Abstract

The Federal Communications Commission (FCC) assigned 7.5 GHz (3.1-10.6) GHz ultrawideband (UWB) for unlicensed use in February 2002. Since then, UWB technology has become a promising candidate for future indoor wireless communication. Characteristics such as wide impedance bandwidth, fractional bandwidth more than 20% and low power emission limit of -41.3 dBm/ MHz has generated countless opportunities to design high data rate UWB communication systems. As a pivotal component of the UWB system and with an increasing demand for smaller wireless devices, the UWB antenna must be compact in size with wide impedance bandwidth and omnidirectional radiation pattern. To use the wide bandwidth efficiently, segmentation of the UWB into multi-band operation is an important need of wireless indoor devices.

The thesis focuses on the study of various novel UWB antenna designs using monopole, slot, defected ground structure and fractal techniques for UWB operation and converting the wide band into multi-band operation. All UWB antenna designed are developed with a small ground plane and various shaped radiating patches. Various novel techniques of band-notch filter designs viz. open ended slot, extended ground plane, a rectangular C-shaped ground plane, and an electromagnetically coupled parasitic patch to achieve wide notch bandwidths across the UWB. The wide notch band characteristic does the segmentation of the UWB and avoids potential interference from existing wireless narrow bands. The notch band structures evade the need to use multiple frequency notch structures in the antenna design, thus making the antenna geometry simple.

Compact UWB and multi-band antennas have been investigated for wide impedance bandwidth. The designed UWB antennas have been simulated with 3D electromagnetic software Ansoft HFSS v.11 in the frequency domain and their investigation is carried out with respect to -10 dB impedance bandwidth, voltage standing wave ratio (VSWR $\leq$ 2), gain, and radiation pattern. These UWB antennas are fabricated and tested in an anechoic chamber with vector network analyzer for their practical use. The investigated antennas are made compact by 20% to 80% size reduction compared with reported research with respect to substrate dimension. The investigated antennas will not only suit integration with microwave integrated circuits but also overcome the potential interference of existing narrow bands.