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Survey on Ultra Wideband Reconfigurable Antenna for Improving the Performance of Cognitive Radio System

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ABSTRACT
Ultra-Wideband (UWB) technology uses very narrow pulses of nano-seconds length to supply very high information rates. The pulses to be used for the UWB are vital and will meet the emission mask regulatory needs to induce smart performance once transmitted over the channel. During this paper we tend to review the ultra wideband reconfigurable antenna for enhancing the performance of cognitive radio system.

Keywords
Reconfigurable antennas, cognitive radio, UWB

1. INTRODUCTION
Newly, with the event of novel communication systems, frequency reconfigurable antennas have gained a lot of attention, by adapting their properties to realize property in frequency, polarization, bandwidth, and gain (Pazin and Leviatan, 2013). A reconfigurable antenna is an antenna capable of modifying dynamically its frequency and radiation properties in a very controlled and reversible manner (Bernhard, 2007). So as to produce a can-do response, reconfigurable antennas integrate an inner mechanism (such as RF switches, varactors, mechanical actuators or tunable materials) that modify the intentional distribution of the RF currents over the antenna surface and manufacture reversible modifications over its properties. Reconfigurable antennas differ from smart antennas as a result of the reconfiguration mechanism lies within the antenna instead of in an external beam forming network. The reconfiguration capability of reconfigurable antennas is employed to maximize the antenna performance during an ever-changing situation or to satisfy ever-changing in operation needs. Reconfigurable antennas apply varied techniques and ways to realize the desired modification in one or a lot of of its operation parameters.
The most common technique relies on using switches like PIN diodes, metal compound Field impact Transistors (GaAs FETs) or Micro-Electro system (MEMS) switches. Different techniques include the employment of optical switches or mechanical structure alteration to attain the necessary modification within the antenna configuration and these are promising ways to overcome the big biasing issues of the electronic switches.

The need for higher information rates is increasing as results of the transition from voice-only communications to multimedia system sort applications. This static frequency allocation has light-emitting diode to a shortage within the radio frequency (RF) spectrum, and hence, the requirement of dynamic spectrum access (DSA) became a requirement. Cognitive radio (CR) is considered one in all the most promising and innovative DSA techniques because of its 2 distinctive properties: cognitive capability and reconfigurability. Several analyses have been done on chromium. Because it has not been standardized nevertheless, totally different analysis teams target different frequency bands.

2. TYPES OF ANTENNA RECONFIGURATION
Reconfigurable antennas will be classified consistent with the antenna parameter that's dynamically adjusted, generally the frequency of operation, radiation diagram or polarization.

- Frequency reconfiguration
- Radiation pattern reconfiguration.
- Polarization reconfiguration.
- Compound reconfiguration.

2.1 Frequency Reconfiguration
Frequency reconfigurable antennas will modify dynamically their frequency of operation. They are significantly helpful in things wherever many communications systems converge because the multiple antennas needed will be replaced by one reconfigurable antenna. Frequency reconfiguration is mostly achieved by modifying physically or electrically the antenna dimensions using RF-switches, electrical resistance loading or tunable materials.

2.2 Radiation pattern reconfiguration
Radiation pattern reconfigurability relies on the intentional modification of the spherical distribution of radiation diagram. Beam steering is that the most extended application and consists in steering the direction of most radiation to maximize the antenna gain in a very link with mobile devices. Pattern reconfigurable antennas are typically designed using movable/rotatable structures. Or as well as switchable and reactively loaded parasitic parts.

2.3 Polarization reconfiguration
Polarization reconfigurable antennas are capable of shift between completely different polarizations modes. The capability of shift between horizontal, vertical and circular polarizations are often wont to reduce polarization couple losses in portable devices. Polarization re-configurability is often provided by ever-changing the balance between the various modes of a multimode structure.

2.4 Compound reconfiguration
Compound reconfiguration is the capability of simultaneously tuning many antenna parameters, as an example frequency and radiation pattern. The most common application of compound reconfiguration is the combination of frequency agility and beam scanning to produce improved spectral efficiencies. Compound reconfigurability is achieved by combining within the same structure totally different single-parameter reconfiguration techniques.

3. ADVANTAGES AND DISADVANTAGE OF RECONFIGURABLE ANTENNA

The advantages are significant:

- Have a multiband antenna in a single terminal for various applications.
- Easy to integrate with switching devices and control circuit.
- Small in size.

