INVESTIGATION OF DIFFERENT ARRAY ARRANGEMENT OF MICROSTRIP PATCH ANTENNA AND IT PERFORMANCE AT 28 GHz FREQUENCY

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DEDICATION

I dedicate this thesis to my beloved Father

Juffri Bin Abdul Hamid

To the loving memory of my Mother

Rohani Binti Abu Bakar

And

To my lovely Grandmother

Som Binti Idris

ABSTRACT

Mobile technology is a rapidly grow technology which gives a huge impact towards society. The next generation of the mobile network which is 5 Generation bring many advantages such as better reliability, better data rate, network scalability and flexibility, better efficiency, amazingly fast, super real time and provide great service in crowded area. This project focusing on investigation of different array arrangement of microstrip patch antenna and it performance at 28 GHz frequency. The different arrangement gives different distribution and radiation pattern with. This project also wants to analyse on radiation pattern of multiport on the antenna and increase the gain performance up to 7dB according to standard ITU-R WP5D. In future work, this project will be more focus on microstrip patch antenna because to achieved the higher gain.

ABSTRAK

Teknologi mudah alih adalah teknologi pesat berkembang yang memberi impak besar kepada masyarakat. Rangkaian mudah alih yang baru adalah Generasi 5 yang membawa banyak kelebihan seperti kebolehpercayaan yang lebih baik, kadar data yang lebih baik, kebolehsekalaan rangkaian dan fleksibiliti, kecekapan yang lebih baik, sangat pantas, masa nyata yang lebih baik dan menyediakan perkhidmatan yang hebat di kawasan yang sesak. Projek ini memberi tumpuan kepada kajian terhadap bentuk susunan Antena Tompok Jalur Mikro dan prestasi pada jalur 28 GHz. Susunan yang berbeza memberikan corak edaran dan radiasi yang berlainan. Projek ini juga ingin melihat corak radiasi apabila pemacu pelbagai digunakan dan meningkatkan prestasi gandaan sehingga 7 dB mengikut standard ITU-R WP5D. Pada masa akan datang, projek ini akan lebih fokus pada Antena Tompok Jalur Mikro kerana untuk mencapai gandaan yang lebih tinggi.

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Secondly, I would like to take this opportunity to express my profound gratitude and deep regards to my supervisor for the Final Year Project I & II, Dr. Imran Bin Mohd Ibrahim for his exemplary guidance, monitoring and constant encouragement throughout the course of this thesis. The blessing, help and guidance given by him from time to time shall carry me a long way in the journey of life on which I am about to embark.

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CHAPTER 1

INTRODUCTION

In this project, we are investigating of different array arrangement of microstrip patch antenna and it performances at 28 GHz frequency. The problem statement of this project, recent developments in the era of low cost and compact communication system have largely been due to advent of small weight and size antennas that are capable of giving good output characteristics over a large frequency range microstrip patch antenna has become very popular and has attracted much attention towards the research because of these reasons compared with conventional antennas. This project will be simulated by CST.

1.1 Microstrip patch antenna

Microstrip patch antenna consist of an upper conductor of finite dimensions deposited on top of a dielectric substrate[1]. The amplitude of the of the surface current

that flow on the conductor becomes significant when the signal frequency is close to a resonance. The current patterns at the resonance are the corresponding Eigen functions, which are also called the resonant modes of the structure. Resonance starts to occur when the conductor size is order of a half-guided wavelength. In principle, an arbitrary shape of printed patch antennas can be used, although its analysis is complex. Basic shapes of printed patch antennas are rectangle, triangle, square, circle, ring, or ellipse.

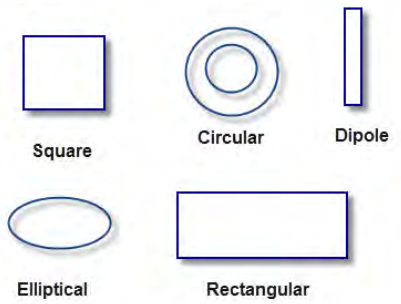

Figure 1.1 Different shapes of antennas.

1.2 Background study of 5G

5G is the next step in the evolution of the mobile communication[2]. It will be a key component of the Networked society and will help realize the vision of the essentially unlimited access to information and sharing of data anywhere and anytime for anyone and everything. 5G will therefore not only be about mobile connectivity for people. Rather, the aim of 5G is to provide ubiquitous connectivity for any kind of device and any kind of application that may benefit from being connected.

Mobile broadband will continue to be important and will drive the need for higher system capacity and higher data rates. But 5G will also provide wireless connectivity for a wide range of new applications and use cases, including wearables, smart homes,

traffic safety/control, and critical infrastructure and industry applications, as well as for very-high-speed media delivery.

Figure 1.2 5G contain all communication.

As opposed to earlier generations, 5G wireless access should not be viewed as a particular radio-access technology. Rather, it is an overall wireless-access solution addressing the demands and requirements of the mobile communication beyond 2020.

LTE will continue to develop in a backwards-compatible way and will be an important part of the 5G wireless-access solution for frequency bands below 6GHz. Around 2020, there will be massive deployments of LTE providing services to an enormous number of devices in these bands. For operators with limited spectrum resources, the possibility to introduce 5G capabilities in a backwards-compatible way, thereby allowing legacy devices to continue to be served on the same carrier, is highly beneficial and, in some cases, even vital.

