PERFORMANCE STUDY OF FLAT ANTENNA IN DIRECT BROADCAST SATELLITE (DBS) APPLICATION

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of the Degree of Master Engineering
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To my beloved parents…

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ABSTRACT

A flat antenna is proposed for the Direct Broadcast Satellite (DBS) reception. The flat antenna which is high efficiency and high gain planar antenna comprises many small antenna elements in its surface. Radial Line Slot Array (RLSA) antenna is one kind of the flat antenna which is another alternative feature that can be use to replace the conventional parabolic antenna. This project involves the study of the characteristics effects of the flat (RLSA) antenna by developing the test-bed for calibration between the DBS receiver and the flat (RLSA) antenna for Direct Broadcasting Satellite (DBS) application in Ku band frequency. In order to evaluate the performance of RLSA antenna in the setup, one of the conventional components e.g. using offset parabolic antenna, that is provided by ASTRO broadcasting company and another one is replace the offset antenna with RLSA antenna test-bed respectively. The performance result had been compared which is given by the manufacturer to show that the RLSA antenna is comparable to the commercially offset parabolic antenna.

ABSTRAK

Antena rata telah dicadangkan dalam tujuan penerimaan isyarat satelit penyiaran langsung (DBS). Antenna rata ini terdiri daripada banyak antena kecil pada permukaannya yang menjadikannya sangat effisen dan mempunyai gandaan yang tinggi. Antena “Radial Line Slot Array (RLSA)” adalah salah satu daripada golongan antena rata yang dapat menggantikan antena parabola. Projek ini melibatkan penyelidikan terhadap ciri-ciri antena rata melalui eskperimen dalam makmal yang disediakan dan juga melaksanakan ujian dasar penerimaan siaran satelit langsung (DBS) dalam julat Ku supaya penyelakuan sistem ini dapat dijalankan. Untuk memudahkan perbandingan di antara antena parabola dengan antena rata, dua ujian dasar penerimaan siaran satelit langsung (DBS) akan dilaksanakan untuk dua antena masing-masing. Segala keputusan akan dicatat dan dibanding dengan data yang diberi oleh pihak pembuatan (Astro) untuk membuktikan bahawa keupayaan antena rata adalah setanding dengan antena parabola.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Figure 1.1 illustrates the technology of the flat antenna in variety of applications in almost all bands of frequency due to its producing to high efficiency over relatively wide bandwidth at low cost and then being treated as an alternative to other volumetric reflector antennas [1]. For example, one of the commercial applications has included fixed terrestrial & satellite distribution network such as Multichannel Multipoint Distribution Service (MMDS) at S-band, local Multipoint Distribution Services at Ka-band (LMDS) use the flat antenna at the moment.

In Malaysia, of course, the Direct-to-Home (DTH) TV program has been operated for several years which provided by ASTRO. This type of broadcasting is via the satellite which operates in Ku-band frequency, and need very high gain of antennas in order to receive the signal from the satellite. The most common used is the standard parabolic antenna or offset parabolic antenna for reception. At the mean time, these two antenna posts a drawback where the primary feed parabolic dish has an aperture blockage at the center of the dish thus will reduce the antenna efficiency. Offset antenna is proposed to solve the primary feed dish problem, but somehow the longer feed which susceptible to physical damages as its feed significantly exposed from the body of the reflector. Furthermore, the latter design, the alignment procedure is quite involved [2].

A more beneficial design is the Radial Line Slot Array (RLSA) type antenna. An advantages of this antenna include its high radiation efficiency, low profile because it can be mounted at roof and wall, installed easily, feed rear-mounted, not subjected to leaf and water build-up due to its flat structure. Furthermore, it also posts the high gain which falls into the range of requirement of gain for Direct Broadcast Satellite (DBS) application which is between 32-37dB for the receiver in the range of 12 GHz frequency.

