Reconfigurable Multi-band Antennas for Multi-Radio Handsets and Laptops

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Multi-band antennas are widely used for smart phones, laptop computers and many other multi-radio platforms, where either one service has more than one standard for different countries, or many services need to be simultaneously supported using one antenna. Meanwhile, reconfigurable antennas have been proven to provide great potential and better S/N performance upon having maximum out of band noise rejection. As the number of required services increases, the development of either one of these antennas becomes more and more challenging due to: achievable bandwidth limitations and design complexity of the multi-band option, and higher losses and DC power consumption while using more switching devices for the reconfigurable structure.

We propose here a novel combined reconfigurable and multi-band antenna design. The developed antennas allow hopping between different multi-band configurations upon switching either various circuit topologies (Behdad, N. and Sarabandi, K., IEEE Trans. Antennas Propag., 54,409-416, 2006) or dynamically adjusting the lengths of the different branches (Yang, S., Pan, H. K., Fathy, A. E., El-Ghazaly, S. and Nair, V. K., Proc. IEEE MTT-S Int. Microwave Symp., 182-185, 2006). Through judicious grouping of selected operating multi-bands, advantages of both the multi-band and the reconfigurable antenna structures can be simultaneously achieved while supporting more services.

Along these lines, two novel hybrid reconfigurable multi-band antenna structures have been developed. The first is designed for handsets and is comprised of a compact reconfigurable meandered monopole antenna structure (Teng, P.L., Microwave Opt. Tech. Lett., 33, 22-25, 2002) with only two multi-band configurations, one serving all the cellular bands and the other covering all wireless frequencies. The second design is for laptops, and is realized by a reconfigurable multi-band twin PIFA structure (Rennings, A. A., Muller, R., Otto, S., Waldow, P. and Wolff, I., Proc. European Microwave Conf., 33, 1263-1266, 2003) which supports GSM850, PCS, WiFi and WiMAX frequencies.

Both of these two designs have been optimized to utilize only two switches, both of which are fed by integrated DC feeds. (Yang, F. and Rahmat-Samii, Y., IEEE Antennas and Propaga. Magazine, 47, 13-29, 2005) The multi-band construction strategy, switch integration schemes, and the simulated and measured results of these novel antenna designs will be presented in detail.