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SURVEY ON PLANAR ANTENNAS FOR 5G APPLICATION

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Abstract *The 5G technology is a key element in the development of multiple access strategies, massive MIMO, hybrid beam forming and ultra-dense networking. Thus, this survey is done on the applications of 5G which covers the frequency ranges of millimeter wave, sub-6Ghz (middle band) and lower band. A comparison table is constructed after a continuous study which compares the parameters such as size, substrate used, no of bands covered, operating frequency ,bandwidth, gain and no of elements used in case of array antennas*

1. INTRODUCTION

5G –A new kind of network, which creates a platform for innovations and elevate today's mobile broadband services. It will also expand mobile networks to support a vast diversity of devices and services and connect industries offering them with improved performance, efficiency, and cost. It is a technology which will reinvent a broad range of connectivity to industries with services from education to entertainment, transportation to mobile communication, and everything in between. It will improve interconnection between people, and also interconnect objects, and devices. It will deliver new levels of performance and efficiency that will empower new user experiences and connect new industries. 5G will deliver multi-gbps peak rates, ultra-low latency, massive capacity, and more uniform user experience. There is wide range of difference between the generations in terms of frequency band, speed, technique used which is explained in fig1.

5G network is the next generation of mobile communication which is off almost no limitation. It has enhanced features when compared to other generation, which is explained in fig2. It offers faster data transmission and high capacity on smart phones and on other devices than ever before. |It is been launched all over the world to provide high connectivity in US, UK and in Australia. 5G is the fifth generation wireless technology for digital cellular networks which was developed widely in the year 2019. The perks and usability of 5G can be clearly understood from the fig3. The frequency spectrum of 5G is been classified as millimeter waves, mid-band and low-band. The Millimeter wave which is also called as Extremely High Frequency is the best and fastest frequency range whose frequency ranges from 30 to 300 gigahertz , and the actual speed is often being 1–2 gbit/s .The 5G mid-band is the most widely deployed and speeds in a 100 MHz wide band and are usually 100–400 Mbit/s down. Frequencies deployed are from 2.4 GHz to 4.2 GHz. The frequency range of Low-band is similar to the frequency range of 4G. The 5G technology adds up an superior power over the other techologies in such a way that it is benificial for all groups of people such as students,engineers ,doctors and to a comman man. It provides a technological sound to heterogenous sevices and facilitate its users to supervision tools for quick action.