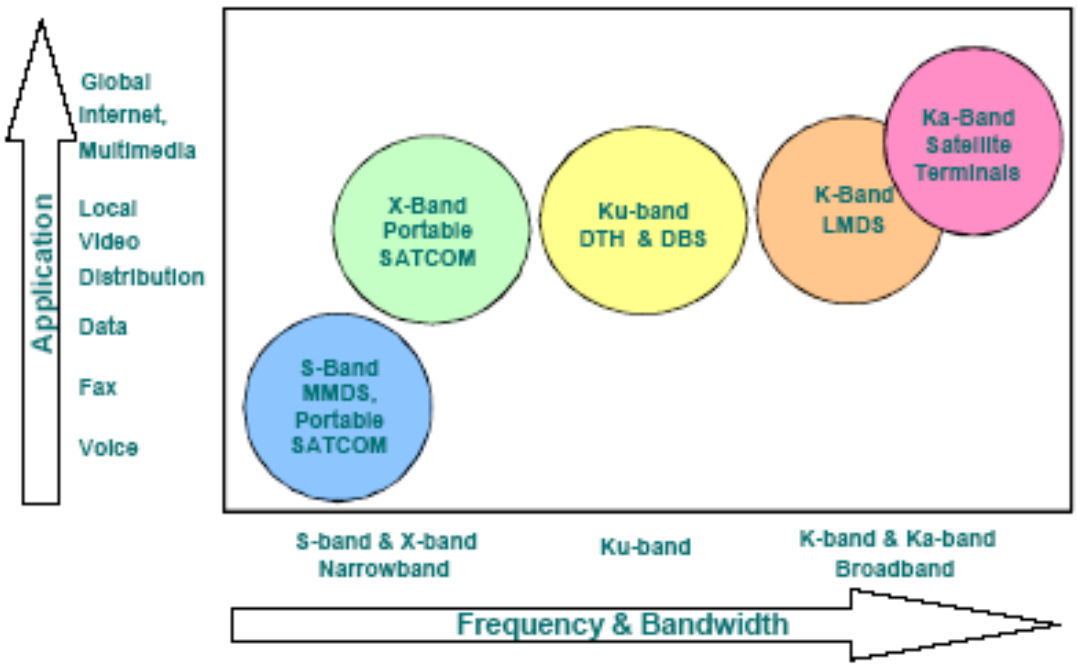

Figure 1.1: Flat Antenna Technology Application [1]

1.2 Project Objectives

This RLSA antenna research can be divided into several major sections. As such, develop the prototype using variety of material. Besides, invent the variety new technique such as reflection canceling slot and beam squinted design for the RLSA antenna. Another research involved antenna performance measurement and setup of test bed for DBS application. This title is involved the investigation of characteristics effect of the flat antenna and develop test bed for calibration between the direct broadcast satellite device and the flat antenna for DBS reception.

1.3 Project Scope

This research work involves investigation of the characteristics of flat antenna and all the measurement results as well, such as radiation pattern, and Standing Wave Ratio (VSWR). The major scope is to develop a test-bed by setting up all the requirements for the devices in order to perform a calibration to the broadcast satellite receiver with the flat antenna and measure the performance of the system. At the same time, the characteristics or specification of the MEASAT satellite is explored by investigating its location and the Effective Isotropic Radiated Power (EIRP) in order to identify the signal reception strength for different location in Malaysia. The flat antenna is expected to be compatible with the broadcast satellite receiver at the end of the research. At the end of this project, the hardware configuration of the DBS application and the flat antenna performance is identified.

1.4 Project Methodology

This project generally is divided into two major parts which consists of report writing and the experimental testing approach or test-bed development which is illustrated by Figure 1.2 and Figure 1.3 respectively. Before preceding any progress of this project, the data, which is related to this scope, had been collected from time to time. All the data has been analyzed in order to produce the useful information for report writing later on. Consequently, with all the information available has been arranged accordingly. The final step before finalizing the report is to combine the experimental results to enhanced readability of the report.

The second part of the flow chart is illustrated by Figure 1.3 above. Firstly, obtain the specific data of MEASAT satellite in terms of EIRP (Effective Isotropic Radiation Power), operating frequency for DBS application, footprint coverage in Malaysia. All this data can be obtained directly from internet or the company in charge because all the specification is fixed. Secondly, performing the investigation of flat antenna parameters will be carried out in laboratory particularly obtaining the VSWR, radiation pattern, gain, and beamwidth. These data are required for calibrating process whether the specification of flat antenna is matched with the criteria of satellite before developing the test-bed for DBS application. After all requirements are ready, the test-bed of the DBS application is being developed for the performance study of flat antenna in DBS application. All the measurement results will be recorded and reclassify if necessary to make readability and will be compared with the market antenna.

