Fully-Embedded Ultra-Wideband Antenna at the Base of Laptop Computers

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Typically, wireless LAN and WAN antennas on laptops are installed on the top or side of the LCD panel of a laptop computer to obtain better range and coverage. The wireless module is located in the bottom section of the laptop system as an additional daughter card or integrated in the system board. A flexible micro-coaxial cable, such as a Hirose cable, is used to interconnect the wireless module to the antenna around the LCD panel. In this case, insertion loss of the coax cable cannot be ignored due to the cable length, especially at high frequencies if one considers an ultra-wideband (UWB) communication device in the laptop. An alternative installation location is the base of the laptop computer, but possible interactions with adjacent metallic structures, such as the heat sink and support frame, can be an issue, lowering the total efficiency of the system. Thus, each installation location (around LCD panel and around laptop base) has pros and cons.

In this presentation, we investigate the best installation location of an ultra-wideband (UWB) antenna at the base of the laptop. We assume that the UWB system uses only the first band group of multi-band OFDM (orthogonal frequency-division multiplexing) UWB, 3.1 – 4.9 GHz. The expected angular coverage is the region behind the laptop LCD panel, minimizing the radiation toward the user.

A proto-type of a planar UWB antenna (designed by Intel) and a laptop with 15" widescreen LCD panel was used in this study. The antenna had a size of 15 mm by 19 mm, printed on a Rogers 4003C substrate (ε_r = 4.5 and thickness of 0.5 mm). The impedance bandwidth of the antenna was 3.1 - 6.5 GHz (VSWR < 2) in free space, which is larger than the required band. The extra bandwidth may be advantageous in accounting for detuning due to proximity structures, causing a narrower impedance bandwidth and a movement toward a lower center frequency (typical). Three installation locations were considered: back side, back corner, and middle side of the laptop base. The embedded antenna at the different locations was characterized in terms of impedance bandwidth, total efficiency, and overall gain pattern. These performance factors were compared through both simulations with a simple laptop model and measurements with an actual commercial laptop. Finally, a “best” installation location of the prototype UWB antenna at the base of the laptop will be discussed.