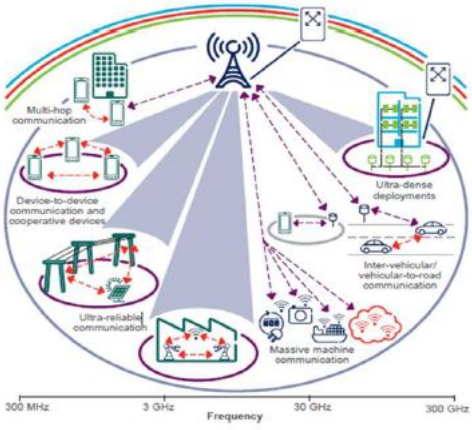

Fig -1: Perks and Usability of 5G

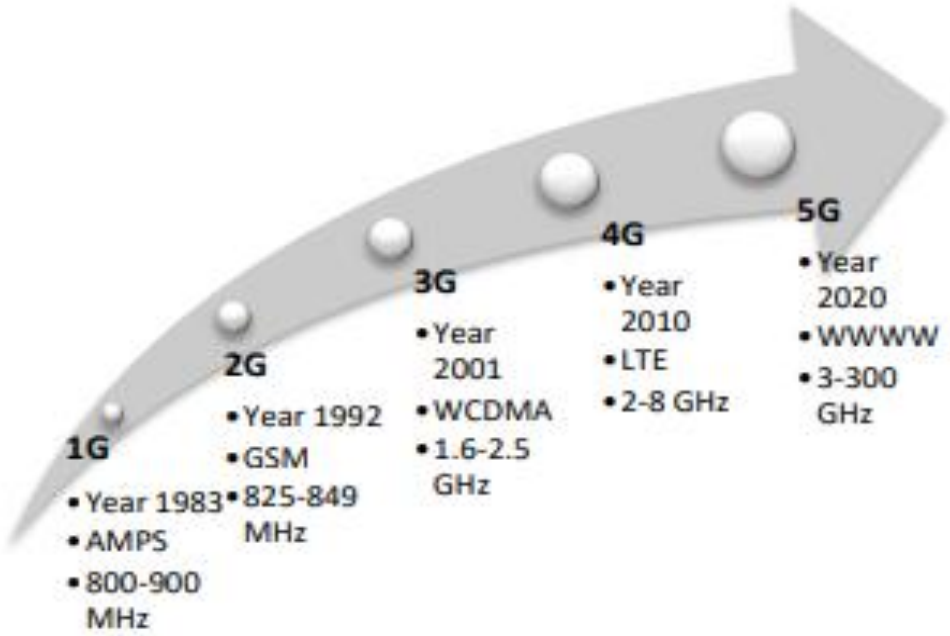

Fig -2: Various Generations of Technologies

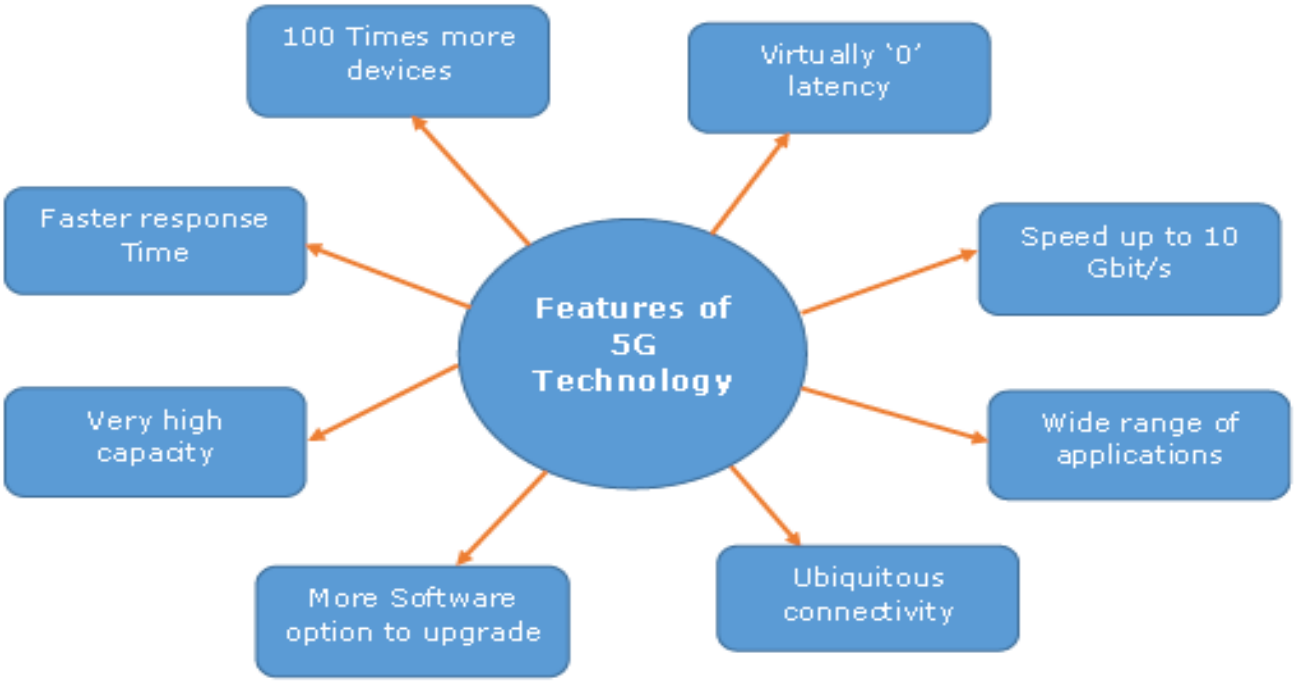

Fig -3: Key Features of 5G

TABLE 1: 5G Frequency Bands Used In Different Countries.

