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| Research Article

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Development of Coplanar Microstrip Antenna for Use in ITS Nad GPS Applications

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Annotation
The goal of this paper is to create a modern, low-profile, coplanar, flexible microstrip antenna that can be used in smart transportation systems and global positioning systems. There is power coming from the middle of the ring -square filled patch antenna, and it is linked in a straight line. These two antennas are put together to make the utility antenna. The utility antenna is made by putting these two antennas together. The linked square-ring patch antenna is an example of a coplanar basic single-fed method. This antenna works with the GPS L2 frequency of 1.300 GHz in basic mode and has circle polarization on the right side. This strategy is being thought about inside the antenna building. The square-ring is an extra part that gives the center-fed square patch antenna vertical linear polarization in TM mode for ITS uses. This causes the resistance bandwidth to grow by a large amount. It turns out that the radiation patterns and the return loss match up very well between the modeling and the test.

Keywords: square-ring, multi-functional , microstrip antennas, Dual polarization

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INTRODUCTION:

The fast growth of wireless communication networks has made a wide variety of services necessary in today's world. These services have been combined with one another so that they may work together . To achieve enhance the utility efficiency of the constrained spectrum and geographical resources, it is essential to use the same antenna for a variety of services. This is due to the fact that we have a limited amount of resources. Because the requirements differ depending on the application, it is not practical to use typical single-fed multiband antennas. These requirements include a range of radiation and polarization performances. As a consequence, the multifunctional antenna, which has a variety of radiation properties, has become a more and more crucial feature Considerations for antenna designers. Vehicles with one multifunctional antenna are one example. This antenna provides omni-azimuthal radiation for terrestrial mobile communication and broadside circularly polarized satellite location. Both designs aim to locate the satellite. This is because many terrestrial wireless communication applications need position-based or vehicle-location data. GPS may be used to exploit this circumstance[1][2][3].

The purpose of intelligent transportation systems (ITS) is to improve the safety of transportation and reduce the negative impact that transportation has on the environment. This is accomplished via the use of traveling information in the process of moving vehicles across highways. The frequency band of 6.2 GHz has been authorized for ITS-dedicated range- short communication service in both China and the United States, with each country having its own allotment of this frequency band. 4G high-performance unlicensed mobile technology that operates in the 6.580–6.836 GHz band Worldwide Interoperability for Microwave Access (WiMAX) has been taken into consideration as a potential contender for use in Intelligent Transportation Systems (ITS) in the United Kingdom[4][5]. WiMAX is a technology that operates in the band. As was mentioned before, GPS is often implemented in order to function in combination with the terrestrial traffic information system (ITS) service. In addition, in order to fulfill the requirements of the rules for communication, the time synchronization that is gathered by GPS is required in order to provide ITS services[6][7]. Because of this, the automobile sector needs solutions that are not only small but also capable of great performance and low cost. For these systems to be effective, they need to be able to provide GPS and ITS services while simultaneously mounting on the roof of a vehicle with the least amount of space feasible. It has been proved that a collocated dual-feed microstrip antenna that is capable of combined GPS and ITS operation may be used. On the other hand, the implementation of the four-layer structure is difficult due to its enormous size and poor impedance matching in comparison to other structures [8][9]

Materials and Methods

DESIGN OF THE ANTENNA:

Figure 1 shows the antenna that is utilized for both GPS and ITS at the same time. This antenna was suggested based on the fundamental geometry of the antenna. Another requirement is that a vertical polarized omnidirectional pattern at the same time. These two frequencies are found together in a frequency band. The two radiators that made up the majority of the In addition, in order to fulfill the requirements of the rules for communication, the time synchronization that is gathered by GPS is required in order to provide ITS services. Because of this, the automobile sector needs solutions that are not only small but also capable of great performance and low cost. For these systems to be effective, they need to be able to provide GPS and ITS services while simultaneously mounting on the roof of a vehicle with the least amount of space feasible.

