Frequency spectrum management

Business, Management

The efficient and effective use of the spectrum encourages the development and rapid deployment of innovative and efficient communications technologies and services. There are hundreds of technologies which are dependent on one this one resource. Spectrum encompasses the entire range of electromagnetic radio frequencies used in the transmission of sound, data, and video. The FCC and the National Telecommunications and Information Administration (NTIA) shareresponsibilityfor managing the spectrum.

Because there is a finite amount of spectrum and a growing demand for it, effectively managing the available spectrum is a strategic issue for the FCC and the NTIA. The implementation of modulation techniques and access techniques are making it possible to reallocate overwhelmed frequency bandwidths. Additionally, new technologies are making it possible to transmit at previously unreachable frequencies with cost being the only controlling factor. Ultimately, a regulated spectrum worldwide may be the only solution for rationing an overloaded spectrum and protecting against those who use radio waves as a means to harm others.

I. Introduction

Telecommunication is the transmission of signals for the purpose ofcommunication. In the past, there were many ways to communicate for example, use of smoke, drums, flags, heliograph, etc. Today, telecommunication refers to electronic transmitters such as mobile phone (wireless), telephone, television, radio and computer. The core of the telecommunications industry follows the radio frequency spectrum where all

information such as voice, data and multi-media communications relies on radio frequency spectrum.

Radio frequency spectrums are very complex to predict the frequencies used for each application. However, computer modeling can help to reduce the complexities of Spectrum Management (SM). The regulator applies two types of efficiency when implementing SM. First, technical efficiency, which refers to use of radio frequency with different uses and users should not interfere with each other. Technical efficiency also helps to tackle host of related problems such as use of faulty or non-standard equipment, illegal use of frequencies, use of levels of power and allocating the location for antennae. Read about FHP wireless

Second, economic efficiency, which refers to use of different services using radio frequency because markets changes over time and consumers are willing to pay different prices for different services.

II. Spectrum Overview

The Radio Frequency (RF) spectrum is a tool used to manage and map the physical phenomena of electromagnetic waves. These waves moves through space at different frequencies, and the set of frequencies is called the electromagnetic spectrum. The frequency rage of radio spectrum is from 3 kHz to 300 GHz which can also be used for wireless communication.

In other word, a subset of the electromagnetic waves is the radio spectrum which lies between the frequencies 9 kHz thousands of cycles per second to 30 GHz billions of cycles per second. The Radio Frequency spectrum is a natural resource similar to water, land, gas and minerals which can be an

exclusive property of the state. The frequency supports broad ranges of activities such as industrial, scientific, business, medical research and cultural activities. In the past, use of radio spectrum was highly regulated due to defense and security reasons.

Today, new innovations in the theory and practice brought changes in the use of radio spectrum. For example, normal publics started to show interest in the use of mobile phones and most of all use of transmitting data, video and voice, etc. At the same time demand for radio spectrum grew to an extent that new regulation for such transmitting became inevitable. Use of Radio Spectrum Toolkit helps to regulate such policy that implements broad range of spectrum management which includes principles of spectrum regulation, pricing, monitoring and international coordination.

The International Telecommunications Union (ITU) generated special rights which states that " the sovereign right of each State to regulate its telecommunication".

III. Spectrum Manager Overview

The wireless telecommunications regulation at national, regional and global levels is call the spectrum management. Spectrum management has many activities such as planning spectrum use, assigning spectrum licenses, enforcing license conditions, interacting with regional and international organizations.

Regulators must set up a system to measure performance and indicators for all of the above activities. For example, monitoring target or measuring the number of licenses granted and the avenge time taken to issue each

licenses. Economic objectives relate to ensuring that spectrum is used in ways which meet the country'sgoalscovering the efficient allocation of resources – that spectrum is employed by both private and public sector organizations in ways which meet the countries economic growth and other objectives [1].