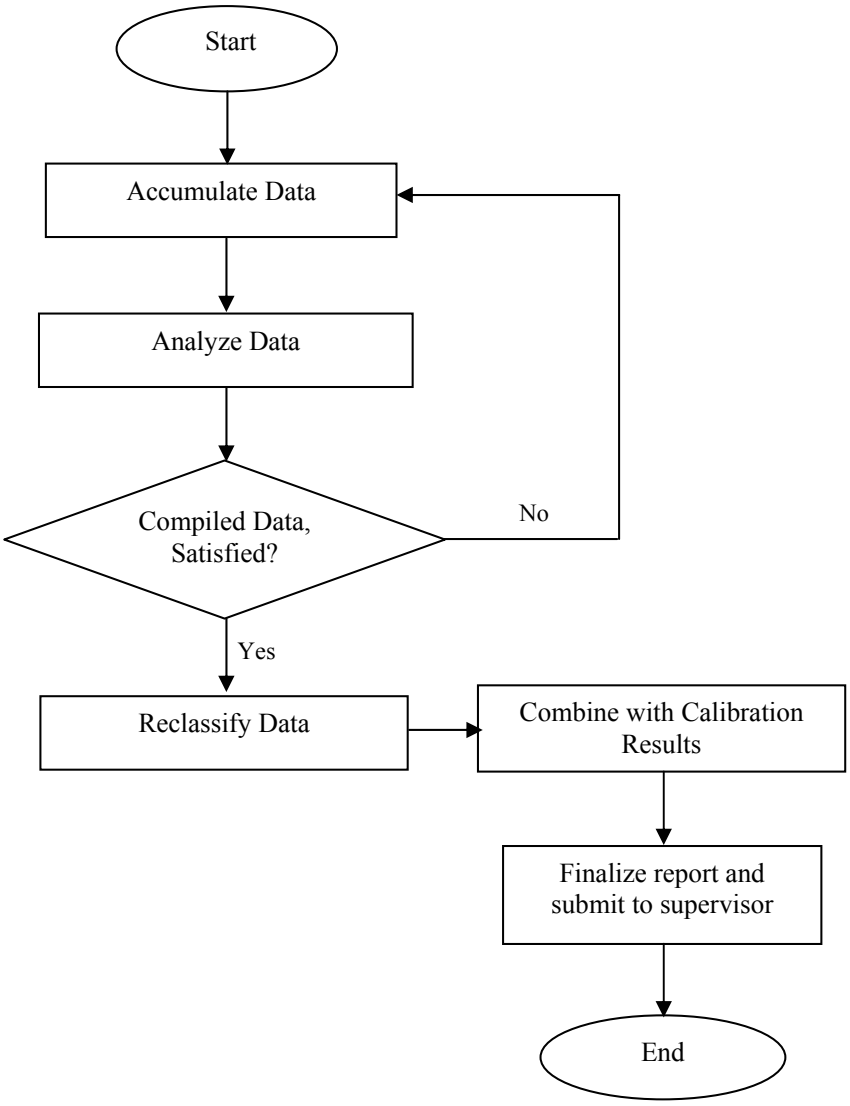

Figure 1.2: Flow chart for report writing

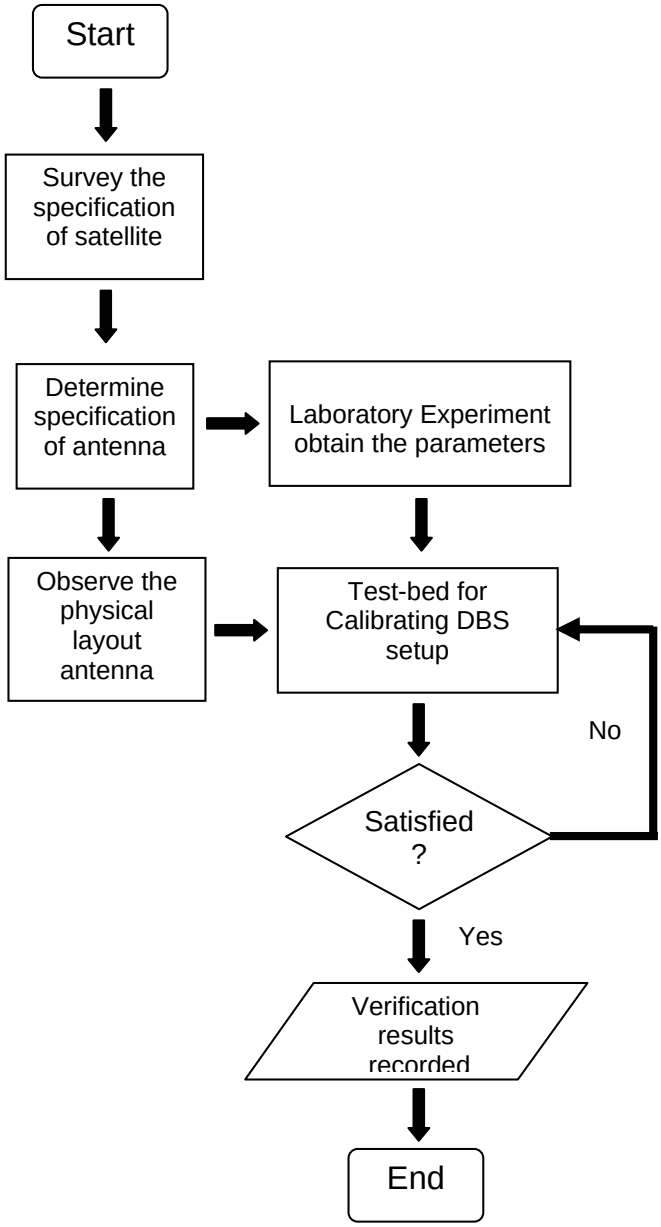

Figure 1.3: Flow chart for calibration device DBS Application

1.5 Thesis Outlines

This thesis is organized into 5 chapters to cover completely the research work for this specific title entitled the performance study of flat antenna in DBS application.

In Chapter 1, some background and history of flat antenna technology, especially in DBS application, have been covered briefly. Besides, the author also includes the project objectives and project scope of doing this thesis. Lastly, the flow chart which shows how to carry out the work task also has been included in this chapter.

Some research and reading of the general characteristics of the antenna has been discussed in the Chapter 2 which is related to the parameter of the measurements later. Apart from that, the function of satellite subsystem had been discussed. Besides, the general layout for DBS also has been discussed in this chapter as well.

Chapter 3 presents the laboratory investigation of RLSA antenna. Through this chapter, author has included the procedure how to perform the measurement by using the specific device which is available in the Wireless Communication Centre (WCC) particularly return loss measurement, VSWR measurement and radiation measurement. The results for the measurement will discussed at the end of this chapter in order to evaluate the performance of RLSA antenna.