Results and Discussion

It has been proved that a collocated dual-feed microstrip antenna that is capable of combined GPS and ITS operation may be used. On the other hand, the implementation of the four-layer structure is difficult due to its enormous size and poor impedance matching in comparison to other structures., it has a distinct method of eating. A single-fed approach is often used to create a circular polarization wave[10][11] [12]

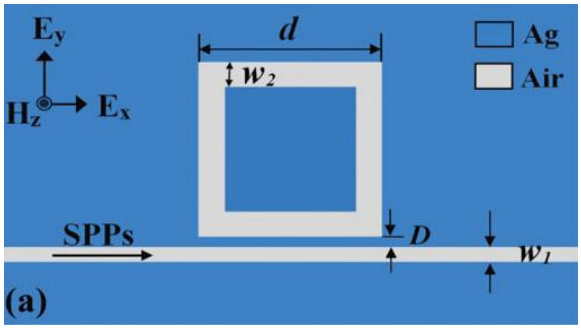

Fig 1. Proposed GPS/ITS combined antenna geometry.

in order to activate two nearly degenerate resonant modes that are produced by catting the edge of the patch antenna or by introducing symmetrical perturbation strips into a feeding configuration or with the idea of attaining the aforementioned aim.

The author of this paper introduces a new coplanar capacitively connected feeding setup with the goal of achieving circular polarization. They are now talking about the reason behind this arrangement. A microstrip line that is parallel and has a short end is employed in order to provide proximity coupling to the radiating outer square ring that is needed for GPS functioning. A microstrip line-coupled directional coupler is a device that may be used to explain the coupling process in a way that is somewhat relevant. Port 1 is responsible for exciting energy on the microstrip line those travels from left to right (the short end). It also induces energy at the radiating square ring that flows from right to left (in the opposite direction of the clock). This is because port 1 is utilized for the operation of the Global Positioning System (GPS). Unlike a traveling-wave mode, this energy flow on the square ring is counterclockwise, and it operates in a manner that is analogous to another mode. In addition to this, it helps to create a right-handed circular polarising effect. It is also possible to make use of the simulated current distributions that were obtained via the usage of the Ansoft High Frequency Structure Simulator (HFSS) described in for the goal of giving an explanation for the CP radiation. In the event that the phase shift occurs, it is possible to see that the greatest currents that are positioned at the azimuth angle rotate in the direction of counterclockwise rotation. This is something that can be observed. On top of that, the currents convert the axis into the axis in a way that is comparable to an.

It is the RHCP wave. By using this single-fed method, which is not only easy but also versatile, it is feasible to generate circular polarization. This approach does not need any alterations to be made to the microstrip radiator, such as slits being added or the corner being truncated.

It is important to have an omnidirectional pattern that is vertically polarized in the azimuth plane in order to facilitate the provision of ITS services. To be more specific, the radiated field is made up of a single component and is always the same as a radiation pattern that is similar to a monopole. There is a possibility that this design will offer enough output that is similar to that of a monopole. On the other hand, Another type of mode is the TM mode, which has a high quality factor number but bad impedance matching. One thing that makes this mode unique is the high-quality factor number. It is planned that the coaxial probe feed will be used for ITS operations. It is situated right in the middle of the inner square patch. This is the spot where the patch is. The upper square ring that was shown earlier is also used to load the center-fed square patch antenna. Each of these steps is meant to improve the impedance matching process.

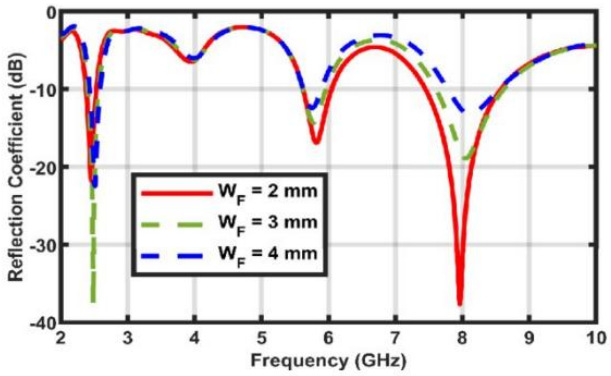

Fig 2. The resistance coefficient that was simulated for the outer square ring with different widths was simulated.