The main objective of Spectrum Management is to rationalize and optimize the use of the RF spectrum. However, there are other objectives which are to avoid and solve interference and design short and long range frequency allocation. Similarly, it also needs to introduce new wireless technologies and most of all integrate wireless communications with neighbors and other entities.

A. FCC The Federal Communications Commission (FCC) is an independent agency located in the United States under the US government which is created and directed by Congressional statute.

Almost all the FCC commissioner are assigned and appointed by the US president. There are 6 main goals of FCC which are focused on broadband, competition, the spectrum, the media, public safety and homeland security, and modernizing the FCC. The establishment of FCC took place in 1934 by the Communications Act of 1934 as the successor to the Federal Radio Commission (FRC). Its responsibility is to regulate the use of radio spectrum which includes radio and television and telecommunication using wire, satellite and cable.

FCC has jurisdiction over 52 states and the District of Columbia. President-elect Barack Obama appointed Susan Crawford and Kevin Werbach on 14th

Nov, 2008 lead the team of FCC. In 2008, FCC, promoted extensive use of broadband services, enhances public safety and homeland security and most of all promote the efficient use of spectrum.

B. NTIA The National Telecommunications and Information Administration (NTIA) is an agency of US Department of Commerce which main goal is to serve the adviser of the president on telecommunication policies.

Currently, it is run by Meredith Attwell Baker who is a Acting Assistant Secretary of Commerce. The main objectives of NTIA are as follows: Making sure all us citizens can afford phone and cable service, implement advance and innovative telecommunications technologies, making sure the hardware is available for enabling public radio and television broadcasters. Apart from the objectives, NTIA also tries to participate in international government-to-government negotiations, participate in the negotiation of ensuring proper spectrum for national defense, public safety, and U. S. business needs, NTIA must also make sure efficient use of federal radio spectrum, it must also make sure that proper usetechnologyin the development and implementation of new emerging telecommunications technologies, it must perform research to explore uses of higher frequency spectrum.

IV. Radio Access Techniques In recent years, many advances took place in field of broadband implementation of wireless networks. This advancement has raised the issue related to service quality for wireless systems.

In telecommunication, there is a method called Channel Access Method which helps to connect several terminals to the same physical medium to transmit over it and share its capacity. The most common circuit mode and

channel access methods are Spread spectrum multiple access (SSMA), Time-division multiple access (TDMA), Frequency division multiple access (FDMA) and Code division multiple access (CDMA).

A. Spread Spectrum Multiple Access (SSMA) Using spread-spectrum techniques a electromagnetic energy generated which is spread in the frequency domain and as a result signal gets wider bandwidth.

The main reason this techniques are used is that it helps to secure communications, helps to resists to natural interference and jamming and most all prevent detection. Spread-spectrum telecommunications is a technique which helps to process transmitted signal on a bandwidth. It is a signal structuring technique that employs direct sequence, frequency hopping and combination of both which can be used for multiple access as well as multiple functions. It also uses a sequential noise-like signal structure to spread the narrowband information signal over relative radio band frequencies.

The receiver compares the signal received to get the original signal. Both combination and individual spread spectrum such as Frequency-hopping spread spectrum (FHSS), direct-sequence spread spectrum (DSSS), time-hopping spread spectrum (THSS), and chirp spread spectrum (CSS) are forms of spread spectrum. These techniques apply pseudorandom number sequences which controls the spreading pattern of the signal across the bandwidth.

B. Time-Division Multiple Access (TDMA) TDMA is a channel access method used in shared medium networks.

It divides the signals into different time slots which enables multiple users to share the same frequency channel. For example, each user transmits in rapid succession using his or her own time slot which allows multiple stations to share one radio frequency channel. TDMA is used in 2G system such as IS-136, Personal Digital Cellular (PDC), GSM, etc. TDMA is also used in satellite system and combat-net radio systems. It is a Time-division multiplexing where one transmitter connected to one receiver.

