CT4001NI Communication Engineering

Report tittle

Assignment Weightage & Type

10% Individual Coursework

2019/20 Autumn

Student name: Ishan Gurung

London Met ID: 19031315

College ID: NP01NT4A190139

Assignment Due date: January 16, 2020

Assignment submission Date: January 17, 2020

Word count:2740

Table of Contents

Acknowledgement:

I would like to express my heartfelt gratitude to my module leader Miss. Suman Gupta for providing me a platform to research regarding my report works. This report based on of the important things i.e. Software Defined Radio which helped me to know more about this topic. And by this project, I am able to have good knowledge about the working of Software Defined Radio in different fields. During this report of Software Defined Radio, I became able to know about working principles of Software Defined Radio in different fields. And a special thanks to our tutor Mr. Bibek khanal in analyzing my task, pointing out the areas of alteration. His cooperation considered to the final touch of this report. Major creditability goes to the references I took help from for my project completion.

Summary

The software-defined radio (SDR), also known as software radio (SR), refers to wireless communication in which the transmitter modulation is generated or described by a computer. Software-defined radio requires the combination of software-based signal processing and the enabling hardware components. The receiver uses a computer to recover the sign intelligence. It is enabling science that is useful in extensive range of an areas with in wireless communication. The basic aim of SDR is to exchange the analog factors and hardwires digital VLSI devices transceiver (a device that can both transmit and receive communications, in particular a combined radio transmitter and receiver) as possible with programmable devices. Though software-defined radio presents many compelling benefits to radio system designers, there stays many open questions on how to successfully enforce and manage flexibility in a wireless system. Software radio structures and testbeds offer researchers and developers the capacity to develop their applications in improve of designing customized hardware. In latest years there have been great enhancements in technology, and inexpensive platforms are now feasible though few are typically available. In telecommunication industry, this science is receiving sizeable awareness and generating great past time. The SDR forum is an international, non-profit organization which includes the individual from academia, the military, wireless service provider, and regulatory bodies. SDR has been also described as the cornerstone in the evolution of GSM (Global System for Mobile communications). In this report, I presented a brief overview of the state-of-the art in SDR platforms and the future technology trends in this area. This platform is currently being used by our collaborators and we wish to share this platform with new collaborators to develop a broader community of users and diverse applications.

1. Introduction

Software defined radio is a concept according to which radio frequency (RF) communication is archived by using software (or firmware) to perform single processing that are typically performed by hardware. It incorporates is insignificant of this software in the base of signal processing functionally. For examples: mixers, filters, amplifier, modulators, demodulators, detector etc.

The basic SDR system may consists of personal computer equipped with the sound card, or other analog-to-digital converter proceeded by some form of RF front end. It is not fully standard term that has one official meaning so the first thing I need to do is established what exactly I mean when I say "software defined radio". Actually, I will start by mentioning two things that I don't mean:

1. A typically hardware-based RF communication system that can be modified in some way via software is not an SDR. For example, a radio has hardware for both frequency modulation and allows the user to choose between the two by mean of a software (or firmware) setting. We are not dealing with SDR. This might be called software-controlled radio.
2. A fully hardware based digital data linked is not an SDR. The "software" in "software defined radio" doesn't refers to the fact that the system transfers digital data.

   SDR is capable of both transmitting and receiving, it might implement the RX path in software ant the TX path in hardware. There is no reason why software has to be used for everything.

   It is used in many application and areas. The uses of this technology allow news wireless features and capabilities to be added to existing radio system without receiving new hardware. It has significant utility for the military and cellphone services both of which must serve a wide variety of changing radio protocols in real time. It reduces the development cost on the software and can be reused.

