System Development For Low Cost Data Acquisition For Mobile Satellite Signal Performance Measurement In Low-Latitude

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Abstract: Mobile Satellite (MS) Signal performance is affected by many factors such as ionospheric effect, multipath fading tree-shadowed and building-shadowed. These cause variations in the received signal quality. Although many studies have been carried out in order to improve the performance of MS signal, there are still many areas lacking data especially from the less-developed and developing countries. Furthermore, costly data acquisition method hinders more study to be carried out in these regions. This paper discusses the cost effective alternative method for MS data acquisition for satellite operating in the L-band by utilizing the GPS satellites data. Details methodology for doing the experimental works will be discussed. The measurements of the signal performance are performed for open space environment in Sarawak. The analysis of the signal performance under different MS environments is performed with respect to the information such as elevation and azimuth angles. The analysis produced forms an important part in the studies of the signal performance. From this research work, we characterized the MS received signal for Sarawak.

Index Terms: GPS, Mobiles Satellite, Sarawak, Hyper-terminal intercept, Cost-effect.

1 INTRODUCTION

MOBILE Satellites (MS) in communication system has become a vital part in human daily life as these can be seen from the number of antennas or parabolic dishes which are fixed in many homes for the television broadcast services. Besides, satellite also play an essential part such as navigation and position allocation, terrain observation, weather monitoring, deep-space exploration, remote sensing and others, as stated [1-3]. The ionosphere is a partially ionized region of the earth's upper atmosphere that extends from roughly 60km to 1000km in altitude, as discussed [4]. The ionization modifies the refractive index of the neutral atmosphere and when it becomes structured or turbulent, can cause strong scintillation of radio waves passing through the disturbed region. If sufficiently intense, these fluctuations can dramatically impact the performance of space based communication and navigation systems [5]. Ionosphere consists of D, E and F layers of varying ion density with the increasing of the altitude, as stated in [6]. The schematic representation of the electron density is shown in Figure 1.

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The density of charged particles in the ionosphere changes from day to night as the production of ions requires direct solar radiation. D layer is at the low altitude and E regions are weaken compare to F region [7] as they only present during day and disappear at night where F region is present both day and night. F2 layer has the highest electron densities of the normal atmosphere and electron densities remains higher at night than in the D and E layers. Ionospheric effects include Faraday rotation and ionospheric scintillation as mentioned by Ippolito and others [8-10]. Communication satellites function as a microwave repeater station for the exchanging of information between the users in different forms [11]. However, Global Positioning System (GPS) is best known as a worldwide positioning system and the main purpose is to provide accurate positioning location at all points on the earth's surface at all times [12-13]. It is intended mainly for military defense purposes but the civilian community now constitutes the bulk of users. The GPS signals consist of carrier frequencies such as; L1:1575.42MHz (0.19029m wavelength) C/A-Code (Code acquisition) and L2: 1227.60MHz (0.24421m wavelength) which normally controlled by the Military users with basic signal of higher precision [14-16], Table I gives the summary of the frequency bands [17-18]. The satellites constellation comprises 24 satellites such that at least 4 satellites are visible everywhere on earth at any time. The orbits are essentially circular at an altitude of about 20,200km, with orbital inclinations of 630° and with 12h (sidereal time) duration [19]. The 24 satellites constellation is shown in Figure 2, as stated [20-21]. In order to provide accurate data and cost effective, a simple and low cost data acquisition system experiment can be used to carry out measurement for different mobile satellite signals. The signal performance of the MS is affected by factors such as ionosphere effect [22], tree-shadowed, building-shadowed and multipath, but this paper only focuses on the satellite signals for an open space environment in which the arriving satellite signal does not experience significant fading effect due to trees or building. Handheld receivers are used for positioning and geo-catching [4] using DGPS-service or WASS/EGNOS signals. This position is realized using code pseudo-range [23-26]. By using Garmin handheld receiver the phase and code information may be transformed in real time on a computer and stored in text file. Some experiment works have been carried out in