

ABSTRACT

This paper analyses over view of Software Defined Radio. SDR technologies are important feature for SDR communication system. Software Defined Radio (SDR) promises to deliver a cost effective and more flexible radio . SDR technologies are important from future mobile communication system. In mobile communication SDR Technology are best because its reconfigurable easy and multimode operation capabilities is high The Software based radio provide a challenges of engineer to add more features to original system hardware and its architecture. The Software based radio is most popular because abilities to realize many application and also efforts to integration of different component. The different technologies used in SDR according to digital Standard and Features. SDR Technologies are best because it is a reconfigurable easy and multimode operation capabilities are high. SDR digital radio standards are a provide challenges the radio design purely digital.

KEYWORDS: Single to Noise Ratio (SNR), Field Programmable Gate Arrays (FPGA), Hardware Radio(HDR), Virtual Radio Machine (VGA), Software-Controll Radio (SCR).

INTRODUCTION

Software Defined Radio (SDR) represents a modern approach to radio engineering communication [1]. In 1992, Joseph Mitola firstly provided the basic concept of Software Defined Radio (SDR) [2]. In SDR, Academic and industry people are interested because, SDR provide the multi wireless standards with a single hardware platform. SDR based on modules like base-band based modules and protocol based modules. These modules are providing an environment for easy application development. Software Defined Radio is also called multiple output devices and SDR is a reprogrammable. SDR allows more efficient and its used for sharing spectrum.SDR is a super flexibility so it can provides opportunity for solving the interoperability problems between number of different standard, and it's also reduced the hardware. SDR is an intelligent system that can communicate on different protocol at different times. SDR are used because they are easy to upgrade by a non-technician using an update bundle, effective for setting up ad-hoc network and minimal infrastructure requirements for use in the field. SDR hardware consists of antenna, Base Band processing elements, filter and mixers and converter. In case of a receiver, the antenna receives a signal and passes it through the analog to digital converter is passed to digital signal processor.

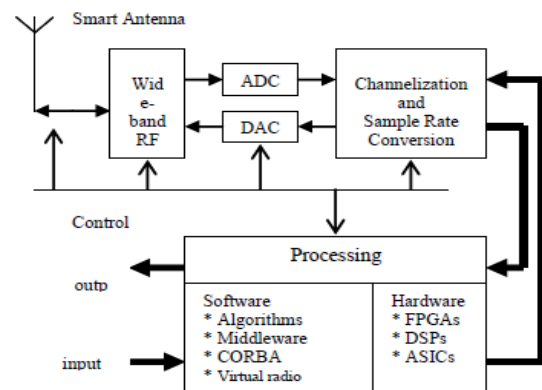


Figure: 1 Basic SDR Architecture [3]

The software is left in charge of every other function for establishing and maintaining a connection, such as modulation/ demodulation, frequency selection, and encryption. A transmitter simply works opposite to the way a receiver does. The architecture is SDR shown in Figure 1.

Description of SDR Architecture

VGA: - When input signal is very high then VGA (Virtual Radio Machine) decrease the amplitude of signal.

Antenna: - Digital antenna used in SDR and it allows full flexibility in the digital domain. Antenna is conned transmitter and receiver and these are class of intelligent antenna because they adapt to changing of environmental conditions and automatically create the optimum communication environment. In smart antenna RF designing is more flexible. In antenna, the design is a flexible radio frequency (RF) front-end handling the wide range of frequencies and modulations. At the receiver side antenna provide minimum interface, noise and gain versus characteristics [3, 4].

ADC/DAC: - ADC/DAC changes the data format from analog to digital and vice versa.

FPGA (Field Programmable Gate Array):- In case of hardware FPGA is used for interpolation of signal processing, digital conversion in both cases like up conversion and down conversion and also provide to execute high bandwidth mathematical calculations [4]. In software defined radio processing is performed approaches like digital signal processors (DSPs), Field Programmable Gate Arrays (FPGAs), application specific integrated circuits (ASICs) and General-Purpose Processor (GPP) [5].

DSP:- It is a specialized processor in SDR and it provides extract the information in the form of signal and Its also represents single in digital signal as a sequence of numbers or symbols The basic operations of processor used like filtering, transformations, correlation, modulation, and convolution. [6].

EPGA:-Field Programmable Gate Arrays is a semiconductor device and also it consisting of logic components and interconnect both these are programmable devices. The both elements are combined then; it operates as a simple logic operations like AND, XOR etc. The FPGA main advantage is allow the parallel operation in a multiple computational [7].

