

What is 2 dB Worth?

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With much of the wireless industry focused on the benefits that 4G will bring to the table, it is important to remember that many of the 4G standards are still three or more years away from implementation. And while 4G will help quell some of the end-user demands that global carriers are facing, there is still a considerable amount of time until carriers will be able to meet those demands. Mobile subscribers want higher data rates, better and faster Internet connectivity, state-of-the-art multimedia capabilities and at the same time, smaller, sleeker devices. This not only creates a challenge to the carriers, but also to the device OEMs who are tasked with engineering a multi-functioning mobile device that must meet the demands of the mobile consumer, while maintaining a smaller, more visually appealing form factor.

Ethertronics, a provider of standard and customized embedded antennas, has noted that these two driving forces in the wireless industry, the need for devices with more capabilities and the desire to have smaller mobile devices, contradict each other and ultimately hinder the overall performance. Ethertronics has solved design problems for many large OEMs with the company's patented Isolated Magnetic Dipole (IMD) technology, which controls the current flow on the antenna, and enables the OEM to place high-performance embedded antennas in complicated devices where other antenna technologies have failed. Through Ethertronics' research, the company has observed that this trend cannot continue unless new design approaches are taken to increase the performance of the device.

depends on the quality of service of the device and whether or not the phone can maintain a connection without dropping calls.

This being said, a poor service quality and too many dropped calls not only create a bad name for the device manufacturer but also for the carrier. It is an all-too-familiar scene when a mobile subscriber changes carriers because of seemingly bad coverage when essentially it was the poor performance on the hot, new device which resulted in the poor service. This is why it is vitally important for wireless carriers to expand the handset selection criteria beyond price and form factor and, explore options to increase mobile phone performance.

Circling back to the device manufacturers and wireless carriers working together to solve this issue, what steps can they take together to ensure that the mobile subscribers' demands are met before 4G services are rolled out? Ethertronics has identified several active antenna-enabled solutions that will yield at least a 2 to 10 dB improvement in link budget. Ultimately, these solutions point to the question: what is a 2 dB link budget improvement worth?

Ethertronics has taken a comprehensive, three-step approach to provide significant improvements in bandwidth and efficiency required from the main antenna in the next-generation handset. Long-term research and development activities have been underway to address the technologies and new architectures required to incorporate into this next-generation antenna, which will provide several dB of link improvement. The three approaches being developed are:

- 1) Active Matching
- 2) Active Antennas
- 3) Null Steering

Active Matching is the most well known of the three techniques and is the easiest to implement. Active matching involves the use of active components in a matching circuit to optimize the impedance match between the antenna and transceiver, and minimize mismatch loss. Coupled with a directional coupler and closed-loop feedback circuit, the active matching circuit can maintain an optimal impedance match dynamically, providing "real time" retuning of the antenna matching circuit to account for environmental changes such as placement of the handset against the user's head or a change in hand placement on the handset.

Active antennas involve implementing techniques that are unique to a specific antenna technology. Ethertronics has developed a method of changing the frequency response of its IMD antenna structure by coupling active components to the antenna structure. This method of changing antenna characteristics provides a higher payoff in terms of improved antenna efficiency, since the antenna structure is re-tuned in real time, instead of just optimizing the impedance match of the antenna as with active matching. By tuning the antenna structure, the antenna is tuned for the specific frequency band or sub-band at that instant in time whereby, the antenna efficiency can be optimized over a narrower instantaneous bandwidth.

Null Steering is the third technique, and in many instances, will be the most powerful in terms of communication link improvement. Ethertronics has developed and is refining a null steering technique that allows for significant change in radiation pattern characteristics of a small, internal main antenna for handset applications. The technique is termed null steering to emphasize the fact that as the radiation pattern is shifted, significant increases in antenna gain in angular regions containing nulls or low-gain characteristics can be achieved with the use of active components coupled to the antennas. Antennas in handsets, like all antennas, have radiation patterns that have peak gain regions and regions of low gain (nulls). By changing radiation pattern shapes in real time, a significant improvement in link quality will be achieved, providing a robust communication link.

By implementing active matching, active antenna and null steering, companies like Ethertronics are able to address the growing contradictory trend of wireless devices supporting more modes in a smaller form factor such that all involved parties are satisfied. When the wireless community eventually rolls out a fully functioning 4G service, next-generation antennas will be needed to increase the link margin in these wireless devices. Thus, Ethertronics is asking carriers and device manufacturers alike: what is 2 dB worth?

Ethertronics' Vice President of Advanced Technology, Jeff Shamblin, will address this question and provide more in-depth analysis on the subject in September at the 2008 Antenna Systems and Technology Conference in Austin, Texas.

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A 2dB Improvement is Possible Today



- Next generation antennas can provide increased efficiency/bandwidth characteristics but will require a control interface to handset transceiver
- Three techniques presently being investigated

1. Active matching → tunable matching circuit at antenna input
2. Switched antennas → antenna structure modified for improved frequency/efficiency characteristics
3. Null-steering → antenna structures modified to change radiation pattern characteristics

Potential Eff. improvement

1 to 3 dB

2 to 3 dB

4 to 10 dB

As mobile devices continue to increase their functionality beyond basic communications, added functions like location-based services, Bluetooth capabilities, digital cameras and mobile Internet further complicate the design process. In addition, the design process gets more challenging as wireless phones continue to get smaller. This creates a design conundrum because the space with which engineers are working continuously shrinks; and yet they are expected to pack even more components onto the board and maintain or improve wireless performance. This contradictory trend has grown so much that carriers and device manufacturers are considering various methods to resolve the size/performance issue. In today's world where the smallest, thinnest and most versatile functioning mobile devices are ranked supreme, device manufacturers and wireless carriers are faced with a decision trade-off of balancing performance, size and function. Ergonomics drive the consumer buying decision and cost reductions for each new phone are expected. How does the industry embrace new technologies that enable ergonomic flexibility and improve RF performance, yet cost only slightly more to implement?

While applications and multimedia functions are essential in creating hype around a device, ultimately the most important aspect of a mobile phone is still the quality of reception that it receives. A device may have all the latest bells and whistles and be the smallest and sleekest product on the market. However, if it does not receive optimal reception it will not be considered a commercial success. When new phones fail to gain widespread customer approval and great product reviews, it isn't always because the product was the wrong shade of green or because its candy bar form factor was three millimeters too large. The definitive success of all mobile devices