Also, the time and cost for operation and maintenance can be reduced due to bug fixing during radio in the service. There is no interference from other direction as it can lock onto particular directional signal it can also fix the error caused by the interference easily. For a simple radio the basic platform maybe too expensive and development of a software defined radio requires both hardware and software skill. So, this is major drawbacks of it. (Anon., n.d.)
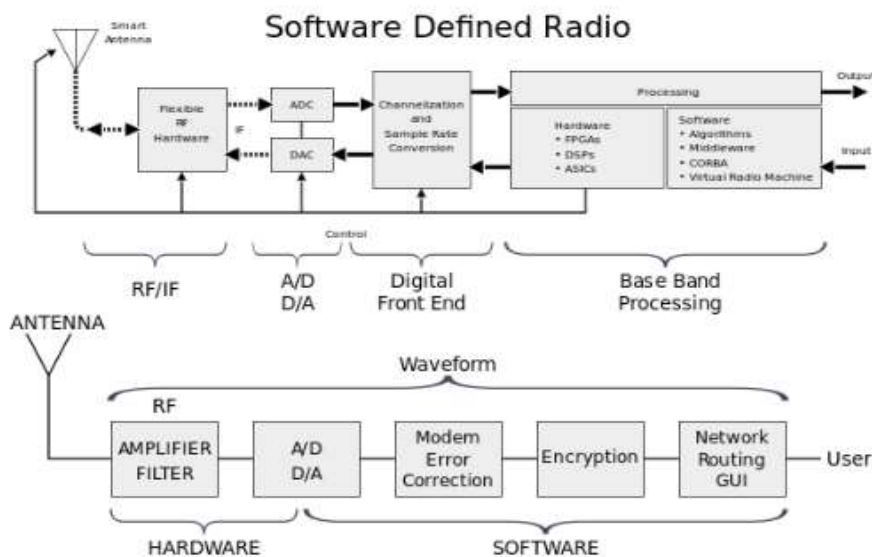

Figure 1 Software defined radio

The benefit of software program defined radio is shown in the following points:

- The capability to receive and transmit a range of modulation method the use of a common set of hardware.
- The capability to alter performance by means of using downloading and walking new software at will.
- The possibility to apprehend and avoid interface with different communications channels.

Like this there are some drawbacks of software program defined radio and they are:

- The problem of writing software program for more than a few target systems.
- The need for interface to digital signals and algorithms.

- A lack of understanding among designer as to what is required.

Albert Einstein said that, "all religious, art and science are branches of the same tree. All these aspirations are directed toward ennobling man's life, lifting it from the sphere of mere bodily existence and leading the individual in the direction of freedom". (Anon., n.d.)

2. The points that expand on the basic definition:

2.1 An SDR does no longer have to be a digital verbal exchange system.

It may appear counterintuitive, however a very difficult digital (actually, mixed-signal) circuit board should be used to implement merely analog RF communication, such as the transmission of analog audio signals.

2.2 An SDR does now not have to provide each transmit and acquire functionality.

It might be solely a transmitter or only a receiver. If it is capable of each transmitting and receiving, it might implement the Rx course in software program and the Tx path in hardware. There is no reason why software program has to be used for everything.
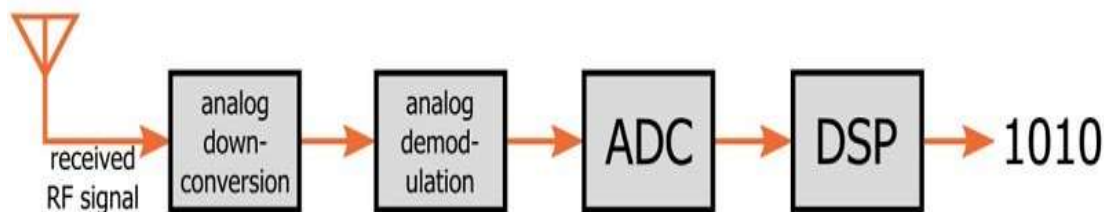
Figure 2 An example of a receive path in a software-defined RF data link

What is software program defined radio?
= With the exponential make bigger in the methods and talent by way of using which human beings want to speak-data communications, voice communications, video communications, broadcast messaging, command and manipulate communications, emergency response communications, etc. editing radio units easily and cost-effectively has grow to be industrial organization critical. Software defined radio (SDR)

ISHAN GURUNG

technological expertise brings the flexibility, price effectivity and electrical

energy to force communications forward, with wide-reaching blessings realized by

using service agencies and product builders via to quit users.