GPP: - GPP is providing a simple or easier to program the platform and makes it flexible. GPP are designed for computer/ workstation. [8]

SDR is also provides flexibility and control of various modulation techniques, security schemes, and operations on different spectrum bands, waveforms for the current and evolving wireless standards. With traditional HDR radio, waveforms and standards are typically implemented in ASIC

In traditional wireless radio components are mixer, filter, amplifiers, modulators, demodulators, and these are all components implement on software [9]. A comparison of SDR with traditional radio (HDR) show in Figure: 2 .

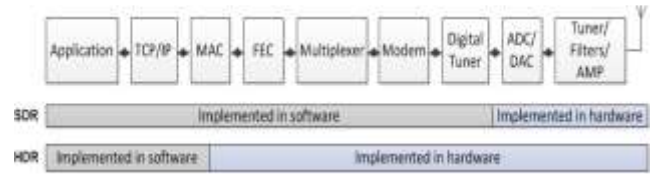


Figure: 2 .Comparison of SDR with traditional hardware radio(HDR). [10]

SDR allows to easy access to all the layers in wireless network system which is not possible in traditional wireless system. In SDR, with the help of MATLAB simulation tool we are easy to access and build up both PHY and MAC layer, wireless waveforms and its applications and sometime in the case of research and modify a certain parts of MAC layer, MATLAB simulation tool Device drive is used [11]. SDR defined a collection of hardware and software technologies. SDR main goals: to create a radio that will work in harmony with many different other radios, both civilian and military, built in encryption, and wideband networking software to allow the system to form ad hoc wireless networks. In currently SDR can be used to implement simple radio, with the help of modern technologies such as Global System for Mobile Communications (GSM), Wide Band Code Division Multiple Access (WCDMA), Wi-MAX, WI-Fi and others and all are in single device and update the newest radio modules by downloading software modules.

Features

The key features of SDR technology [12] are:-

Reconfigurability:

SDR system apply different standards . In infrastructure and handsets in which, that make possible selecting appropriate software module dynamically.

Interoperability:

SDR provides open system implementation. Users can use third party application on their handset and it improves the demand and usage of handsets.

Reliability:

SDR provides enhance reliability with the help of software program, which indicates software error prevention, fault detection and removal.

Redundancy:

SDR has duplicative nature of software it can without change in hardware redundancy or functionality of radio within a system is exactly same.

Scalability:

SDR systems have ability to adjust and develop and expand according to users requirements. SDR functionality of system can be changed according to software and its defined characteristics in software are generally so easy.

Security:

It secures devices depending on software based algorithms. It provides error free and uncompromised exchange of information and in SDR because it indicates the end-to-end reliability of the transmissions process.

Used SDR Technologies

SDR technologies [13] are:-

Tier 0:- Hardware Radio (HR)

It is pure hardware radio. But in which no control the system with the help of software [13].

Tier 1:- Software-Control Radio (SCR)

It is called software radio so it's all functionality control and implementation by software. But without changing hardware, its attributes like modulation and frequency band cannot change.

Tier 2:- Software-Definde Radio (SDR)

Capable of covering modulations methods, band selection between wide or narrow, storing large number of waveform or air, security mechanisms and controls such as hopping pattern management, and wave form selection are all handled by software. Added functionality is more, it apply new or replace modules .The transmission chain provides reverse function such as D/A converter analog up-conversion, filtering and amplification and foreword function such as A/D converter, amplification and down-conversion.

Tier 3:- Ideal-Definde Radio (IDR)

It is fully programmable radio. IDR is same as SDR, it capability such as eliminates the analog amplification and heterodyne mixing prior to A/D conversion and D/A conversion.

Tier 4:- Ultimate-Software Radio (USR)

USR are performing a wide range of adaptive services for user. This type radio capable of anything a user can imagine, from storing money transfer information on

smart cards, to receiving satellite transmissions in real time. No need external antenna and it intended for comparison purposes rather than implementation. USR Radio is absolute model of perfection, and they exist only on paper.

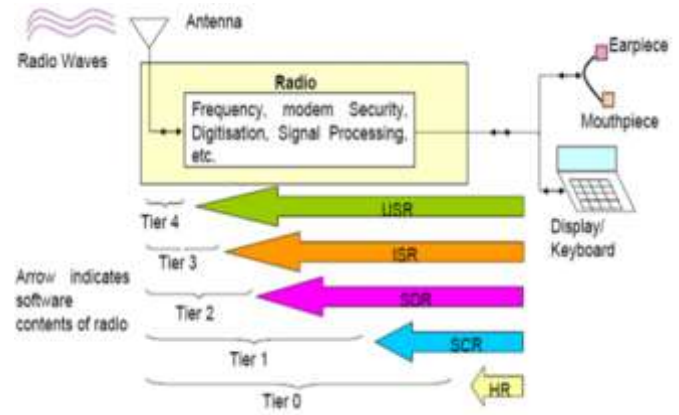


Figure: 3 Collaboration of the SDR Technology. [13]

Technologies based on SDR

SDR can act as key enabling technologies for the other different reconfigurable radio equipments. In advanced wireless market most commonly used technology and discussed. SDR technologies can provide the flexibility for them and achieves the benefits like reduction of cost and increasing the system efficiency. Technology allows the radio control entirely by software [14].

