Multi-Band Antenna for Different Wireless Applications

Multiband antennas may have lower-than-average gains or be physically large in comparision to single-band antennas in order to accomodate the multiple bands.

A multiband antenna that operates over the hepta-band in LTE/GSM/UMTS services. The proposed antenna consists of a folded-loop and a meandered planar inverted-F antenna (MPIFA) with an additional branch line. The folded-loop antenna operates at the high-frequency band covering GSM1800 (1710–1880 MHz), GSM1900 (1850–1990 MHz), UMTS (1920–2170 MHz), LTE2300 (2305–2400 MHz), and LTE2500 (2500–2690 MHz), and the MPIFA with an additional branch line covers the low-frequency band, including GSM850 (824–894 MHz) and GSM900 (880–960 MHz) [2–6]. The proposed antenna satisfies the 6 dB return loss bandwidth in all operating frequency bands and exhibits near-omnidirectional radiation patterns.

With the rapid growth of the wireless mobile communication technology, the future technologies needs a very small antenna and also the need of wide band and multi band antenna is increased to avoid using two antennas. Microstrip patch antenna is promising to be a good candidate for the future technology. Microstrip patch antenna consists of a dielectric substrate, with a ground plane on the other side. Due to its advantages such as low weight , low profile planar configuration, low fabrication costs and capability to integrate with microwave integrated circuits technology, the microstrip patch antenna is very well suited for applications such as wireless communications system, cellular phones, pagers, Radar systems and satellite communications systems.

The design of compact planar multiband antennas intended for existing wireless services including LTE, GPS, GSM, PCS, DCS, GPS, UMTS, WLAN and WiMAX bands. The present techniques available in the open literature include the modification of the main radiator via bending, folding, meandering and wrapping. Each approach offers different advantages, depending on the required application. The constraint for the lower band generation is the main challenge in radiator miniaturization. The quarter wavelength radiator that is subjected to miniaturization may suffer from limited bandwidth and low radiation efficiency. An alternative approach which relies on modifications to the ground plane is a promising technique, which often has been previously overlooked by antenna designers. The introduction of a ground slot in a finite antenna ground plane can be further extended to include reconfigurable features. Thus, such antennas that are compact and have multiband capability can be promising candidates for many wireless applications.

Antennas for wireless communications are commonly developed in the form of passive planar structures, which consist of a main radiating element, a supporting ground plane, a supporting substrate, and a feeding structure. The design configurations, sizes and type of substrates will depend on the desired frequency of operation and its radiation performances. Nowadays, planar antennas for wireless devices are mainly constructed using printed planar technology. Fundamentally, the small antenna design is based on the configuration of a monopole. Following the expansion of research on antenna design, the monopole configuration started to change, forming many alternative designs such as the popular planar inverted-F antenna abbreviated as PIFA and coplanar inverted-F antenna abbreviated as CIFA.

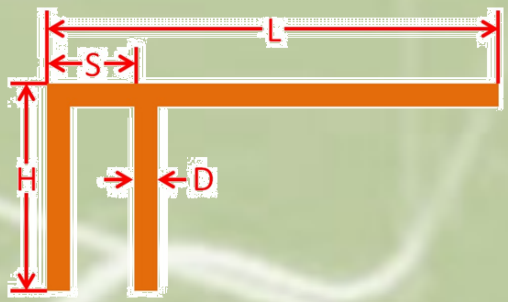

Fig 1: Inverted F antenna structure

In general, there are two main considerations that govern planar antenna designs; antenna miniaturization techniques and multiband operation. In antenna designs, multiband operation can be achieved by modifications to the main radiator applied using two strategies. The first strategy is to create several radiators for different resonances from a single feeder. The second strategy is to elongate the main radiator's physical length to achieve multiple resonant modes. However, creating several radiating branches may occupy more space, hence making the antenna physically larger than the desired volume. For this reason, while designing a multiband antenna, the designs must also apply miniaturization approaches, such as the ones presented in the following design strategies

Design strategies for achieving multiband operation

MODIFICATION OF THE MAIN RADIATOR

The main radiator of a monopole/PIFA/CIFA type antenna plays a major role in determining the resonant frequency of the antenna. For a small antenna, particularly the λ/4 radiator configuration, miniaturization can be achieved in many ways. The main radiator arm can be modified by changing its configuration in such a way that it occupies optimally the limited area/volume provided for it.

Multi-Band Antenna for Different Wireless Applications

One of the design techniques to achieve multiband operation is to have branches for the main antenna radiator. The branches are of monopole strips or arms to create different current paths for different resonances. This technique allows the excitation of multiple resonant frequencies at their fundamental mode. Multi-stacking or multi-layering is another technique that offers similar operation as the multi-branching technique. Similarly, it is capable of creating different current paths and thus different resonances.

A multi-resonator configuration is also achievable through proper application of some sort of slot or slit, sometimes also known as a notch geometry. In this approach, the radiator is modified in such a way that its original geometry is introduced with fine-tuned defined configurations of slots or slits. The resulting modification separates the main current stream into several other paths, which in turn create different resonators. It is worthwhile to mention that designs utilizing slots are not necessarily limited to straight lines or rectangular geometries. Other shapes have also been proposed such as a U-slotted PIFA, a V-slot loaded patch antenna, a Z-shaped slot antenna, or an open-ended Rampart -slot antenna.

The second strategy for the antenna design has the goal of obtaining a compact design and multi-band operation while using a single radiator without splitting it into branches. A con□ siderable number of work employing this design strategy can be identified in the antenna literature. Among the popular techniques to elongate a single radiator to achieve multiple mode resonances without diminishing the antenna's compact feature include spiralling, looping, folding into a 3-D geometry, and bending.

Miniaturization can also be accomplished by meandering the antenna structure. The work□ ing principle is similar to that of spiralling. The meandered geometry preserves the original length of the radiating element but miniaturizes its overall size.

MODIFICATION OF THE GROUND PLANE

Even though the geometry of the main radiating element plays a main role in determining the resonant frequency and other performances of an antenna, the importance of the ground plane as the natural complimentary agent to a radiating current must not be neglected. The modification includes size variation, location of radiating element within the ground plane area or inserting slots in the ground plane. Variations in a finite ground plane size and geometry affect the performance of an antenna. The resonant frequency of a conventional PIFA starts to converge slots in the ground plane. Variations in a finite ground plane size and geometry affect the performance of an antenna. The resonant frequency of a conventional PIFA starts to converge to that of the case of an infinite ground plane when the size of the finite ground plane is increased above a unit wavelength. Also, the bandwidth increases with the length of the ground plane.

RECONFIGURABLE APPROACH

With multiband capability, reconfigurable antennas can utilize more efficiently the radio fre- quency spectrum, facilitating better access to wireless services in modern radio transceivers. Reconfigurable antennas are generally divided into two main categories: frequency tunable and pattern diversity antennas. Furthermore, the selection of electronic switches is of para- mount importance. Depending on the type of antennas, switches such as RF MEMS, varactors and PIN diodes can be used. The choice is governed by electrical specifications, fabrication complexity, bias requirement, switching time, and price.

Name: **Ms. Chitra Takle**

Designation: **Assistant Professor**

Arear of Interest: **Microwave and Antenna, Image Processing**