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MM-Wave Planner Antenna For Wireless Communication

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Abstract**—**The expectation of end users for and data allowance puts pressure on network operators in meeting demand and leads to requests from operators for access to greater amounts of spectrum. Making spectrum available to meet the future requirements of mobile broad band services is complex as prime spectrum for mobile broadband services is also access to services exhibiting increased speed heavily utilised by other services and is a scarce resource. Communications regulators must consider the impact on existing spectrum management arrangements and incumbent users. When making further spectrum available. Some of the issues to be taken into account ,

1. Determining when the effect of making spectrum available for mobile broadband services is no longer the highest value use as this may preclude other uses of the spectrum with inherent public benefit.
2. Considering whether greater spectral efficiency can be achieved by network operators in existing spectrum holdings.
3. Considering whether the needs of incumbent users of spectrum can be balanced with the future spectrum requirements for mobile broadband services.

The global bandwidth shortage facing wireless carriers has motivated the exploration of the underutilized millimeter wave (mm-wave) frequency spectrum for future broadband cellular communication networks. There is, however, little knowledge about cellular mm wave propagation in densely populated indoor and outdoor environments. Obtaining this information is vital for the design and operation of future fth generation cellular networks that use the mm-wave spectrum. In this paper, we present the motivation for new mm -wave cellular systems, methodology, and hardware for measurements and offer a variety of measurement results that show 28 and 38 GHz frequencies can be used when employing steerable directional antennas at base stations and mobile devices.

Keywords—CPW, aperture coupled slot, frequency, spectrum, mm wave technology.

I. Introduction

Communication between humans was first by sound through voice. With the desire for slightly more distance communication came, devices such as drums, then, visual methods such as signal flags and smoke signals were used. These optical communication devices, of course, utilized the light portion of the electromagnetic spectrum. It has been only very recent in human history that the electromagnetic spectrum, outside the visible region, has been employed for communication, through the use of radio. One of humankinds greatest natural resources is the electromagnetic spectrum and the antenna has been instrumental in harnessing this resource.

In recent years, the demand for high data rate telecommunication has been increasing faster than ever. The Industrial, Scientic, Medical (ISM) application band at 2.4 GHz has been overcrowded by numerous and various commercial products of end users, among others, WLAN, Bluetooth, and Wireless Sensor Network (WSN). The use of wireless communication has also rapidly increased, much faster than its wireline counterpart. As a result, the required bandwidth doubles every 18 months. Moreover, the number of owned wireless devices per user has been ever increasing. Not only will the wireless devices connect people to people, but also people to machines and machines to machines.

Thus, the limited bandwidth around 2.4 GHz (ISM-band) cannot support the higher data rate if the band has to be shared among many potential users. The availability of 7 GHz around 60 GHz (ISM-band) is able to accommodate high data rate communication. Furthermore, the propagation condition in the 60-GHz wireless channel enables frequency.

Antenna Characteristics:

An antenna is a device that is made to efficiently radiate and receive radiated electromagnetic waves. There are several important antenna characteristics that should be considered when choosing an antenna for your application as follows:

- Antenna radiation patterns
- Power Gain
- Directivity
- Polarization

A: Defination of Millimeter waves:

Extremely high frequency (EHF) is the ITU designation for the band of radio frequencies in the electromagnetic spectrum from 30 to 300 gigahertz, above which electromagnetic radiation is considered to below (or far) infrared light, also referred to as terahertz radiation. Radio waves in this band have wavelengths from ten to one millimeter , giving it the name millimeter band or millimeter wave, sometimes abbreviated MMW or mmW. Millimeter length electromagnetic waves were rst investigated in the 1890s by pioneering Indian scientist Jagadish Chandra Bose. Compared to lower bands, radio waves in this band have high atmospheric attenuation; they are absorbed by the gases in the atmosphere. Therefore, they have a short range and can only be used for terrestrial communication over about a kilometer. In particular, signals in the 57-64 GHz region are subject to a resonance of the oxygen molecule and are severely attenuated. Even over relatively short distances, rain fade is a serious problem caused when absorption by rain reduces

signal strength. In climates other than deserts absorption due to humidity also has an impact on propagation. While this absorption limits potential communications range, it also allows for smaller frequency reuse distances than lower frequencies. The short wavelength allows modest size antennas to have a small beam width, further increasing

frequency reuse potential. With a reasonable assumption that about 40% of the spectrum in the mmWbands can be made available over time, we open the door for possible 100GHz new spectrum for mobile broadband More than 200 times the spectrum currently allocated for this purpose below 3GHz.

