PREFACE
As lower microwave frequency bands become saturated with users, there is a motivation for the development of applications that utilize higher frequencies, especially in the microwave and millimetric wave range. Various high frequency digital wireless communication applications in the high frequency band, are in the process of development for providing inter-satellite links, collision warning systems, road monitoring systems, railroad communication systems, military field applications etc. The wireless communication system uses wireless channel as the medium of communication. The signal propagating through this wireless medium is very effective to environment through which it propagates and the atmospheric effects of the propagating medium.

The major difficulties for a signal in the high frequency band are atmospheric absorption and phase dispersion by gases, water vapour and raindrops. Due to its magnetic dipole moment, the gaseous molecule absorbs power and causes phase dispersion of an electromagnetic wave. Although attenuation due to atmospheric gases at sea level is around 5 dB/km, experts in industry are utilizing the attenuation to minimize interference between channels. However, with wideband digital signals, phase dispersion may cause parts of a digital waveform to fall into neighbouring time slots (either the previous bit or the next bit), causing inter-symbol interference (ISI).

Previous research on microwaves and millimetric signals focussed on how much attenuation due to Atmospheric gas such as oxygen exists in the link. But a look at the physical properties of atmospheric gases reveals the reason why atmospheric gases absorb electromagnetic waves and how pressure affects atmospheric gases. Atmospheric gases resonate at high frequency due to transitions among its three closely spaced rotational states. These transitions, combined with the magnetic dipole moment of atmospheric gases, cause attenuation and phase dispersion in electromagnetic waves.
At lower pressures, the individual resonance lines of atmospheric gases appear in the attenuation and the phase dispersion plots. As pressure increases, the resonance lines broaden and contribute to neighbouring resonant lines. The effect of attenuation and phase dispersion in a wideband signal becomes greater at lower atmospheric pressures, which results in signal distortion. The signal distortion leads to a number of bit errors and results in the presence of inter-symbol interference (ISI) in the received signal.

Another major issue for the high frequency transmission is the propagating medium taken for transmitting the data. The wireless channel presents an impulse effect on the transmitted signal, which brings down the accuracy rate for the communicating system. Because of the possible variability in locations that the system can be deployed, it is necessary to find the most useable channel at the site as quickly as possible. Because of the random nature of channels, channel models are statistical. The models act as filters to incoming waveforms. More specifically, the models or channel impulse responses are the resultant waveforms if a single ideal impulse is sent through the system. If the channel is not a Free LOS path, there may be some distortion of the signal at the receiver due to attenuated, time-delayed and phase shifted replicas of the transmitted signal.

In the areas where LOS does not exist, radio paths are called shadowed. Vegetation, buildings, or other objects blocking the path between the transmitter and the receiver cause shadowing. Radio waves that cannot go from the transmitter site to the receiver site directly may bounce and cause signals to arrive at delayed times. The radio wave can be reflected, scattered or absorbed by the various objects it meets. Many studies have focussed on methods of enhancing the propagation of signal in microwave range. One more investigating factor in high frequency radio wave communication is the effect of the reflected paths and scattering in the communication system.
The aim of this research is to determine the effect of propagating medium for millimetric and microwave range wireless communication. The effect of wireless channel impulse, the path of propagation and the atmospheric effect on these signals are explored. This research work mainly focusses on the study of how propagation link and atmospheric gaseous molecule causes attenuation, phase dispersion and group delay in the link, as well as how it affects a wideband digital signal.

The Thesis is presented in nine chapters;

Chapter I: This chapter presents an introduction and overview to the high frequency wireless communication systems and associated problems for propagation in millimetric and microwave range. A special reference to various operating modes of high frequency communications is presented in this chapter. Indian Satellite communication system is explained. The various propagating modes are explained.

Chapter II: This chapter provides an introduction to microwave and millimetric wave propagation. The effect of rain, fog and atmospheric gasses on micro wave and millimetric wave are studied. The phenomena of scattering, refraction, multi path are studied.

The sampling swept time delay short pulse wireless channel sounder is used to study the power delay profiles of different systems. BER Vs Eb/No for different systems are studied.

Chapter III: This chapter presents local multi point distribution service. The main features of ray tracing model are presented, the variation of path loss with distance in LOS and NLOS are studied.

Chapter IV: This chapter presents the effect of Oxygen on microwave and millimetric wave propagation. Attenuation of Oxygen on 28 to 33 GHz signal at
different pressures such as 1013 mbar, 310 mbar and 75 mbar are studied. The phase dispersion and group delay in the link are studied. The eye diagrams with and without Oxygen in the link with variable data rates are studied.

Chapter V: This chapter presents the design and measurement of scatter phenomena. The purpose of data collection measurement are to test the channel sounder and to study the scattering phenomena of obstacle in the 28 – 33 GHz band.

Chapter VI: The data processing procedure and the analysis of channel impulse response are presented in this chapter. The reading details used for these studies are collected from MCEME, Hyderabad. The processing is done using MATLAB.

Chapter VII: This chapter presents the measurement and analysis of scattering phenomena of two surfaces (smooth and rough) with variation of angle of incidence and the distance between the transmitter and the receiver. Power delay profiles for different setups are presented.

Chapter VIII: This chapter presents the variation of reflected pulse width, excess delay, excess pulse width with the angle of incidence for the smooth and rough surfaces. This variation is studied at 3 dB, 10 dB power levels. The variation of the reflection co-efficients with angle of incidence for smooth and rough surfaces are presented.

Chapter IX: This chapter provides the summary and conclusions of the research work.

The results presented in the Thesis has been carried by the author in the Department of Physics, S K U P G Center, Kurnool under the direction and supervision of Prof. D Punyaseshudu.