There are many features of TDMA, for example, it shares single carrier frequency with multiple users. It is a Non-continuous transmission which helps to make handoff simple. It has higher synchronization overhead than CDMA and has advanced equalization which is necessary for high data rates. Each slot can be assigned to dynamic TDMA and has slot allocation complexity and most of all it has pulsating power envelop where it can control the interference with other devices [5].

C. Frequency Division Multiple Access (FDMA)

FDMA is also a channel access method which is used in multiple-access protocols. With the help of FDMA users can have individual allocation of multiple frequency bands where each user can use the frequency without any interference. Multiple Access systems synchronize access between several users. There are many features of FDMA such as it requires high-performing filters in the radio hardware, it is similar to TDMA which is not vulnerable to timing problems, FDAM has a continuous flow of data due to allocation of predetermined frequency and FDMA is not sensitive to near-far problem.

There is a difference between FDMA and FDD where FDMA allows access to multiple users while FDD relates to only shared radio channel [6]. FDMA is allocated for wireless cellular telephone communication into 30 channels each of which carries voice conversation with digital data such as SMS, pictures, etc. It is a basic technology in the analog Advanced Mobile Phone Service (AMPS), it is widely implemented in North America. The Digital-Advanced Mobile Phone Service (D-AMPS) also uses FDMA which includes additional feature such as TDMA that helps to add three channels for each FDMA channel.

D. Code Division Multiple Access (CDMA). Another channel access method is CDMA, which is used by many radio communication technologies. CDMA is different compared to the ones used in mobile phone such as CDMA-1 and CDMA 2000 which basically it uses CDMA as their underlying channel access methods. Multiplexing is when several users to share a bandwidth of frequencies and CDMA takes help from SSMA to allow multiple users to be connected over the same channel and takes help from TDMA for time division multiple access and FDMA for frequency division.

To avoid confusion, user can take turns speaking which is time division can speak at different pitches which is frequency division or speak in different languages which is code division. The main advantage of CDMA is it can use the spectrum more proficiently in mobile phone applications. It also has flexible allocation of resources. " There is no strict limit to the number of users that can be supported in an CDMA system, only a practical limit governed by the desired bit error probability, since the SIR (Signal to Interference Ratio) varies inversely with the number of users" [3].

V. Bandwidth Allocation Techniques Bandwidth allocation focuses on different method utilized in different communication industry to design and assign frequency channels to different wireless applications. In telecommunication, there is a technique called Dynamic Bandwidth Allocation (DBA) through which traffic bandwidth in a shared telecommunications medium can be gathered on demand. This is a type of bandwidth management and it is similar to statistical multiplexing.

DBA has many advantages such as all users are not connected to the network at one time and even if they are connected they are not transmitting data at all times. Different network protocols implement DBA in different ways and these methods are defined by International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE), Internet Engineering Task Force (IETF). VI. Problems with Unregulated Spectrum in Foreign Countries

Before 1912, the radio communications spectrum was generally unregulated and it is after the sinking of the Titanic brought the changes in the subsequent Radio Act of 1912 in the US. The act started the process of spectrum usage under licensed control, and the license holders must restrict themselves to their assigned frequencies to avoid meddling and to prioritize distress signals. The Radio Act 1927, created the Frequency Radio Commission (FRC) to manage spectrum as a national asset. However, the signal interference still was the most critical issue as the demand for frequency increased.

Countries like India where huge swathes of the spectrum is controlled by the military and government agencies, shortage of spectrum became scares and

problems in quality and services became more and more visible for urban mobile phone users. The supply of spectrum is controlled by ITU's World Radio Conferences (WRC) which is held every 2 to 3 years. ITU controls spectrum using three region where Europe and Africa, Asia (Oceania) and Americas. Each region coordinates allocations for same purpose and is doing so in their own self-interest and economics.

