnel zone is

$$R_n = \sqrt{n\lambda \frac{d_1 d_2}{d_1 + d_2}}$$ [4]

Assumed that Rn<<d1and Rn<<d2

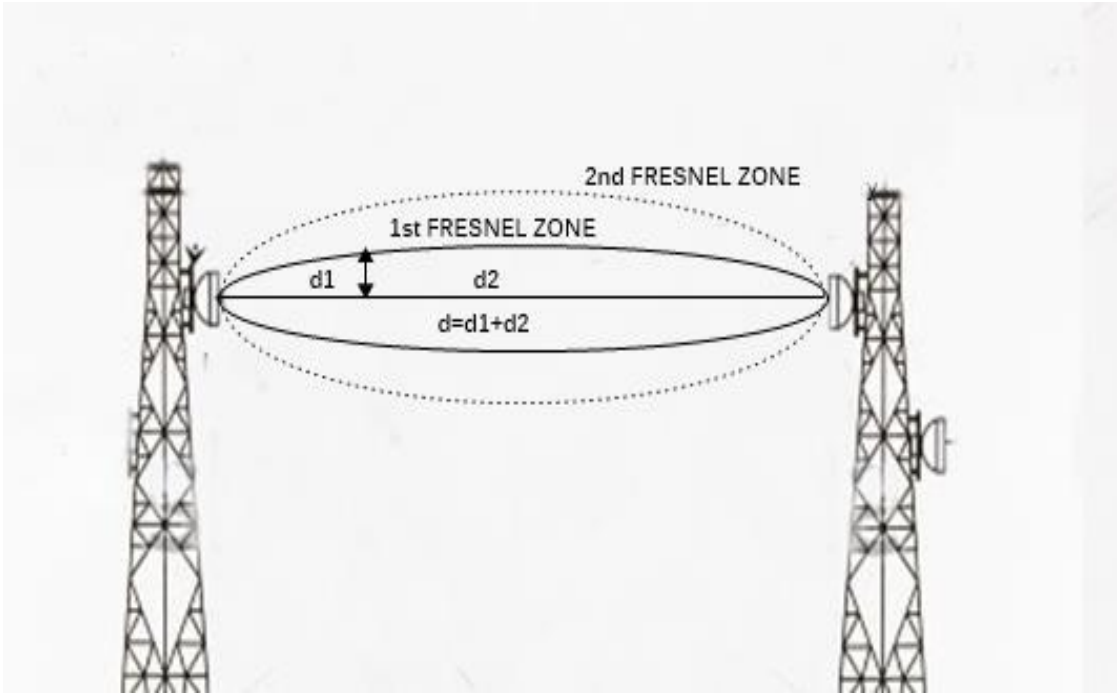
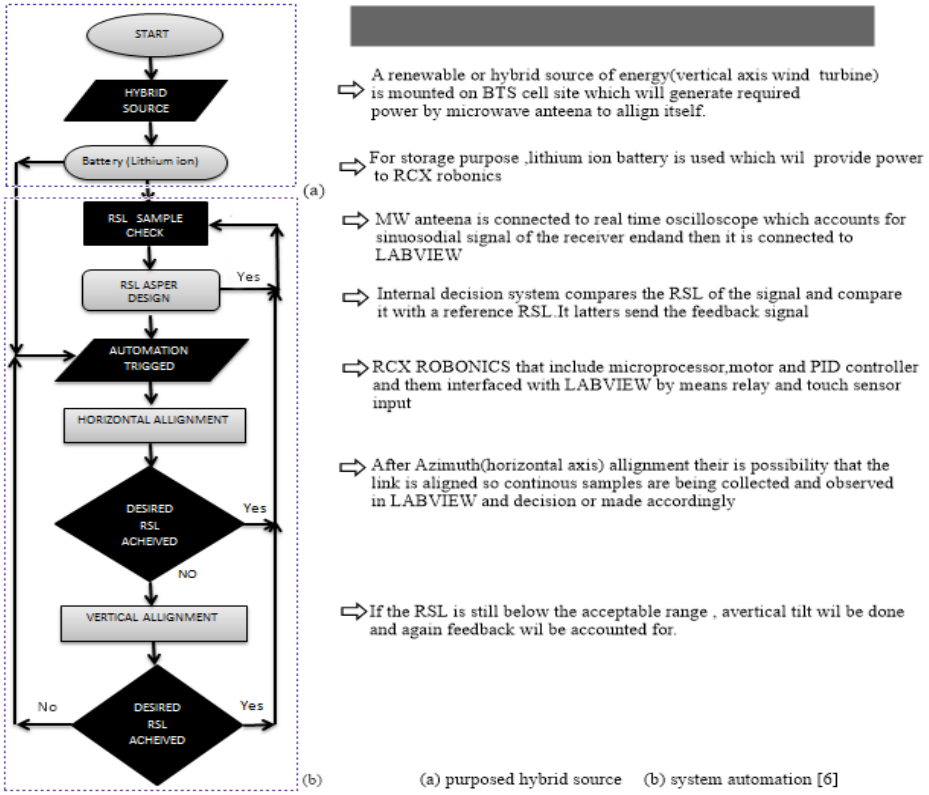


Fig.3. Fresnal zone [4]



(a) purposed hybrid source (b) system automation [6]

The Path Align-R™- Is designed equipment used to quickly and accurately optimize the transmission path between to microwave antennas. This equipment has tunable operating bands 1.5 to 19.4GHZ (2200) or 1.5to 23.5GHZ (2000 or 2241), path loss displayed in db [5].The battery powered path Align R™ robotics is specially design to quickly and accurately optimize the transmission path between two cell sites, for example table lists the 2200 microwave test specification.

Transmission	Full Duplex
Transmitted output power(dbm)	O nominal
Transmitter stability (%)	0.005
Tunable Operating Bands Band 1 Band 2 Band 3 Band 4	 1.8 to 2.5 5.8 to 6.6 11.0 to 12.0 18.1 to 19.4
Modulation (1KHZ voice tone)	FM
Transmit/receive Offset MHZ	39
Receiver Sensitivity(dbm)	-100 nominal
Receiver bandwidth (khz)	100 nominal
Receiver readout resolution(db)	0.1
Operation temperature(Celsius)	-10 to +40
Input power	VWAT turbine and rechargeable lithium ion battery

TABLE 1: Specifications of microwave antenna 2200 self-align [7]

V. CONCLUSION AND FUTURE WORK

In this paper we have discussed about the automated microwave antenna alignment. Automated microwave antenna works without human interference as a result to reduce the down time. It provides reliable communication between different BTS (base transceiver station). The power required for alignment can be generated by using renewable resources like windmill. .VWAT turbines are preferred over HWATs turbines because it overcomes all the limitations of HWATs turbines**.** Storage system can be used to store the generated power which is required for alignment of microwave antenna like lithium based batteries.

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