Evaluation of Digital Codings on the SoC-based Software-Defined Radio for the Military Communication

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***Abstract*—The modern military communication extensively utilizes radio spectrums to convey important information. Radio transceivers have evolved from large analog transceivers to miniature digital transceivers. Digital transceivers are relied on digital communication techniques, which include various digital codings and digital modulations. Digital codings are crucial processes in most digital communications. The outstanding advantages of digital codings are that it conserves channel bandwidth, and it makes information more robust. There are plenty of digital codings in military communications. Each coding is suitable for the specific application and environment. The implementation of various digital codings on one device is possible with a software defined radio (SDR), at which the transmission characteristics of a SDR can be defined by the software running on the device. Hence, a SDR can be reprogrammed to meet the require transmission characteristics. A logic parts of SDR can be implemented either by Digital Signal Processor (DSP) or Field Programmable Gate Array (FPGA). With the current semiconductor technology, both DSP and FPGA can be integrated into one chip, which is known as a System-on-Chip (SoC). This article evaluates the performance of the military digital codings on SoC as the digital processing unit. The result shows that SoC-based SDR can be a potential for SDR in the military communications.**

***Index Terms*—Digital Coding, Software Defined Radio, Military Communication.**

I. INTRODUCTION

Military communication is meant to convey information for the purposes of command and control among forces. In addition, dispatched forces are relied on military communication and network to report the situation to the command and control unit. Hence, military communication is the vital element to every military operations. Radio communication system has been involved in military operations, since it was first introduced in the 19th century [1]. The first radio introduced by Guglielmo Marconi was built for wireless telegraphy [2]. Since then radio communication has been the core element in the military communication. Radio equipment have been evolved from large analog telegraphy to miniature digital transceiver, which is capable of conveying many types of information. Digital communication continues to replace analog communication, as it is less susceptible to noise and simple to manipulate.

Digital radio communication system contains the RF front end in both transmitting and receiving paths. In the transmitting path, the RF front end converts digital baseband signal to analog passband signal, amplifies passband signal, filters out unwanted signals and radiates radio signal through the antenna. In the receiving path, the RF front end receives analog passband signal through the antenna, filtered out unwanted signals, amplifies passband signal, and converts analog passband signal to digital baseband signal. The RF front end is based on analog signal processing such as analog filter and RF amplifier; it prepares information into the suitable format for transmitting over the radio channel, and processes received signal from radio channel such that information can be extracted from the signal. The RF front end is the basic element in both analog and digital communications. It is the digital signal processing unit that makes the digital radio communication system differs from the analog radio communication system. The main purpose of a digital processing unit is to provide digital codings to the information such that information is suitable to be transmitted over noisy, unsecured, band-limited radio channel. This article contemplates on the digital codings as it is the vital element to digital radio communication system.

Digital coding techniques can be categorized into source coding and channel coding [3][4]. The primary objective of source codings is to reduce redundancy in original information; in contrast, channel coding tends to increase redundancy in information such that it is more robust to noisy channel. There are numbers of sophisticated source codings and channel codings, but only a few are acceptable as the military standards. This article explores digital codings codings that meet the requirement for military standards (i.e., MIL-STD and STANAG). This article also evaluates the performances of the explored digital codings with the SoC-based Software-Defined radio as the hardware in the loop. The rest of this article is organized as follows. Section II describes acclaimed source codings and channel codings in military communication. Section III describes the software-defined radio's architecture, which is used to assess the performances of the digital codings. Section IV assesses the performances of the digital codings with SoC-Based Software Defined Radio in the test loop. Finally, Section V concludes the study.