Adaptive Radio

Adaptive Radio is a radio in which communications system will monitor there is own performance. Adaptive Radio according to performance improved, its operating parameters are also modifying. In adaptive array antenna is ultimate potential realized so in communications link provide higher levels of performance, better quality of service and this technologies enable greater degrees of freedom in adaptation .

Cognitive Radio.

Cognitive Radio is mostly used for improving the usage of natural resource (radio electromagnetic spectrum). This is aware from the environment and their internal state. Cognitive Radio communication system knows their location and utilization on RF frequency spectrum at that location and that can make decisions about their radio operating parameter by mapping information against predefined objectives.

Cognitive Radio is further defined by many to utilize Software Defined Radio, Adaptive Radio, and other technologies. Cognitive Radio operations to achieve desired objectives or behavior, it automatically adjust technologies. This will reduce cost to end- user.

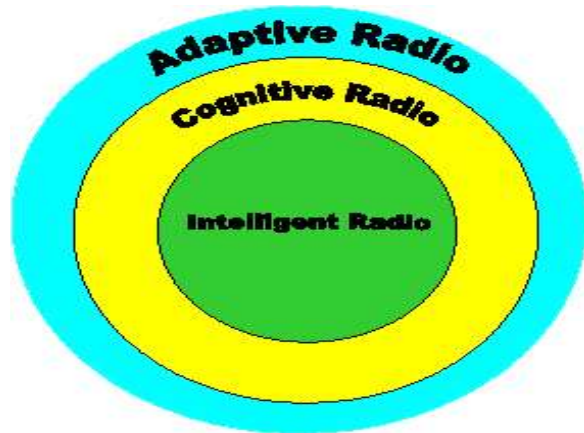


Figure: 4. Venn diagram illustrating relationship between associated advanced wireless technologies. [14]

Intelligent Radio.

Intelligent Radio is also called is Cognitive Radio. This is a capable of machine learning. Cognitive Radio improve with the help of Intelligent Radio and that allows improve the way which it adapts to change in performance and environment to better serve the needs of the end user.

Existing digital radio standard

Truly challenging for these standards is radio design purely digital, and provides error protection schemes, coding technologies, more flexible, more economic, reeducation of radio reception pipe diversity using SDR technology and these are based on different broadcast standard [15].

Digital Radio Mondiale(DRM)

In DRM system uses coded orthogonal frequency division multiplex (COFDM). DRM is a digital radio system and below 30 MHz at operate in short-wave, medium-wave, and long-wave radio. In DRM maximum bit rate is 72 Kbit/s. DRM consist of parameter of the OFDM and coding system that can be DRM to operate successfully in different propagation environments. In DRM systems apply MPEG-4 high efficiency advanced audio compression (HE-AAC+V2). At low data rate it can provide high audio quality and speech-only programming in speech compression algorithms and code Excited Linear Prediction (CELP) and Harmonic Vector eXcitation

coding (HVXC).In all carriers are contained within the transmission channel. Time and Frequency interleaving is applied to mitigate fading from multipath disturbances.

DRM+

Advanced or Development of DRM is denoted as DRM+ and used digital radio transmissions. DRM+ is "smoothly" integrate into DRM. DRM+ consist of two standard are Band 1(the old VHF TV band) and Band 2(the VHF/FM radio band) In this OFDM provide a highly efficient usage of spectrum, no interference in undisturbed mobile reception and its bandwidth is 95 KHz. HE-AAC+ audio compression provide integration up to 4 different audio stream and that also including additional data services or even video streams. In Europe DRM+ 100 KHz fits into FM channel spacing and can be transmitted with in respective gaps in band 2.

Digital Audio Broadcasting (DAB)

DAB system was designed in 1980s. DAB is used to digital radio broadcasting with help of MPEG-2. It's five objectives and also provides: - To CD- quality radio, to batter in car reception quality than on FM, to use the spectrum more efficiently, to allow data to be transmitted.

DAB+

DAB+ is used to audio layer 2 for audio compression with help of HE-AAC+V2. According to required bit rate three options allow superset structure (HE-AAC+V2 is superset of audio compression AAC) like plain AAC for high bitrates, AAC and SBR (spectral band replication) i.e. HE- AAC use for medium bitrates, AAC and SBR and PS (pseudo stereo) i.e. HE- AAC+ V2 use for low bitrates

T-DMB

T-DMB is used ETSI standard (EN 300 401). T-DMB is depended on DAB transmission system and ETSI standard (EN 300 401). T-DMB under used a coding standard are AVC (advanced video coding) is used for video services, BIFS (binary format for scene) is used for audio services, BSAC (bit sliced arithmetic coding) or HE-AAC+V2 is used for audio services for audio coding.

