A Method for Triggering Disparate Types of Scientific Instrumentation and LTE Network Equipment

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Being able to measure various interfering effects, such as Wi-Fi, on an LTE signal is crucial in determining how and what effects the signal. However, measuring, or even defining what interference is can be problematic. Attaching metrology-grade instrumentation to commercial LTE network hardware (e.g., a UE traffic generator or base station/eNodeB) enables such interference measurements to take place. Though this testing can take place, synchronizing the LTE hardware with the instrumentation is a challenge. Test equipment, in general, keeps track of time through internal clocks set with GPS. LTE hardware uses GPS as well, but the way LTE synchronizes via the air interface is through subframes, more specifically, information contained within the subframe headers. The two main parameters used to accomplish this are the timing advance and the system frame number. In measurements or experiments involving LTE network hardware and RF instrumentation there is no direct method to synchronize the instrumentation with the network hardware. To solve this problem, we devise a stand-alone unit that serves as the master GPS clock and also tracks the LTE frame numbers for either event triggering and/or monitoring.

This unit utilizes a software program to decode and count the number of LTE subframes. This is a useful way to track frames for a short period of time; after about 10 seconds, the LTE frame number recycles. For testing periods that exceed this, we couple the LTE frame number with a GPS-based timestamp.

The software developed as part of this work has the ability to decode and distinguish unique LTE frames. The hardware interface will be through a software defined radio (SDR) and a stand-alone computer. Once the SDR is programmed, the computer will simply monitor data flow, it will not manipulate data or control the SDR.

This timing and triggering solution should provide enough precision to trigger instrumentation at the subframe level (~1 ms). This enables detailed analyses of transient effects on LTE systems.