Chapter 4 discusses the development of the test bed for DBS application. From this chapter, author will briefly describe which component is needed to establish the test bed for DBS application. Besides, the function of each component will be explained in this chapter. Lastly, the performance study of the test bed from conventional and the RLSA antenna will be evaluated in this chapter.

As a conclusion, all work tasks has been summarized and will be discussed and the future work also has been included to enhance the recent work.

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Direct-broadcast satellite. From Wikipedia, the free encyclopedia. For the Japanese communication satellites, see Broadcasting Satellite (Japanese). A DTH dish antenna mounted on wall. A direct-broadcast satellite (DBS) is a type of artificial satellite which usually broadcasts satellite television signals for home reception.[1]. The type of satellite television which uses direct-broadcast satellites is known as direct-broadcast satellite television (DBSTV) or direct-to-home television (DTHTV).[2] The term "direct broadcast" is used to distinguish satellites which transmit radio or t Direct broadcast satellite (DBS) reception requires a circularly polarized antenna with high gain and low axial ratio. Recently, various types of planar antennas have been studied and developed for DBS reception in the 12-GHz band. A summary is presented of properties and classification of planar antennas both commercialized and reported. The basic configurations, working principles, and performance of various planar antennas are described.< > Published in: IEEE Transactions on Broadcasting (Volume: 34 , Issue: 4 , Dec. 1988). Page(s): 457 - 464.