Feature, design and specifications

For Radio Equipment Manufacturers and System Integrators, SDR Enables:

A household of radio "products" to be carried out the usage of a frequent platform

architecture, permitting new merchandise to be greater quickly introduced into the

market. Software to be reused across radio

"products", reducing development charges dramatically. Over-the-air or different far

off reprogramming, permitting "bug fixes" to take place while a radio is in

service, accordingly decreasing the time and costs related with operation and

maintenance.

2.2 For Radio Service Providers, SDR Enables:

New points and competencies to be
delivered to existing infrastructure barring requiring primary new capital
expenditures, allowing provider vendors to quasi-future proof their networks. The uses
of a common radio platform
for multiple markets, appreciably lowering logistical assist and working expenditures.

Remote software program downloads, through which ability can be
increased, capability upgrades can be activated and
new income producing elements can be inserted.

2.3. For End Users- from enterprise travelers to soldiers on the

battlefield, SDR technological know-how targets to:

Reduce expenses in offering end-users with get entry to

ubiquitous wireless communications – enabling them to communicate with whomever

they need, whenever they need to and in whatever manner is appropriate.

3. Rate of Adoption:

The SDR Forum commissioned a number of research reports in 2006 to evaluate the

adoption of SDR applied sciences in a variety of markets. The effects of

these research demonstrated that, in certain markets, SDR is transferring past the

innovators and early adopters as defined by Geoffrey Moore in "Crossing the Chasm" into the early majority phase defining the mainstream market. In this phase, adopters pick out a technology not due to the fact it is progressive or visionary but because it has been proven to successfully remedy a trouble inside their unique market.

## Examples of SDR adoption illustrating the transition to the mainstream are abundant:

• Thousands of software program described radios have been successfully deployed in defense applications
• Cellular infrastructure systems are increasingly more the usage of programmable processing units to create "common platform" or "multiband-multiprotocol" base stations assisting more than one cellular infrastructure standards
• Cellular handsets are an increasing number of using System on Chip (SoC) devices that comprise programmable "DSP
Cores" to guide the baseband signal/modem processing
• Satellite "modems" in the industrial and defense markets make pervasive use of programmable processing units for intermediate frequency and baseband signal processing.

While these kinds of structures are regularly no longer marketed as "SDR's", they utilize and gain from SDR applied sciences to remedy market specific troubles such as; cost of development, cost of production, price of improvements and maintenance, time to market in aiding new and evolving air interface standards, or problems associated with community interoperability

In addition, the SDR Forum's market and technology studies have proven that cost effective radio frequency applied sciences helping the operation of software defined radios over a large spectral vary have begun to mature, permitting for the first time the use of software program defined radio as an enabling technological know-how for dynamic spectrum access systems with cognitive or clever radio functionality.
This style is expected to continue over the subsequent a number of years, allowing SDR to finally attain the defined vision of lowering costs in offering end-users with get right of

entry to ubiquitous wireless communications – enabling them to talk with whomever they need, whenever they want to and in anything manner is fabulous.
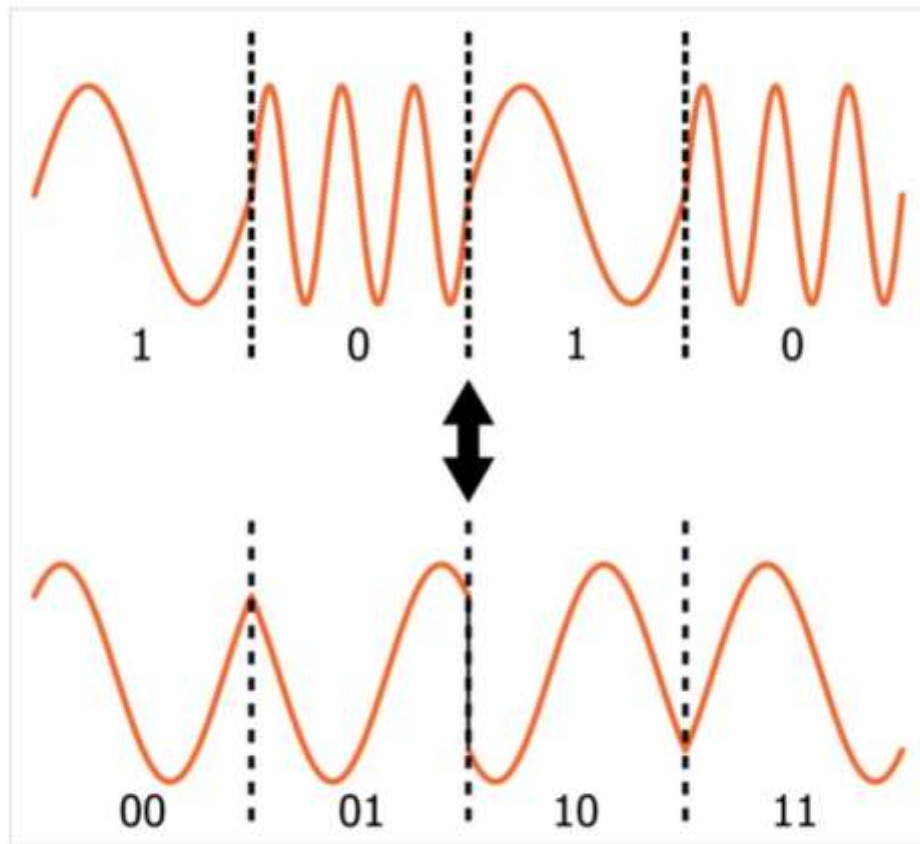
An SDR could switch between FSK and QPSK based on which one is currently providing the lower bit error rate.

