Tunable Antenna for Smartphones

Enabling Tunable Antennas Using QuickLogic CSSPs

Market Dynamics

iPhone's so-called "death grip" has frustrated not only iPhone 4 users, but has raised the awareness of all mobile phone vendors regarding the importance of antenna quality. The introduction of Long-Term Evolution (LTE), commonly known as 4G, has created more band selection along with the increasing demand of sensors which can potentially further affect the antenna quality. One solution is to adopt the tunable antenna solution.

According to IHS, the discovery of a tunable antenna signals the firing of the starting gun for a market that is set to grow by a factor of 200 by the year 2015. See Figure 1.

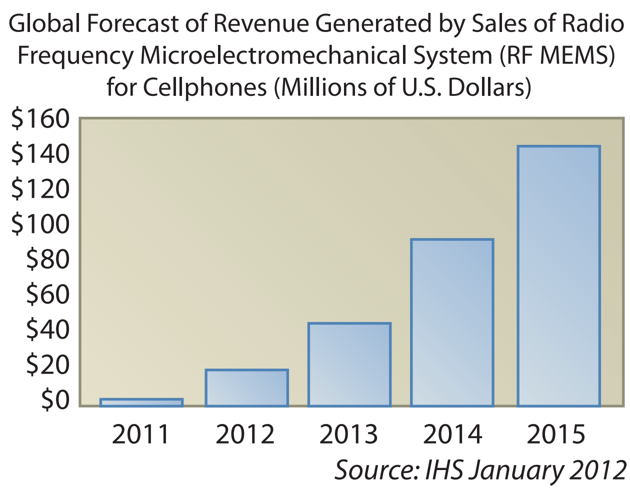

Figure 1. IHS Projected Tunable Antenna Usage in Mobile Applications

In fact, there are already phones equipped with the tunable antenna solution in the market today. For example, the IHS teardown on Samsung's Focus Flash shows it contains a tunable antenna solution, also known as RF MEM, from WiSpry, Inc.

There are multiple direct benefits of using a tunable antenna solution in a smartphone. Beyond the elimination of the "death grip" signal dropout issue, the tunable antenna can improve the antenna efficiency in smartphones resulting in increased transmission data rates. For example, in the U.S. LTE standard, antenna tuning can boost data rates by as much as 40 percent.

Furthermore, a tunable RF device enables smartphones to employ smaller antennas that have the same or greater efficiency than larger ones. This enables the design of thinner smartphones.

Designer's Challenge

There are some critical points to consider when adopting the tunable antenna solution in smartphones:

- Response time – The time required to adjust the tunable impedance device to set the correct parameters for the antenna.
- Flexibility – The ability to adopt new parameters during development and production for performance improvement on the tunable impedance device.

Figure 2 illustrates how a tunable RF device is used inside a smartphone.

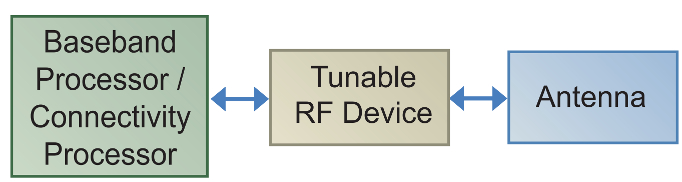

Figure 2. Antenna Architecture with Tunable RF Device

There is a critical point to consider when adopting the tunable antenna solution in a smartphone. In a typical use case, the baseband processor or connectivity