B: Millimeter technology:

Despite industrial research efforts to deploy the most efficient wireless technologies possible, the wireless industry always eventually faces overwhelming capacity demands for its currently deployed wireless technologies, brought on by the continued advances and discoveries in computing and communications, and the emergence of new customer handsets and use cases (such as the need to access the internet). This trend will occur in the coming years for 4G LTE, implying that at some point around 2020; wireless networks will face congestion, as well as the need to implement new technologies and architectures to properly serve the continuing demands of carriers and customers. The life cycle of every new generation of cellular technology is generally a decade or less (as shown earlier), due to the natural evolution of computer and communications technology. Our work contemplates a wireless future where mobile data rates expand to the multi gigabit-per-second range, made possible by the use of steerable antennas and mm-wave spectrum that could simultaneously support mobile communications and backhaul, with the possible convergence of cellular and Wi-Fi services. Recent studies suggest that mm-wave frequencies could be used to augment the currently saturated 700MHz to 2.6GHz radio spectrum bands for wireless communications [2]. The combination of cost-effective CMOS technology that can now operate well into the mm-wave frequency bands, and high-gain, steerable antennas at the mobile and base station, strengthens the viability of mm-wave wireless communications. Further, mm-wave carrier frequencies allow for larger bandwidth allocations, which translate directly to higher data transfer rates. Mm-wave spectrum would allow service providers to significantly expand the channel bandwidths far beyond the present 20 MHz channels used by 4G customers [1]. By increasing the RF channel bandwidth for mobile radio channels, the data capacity is greatly increased, while the latency for digital traffic is greatly decreased, thus supporting much better internet-based access and applications that require minimal latency. Mm-wave frequencies, due to the much smaller wavelength, may exploit polarization and new spatial processing techniques, such as massive MIMO and adaptive beamforming. Given this significant jump in bandwidth and new capabilities offered by mm-waves, the base station-to-device links, as well as backhaul links between base stations, will be able to handle much greater capacity than today's 4G networks in highly populated areas. Also, as operators continue to reduce cell coverage areas to exploit spatial reuse, and implement new cooperative architectures such as cooperative MIMO.

II. MILLIMETER WAVE ANTENNA TOPOLOGY

The development of appropriate antennas and associated technology will be important to the success of millimeter-wave wireless personal communication systems. Research in these areas and also on the processes of indoor propagation has been carried out [1] with particular emphasis on integrating antennas with multifunction GaAs monolithic microwave integrated circuits (MMIC's). The choice between antenna and circuit type depends on many factors such as the intented application, the type of device being used and considerations involving unwanted radiation from the circuit elements and the significance of substrate surface modes. As it is well known, planar antennas consisting of patches, dipoles or slots, fed by a microstrip transmission line, are extremely useful due to their low cost, light weight, and flexibility of design. In general, a combination of slot and patch antennas lead to convenient geometries. Of these the most likely candidate for integration with GaAs MMIC's is the coplanar waveguide (CPW) aperture-coupled patch antenna that uses a single substrate. Indeed, for components including active devices, in particular, MMIC's, the popularity of CPW has increased significantly in recent years because the advantages of CPW like wider bandwidth, smaller mutual coupling between two adjacent lines, and easier integration with solid-state active devices on one side of the planar substrate, thus avoiding via hole connections. Over the past few years, a considerable number of studies have been carried out on the linearly polarized antennas, loop antennas, and slot antennas [2], but only a few attempts have so far been made at realizing antenna patch fed by CPW in the millimeter-wave region. In light of this, considering

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Fig. 1. Layout of the test-patch antenna and feeder network.

