Chapter 2
Developments in Efficient Antenna Designs Using EBG Structures

Naveen Jaglan
Jaypee Institute of Information Technology, India

Binod Kumar Kanaujia
Jawaharlal Nehru University (J.N.U.), India

Samir Dev Gupta
Jaypee Institute of Information Technology, India

Shweta Srivastava
Jaypee Institute of Information Technology, India

ABSTRACT

Since 2002, when the Federal Communication Commission (FCC) released the bandwidth 3.1-10.6 GHz, there has been increasing interest in the use of UWB systems because of their low power consumption, low cost, precise positioning and promising candidate for short-range high-speed indoor data communications. Planar circular monopoles like designs are a good example for UWB applications due to their merits such as ease of fabrication, Acceptable radiation pattern, and large impedance bandwidth. However, some narrowband systems also operate in this frequency like WiMAX, WLAN and X-Band satellite downlink communication band etc. cause interference in UWB range. To overcome any interference with these systems it is desirable to design UWB antenna with band notches. However, most techniques of obtaining notches uses antenna design specific approaches therefore EBG structures can be used to obtain single and multi-notch antennas. The technique used for obtaining notches using EBG is antenna design independent and can be applied to most of the antennas without compromising antenna performance.

INTRODUCTION TO MICROSTRIP ANTENNAS

An antenna is defined as the structure used with the region of transformation between a directed wave and a free space or vice-versa. When discussing any antenna, one usually describes its properties as a transmitting antenna. From the reciprocity theorem in antennas one can conclude that the radiation pattern of receiving antenna is identical to the transmitting antenna provided nonlinear or unilateral

DOI: 10.4018/978-1-5225-0773-4.ch002

devices are not employed with antenna structures. The idea of microstrip radiators was first introduced by Deschamps (Deschamps, 1953). Microstrip antennas development increases during 1970s because of availability of various substrates with desired thermal and mechanical properties, advances in photolithography and improved analytical antenna design models. The first practical microstrip antenna was proposed in (Bahl & Bhartia, 1980; Munson, 1974; Howell, 1975). Since practical antenna development continuous efforts are being made to explore various advantages of patch antennas like light weight, low cost, low volume, conformability, compatible with integrated circuits etc. The review of much of the work done initially on microstrip antennas can be found in (Carver & Mink, 1981; Garg & Bhartia & Bhal & Ittipiboon, 2001; Kumar & Ray, 2003; Pozar, 1992; Wong, 2002).

ADVANTAGES AND DISADVANTAGES OF MICROSTRIP ANTENNAS

Microstrip antennas have several advantages over traditional microwave antennas over the whole frequency range from ~100 MHz to ~100 GHz. Some important advantages are low volume, light weight, conformability, cheap fabrication for mass production, easy to achieve different polarizations with antenna feed; multi-frequency operation can be achieved, easy to integrate with integrated circuits and easy to fabricate feed lines with antenna itself. These antennas have high performance because a huge number of matching elements, power dividers, and phase shifters can be added without any cost enhancement. Microstrip array is very reliable because traditional antennas may fail at the points of interconnections where as microstrip antenna entire array is made on continuous sheet of copper. However these antennas have some limitations like narrow bandwidth, lower gain and large ohmic loss in antenna array feed structures, mostly radiates in half space, poor end fire radiations, radiations from feed and junctions, low power handling capability, mutual coupling among individual elements in antenna arrays, higher levels of cross-polarization and excitation of surface waves in antenna substrates.

Applications of Microstrip Antennas

With tremendous being research done on microstrip antennas today the advantages of microstrip antennas exceeds far more than its disadvantages. Initially Microstrip antenna's use was limited to systems such as rockets, aircrafts, smart weapons, missiles and satellites. Today, because of tremendous ease of fabrication process and availability of good substrates these antennas are being used in commercial applications (Huang, 1995; Lee & Chen, 1997) and are expected to replace traditional antennas for most of applications. Some of the important applications of microstrip antennas are in mobile and satellite, Global Positioning Systems (GPS), Direct to Home (DTH) applications and in medicines for treatment of hyperthermia.

Feeding Methods in MPA

The five most commonly used feeding techniques in antenna design are microstrip line, proximity coupling, aperture coupling, co-planar waveguide feed and coaxial feed shown in Figure 1(a),Figure 1(b),Figure 1(c),Figure 1(d) and Figure 1(e).