Software Defined Radio for wireless communication

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ABSTRACT
The drastic escalation in the ways and means by which user need to exchange information, replacing RF unit effortlessly and cost-reduction has become important. Software Defined Radio (SDR) tools provides the flexibility, price competence and influence to make communications possible, with extensive accomplishment benefits offered by the RF operators and manufacturers. It has several advantages which can be useful in business development, as they do not need to set up the whole hardware again and again they just need to set up the hardware once and every time as the technology changes only software up gradation will be required. Initially it is costly at the installation level but after installation it is cheap for long time end users.

Keywords
GNU; SCA; SDR; USRP

1. INTRODUCTION
The aim of SDR development is to implement radio functions on a single stable architecture through software, there are number of definition by which we can define SDR. SDR is a Radio which provides software defined functionality over physical layer. Traditional hardware based radio devices depends on hardware thus they are costly and they have limited functionality as they were not supporting various standard on a single hardware, whereas SDR is basically software based it provides all functionality with software instead of requiring additional circuitary for different operation. According to application we need to modify the software and this makes the SDR compatible with each applications on a single hardware. Thus every time when standard changes we need to change software only and the hardware become compatible with the new technology, thus for long time user it is cheap[1]. The fundamental architecture of SDR includes RF module, conversion module and the processing module, which is software part of the SDR all processing has been done in a software. In this paper the software which we used is a "GNU RADIO", is a open source software together with the hardware Universal Software Radio Peripheral (USRP). In figure 1 block dig. Of SDR is depicted. Which is divided into three parts: The left part is RF front end, IF is the stage placed between antenna and the baseband processing, it is responsible to down the frequency which is accessible by the digital converter. In the third block processing has been done which is done completely in software[2]. In Section 2 application of SDR included. In section (3) Software architecture has been added. In section 4 hardware and software part of SDR described. Simulation and result of GMSK added.

Figure:1 – Block diagram of SDR

2. APPLICATION
These technologies can be used to work out many of the interoperability problems among communications equipment in the Public Safety sector since the reconfigurability of these systems allows them to understand several communication standards. With the use of SDR/SR technologies, the military expects to have low cost development and maintenance of radio by a standard and stable platform which is capable to provide multiple services[3]. This technology would also give more flexibility to the military in executing joint operations with other nations (which have their own radio systems[4]. SDR can also be use on wireless devices and these devices can be update to newer version by upgrading software only.

3. THE SOFTWARE COMMUNICATION ARCHITECTURE
The Software Communication Architecture (SCA) defines the software structure of an SDR. The SCA is an open architecture framework that provides an idea about the designing of hardware and software. It governs the structure and operation of the military's JTRS. Every handset require a core framework which providing a standard operating environment. SCA provides a unique way in which waveform software and other elements of a software-defined radio interact with the hardware. With standardization, waveforms are compatible, not only with one platform, but also for any device supporting SCA. A software waveform can then be used in many different radio sets, be it handheld devices or other communication equipment. APIs are responsible for connection between the applications and the core. "Cognitive radio: A radio or system that senses its operational electromagnetic environment and can dynamically and autonomously adjust its radio operating parameters to modify system operation, such as maximize throughput, mitigate interference, facilitate interoperability, access secondary markets." Combination of a cognitive "engine" and the SDR together comprise a "cognitive radio"[5].

SDR is a radio communication system where components are hardware implemented but instead SDR need only software implementation on personal computers or embedded system.

4. UNIVERSAL SOFTWARE RADIO PERIPHERAL (USRP)
The USRP is inexpensive hardware, used for SDR, and is generally used by labs, universities for practical purpose. With

the help of UHD driver USRP models can be controlled. USRPs with GNU radio software jointly create SDRs system.

4.1 Design

In USRP family there is variety of models available but all have similar structure. A front – end, called a USRP daughterboard, used for up/down conversion i.e. RF to IF conversion, connected to USRP motherboard. A motherboard provides FPGA, ADCs and DACs. The operating frequency which is generally used is between DC and 6GHz. On motherboard, analog samples converted to digital and given to FPGA for further processing.

