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1. Program of research and development

Cognosos has developed a patented wireless communications system (RadioCloud) that utilizes low-power UHF transmitters and Software Defined Radio (SDR) receivers to provide Internet of Things (IoT) applications for multiple industries. The optimization required for many IoT applications using low-power radio links results in very asymmetrical uplink and downlinks and in many cases with link budgets that limit the ability to update device firmware over the air (FOTA). The proposed program of experimentation is to develop techniques for low power FOTA using unlicensed and licensed spectrum and advanced forward error correction (FEC) coding systems such as turbo product (TPC) and low density parity check (LDPC) codes. The other limitation of FOTA systems that use cellular networks, for example, is that they rely on persistent TCP/IP connections to each device. This approach does not scale when sending a coming FOTA download to thousands or tens of thousands of devices within a single network. Tests will be conducted in the 420 MHz to 470 MHz band with fixed base stations sending signals to receivers attached to mobile and fixed objects. Radio equipment will consist of modified Cognosos PCA-10015 radio modules.

2. Objectives of research

The overall objective of this program is to develop a FOTA system capable of highly efficient broadcast and multicast FOTA over a limited geographic area. Specifically objectives are:

A. Development of broadcast and multicast PHY techniques that are resistant to high bit error rates and link interruptions
B. Test various waveform and frequency combinations to see if differential multi-path measurements can be offset via software algorithms
C. Investigate the use of low density parity check (LPC) and turbo product codes (TPC) forward error correction coding to improve link budgets and thus reduce needed transmit power
D. Determine if periodic location timing bursts can be broadcast along with dynamic algorithms to allow devices to perform internal configuration changes to improve the reliability of FOTA

3. Development contribution

More than 75 billion Internet connected IoT devices are expected by 2025. The vast majority of these devices will be connected via wireless networks and a significant portion through non-cellular low power wide area networks. With growing concerns over cyber security and the need to provide frequent firmware patches and updates, significant portions of valuable spectrum will be needed just to support FOTA. FOTA spectrum needs could conceivable grow larger than that required for actual IoT traffic given the relative low data rates of IoT applications and the growing processing power and memory capacity of inexpensive MCUs. This experimental program will contribute to the understanding on the use of advanced coding and data broadcasts to reduce spectrum required for large scale FOTA distribution.