Frequency Band	Frequency Range	Countries/Regions	Comments
Low Band	<1 GHz (UHF) usually 600/700 MHz	EU, USA, India	Current favourite as longer range, so less costly infrastructure and more familiar technology
Mid Band	3-5 GHz (above UHF)	EU, Korea, Rep., China, India with USA at 2 GHz; China and Japan in 2020	More spectrum available, with compromise on range and performance
High Band	20-100 GHz	EU, USA, Korea, Rep.; in 2020 - China, Japan, India	Short range (10-150m), high speed, low latency

2. PAPER SURVEY:

2.1. MULTIBAND 10 ANTENNA ARRAY FOR THE SUB-6Ghz MIMO APPLICATION IN 5G SMARTPHONE:

The multiband 10 antenna array working at sub-6Ghz spectrum for massive MIMO application is proposed to realise 10x10 MIMO application in three LTE bands. 10 T-shaped coupled-fed-slot antenna element that can excite dual resonant modes are integrated. Two techniques have been deployed which are spatial and polarisation diversities technique which helps in improving isolation and achieves coupling effects. The proposed antenna has efficiency higher than 42%and 62%in low band and higher band respectively. The ergodic channel capacity of 10x10 MIMO system working in the LTE bands 42/43 and LTE band46 and reached upto 48 and 51.4b/s/Hz.

2.2 RECONFIGURABLE RADIATION PATTERN OF PLANAR ANTENNA USING METAMATERIAL FOR 5G APPLICATION:

A Reconfigurable metamaterial structure was designed using a millimetre wave band with two configuration that exhibits different refractive indices.MM configuration creates a phase change in the electromagnetic wave of the antenna, which deflects the main beam also a contiguous square resonator is reconfigured using three switches to achieve different refractive indices .These configuration are used to guide the antenna's main beam in the frequency band of 28Ghz. A 2x3 array of configurable MM was inserted on the antenna's dielectric layer to perform positive deflection and negative deflection angles. The enhanced gain of the proposed antenna is 1.9db and 1.5db in positive deflection and negative direction respectively.

2.3. COMPACT PLANAR BEAMFORMING ARRAY WITH END-FIRE RADIATING ELEMENTS FOR 5G APPLICATION:

Based on microstriplines, a compact 4x6 butler matrix is designed and applied to linear antenna array. This design creates four beams in four different direction within 27.5Ghz and 28.5Ghz.The size of the beamforming network is realised which adds an advantage to this design. Using a dual substrate structure the 4x4 BM is modifies to 4X6 BM to avoid crossing lines using microstrip - to- slotlinetransition. The BFN is cascaded with 6-element linear antenna array with end fire radiating element, so that the array can be easily integrated with the BFN. The multibeam antenna size 5.6λx4.6λ which the new design is only 3.5λ0x 1.4λ0 which is only half as large as the traditional one.

2.4. 12 PORT 5G MASSIVE MIMO ANTENNA ARRAY IN SUB-6Ghz MOBILE HANDSET FOR THE LTE BANDS 42/43/46 APPLICATION:

The proposed MIMO antenna is a 12-port antenna array operating in the long term evolution band 42/43 and LTE 46 band .The MIMO antenna is composed of three different antenna element types, which are as follows, inverted pi shaped antenna , long inverted L-shaped open antenna and shorter inverted L-shaped open slot antenna .Thus in total 8 antenna elements are used for 8x8 MIMO in LTE bands 42/43 and 6 antenna elements for the 6x6 MIMO in LTE band 46.It has channel capacity higher than 34 and 26.5b/s/hz in LTE 42/43 and LTE 46 band. The proposed antenna is capable of diversity and multiplexing under the presence of users hand.

2.5. FRACTAL ULTRA WIDEBAND ANTENNA FOR 5G APPLICATION:

The proposed fractal prototype has extremely reduced size of 18x25mm and works on the band from 20 GHz to 50 GHz. This antenna is designed using rogers RO4232 material. The realised gain is 6.6db at 3.8Ghz.and enhanced up to 12.5db.The return loss is less than -10db throughout the band.