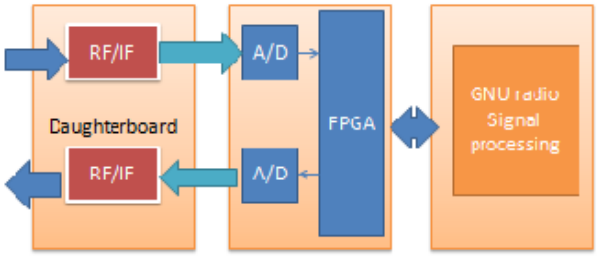

Figure: 2- Design Of SDR

4.2 Software

In this paper the software which we used with USRP is GNU radio. Other software including Lab-VIEW, MATLAB can be used. GNU Radio is a toolkit which is freely available. It provides platform for programming which is easy to use. Applications which is used in GNU is generally called "flow-graph". The language it is supporting is either C++ or Python to perform signal processing. Generally, flow-graphs written in C++. There is also an easier way to use GNU radio is GRC. This is graphical approach, there are number of building blocks combine to build SDR. In this paper we include an example figure: 3, to build flow-graph of GMSK modulation. As we start with GRC two blocks already present : options, and a variable with samp_rate. Other blocks we have to plot as per the requirement.

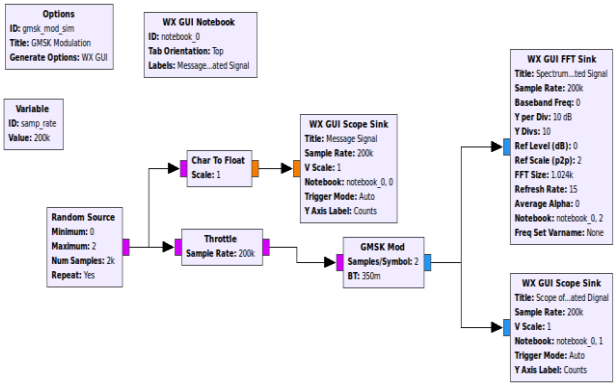

Figure: 3- Block dig. Of GMSK modulation

5. SIMULATION AND RESULTS

Input stream of bits which is applied to the GMSK modulator, which is random in nature. In figure 4 & figure 5 time domain representation of Modulated Signal is given frequency domain representation of Modulated Signal[6][7].

6. CONCLUSION

Telecommunication service providers have continuous pressure to provide services at a low cost. Software radios can lower infrastructure and operation costs for a wireless telecommunications provider by providing a platform that can support multiple standards. In which all hardware blocks are replaced by software function, it can be classified as Tier 0, 1, 2, 3.Higher number of Tier shows higher software control over hardware. Additionally, software radio technology can increase the hardware usefulness lifetime (both for the base station and the user terminal) providing protection to investments made on infrastructure since hardware can be reused by making software changes until new generations of hardware platforms are required.

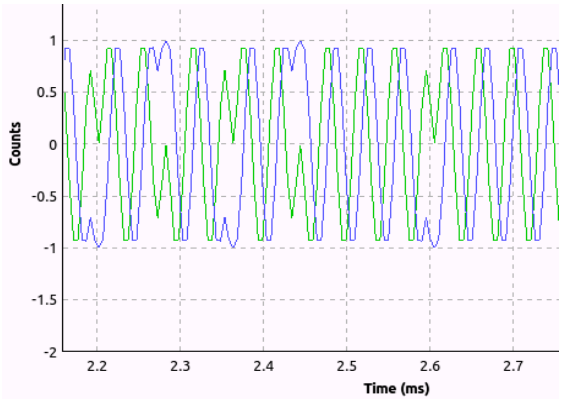

Figure: 4- Time domain representation

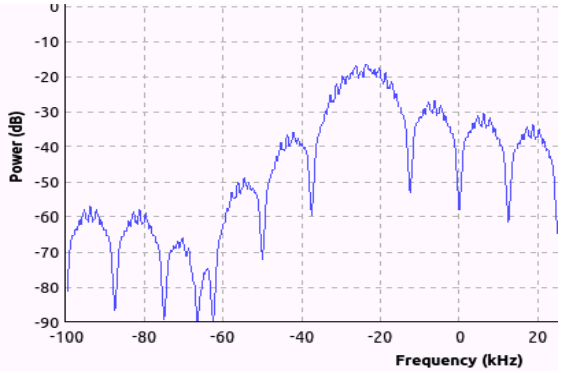

Figure: 5- Frequency domain representation

7. FUTURE WORK

As with the development of LTE, challenges operator, to planned bandwidth in a large area as they have limited spectrum. One simplest approach is to use frequency reuse concept. In this concept, large area is divided in to smaller area, use same frequency. But it causes interference. Also building and maintaining these infrastructure can be costly. SDR in LTE base station can be solution to this problem as their processing has been done in software and also it uses general purpose hardware thus it also reduces cost[8] also it provides facility to build more than one network[10]. eNB can be programmed to support number of technologies on the same hardware thus we can plan to serve number of users on the same base station.

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