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Software-Defined SDR Radio System

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Abstract

The article presents software, which is one of the types of computer system support, along with technical (hardware), mathematical, informational, linguistic, organizational, methodological and legal support.

Keywords: Software, Software-defined radio, digital-to-analog converters, feeding automatic gain control.

Introduction

A software-defined radio system (eng. Software—defined radio, SDR, or POR) is a radio transmitter and/or radio receiver using technology that allows using software to set or change operating radio frequency parameters, including, in particular, the frequency range, type of modulation or output power, except for changing the operating parameters used in the course of normal pre-defined work with pre-installations of a radio device, according to a particular specification or system. The PORE performs a significant part of digital signal processing on a conventional personal computer or on an FPGA. The purpose of such a scheme is a radio receiver or radio transmitter of arbitrary radio systems, modified by software reconfiguration (hence the alternative name of such systems - software configurable). Such radio systems are widely used for military applications and wireless communication services, as they allow you to service a large number of radio protocols. PORE equipment usually consists of a superheterodyne receiver that converts a signal from a radio frequency to an intermediate one, analog-to-digital and digital-to-analog converters (ADCs and DACs). Currently, they are used to implement simple radio modems, in particular GSM, WiFi, WiMAX. Over time, PORE may become the main technology in radio communications. PORE is a prerequisite for the implementation of cognitive radio. [1]

A radio transmitter (radio transmitting device) is an electronic device for generating a radio frequency signal to be emitted. The radio transmitter has the ability to independently generate an alternating current of radio frequency, which is fed by a feeder to the transmitting antenna, which, in turn, emits radio waves. A radio receiver (short receiver, short radio) is a device connected to an antenna and used to carry out radio reception, that is, to isolate signals from radio emission.[3]

A radio receiver is understood to be a radio receiver equipped with an antenna, as well as means of processing the received information and reproducing it in the required form (visual, audio, in the form of printed text, etc.). In many cases, the antenna and reproduction means are structurally part of the radio receiver.

The radio receiving device performs spatial and polarization selection of radio waves and their conversion into electrical radio signals (voltage, current) using an antenna, frequency conversion, isolation of a useful radio signal from a set of other (interfering) signals and interference acting at the output of the receiving antenna and not coinciding in frequency with the useful signal, amplification, conversion of a useful radio signal to the type that allows you to use the information contained in it. Formally, radio receivers are classified as radio stations, although such a classification is rarely found in practice. Software (pronunciation is also acceptable software) is a program or set of programs used to control a computer. There are other definitions from international standards: -a set of information processing system programs and program documents necessary for the operation of these programs; -all or part of the programs, procedures, rules and related documentation of the information processing system; -computer programs, procedures, and possibly related documentation and data related to the operation of a computer system. The academic fields studying software are computer science and software engineering. In computer slang, the word "software" is often used, derived from the English word "software", which in this sense was first used in an article in the journal American Mathematical Monthly by John Tukey, a mathematician from Princeton University in 1958. From 1990 to 1995, the purpose of the Speak Easy program was to demonstrate a radio station for tactical ground control of the United States Air Force, which could operate in the range from 2 MHz to 2 GHz and thus interact with ground forces radio stations (VHF, FM and SINCGARS), Air Force radio stations (VHF AM), radio stations Navy (VHF AM and HF SSB tele printers) and satellites (microwave QAM). Some specific goals were to provide a new signal format within two weeks of launch, and to demonstrate a radio station into which several contractors could insert parts and software. The project was demonstrated at the TF-XXI Advanced Warfighting Exercise and showed all these goals in a non-serial radio receiver. There was some dissatisfaction with the fact that these early software radio stations could not adequately filter out-of-band radiation, use more than the simplest modes of interaction of existing radio stations, as well as lose communication or unexpectedly fail. His cryptographic processor couldn't change the context fast enough to keep multiple radio conversations on the air at the same time. Its software architecture, although practical enough, bore no resemblance to any other. The SpeakEasy architecture was refined at the MMITS Forum between 1996 and 1999 and inspired the Department of Defense's Integrated Processes (IPT) team for Programmable Modular Communications Systems (PMCS) to develop what became the Joint Tactical Radio System (JTRS). The basic circuit of the radio receiver used an antenna powering an amplifier and a step-down converter powering an automatic gain control that powered an analog-to-digital converter located on a VMEbus computer with a large number of digital signal processors (Texas Instruments C40s). The transmitter had digital-to-analog converters on the PCI bus, feeding a step-up converter (mixer) that led to a power amplifier and antenna. A very wide frequency range has been divided into several sub-bands with different analog radio technologies powering the same analog-to-digital converters. Since then, this has become the standard design scheme for broadband software radios. [2]

The goal was to get a more quickly reconfigurable architecture, i.e. multiple conversations simultaneously, in an open software architecture, with cross-channel communication (radio can "bridge" various radio protocols). Secondary goals were to make it smaller, cheaper, and weigh less. The project created a demonstration radio station in just fifteen months of a three-year research project. This demonstration was so successful that further development was suspended, and the radio station went into production with only a range from 4 MHz to 400 MHz. The software architecture defined standard interfaces for various radio station modules: "radio frequency management" to control the analog parts of the radio station, "modem management" managed resources for modulation and demodulation circuits (FM, AM, SSB, QAM, etc.), "waveform processing" modules actually performed modem functions, "key processing" and The "cryptographic processing" controlled cryptographic functions, the "multimedia" module performed voice processing, the "human interface" provided local or remote control, There was a "routing" module for network services and a "management" module to keep it all in order. It is believed that the modules interact without a central operating system. Instead, they send messages to each other over the PCI computer bus using a layered protocol. As a military project, the radio strongly distinguished between "red" (unprotected secret data) and "black" (cryptographically protected data).[4]

References

1. Afonsky A.A. – "Digital analyzers of spectrum, signals and logic/ A.A. Afonsky – M": Solon Press, 2009
2. Pronin K. – "Design, optimization and modeling of SDR." Electronic components.-2012.-No.2.-pp.49-53.
3. Hasanov O. S. – "Principles of building radios with digital signal processing" Electronic components -2010.-No. 12-pp.63-65.
4. Chalil M. B. – "Implementation of digital radio" Electronic components - 2013.-No.5.-Pp.37-41.