achieving a match between the impedance of the ITS band and the GPS wavelength without having an overwhelming influence on the receiver. When the ITS band is operating in the TM mode, it is conceivable to interpret that the band stimulates both the inner square patch and the outer square ring, which is called dual resonance. This is done so that the goal can be reached. Please read the following to understand why this is happening.. The resonance frequency will

decrease if the width of the slot is decreased. This will occur as a result of the link between the inner square patch and the outside square ring becoming stronger. This will occur because the resonance frequency in the slot will go down. In addition, the antenna's quality factor decreases as a result of coupling, which leads to a wide bandwidth occurring at the same moment. The mechanism that is responsible for the coupling of circular polarization is often classified as a directional coupler. This has been mentioned before. This is the reason why the length of the short-ended microstrip line affects the phase relationship and the coupling factor. Furthermore, Once the impedance matching is done, the short-ended microstrip line's length can be changed to get the right axial ratio for GPS to work. To get the best possible working success, this could be done. When the microstrip line is 70 millimeters long and has a short end, the largest axial ratio that can be reached at 1.357 gigahertz is about 0.41. The most that can be achieved is this number

OUTCOMES OF EVALUATION

A prototype of the antenna was constructed and measured according to the requirements that are shown in Table I. Figure 3 shows a comparison between the estimated values of the axial ratio and the GPS operation and the data that was seen. The findings of the simulation are typically consistent with the observed data. The VSWR

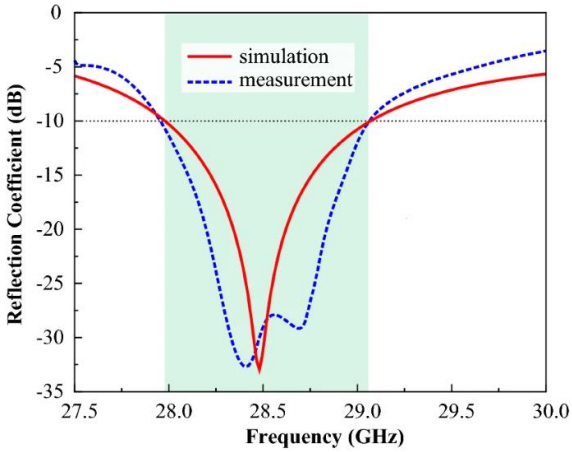

Fig. 3. axial ratio for GSP operation and reflection coefficient measured and estimated.

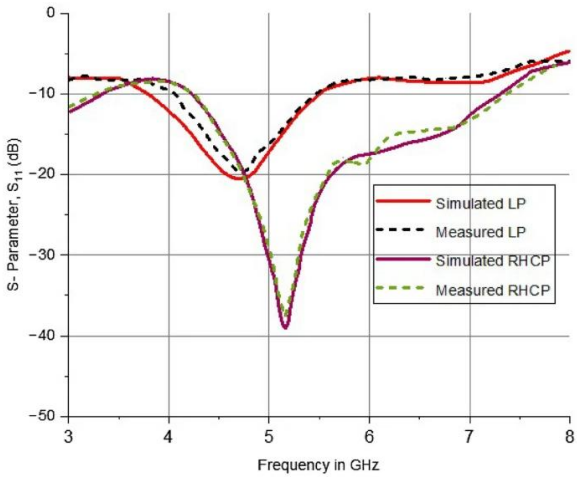

Fig. 4. The antenna's performance study presents S-parameters (S11) for both operational modes.

We tested the system indoors, where there was a non-line of sight (non-LoS) transmission situation and about 30 m of space between the listener and the emitter. We used the Sigfox SDR kit to keep an eye on the data bits we were receiving and record the RSSI quantity of each one. Following the tests, the reference circular antenna got an average RSSI of -44.56 dBm, the reference patch antenna got an average RSSI of -46.56 dBm, and the suggested new IoT antenna

got an average RSSI of -38.56 dBm. Figure 15 shows the changes in RSSI parameters for the standard antennas and the newly built IoT antenna. This shows that the suggested IoT antenna worked the best based on the data.