the recent development that shows that microstrip patch antennas can be coupled with CPW transmission lines [3]–[7] via a slot in the ground plane, a new structure of the printed antenna fed by CPW that conjugates the advantage of aperture-coupled microstrip antenna and the wide range of flexibility is proposed using the innovation that uniplanar technology offers. Indeed, the patch antenna is an extremely useful configuration for millimeter-wave wireless applications. When the patch is excited by CPW, a CPW to slotline junction is required to ensure the antenna works at high efficiency. The paper proposes the use of the CPW stub patterned on the center conductor to obtain optimum matching. It is important to note that the design of CPW coupled microstrip patch antenna with the CPW series stub within the center conductor leads to greater field confinement resulting in suppression of spurious radiation emitted by this stub and provides both low loss and longitudinal symmetry whose eliminates the need for air bridges. This arrangement provides additional degrees of freedom compared to classical topologies resulting in extremely compact configuration. The feasibility of integrating this novel antenna topology on high-dielectric constant substrate ("r =9 :9), which is close to the dielectric constant of

GaAs in millimter wave region is also demonstrated. The measured results shows the usefulness of the proposed antenna configuration and the effectiveness of uniplanar technology both in terms of performance and cost.

A: Designing of planner Antenna using EM cube.

So far as designing of the antenna is concerned we have to use the EM.cube software for designing the antenna.

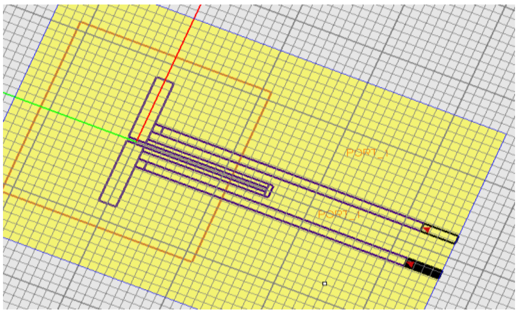

Fig.1: The designed millimeter wave antenna using EM.picasso module.

B: Modules in the Antenna system:

Using a 400 Mcps sliding correlator channel sounder with 2.3 ns multipath resolution. The block diagram of the transmitter (TX) and receiver (RX) is given in Fig. 2. A pseudo-random noise (PN) sequence sliding correlator was utilized as the probing signal, which was modulated to a 5.4 GHz intermediate frequency (IF) and upconverted to 28 GHz after mixing with a 22.6 GHz local oscillator (LO). The transmitter power was +30 dBm (a typical value for lower power femtocells), fed to a steerable 10◦ beamwidth 24.5 dBi horn antenna or a 30◦ beamwidth 15 dBi horn antenna that was mechanically
rotated

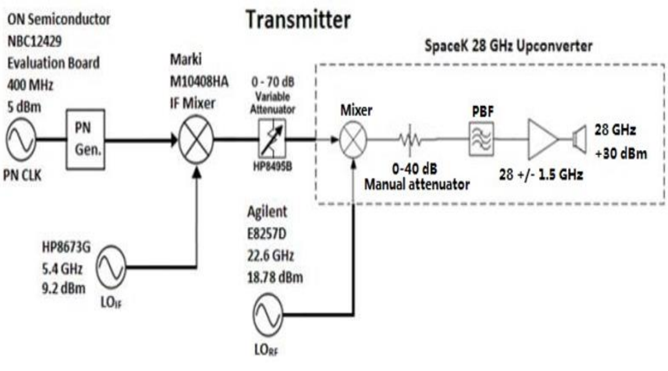

Fig.2: The antenna module for the millimeter wave antenna present for feeding the antenna.

C: Theoratical Analysis:

The geometry of a rectangular micro strip antenna fed by an open- end coplanar waveguide . We assume that the substrate and the ground plane extend to infinity in the x and y directions and that the conductors are perfectly conducting and of negligible thicknesses. The coordinates are chosen such that the ground plane coincides with the zy-plane, the coplanar waveguide is symmetric about the z-axis, and the y-axis is placed along the edge of the end of the coplanar waveguide. To simplify the analysis, the patch is also placed symmetric about the z-axis; nevertheless, our theory can easily be modified to allow asymmetric placement of the patch. By invoking the equivalence principle and applying suitable bound- ary conditions, the magnetic field H in the slot aperture and the electric field Ep on the patch surface can be expressed as where the superscripts a and b denote the fields or the sources just below and above the slot aperture surface, respectively, 7 and are the electric and magnetic surface currents on the patch and in the slot aperture, respectively, and the subscripts z and y represent the corresponding components of the fields. Each field in (1)-(4) is the field due to the specified current radiating in its corresponding region (region of half free-space or half-space with grounded dielectric slab). All the fields can be calculated from suitable Green's functions, whose spectral domain forms can befound from, SI or derived from the immittance approach . A Galerkin moment method solution of is fp by choosing expansion functions for the unknown currents. For the patch current -