COMPARISION TABLE:

The following comparison table is constructed based on the survey and has different parameters of an antenna such as,

- Size ,
- Substrate used ,
- Bandwidth ,
- Gain,
- Number of elements and
- The number of frequency bands covered.

Table 2: Comparison Table

S.NO	SIZE OF THE ANTENNA	SUBSTRATE USED	NO OF BANDS COVERED	OPERATING FREQUENCY	BANDWIDTH	GAIN	NO OF ELEMENT
1.	50*50mm^2	Rogers RT/DUROID	3	24.5Ghz-27.5Ghz 31.8Ghz-33.4Ghz 40.5Ghz-43.5Ghz	25Ghz	6.09db	---
2.	4.4*4.2mm^2	FR4 Substrate	3	17.0Ghz, 28.60Ghz, 32.5Ghz.	25Ghz	0.22db ,1.1db, 2.96db	---
3.	4*3.5mm^2	Rogers RT5880	2	24.2Ghz, 37.42Ghz	28Ghz	5.25db	8
4.	39*30mm^2	RT/DUROID	2	3.428Ghz, 42.5Ghz	37.528Ghz	6.84db	----

5.	65*350mm^2	FR4 Substrate	2	3.5 Ghz,4.8Ghz	More than 1Ghz	2.82db	---
6.	110*60mm^2	Rogers RT5870	1	28Ghz	3.18Ghz	8.8db	---
7.	9.8*27.4mm^2	Rogers RO3003	2	24 Ghz-30Ghz	6Ghz	10.7db	----
8.	40*30mm^2	LTCC AND Rogers2929	2	58 Ghz-62Ghz	60Ghz	12.2db	---
9.	2.56*3.03 mm^2	Rogers RO4350b	1	28Ghz	1.5Ghz	18db	4
S.NO	SIZE OF THE ANTENNA	SUBSTRATE USED	NO OF BANDS COVERED	OPERATING FREQUENCY	BANDWIDTH	GAIN	NO OF ELEMENT
11.	2.7*3.52mm^2	FR4 Substrate	2	2.21Ghz-2.79Ghz	3.16Ghz	6.37db	----
12.	7.5*12.8mm^2	PET	2	22Ghz-40Ghz	25Ghz	8.2db	---
13.	4*9.45mm^2	FR4 Substrate	2	28 Ghz-34.5Ghz	25.2Ghz	13.8db	---
14.	30.5*35mm^2	Rogers RT5880	3	27.5Ghz,28Ghz,28.5Ghz	25Ghz	11db	6
15.	150*80mm^2	FR4 Substrate	2	3.6Ghz,5.5Ghz	3.8Ghz	6.5db	8
16.	14.96*12.47 mm^2	FR4 Substrate	2	3.8Ghz,4.8Ghz	3Ghz	40db	---
17.	150*80*0.8 mm^3	FR4 Substrate	2	3400-3800Mhz 5150-5925Mhz	3.5Ghz	6db	10
18	16*12mm^2	RT5880	1	28Ghz	20.45db	1.9db	----
19.	18*25mm^2	Rogers RT4232	6	25 Ghz, 24.6Ghz,31Ghz,38Ghz,46.5Ghz,50.2Ghz	23Ghz	6.67db	---
S.NO	SIZE OF THE ANTENNA	SUBSTRATE USED	NO OF BANDS COVERED	OPERATING FREQUENCY	BANDWIDTH	GAIN	NO OF ELEMENT
20.	8*10mm^2	Rogers RO3003	4	34Ghz-55Ghz	39.5Ghz	6db	---

CONCLUSION:

Thus the survey has been made based on the different frequency bands of 5G which also gives an extensive knowledge about the 5G technology, it's frequency bands, usage of it in other coutries. The different parameters like size of the antenna, substrate used, no of bands covered, operating frequency, gain, bandwidth and no of elements used have been comparatively constructed.

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