



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS**

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SHORT ABSTRACT

To be able to connect wirelessly to the internet is nowadays a basic part of daily activity and the number of wireless devices accessing wireless networks are increasing rapidly. However, the significant growth in the number of wireless devices along with the development of new high-rate applications and scarcity of microwave frequency spectrum are the major challenges. A promising way to increase the amount of available bandwidth is to utilize the higher frequency spectrum. Ultra-wideband (UWB) and Millimeter wave (mm-Wave) are the potential technologies for high-rate and short distance wireless communication. Both technologies have received great attention due to the license-free utilization of wide available frequency spectrum. Apart from the benefits, wide frequency spectrum has introduced few additional challenges in the typical Saleh-Valenzuela (S-V) channel model. One of the challenges in the modified S-V channel model is the distribution of multipath gain coefficients are lognormal rather than Rayleigh. As we know that, a lognormal random variable has no closed-form expressions of its cumulative distribution function, moment generating function and characteristic function, which are required to find the closed-form BER expression of wireless systems for such channels. For this reason, a lot of research has to be conducted to find the computable BER formulae for such wireless communication systems. Therefore, the thesis focuses on the derivation of computable BER formulae of UWB and mm-Wave wireless communication systems. Firstly, we present an approximate model of a square of lognormal shadowing by a Mixture of Gamma (MG) distributions by using a moment-matching with non-linear curve fitting method. Using this approximation, we derive the characteristic function based computable BER formula of UWB system over the IEEE 802.15.3a channel model. Secondly, we derive an expression of BER for transmit antenna selection with maximal ratio combining (TAS/MRC) scheme based UWB-MIMO system, where the parameters of MG approximation are estimated by using the Expectation Maximization algorithm. Third, we evaluate the average BER for relay based UWB and LR-UWB systems over the IEEE 802.15.3a and the IEEE 802.15.4a channel models, respectively. In the analysis, each node is equipped with multiple antennas and the antenna selection scheme is performed at the source and the relay nodes. Next, we analyse the performance of antenna beamforming based mm-Wave MIMO system over the IEEE 802.15.3c channel at 60 GHz band. Besides, we show the impact of Rake's fingers on the BERs and suggest the sufficient number of Rake's fingers required to capture the maximum signal energy carried by multipath components in the various channel environments. We also show the effects of various parameters of the UWB and mm-Wave channel models on the performance. All the derived analytical expressions reported in this thesis are validated by the Monte-Carlo simulation results.