Today, WRC, controls the supply of spectrum in which the use of spectrum can be market driven. Interference is the main issues today and two factors are considered. Firstly, acceptance that market-type reforms are the proper way to attain and control efficient use of spectrum and secondly, advance in micro-electronics will help in detecting and controlling the interference. Since spectrum is a scarce resource it must be controlled in such a way that interference can not be an issue when users are using the frequencies over the airwaves. Read about FHP wireless

A. Network Overcrowding

Wireless networking is the best way to solve many communication problems such as problems with distance between mobile company, creating in-building LANs, etc. However, this type of networking has a dark side for instance interference, in wireless devices such as mobile phones. Since wireless networking brings interference, FCC follows one tactics for example limiting the combined strength of the signals radiated by all the transmitters in a particular system. Requiring conformance to a protocol helps network to communicate side by side instead of colliding with one another.

Free more bandwidth also helps unlicensed user not to come across licensed user and stay free from interference.

B. Public Safety Interference and

C. Terrorist Acts When unwanted radio signals that degrade or interrupt radio communication and broadcasting services it can create hazardous problems for both the public as well as the company. Interference such as affect the quality of your reception or communication, cause only a temporary loss of signal and prevent reception. The first thing the 9/11 commission recommended was call for nationwide frequency and channel standardization of public safety.

The main issue was that the disposition of the 700 MHz spectrum where 30 MHz of this spectrum dedicated to an advanced public safety. However, the security implications of sharing information must be strong in order to assure safety for both the public and the company. The main security issue such as data access must be implemented in such a way that the privilege given to the users is controlled and manipulated. Keeping off the malicious users from accessing valuable company information and other external information that can be used against the company and the public needs to be taken under consideration.

Sending emails and other attachments using wireless communication must be allowed according to hierarchy of access permissions. Other issues that need to be taken under consideration are such as the network access and security tokens needs to be changed constantly and most off all securing the connection to local devices that are connected to the network such as

internet connected using the mobile. Routers and switches should be organize and installed as securely as possible and web based configuration should be disabled as well as network access to the device's should be limited.

The history of telecommunication security has been delineated, leading now into some of the numerous potential threats to information on a network. Threats to network security range from harmless pranks to devastating crimes of destruction and theft. Breaches in security occur internally by employees and externally by hackers. " In a recent attack on the Texas A; M University computer complex, which consists of 12, 000 interconnected PCs, workstations, minicomputers, mainframes, and servers, a well-organized team of hackers was able to take virtual control of the complex.

" [8]. Texas A; M attack is one of many examples that can be set as an extreme threat for any organizations. In order to avoid such attacks an organization need to be fully equipped with latest technologies and state of the art software such as antivirus. " It is often impossible or very difficult to know if you are under attack and from whom and attackers sophistication has increased enormously in the last 5-10 years. " [7] Other threats such as virus development have increased at an alarming rate.

However, the most common cause of security problems are as stated " Human Error 52%, Dishonest people 10%, Technical Sabotage 10%, Fire 15%, Water 10% andTerrorism3% and many computer crimesMoneytheft 44%, Damage of software 16%, Theft of information 16%, Alteration of data 12%, Theft of services 10%, Trespass 2%. " [7].

VII. Conclusion This report discusses the issue related with radio spectrum which is needed for all types of communication. Communication using wireless device, television, radio, and other devices share frequency which is available all over the world.

But, using such scares resource became a critical issue due to conflict, interference. Using such methods of communication is a huge economical resource for any country. In recent years, many advances took place in field of wireless networks. Advancement such as Channel Access Method helps to connect several terminals to the same physical medium to transmit over it and share its capacity. Channel Access Method such as SSMA retrieves wider bandwidth; TDMA divides the time, FDMA divides frequency and CDMA which is combination of SSMA, TDMA and FDMA.

Channel Access Method process spectrum in such a way that limited interference and other hazardous problems can be solved which were impossible using traditional methods. With introduction to these methods came many problems related to public safety and security. In assuring public safety and security companies that utilizes radio frequency spectrum must worry about avoiding and solving interference at the same time worry about design short and long range frequency allocation.

However, maybe in the future when introducing new technologies and most of all integrate wireless communications with neighbors and other entities could solve many problems related with telecommunication and use of frequency.