However, the design of reconfigurable antenna are typically driven by the balance of trade-offs. Compared with fixed-tuned antenna, due to its short developing time, there are still some disadvantages waiting to be solved:

- The technology of reconfigurable relies largely on RF switch technology, which is not mature enough yet.
- Increased complexity and cost to the mobile phone.
- Reduced Efficiency.

4. LITERATURE SURVEY

Mustafa S. Bakr et al.[1] "Reconfigurable Ultra-Wide-Band Patch Antenna: Cognitive Radio", In this paper, the basics of cognitive radio system and a replacement compact reconfigurable UWB patch antenna were printed. The target of using reconfigurable antennas in cognitive radio setting is to change economical use of the spectrum. This motivates the look of the planned compact reconfigurable patch antenna. Three switches are wont to realize a dual UWB case and 2 single UWB cases. The antenna covers frequencies ranging from 4.3 to 9 GHz with acceptable radiation characteristics. The planned antenna exhibits a complete size of 25 x 23 x 4 mm, that makes it attractive for net of Things and compact transceiver application.

Sumin D. Joseph et al.[2] "UWB Sensing Antenna, Reconfigurable Transceiver and Reconfigurable Antenna Based Cognitive Radio Test Bed", In this paper, a unique cognitive radio workplace consisting of an ultra-wide band antenna, reconfigurable transceiver and reconfigurable antenna has been projected. Spectrum sensing algorithmic rule (energy detection) was tested exploitation host laptop in PXI module that verified the performance of sensing antenna over big selection of frequencies. Elliptical UWB patch antennas dimensions are acquired by optimizing the values by constant analysis. Separate study was conducted for various slots in ground and patch. Antenna has almost position pattern in wide bandwidth. Antenna radiation diagram in numerous individual frequencies were conjointly studied. Because of the fabrication and soldering errors, the measured bandwidth is slightly below that of simulated. Each the antennas were interfaced with the reconfigurable RF transceiver which may switch the frequencies for cognitive radio operation. Thence configurability has been achieved from baseband processor level to antenna level making all the parts programmable. This can be not an entire system. Sure developments are additional required to enhance the practicality and reliability.

A. Raza et al.[3] "A Frequency Reconfigurable MIMO Antenna System for Cognitive Radio Applications", A modified, planar 2-element patch MIMO antenna is presented for wireless chromium applications to satisfy the higher rate and spectrum efficiency wants. The planning relies on copper patches on the highest plane and GND at the rear aspect with a complete substrate size of 50 × 100×0.8mm3. The annular slot is inserted to reduce the electrical size of the patch and reconfigurability is achieved by using varactor diodes across the annular slots through capacitive coupling. The planned style provides a smooth transition between 2.12, 2.14, 2.158, 2.2, 2.242, 2.294 and 2.318 ghz for various bias voltages. The isolation between the weather is giant and larger than−12 dB for every bias voltage. The planning is additionally tested for MIMO parameters and provided a good response supported the TARC and ECC parameters.

Fatemeh Zadehparizi et al.[4] "Frequency Reconfigurable Antennas Design for Cognitive Radio Applications with Different Number of Sub-bands Based on Genetic Algorithm", The goal of this paper was to style monopole antennas for chromium applications with totally different number of sub-bands and therefore the possible minimum numbers of switches. The planned styles operate within the entire band wherever wide bands are used for sensing the spectrum and also the two/three sub-bands for communication antennas. The shapes of slots within the ground plane and therefore the switches locations are obtained exploitation the GA in conjunction with IMPM by introducing a new and desirable price operate. Also, this operate are often used for wideband/UWB and UWB with notch band antennas style. A prototype antenna is made-up and measured confirming the accuracy of the theoretical results. The results from measurements and simulations united well too.

N. Anvesh Kumar et al.[5] "A Compact Novel Three-Port Integrated Wide and Narrow Band Antennas System for Cognitive Radio Applications", In this paper, an antenna system composed of 3 antennas integrated within the same substrate, utilized for the conclusion of cognitive radios, has been conferred. it's utilized with 2 narrow band antennas to overcome the drawbacks of the reconfigurable antennas throughout their practical implementation. So, once a short discussion regarding the characteristics of cognitive radios, functions of the UWB antenna and of the 2 narrow band antennas forming the projected antenna system are represented. Then, the analysis and style of every antenna are illustrated in detail. Full-wave commercial software system supported the FEM technique has been used for an accurate prediction of the projected antennas performances. The antenna measurements applied on an antenna prototype have shown a good agreement with the experimental measurements. Owing to compact structure and higher performance, projected systems are often a good candidate for rising cognitive radio technology.