*Figure 3 An SDR could switch between FSK and QPSK based on which one is currently providing the lower bit error*

Value Chain:

The time is now to have interaction SDR at all degrees of the chain.

The benefits and anticipated possibilities for SDR science are having
a widespread impact on the wireless industry's fee chain. This chain consists of product-based and service-based providers,
with fee brought at each stage, subsequently resulting in SDR end merchandise and services that meet the desires of the cease users and subscribers.

6

Throughout the chain, the providers can also be supported by means

of exterior groups such as educational

institutions, lookup laboratories, industry requirements bodies,

investors, assessments & verification and government.

These helping groups grant fundamental input as development progresses via the

chain, finally reaching the cease user. The element of the chain and the

relationship within the context of the SDR Forum membership is outlined below.
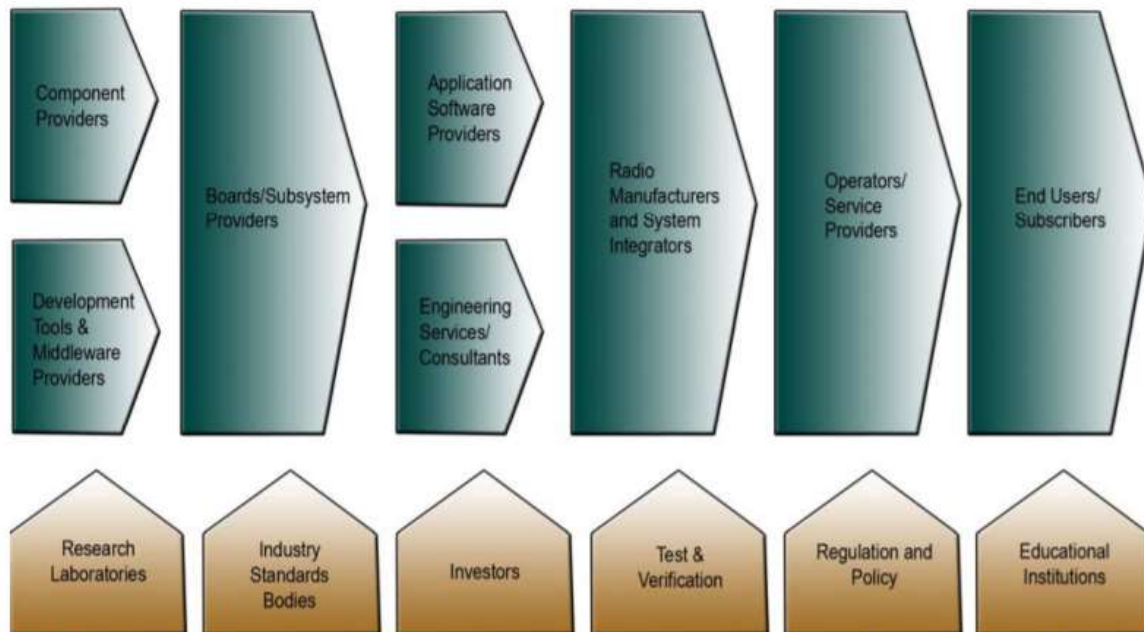
Figure 4 SDR value chain

Please note: corporations may additionally signify more than one class in the cost chain.