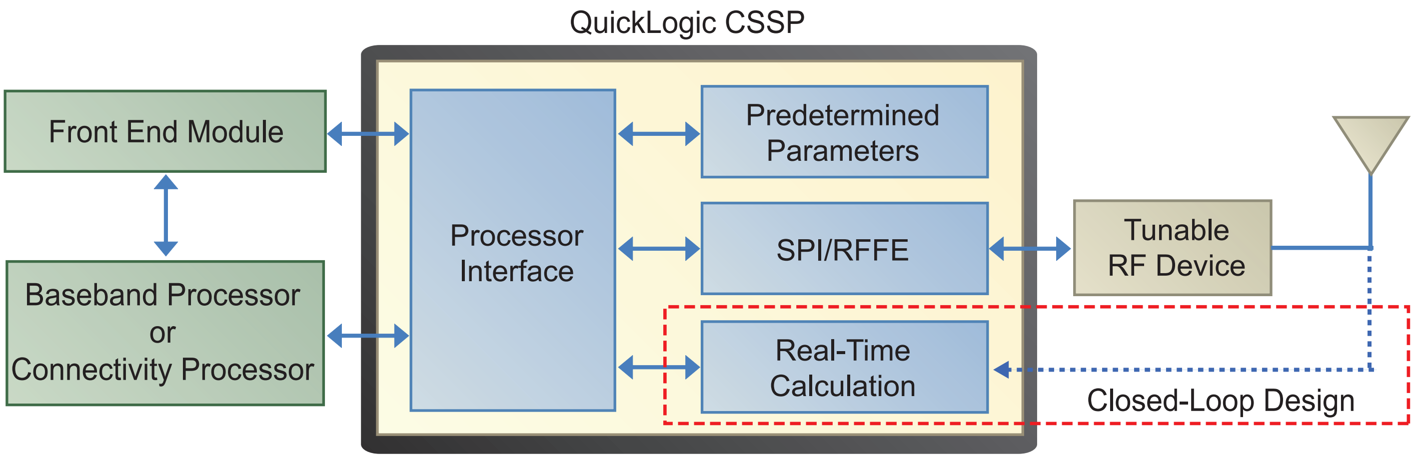

Figure 3. QuickLogic Tunable Antenna Control Solution

processor connects directly to the tunable RF device (such as the device from WiSpry, Inc.). However, the problem with this scheme is that the tunable RF device only supports low-speed serial interfaces which are typically lower priority in the processor architecture making it impossible to guarantee the exact timing.

QuickLogic implements a function in the Customer Specific Standard Product (CSSP) to resolve this problem. The solution is hardware-based so that guaranteed timing can be met. As shown in Figure 3, the design consists of three fundamental blocks and one option block, depending on the design implementation:

- Processor interface – This block receives input from the processor and the Front End Module (FEM). The signals that have the potential to influence the antenna quality are integrated here. For example, the proximity sensor, LCD and microphone on/off from the processor and band selection from FEM.
- Predetermined Parameters – This block has a pre-set tuning table that contains the tuning parameters based on the input from the processor and FEM. The smartphone developer sets these parameters for different conditions.
- SPI/RFFE Controller – This block is the main interface block that sends tuning parameters to the tunable RF device.
- Real-Time Calculation – This block is used when the closed-loop design is implemented. After tuning parameters are sent to the tunable RF device, the antenna efficiency is sent back via feedback loop to the real-time calculation block to determine if additional tuning is required.

Open-Loop Vs. Closed-Loop Design

Designers can choose to use either an open-loop or closed-loop design implementation. Since the open-loop implementation is easier than the closed-loop design, it yields a shorter design cycle and smaller device, thus lowering overall design and device cost. The trade-off is that pre-determined parameters are different from region to region, hence, they are not portable and must be redone for each region.

Alternately, the closed-loop implementation requires more design resources yielding longer development cycle with a bigger device, but is portable throughout regions, so it can be used for all regions without additional modification.

In a closed-loop design, the feedback path from the antenna are analog-based signals and require an additional analog-to-digital device.

QuickLogic

www.quicklogic.com

Printed in USA

CORPORATE OFFICES

QuickLogic Headquarters
Sunnyvale, CA USA
(408) 990-4000
info@quicklogic.com

SALES OFFICES

Taiwan
+ (886) 2-6603-8948
asia-sales@quicklogic.com

China
+(86) 21-5179-8487
asia-sales@quicklogic.com

Japan
+ (81) 3-3593-2230
japan-sales@quicklogic.com

United Kingdom
+ (44) 1932-213160
europe-sales@quicklogic.com

For sales offices in your local area, go to www.quicklogic.com/sales