Open Source Software Defined Radio

Andrew Kapenkov
FSBEI of HPE «KSTA named after V.A. Degtyarev», Kovrov, Russia
plddesigner@gmail.com

***Abstract*— This paper demonstrate how easy a flexible radio communications system can be build using open source projects.**

Keywords*— *software defined radio; base stations; telecommunications; hardware; open source; digital signal processing

I. INTRODUCTION

Software defined radio (SDR) was redefined with the dawn of the Universal Software Radio Peripheral (USRP) produced by Ettus Research [1]. Radio communication has been around since the late 1800s, and the radio spectrum has continuously evolved into the complex, country or region specific, spectrum which is present today. The vast array of available applications requires universities, researchers and hobbyists to invest in multiple radio hardware designs based on the specific applications, but embedded SDR reduces the required investment and paves the way for flexible and even intelligent radio designs for the future.

II. UNIVERSAL SOFTWARE DEFINED RADIO

The basic design of a SDR is rather simple, but the hardware selected can greatly change the usefulness and flexibility of the radio. Fig. 1 shows the basic model of a SDR.

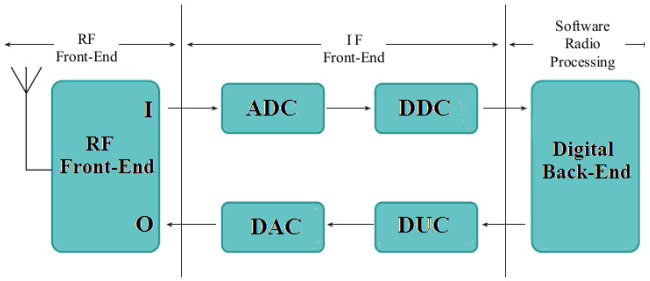

Figure 1. Basic model of software defined radio system.

Typically, the maximum achievable bandwidth of the SDR is driven by the speed of the analog-to-digital converters (ADCs) and digital-to-analog converters (DACs). As a result, SDRs have only become a reality in the past two decades. Programmable sample rate conversion for wide bandwidths must be accomplished using high speed programmable hardware, so field programmable gate arrays (FPGAs) are commonly used for sample rate conversion in modern SDRs. Finally, software radio processing is typically accomplished on a standard single core processor or multiple core processors and provides control signals to the radio frequency (RF) front-end, ADC, DAC and sample rate converter.

The primary motivation for this paper was to demonstrate a flexible radio communications system for universities and researchers.

The hardware requirements for research were to procure or design a low cost, programmable, and wide bandwidth radio with analog front-end. There are numerous hardware solutions on the market today for a software radio design: USRP1 an USRP2 by Ettus Research, some platforms from Lyrtech RD and some SDR systems by National instruments (NI USRP-2921 for example).

Not all presented solutions have "user friendly" graphical user interface. This reduces research convenience and enlarges time needed for developing. Cost is another very important factor for researchers at universities. rice range for the above products is from $2000 to $10000 per development board.

Not so long ago (Jan 2011) was founded Moscow based company "Fairwaves LLC". It focuses on development of cost-effective mobile access solutions and provides software and hardware development services in the area of SDR.

The development team of Fairwaves LLC created open-source project "UmTRX". UmTRX is hardware and supporting software to build a low-cost field-deployable GSM base station. Source code of this project distribute under GPL license. UmTRX is cost-effective solution for researchers at universities ($1500-$2000 per development board).

UmTRX has Dual TRX (from 300MHz to 3 GHz), GPS-locked clock and 3mW output power. Fig. 2 shows structure of UmTRX board [2].

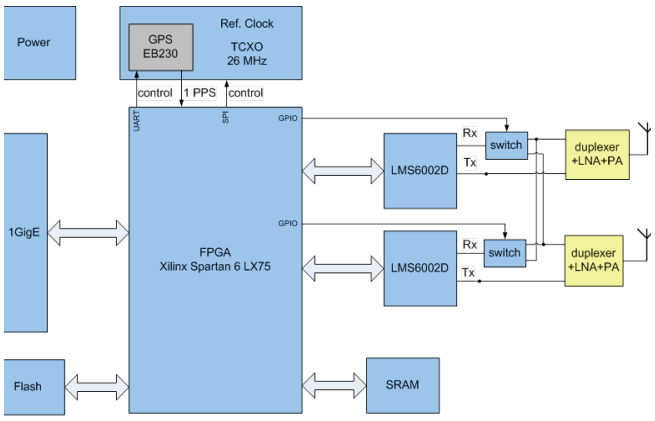

Figure 2. Structure of UmTRX board.

A favorable distinction of this platform is use of more modern electronic components such as Xilinx Spartan 6 and Lime Microsystems broadband transceiver LMS6002D.

UmTRX project are compatible with Gnuradio and OpenBTS projects. Which allow you to build own SDR systems or even base station subsystems for cellular networks.

Currently work is underway to develop an intuitive graphical user interface for configuration FPGA part of UmTRX project. This will allow users to make their own structure of digital signal processing part of SDR, which are contained in FPGA [3].

III. CONCLUDIONS

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