For instance, some defense contractors develop their own SDR subsystems and

application software. Equally most aspect providers also furnish improvement tools.

ISHAN GURUNG

SDR has far attaining implications within the chain impacting a variety of groups and industry sectors thru the radio frequency (RF) chain (front cease components, software developers, chips makers, etc.) and for the duration of commercial enterprise modes (service providers, OEMs, IP holders, etc.). In order
to provide potential products and services to meet the future development
potential of SDR technology, groups must appear to structure SDR into all levels of the value chain. With successful functions considered in a range of markets, the chance to fully engage SDR at all degrees of the chain is now.

The SDR Forum engages world classification technical, commercial
enterprise and government leaders from EMEA, Asia and the Americas, at all levels of the wi-fi industry's fee chain. These members are committed to solving their customers' communications issues via families of radio devices that assist a large vary of disparate wireless networks, evolving standards, and the addition
of value introduced services. The dedication to promotion the success
of subsequent generation radio applied sciences that will
inherently aid software described and cognitive radio (CR) capabilities is at the basis of the Forum. Through its collective industry power, the Forum can help the adoption of SDR applied sciences thru the fee chain thru advocacy, opportunity development, commercialization and education.

Application

Related Technologies

SDR can act as a key enabling science for a range of other reconfigurable radio
equipment commonly discussed in the advanced wi-fi market. While SDR
is not required to implement any of these radio types,
SDR technologies can provide these sorts of radio with the flexibility
necessary for them to attain their full potential, the advantages of which
can help to decrease cost and make bigger machine efficiencies:

Adaptive Radio

Adaptive radio is radio in which communications systems have a capacity of
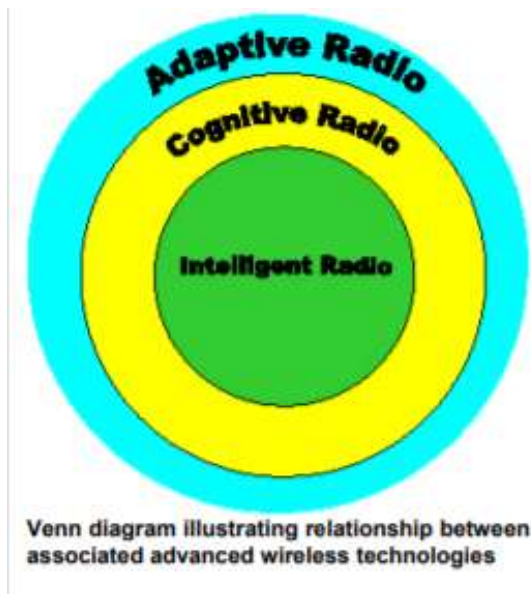
ISHAN GURUNG

monitoring their very own performance and modifying their operating parameters to improve this performance. The use of SDR technologies in an adaptive radio system enables larger tiers of freedom in adaptation, and thus higher tiers of performance and better quality of provider in a communications link.

Cognitive Radio

Cognitive radio is radio in which communication systems are conscious of their internal nation and environment, such as location and utilization on RF frequency spectrum at that location. They can make decisions about their radio operating behavior with the aid of mapping that information against predefined objectives. Cognitive radio is in addition defined by means of many to utilize Software Defined Radio, Adaptive Radio, and other technologies to automatically alter its behavior or operations to gain preferred objectives. The utilization of
these factors is integral in allowing end-users to make superior use
of on hand frequency spectrum and wireless networks with a common set of radio hardware. As referred to earlier, this will minimize cost to the end-
user while allowing him or her to communicate with whomever they want on every occasion they need to and in whatever manner is appropriate.