Y. Tawk et al.[6] "Reconfigurable front-end antennas for cognitive radio applications", In this paper, authors propose 2 totally different techniques to realize a frequency reconfigurable antenna for chromium systems. Within the case of each style, no bias lines are required to activate the switches. This enables for a better integration of the antenna during a complete RF chain and reduces the amount of quality that's introduced by the utilization of bias lines. A stepper motor is required to realize the specified rotation with the mobile reconfigurable chromium antenna. Optical device diodes ought to be incorporated with an optically reconfigurable antenna style. The quantity of output optical power may be adjusted via an optical device current driver and might be controlled via a laptop or a microcontroller. Within the case of each style, a model antenna was fancied to prove the projected methodology. An honest agreement was achieved between simulation and measurements. The 2 projected antennas are an honest candidate for future chromium communication systems. As for future work, authors will try to control rotation of the reconfigurable communication antenna via an FPGA or a microcontroller. Also, authors are going to investigate techniques to reduce the transition thresholds of the photoconductive switch components.

Sonia Sharma et al.[7] "A Novel Reconfigurable Antenna with Spectrum Sensing Mechanism for CR System", A versatile antenna capable of frequency, polarization, bandwidth and pattern reconfiguration in a very single structure is projected here. The functioning of every mode has been verified through measurement.

Sonia SHARMA et al.[8] "An Integrated Frequency Reconfigurable Antenna for Cognitive Radio Application", In this work, authors integrate the NB antenna into an oversized UWB antenna while not affecting every performance. The UWB antenna, slot antenna was written onto the highest side of the substrate and also the reconfigurable feeding structure for the U slot antenna was written onto the bottom facet of the substrate. This has the advantage of reducing area necessities and making the 2 antennas lying within the same plane needed for cognitive radio communication. The arrangement has potential for varied chromium applications.

Zainab Aizaz et al.[9] "A Survey of Cognitive Radio Reconfigurable Antenna Design and Proposed Design using Genetic Algorithm", In this survey paper, authors have got mentioned the look of antennas for reconfigurable cognitive Radio applications. Cognitive Radio could be a revolutionary frequency assignment technology that permits unlicensed users to use spectrum bands that are authorized to primary users, whereas satisfying the interference constraints. Spectrum underlay and spectrum overlay are the essential 2 approaches to share frequency spectrum between the first and also the secondary users. Ultra band antennas are required for sensing in overlay cognitive networks, and for human activity in underlay networks. Our aim is to style a reconfigurable antenna that is optimized by genetic algorithmic rule. The target is to realize most bandwidth for the communication antenna by employing a minimum variety of switches or different strategies which will be used for achieving reconfigurability.

Vikas Goyal et al.[10] "Improving Ultra Wideband (Uwb) System By Modified Random Combination Of Pulses", This paper presents the projected random combination approach of signal generation to be used for ultra wideband communication systems which might give economical leads to meeting the laws for the sending pulse set by the regulative authorities. The new combined pulse using the primary 5 gaussian derivative pulses with optimum shaping factors as basic functions are generated with success with the channel coefficients and pulse shaping factors meeting the facility spectral density necessities of an ultra-wideband signal. The transmission and reception ultra wideband system model are created and simulated in Matlab using binary modulation and pulse position modulation time hopping multiple access modulation scheme within the presence of IEEE UWB multipath Non line of Sight channel model CM2 and CM3. The rake receiver results plotted as bit error rate (BER) versus normalized energy per bit to noise power spectral density ratio in dB shows that the combined transmitted pulse UWB system and also the Gaussian fifth derivative pulse system using optimum pulse form factors showed higher performance over Non line of sight multipath channel model three for the 3 rake receivers. Also, the projected optimum combined Pulse form multiple access system offers an improved performance in terms of bit error rate at totally different normalized signal to noise ratio (Ex/No dB) values over the Gaussian fifth derivative pulse for A rake, selective rake, and partial rake receiver configurations. The projected pulse ultra wideband system additionally showed improved results as compared to the previous literature results. These optimum pulses are often used as a reference for achieving improved leads to multipath channel environments.

5. ANTENNA THEORY

5.1 Antenna Definition

An antenna may be outlined as a sometimes metallic device that radiates and receives electromagnetic waves (EM waves), additional specifically, another explanation says that an antenna is the transition between a guided EM wave and a free-space EM wave. And vice-versa. This method is explained by a general communication between a transmission antenna and a receiving antenna.