HD-Radio

HD-Radio method is digital and also used broadcasting digital radio signal on same time, same channel, with help of AM or FM signal (in-band, on-channel, or IBOC). HD-Radio is mainly proprietary provide digital transmission use witch COFDM system and the normal AM/FM signal it create set of digital sideband on each side. HD-Radio system are digital so by digital spectrum, it can allows for growth

towards eventual full utilization in three steps: Hybrid, Extended hybrid and full digital.

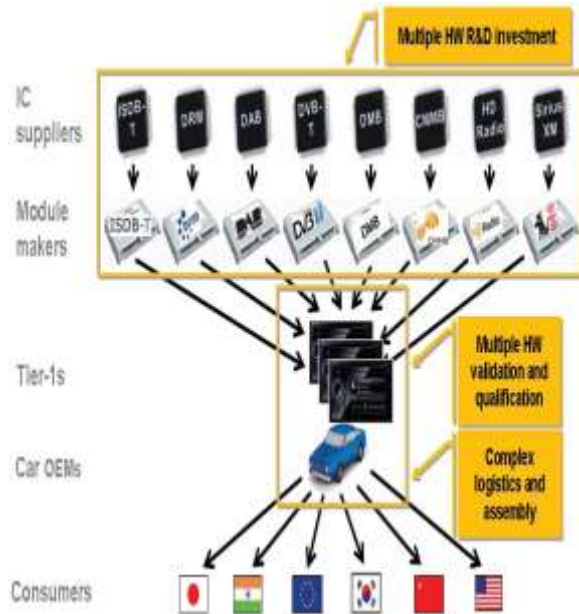


Figure: 5 Production obtain using single devices for each standard. [15]

Different issues in SDR

SDR main issues [16] are:-

- SDR main problem is trying to set up a single unifying network because sometime many SDR network referred to silver bullet to induce an attention.
- The competitor's paradox.
- An accidental misc-configuration networking used in other network the region is potential for knocking out other networks.
- SDR other problem create with multiple service levels and fraud.
- SDR main problem in security system like: - Authentication, Authorization, Misuse, Verification of validity of software update.
- SDR is main problem is higher internal cost like: - implementation cost and switchover cost, upfront cost is higher than with ordinary hardware radio. Sometime the customers pay more because it s actual need flexibility, sunk cost associated with legacy equipment that is no longer used.
- Wideband radio circuit in receiver side more requirements.

APPLICATIONS

SDR most use in military because SDR enable and improve efficiency like interoperability (provide connection between different system) and joint operations (provide cooperation between separate troops). The need of civil service sectors and agencies, organizations under like: police, coast guard, fire and other communication system [17]. SDR is applicable international and national operations. Role of SDR in commercial applications is not yet clear but in future implementation of 4G-terminal under are some terminal or base station can operate in several different system. In heterogeneous networks are reconfigurable multi-standard. SDR commercial application is a Alcatel-Lucent.[18] In SDR reconfigurable depend upon 3G base station and also there economics driver is a provide opportunity to parallel processing computing platforms, all are active on base stations and base station potentially provide a low cost because base station expanding the production of commercial products. The innovative approaches of SDR technology apply then software based-CDMA as a proximity sensor for a virtual mouse [19].

Organizations like Research Laboratories, Industry standards, Investors, Test and Verification, Regulation and Policy, Educational Institutions. SDR base station modules can be installed on the 500,000 base stations and they are already developed and they are smooth path or more advanced capability for future.

ACKNOWLEDGEMENT

I would thank my guide Er. Vaishali Bahl for her consistent guidance and support that motivates me to explore the new horizons and contribute to the present on going research.

CONCLUSION

This paper represented a Software Defined Radio comparison, who can operate hardware SDR and operate software programmable hardware SDR and both are discussed, Software SDR is best choice because it integrates a high performance FPGA. The progress in DSP and FPGA capabilities solve the computational requirements. It can also represent SDR technology and technology based SDR and currently used digital standard. It will serve to increase radio coverage, reduce power consumption. SDR based on different technology in radio communication by providing up gradation facility which is flexible and withstands for long time while providing multi-standard terminal for end user with financial feasibility. Cognitive radio which is context-sensitive, adaptive and learning radio units utilizes SDR as based technology. The mobile wireless communications infrastructure develops and services providers are new

coming up with applications of software defined radio in their business solutions.

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