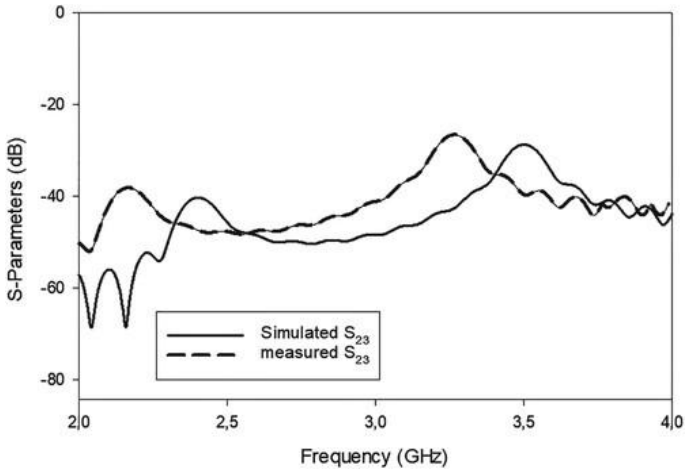

Fig. 5. Tested and proven that the feeding ports for GPS operation and ITS operation are separate.

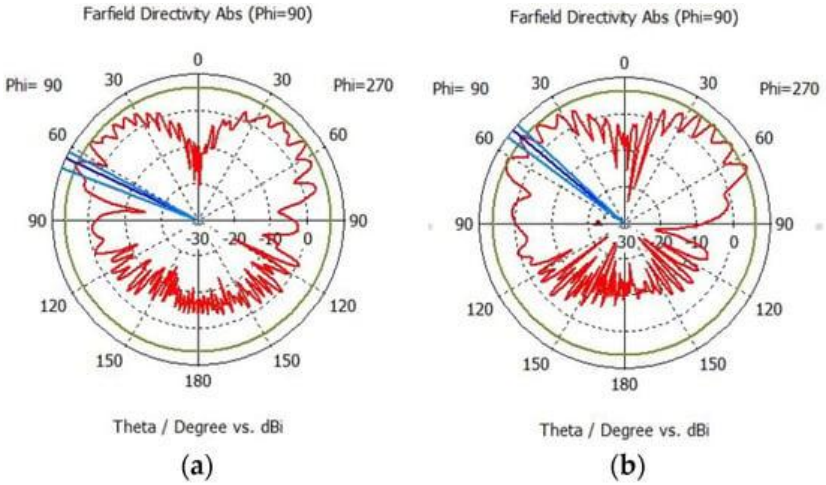

Fig. 6. The integrated GPS antenna's emission patterns were measured and predicted at 1300 MHz. (a) *yz*-plane; (b)*yx*-plane

The isolation that was seen and anticipated between the two feeding ports is shown in Figure 5. Both the GPS band and the ITS band achieve excellent isolation (22 dB), which means that each integrated antenna functioned properly without considerable The best thing about the Sigfox communication system is that it has a duplication device that sends the same message three times, on three different channels, at three different timestamps. This makes sure that there is variety in both time and frequency.

The RSSI (Received Signal Strength Indicator) is a measurement that shows how good the radio link is between the sender and listener. It is a measure of how well the link is working. This means that the radio signal is stronger when the RSSI numbers are higher. The SigFox decoder picks the packet with the highest RSSI at the receiving end. However, the fact that all three data packets arrive at the same time indicates a good link, which is the best case scenario.

CONCLUSION

We describe the design, creation, and testing of a microstrip patch antenna that is small and can be used for Internet of Things (IoT) purposes. Antenna was built into a SigFox transmitter that was

made to work at 868 MHz. To make the patch longer electrically, we added two cuts to the horizontal direction of transmission. The antennas for this frequency are big, with dimensions of

the location of the receiving point was changed. Following the design and simulation of the antenna, it was built and tried in a real IoT setting.

Based on the data we got, we came to the conclusion that the suggested antenna can make SigFox radio communications work better.

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