Intelligent Radio

Intelligent radio is cognitive radio that is successful of computer learning. This allows the cognitive radio to enhance the ways in which it adapts
to modifications in performance and surroundings to better serve the needs of
the end user. These sorts of radio – adaptive radio, cognitive radio and sensible radio – do no longer necessarily define a single piece of equipment, however can
also alternatively incorporate factors that are spread across an entire network. (Anon., n.d.)

Venn diagram illustrating relationship between
associated advanced wireless technologies

Figure 5 Venn diagram of related technologies

Software defined radio components:

I think it is safe to affirm the following: If your gadget does now
not have each a records converter and a fairly-heavy-duty processor, it is now not an
SDR.

Typically, the processor is a DSP, which in this case stands for
"digital sign processor" rather of "digital signal processing." This is a identify given to
processors that are designed to emphasize sure capabilities, such as excessive core
frequencies or hardware that helps mathematical calculations. These elements separate
DSP chips from microcontrollers, however needless to say the line can get blurry as
microcontrollers emerge as quicker and extra sophisticated.

The DSP wants to be pretty effective if you prefer to implement decoding in software
program due to the fact this involves some serious math, and the
processor desires to perform decoding calculations quickly adequate to maintain up with
the incoming data. On the other hand, if all you are doing with the processor

ISHAN GURUNG

is producing a baseband waveform that will be sent to a DAC and up-
converted via hardware, an above-average microcontroller may be adequate.

The facts converter will be an ADC or a DAC (or both). You need an ADC
for acquire performance and a DAC for transmit functionality.
An apparent obstacle here is the maximum sampling rate: RF verbal
exchange involves high frequencies, now and again very excessive frequencies, and
the converter's sampling charge need to be excessive enough to provide ample signal-
to-noise ratio.

Important SDR abilities are:

1. The SDR module is capable of reconfiguring RF and can be programmed to tune to
a broad spectrum vary and operate on any frequency bands within the range.
2. SDRs can be quickly and without difficulty upgraded with enhanced features.
3. SDRs can speak and pay attention to more than one channels simultaneously.
4. Diverse wishes for specific systems can now be at ease with a single time-
honored hardware, consequently achieving outstanding interoperability among a
number of wi-fi networks.
5. The attainable of SDR is maximized when mixed with spectrum sensing and cognitive
engine.
6. SDR has a vast spectrum of applications for both army and civilian wireless networks,
many of which may additionally require assisting a wide range of evolving wi-fi protocols
in real time.

Conclusion

SDR stands for Software Defined Radio. SDR is one of the best devices to use in order to deliver information in cheap and efficient manner. It is now in just a starting phase but it impacts and applications are yet to understood and recognized. In the longer term as the software radio becomes commercialized and much more positive impacts in different ways on comminution and on other industries. It helps to avoid the cost of different small instruments that are used in a radio of communicate by replacing it with a software. The radio system also becomes efficient and reliable with better performance. This technology is already receiving huge recognition and it has already established that generating web spread interested in telecommunication industry. Software defined radio (SDR) has made transition to commercial in less than the decade. It has emerged from military research to become a wanted prospective for regional and global communication. The ways of blocking the way for SDR development are also being solved. So, I expect it to offers the benefits over wireless system and allowing in the quality of service and minimize the costs of using the devices. The benefits of SDR can be realized if the task is taken throughout the development of the technology.

Now I know that SDR is playing an important role in modernizing and in military field an it has contributing a lots things in this filed. It is the portable kind of the communication devices. Overall, it is very important to keep developing the software defined radio and encourage people to use it because it not only helps people in cost management but also in better communication.

References

Anon., n.d. [Online]
Available at: https://en.m.wikipedia.org/wiki/Software-defined_radio

Anon., n.d. [Online]
Available at: https://en.m.wikipedia.org/wiki/Software-defined_radio

Anon., n.d. [Online]
Available at: https://ieeexplore.ieee.org/document/1343223/references#references

Anon., n.d. [Online]
Available at:
https://www.wirelessinnovation.org/assets/documents/SoftwareDefinedRadio.pdf?fbclid=IwAR3qqr3ad
QakDYjLX67wb451v32IKHivxmU2oRpq0iq92jyr_Ci1r6YvBn8

Anon., n.d. [Online]
Available at: https://ieeexplore.ieee.org/document/1343223/references#references

ISHAN GURUNG