III. EXPERIMENTAL RESULTS

The experimental results of plannar Antenna using AMS(Antenna Measurement system) Shows Fig. 3: HPBW, Fig. 4: Radiation Pattern on Hardware, Fig. 5: HPBW 3-D view, Fig. 6: Gain of Antenna, Fig. 7: Directivity of Antenna.
The simulation of the project in the Emcube is depicted the various designed parameters of the antenna hence has been shown in Fig.8: Radiation pattern and the directivity of the antenna, Fig.9: Frequency sweep of the antenna for various frequencies, Fig.10:Z11 parameter of the antenna.

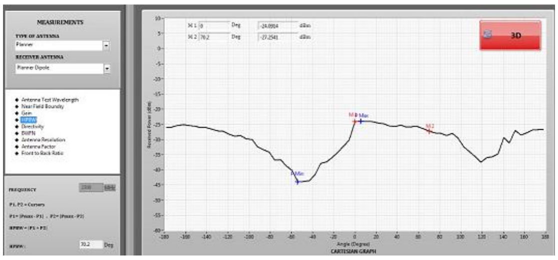

Fig. 3: HPBW using AMS

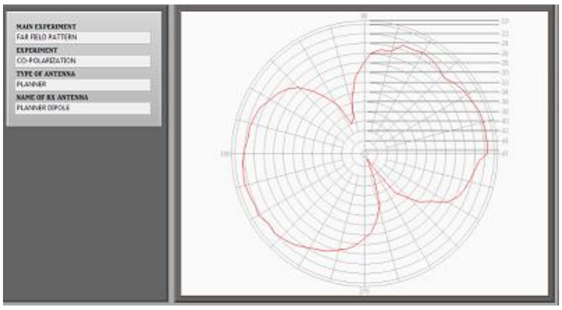

Fig.4: Radiation Pattern on Hardware using AMS

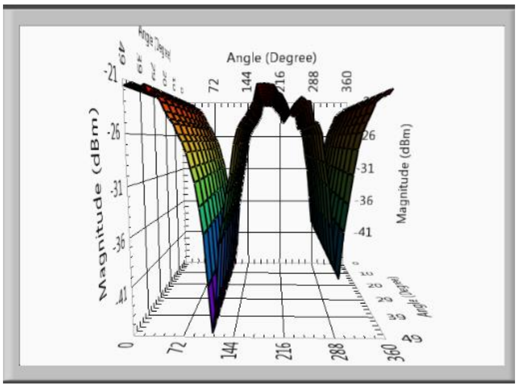

Fig. 5: HPBW 3-d view using AMS

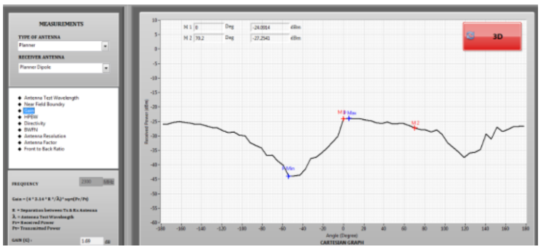

Fig.6: Gain of Antenna using AMS

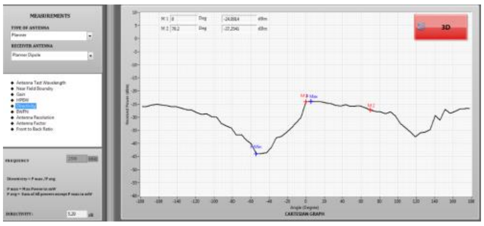

Fig. 7: Directivity of Antenna using AMS

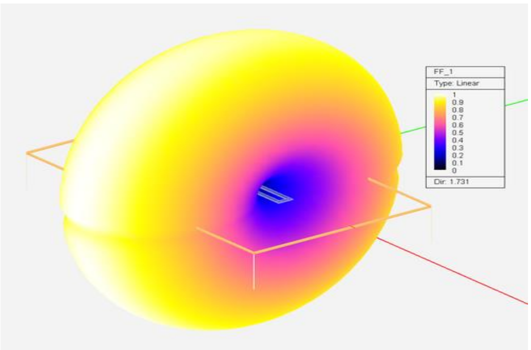

Fig.8: Radiation pattern and the directivity of the antenna.

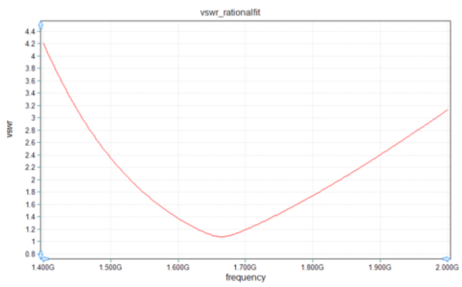

Fig.9: Frequency sweep of the antenna for various frequencies.

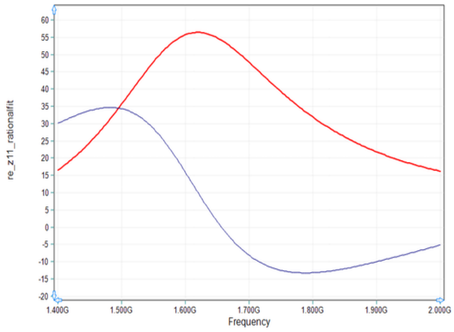

Fig.10:Z11 parameter of the antenna.

The circuit was implemented on high-dielectric constant substrate r =9:9, h =0:254 mm and to demonstrate the feasibility of integrating this antenna structure into monolithic circuits. The novel CPW-fed patch antenna operates at 36.84 GHz. The measured return loss and normalized input impedance as a function of the frequency of this structure are shown in Fig. 2. A fairly good matching is obtained, namely S11 = 42 dB at f1 = 36:84 GHz. The bandwidth at the resonance frequency is around 1 GHz for VSWR < 2. One of the most promising aspects of the new antenna consists in the capability of matching the input impedance with a compact CPW stub printed on the center conductor to get better performance in one hand and, on the other hand, the feasibility of integrating this antenna structure on high-dielectric constant substrate "r =9:9, which is close to the dielectric constant of GaAs.