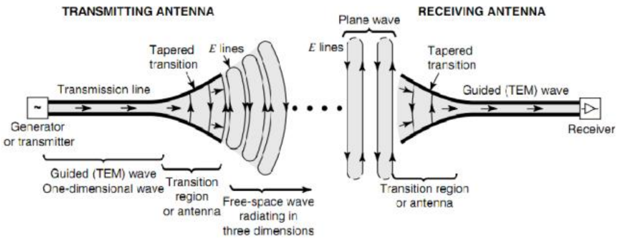

Fig.1: The antenna as a transition structure, for a transmitting antenna and for a receiving antenna

As shown higher than, for each antenna, the transmission line has the shape of a coaxial line or a wave guide. The latter, once a sending antenna is considered, is connected to a transmitter that generates radio-frequency (RF) energy that's guided through the uniform a part of the road as a plane. Transverse electromagnetic (TEM) wave with very little loss, transformed into an indication that's amplified, modulated and applied to the antenna; otherwise, once a receiving antenna is considered, the line is connected to a receiver that collects the alternating currents that resulted from the transformation method of the received radio waves by the antenna.

Antenna characteristics regarding to radiation are primarily identical despite its kind. Therefore, if a time-changing current or an acceleration (or deceleration) of charge happens, the radiation are created during a sure length of current part. This could be described by

$$l.\frac{dl}{dt} = l.qi.\frac{dv}{dt}\left(A.\frac{m}{s}\right) \qquad (1)$$

Where:

l - Length of the current element in meters (m);

di/dt Time-changing current in ampere per second (A/s).

qi Charge per unit length (coulombs/m). Note that q = I. t = 1.602×10-19 Q.

Furthermore, the radiation is always perpendicular to the acceleration and its power is proportional to the square of both parts of the equation (1). It is important to refer that the spacing between the two wires of the transition line is just a small part of a wavelength; therefore, the more the transition curve of the antenna opens out the more the order of a wavelength or more is reached; consequently, the more the wave tends to be radiated and launched into the free-space (Kraus and Marhefka, 2003).

Looking at the antenna structure as a whole, the transition region of the antenna is like a radiation resistance (Rr) to the transmission line point of view, which represents the radiation that the antenna emits, analyzing it as a circuit. Figure 2 shows the complete circuit of an antenna; where the source is an ideal generator with a tension Vg(or Vs) and with an impedance Zg (or Zs); the transmission line is a line with characteristic impedance Zc (or Zo), and the antenna itself is represented by a load impedance ZA [ZA=(RL+ Rr) + jXA] connected to the transmission line. The load resistance RL is used to represent the conduction and dielectric losses associated with the antenna structure while Rr, referred to as the radiation resistance, is used to represent radiation by the antenna.

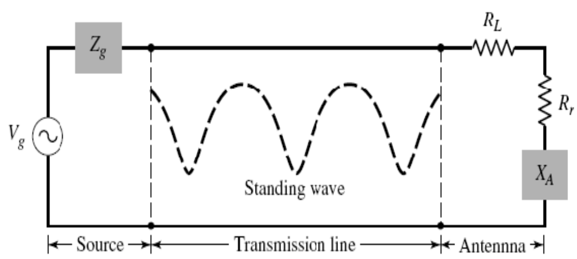

Fig.2: Circuit representing antenna as whole structure

The reactance X_A is used to represent the imaginary part of the impedance associated with radiation by the antenna. Therefore, if ideal conditions are applied, the radiation resistance Rr, which is used to represent radiation by the antenna, will get all the energy that is generated by the transmitter.

5.2 Radio Frequency

EM waves are a type of electromagnetic radiation which is organized according to the frequency (f) of its waves. Frequency counts the number of incidences that a repetition of an event occurs per unit of time. Usually, a frequency is given in Hertz (Hz) which means the number of cycles per second. Each cycle is also mentioned, as a period (T) .There for, frequency is the reciprocal of period:

$$F=1/T \qquad (2)$$

EM waves cover the whole spectrum; radio waves and optical waves are just two examples of EM waves.

6. CONCLUSION

This brief study on the ultra wideband reconfigurable antenna attempts to illustrate the recent research work that has been done in the field. Some research papers were discussed, all focusing on different aspects and advantages and disadvantages of antenna. In this paper, brief study of antenna theory and types of antenna reconfiguration. All these study have been done for improving the performance of cognitive radio system.

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