In parallel, new radio-access technology (RAT) without backwards - compatibility requirements will emerge, at least initially targeting new spectrum for which backwards compatibility is not relevant. In the longer-term perspective, the new non-backwards-compatible technology may also migrate into existing spectrum.

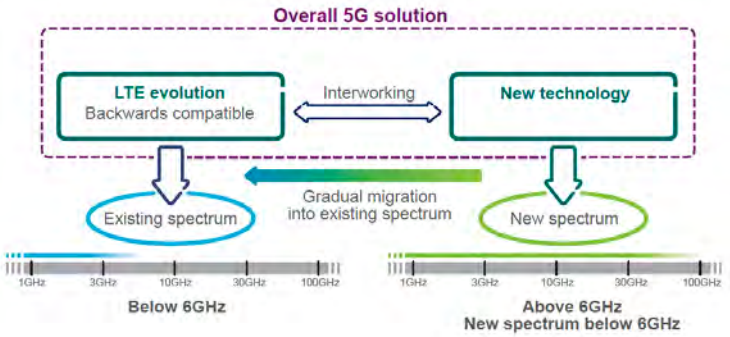

Figure 1.3 The overall 5G wireless-access solution consisting of LTE evolution and new technology.

Although the overall 5G wireless-access solution will consist of different components, including the evolution of LTE as well as new technology, the different components should be highly integrated with the possibility for tight interworking between them. This includes dual-connectivity between LTE operating on lower frequencies and new technology on higher frequencies. It should also include the possibility for user-plane aggregation, that is, joint delivery of data via both LTE and a new RAT.

1.3 Spectrum of 5G

In order to further extend traffic capacity and to enable the transmission bandwidths needed to support very high data rates, 5G will extend the range of frequencies used for mobile communication[2]. This includes new spectrum below 6GHz, expected to be allocated for mobile communication at the World Radio Conference (WRC) 2015, as well as spectrum in higher frequency bands, expected to be on the agenda for WRC 2019. It is still unclear what spectrum in higher frequency bands will be made available for mobile communication, and the entire frequency range up to approximately 100GHz is considered at this stage. The lower part of this frequency range, below 30GHz, is preferred from the point of view of propagation properties. At the same

time, very large amounts of spectrum and the possibility of very wide transmission bandwidths, in the order of 1GHz or even more, will only be available in frequency bands above 30GHz.

Thus, spectrum relevant for 5G wireless access ranges from below 1GHz up to in the order of 100GHz.

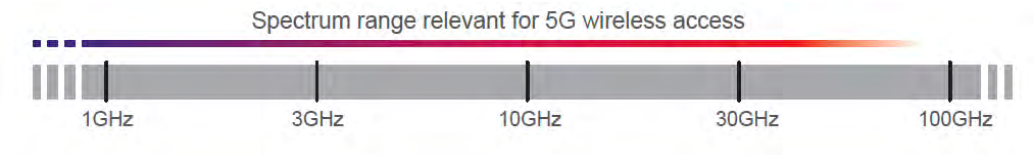

Figure 1.4 spectrum relevant for 5G wireless access.

Understand that high frequencies, especially those over 10Ghz, can only serve as a compliment, giving extra system capacity and very wide transmission bandwidths for extreme data rates in dense deployments. Lower frequencies will remain the spine for mobile-communication networks in the 5G era, providing ubiquitous wide-area connectivity.

1.4 Importance of 5G

Speed of delivery is not the only advantages of 5G over 4G which admittedly could be between 10Gbps and 100Gbps but the latency. Nowadays, 4G is capable of between 40ms and 60ms, which is low-latency but not enough to provide real-time response. To illustrate, multiplayer gaming requires a lower latency than that when you hit a button, the remote server responds immediately. Besides that, EE's Sutton, who said that 5G's prospective ultra-low-latency could range between 1ms and 10ms[1]. This would allow, he said, a spectator in a football stadium to watch a live stream of an

alternative camera angle of the action that matches what is going on the pitch ahead with no perceivable delay.

The other importance factor is capacity. As we know Internet of Things becoming more and more important over time, where smart gadgets and object employ smart, connected features that they have never had before, the strain on bandwidth will continue to grow. Initial ideas behind 5G is that an infrastructure will be in place to avoid that. It will be more adaptive to user's needs and demands and therefore able to allocate more or less bandwidth based on the application.

Table 1.1 Comparison of all generation of mobile technologies.

Technology Features	1G	2G	3G	4G	5G
Deployment	1970-1980	1990-2004	2004-2010	2010 >	2020
Data Bandwidth	2Kbps	64Kbps	2Mbps	100Mbps	> 1Gbps
Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Technology	Analog Cellular	Digital Cellular	CDMA 2000 (1 X RTT, EVDO)	Wi-Max LTE, Wi-Fi	WWWW

1.4.1 Internet of Things

By the year 2020, it is predicted by analysts that each person in the UK will own and use 27 internet connected devices. There will be 50 billion connected devices worldwide. These range from existing technology, such as tablets, smartwatches and smartphones, to cars, fridges, augmented reality (AR) specs and even smart clothes.