CHAPTER 1

INTRODUCTION

1.1 Background

There is a growing interest in providing broad-band services through local access networks to individual users. Millimetric-wave radio solutions are considered as the optimal delivery systems for these services. They are termed as broad-band wireless access (BWA) systems or local multipoint distributed services LMDS. (Panagopoulos *et al*., 2002).

The new broadband networks and services are developed continuously to serve the different demands, e.g., Internet, mobile Internet, broadcasting, telephony, e-commerce, Video on Demand, etc. Point-to-multipoint wireless system could be a promising solution to connect the users to the backbone network instead of broadband wired networks because of its cost efficiency, easy and fast installation, and re-configurability; however due to the time and location variable channel conditions the system should apply fade mitigation techniques to reach the quality of service requirements. (Sinka and Bito, 2003).

The Ka (20/30 GHz) and V (40/50 GHz) frequency bands are becoming increasingly attractive for user oriented future commercial satellite services, due to their large available bandwidths. However, they suffer more from rain fades in comparison to the almost congested Ku (12/14 GHz) band. Therefore, prediction models for annual rain attenuation, such as the ones developed by several research groups over the past three decades are required to provide guidance in the course of balancing availability requirements and cost. (Panagopoulos *et al*., 2002).

To combat rain attenuation, several fade mitigation techniques have been developed such as diversity protection schemes, power control and adaptive processing techniques. Among these techniques, the most efficient is site diversity (SD). SD takes advantage of the spatial characteristics of the rainfall medium by using two earth stations to exploit the fact that the probability of attenuation due to rain occurring simultaneously on the alternative Earth-space paths is significantly less than the relevant probability occurring on either individual path. (Panagopoulos *et al*., 2002).

Though the cost effectiveness of SD remains questionable, the interest on SD has been renewed, due to the significant reduction of ground terminal antennas and other hardware sizes. Nowadays, terminals can be installed in customers' premises and the use of public terrestrial networks to carry out signaling seems possible. (Panagopoulos *et al.,* 2002).

A rain-cell degrades the system performance at a part of the service area but the rain can improve the carrier-to-interference ratio C/I conditions elsewhere depending on the locations of the Base Station, Terminal Station and the rain-cell. Interference fluctuation is a very important thing in LMDS network planning procedures, which needs countermeasure techniques to avoid degradation of the quality of service. (Sinka *et al*., 2002).

From the pervious paragraphs, it is clarified that the problem statement of this project indicates that the high availability of LMDS can not be obtained under rain effects, so site diversity should be suggested as one effective means to overcome rain fading.

1.1 Objective of the Project:

The main objective of this project is to study the effects of site diversity in LMDS under rainy conditions in Malaysia.

1.2 Scope of the Project

The scope of this project includes:

- To analyze the effects of a moving rain cell over an LMDS system
- This study includes calculation of Rain Attenuation in a given LMDS system.

1.3 Methodology of The Project

To carry out this project, the following methodology is designed as the following steps:

- Establishing of LMDS Network:

  By determining

  - Frequency used and sectorisation
  - Structure of system (BS & TS)
  - Distance or cell size

- Calculation of Rain Attenuation based ITU-R Model by using Rainfall rate of different locations over Malaysia in order to cover all Malaysia region weather and therefore the study can be generalized to include the regions that have the same climate (tropical climate weather).

- Analyzing of Rain cell Movement within LMDS, this is done by taking all possibilities or terminal station situations over LMDS area and effect of Interference signals.

- Site Diversity Implementation, this step is done according to the previous studies related to LMDS system.

1.5 Thesis Outline

The layout of this report is as follows, chapter one includes a brief general background of LMDS system and rain attenuation. The objective of this project is clearly stated. The research scope and methodology are presented.

Chapter two is the first chapter of the literature review, presents the Local Multipoint Distribution Service Systems and its specifications and components as will as rain fading and its effects on the signal, also this chapter includes steps to calculate rain attenuation.

Chapter three shows the concept of Site Diversity system and expressions which are used to describe the performance of the site diversity. This chapter explains brief details about how to implement site diversity in LMDS system during rainy conditions and some parameters to express site diversity.

Chapter four represents the methodology of this project, including the details of how to establish LMDS, rain attenuation calculation, effects of rain over LMDS area and site diversity implementation are presented.

Chapter five presents the whole results of this work and discussions of these results as well as some of analyses. The results include specific rain attenuation, rain attenuation and different LMDS cell sizes with and without site diversity. Comparisons and simulations of these results are also presented.

Chapter six contains summary, conclusion and the recommendations or future work which are presented based on the obtained results.