IV. CONCLUSIONS

- Millimeter wave can be classified as an electromagnetic spectrum that spans between 30 GHz to 300 GHz, which corresponds to wavelengths from 10 mm to 1mm.The main advantage of using this project is we can use the commercial unlicensed broadband spectrum which is currently unused hence using this we can radiate into 30-300 Ghz spectrum. The major advantage of this is it a continuous spectrum and having very less power limit. This huge bandwidth represents high potential in terms of cellular capacity and exibility that makes the millimeter wave antenna the future of wireless communication especially for multi gigabit internet services such as Gaming, Ultra HD streaming, etc.There is widespread recognition that mobile broadband services are an economic enabler within society and the provision of these services, technologies and applications in the wider community is in the public interest.
- Printed active antennas are a particularly exciting topic, which opens new horizons for integrated systems. The proposed antenna demonstrates the efficiency of the approach based upon CPW series stub within a center conductor in order to get better performance and compactness. It has been shown that the use of CPW series stub printed on the center conductor is potentially effective to ensure the antenna works at high efficiency in millimeter waves. In addition, several other advantages can be gained from this kind of antenna as pointed out in the introduction. The measured results demonstrate the usefulness of the proposed antenna configuration for application in the field of personal communications as a phased array antenna using MMIC's with microwave device. This

design is straightforward to implement in MMIC and MIC circuits and allow for easy insertion of printed antennas for a multitude of applications where a large number of systems such as short-range communications for people and vehicles as well as short-range mill metric sensors will become possible.

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