Digital Upgrade of Analog Communication Systems Using Software-Defined Radio Techniques

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The process of building a new communication system is costly and time-consuming, requiring the design and characterization of many components to satisfy multiple requirements. However, there are ways to upgrade an existing communication system like analog radios and tuning, without building a new one. In this project, software-defined radio (SDR) techniques are used to overcome the limitations of a pre-designed communication system. The SDR technique provides the flexibility of modifying system elements and specifications utilizing software upgrades, without having to buy or integrate new hardware components. The focus is on upgrading the ME1000 communication system, which is limited in that it only supports simplex transmission of analog signals, has limited bandwidth, and is insecure. The upgrade process involved first characterizing all the components from antennas, power amplifiers, local oscillators, and band-pass filters for each building block using a signal generator and a spectrum analyzer. Then an SDR system was implemented which enables incorporating several features, including the ability of half-duplex transmission of digital information. The developed system was tested under ten different carrier frequencies to verify its ability to transmit digital data with a low bit error rate. In the final design, a piano sound was transmitted at 200MHz with a 300MHz carrier and was successfully received. The upgrade that was implemented is cost-effective, improves area coverage, and compensates for the limitations of the obsolete analog system as now it can adapt to modern applications such as IoT.

Awards Won:

K. Soumyanath Memorial Award: First Award of $3,000

K. Soumyanath Memorial Award: $1,000 will be awarded to the winner's school.