

# Static and dynamic spectrum allocation computer science essay

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As the requirements of the wireless services keep growing, the number of variant wireless standards increases, which consequently imposes increasing stress on the fixed and limited radio spectrum. However, extensive measurements reported indicate that large part of licensed bands is in low utilization, as show in Figure 2. 1. Spectrum utilization is strongly depended on place and time. Fixed spectrum allocation wastes resources. [1]

Figure . 1 Spectrum Utilization

Nowadays applications require more bandwidth for better services. Electromagnetic spectrum, however, is a kind of limited natural resource as well as water and crude oil. Recent studies noted the poor utilization of traditional exclusive spectrum assignment. An intuitional way to improve the sparse usage is to allow an unlicensed user to access the resource during idle time. We can improve efficiency by allowing unlicensed users to exploit spectrum whenever it would not cause interference to licensed users.

2. 2 Spectrum Assignment Policy:

Why A fixed spectrum fraction is assigned to licensed holders on a long term basis for large geographical regions. Figure 2. 2 show fixed spectrum assignment to different standards.

Figure 2. 2 Spectrum Assignment policy

According to Federal Communications Commission (FCC), this exclusive assignment limits the usage and results in many spectrum holes, also called white space. It shows most traffic over wireless network concentrates on particular frequency, in particular region, at particular time while a <https://assignbuster.com/static-and-dynamic-spectrum-allocation-computer-science-essay/>

significant amount of the spectrum remains unused. Throughout the whole spectra, utilization varies from 15% to 85% in frequency, time and geographic domains. Much worse is that, 90% of the time, certain portions of licensed bands are unoccupied. As users demand for better quality of services and higher data rate, efficient spectrum usage is becoming a critical issue. [2]

## 2. 3 Static and Dynamic Spectrum Allocation:

There has been numerous protocol standards on the wireless spectrum that rely on a static spectrum allocation policy under which each licensed spectrum band is statically assigned to the specific licensed service and its users. Once a spectrum band is assigned to a certain service, its allocation is not allowed to change. However, a new concept of dynamic spectrum allocation has become necessary to overcome critical limitations of the traditional static allocation scheme. Recent studies have shown that the use of static spectrum allocation has degraded spectral efficiency significantly. Moreover, current standards cannot guarantee the prevention of unexpected interruptions by wireless network users. To alleviate these problems, FCC has recently suggested a new concept of cognitive radio networks (CRNs) that serves as a framework in realizing dynamic spectrum allocation. It requires the enhancement of current PHY and MAC protocols to adopt spectrum-agile features. The basic idea of spectrum agility is to allow secondary users (SUs) or unlicensed users to access licensed spectrum bands as far as they do not produce undesirable interference with the licensed users. To achieve this goal, SUs must monitor each channel

s usage pattern by its PUs to identify spectrum holes or opportunities to exploit. Whenever SUs find a channel that can be utilized without interfering with its PUs, it can be assigned to and will be shared by the SUs. The SUs are also responsible for monitoring returning PUs on the channel they are currently using so as to promptly vacate the channel in such a case. [3]

## 2. 4 Unlicensed Spectrum:

There are two major advantages of using unlicensed spectrum. First, there is no requirement to register for using the spectrum and its deployment is very fast and cost effective as well. Second major advantage of using unlicensed spectrum is that it is shared among users which is indeed useful for wireless systems in which devices can dynamically change its position like notebooks, cell phones, etc. It would not be practical to require the owners of a portable device to acquire a license that covers every place they may ever wish the system to operate. Fixed applications that transmit sporadically or at fluctuating rates can also make more efficient use of unlicensed spectrum; when one is not transmitting, another can. It has been shown that cellular systems could carry significantly more traffic if they shared spectrum dynamically, provided that competing firms are willing to adopt cooperative strategies that serve their common interest. Metropolitan area networks carrying bursty data traffic could expect even greater efficiency gains, if competing networks can be motivated to adopt such techniques. [11]

### 2. 4. 1 ISM band:

The industrial, scientific and medical (ISM) radio bands were originally reserved internationally for the use of RF electromagnetic fields for industrial, scientific and medical purposes other than communications.

Figure 2. 3 shows spectrum of ISM band. [13]

### Figure 2. 3: ISM Band

There are many factors which raises interest for using these bands such as time consuming standardization. Also, there is no requirement of registering the users using these bands, no particular restrictions on users for their usage and users can use the products anywhere at any place. There is no license fee for this band and the devices using these bands are cost effective. Many wireless communication standards are aimed to use unlicensed ISM band because it is easier to coexist with existing wireless networks than to assign a new separate empty spectrum. Currently most of spectrums for wireless communication are saturated. There are heavy interference and competition in ISM band because many wireless devices flow into this frequency area. On the contrary, spectrums of TV broadcasting, digital TV and wireless microphone tend to inactive depend on devices's location or time. In TV broadcasting, the spectrum is busy in TV broadcasting hours, but no one can use the spectrum when broadcasting signs off. Also TV spectrum is changed in compliance with localization. The 2.4 GHz ISM band has become particularly popular in last few years such as household and virtually all commercial buildings are likely to have equipment that operates in this band. Applications include wireless LANs, Bluetooth and infrared devices for short range communication and for

Advanced Traveler Information and Management Systems like door openers for garage, home audio system, cordless phones, remote control, etc.

## 2. 5 Wireless Regional Area Network (IEEE 802. 22):

IEEE 802. 22 Working Group came in to being in November 2004 with a purpose of making a standard for wireless regional area network (WRAN) capable of using cognitive radio technology. According to its technical specifications, 802. 22 WRAN systems will operate on the VHF/UHF TV bands ranging from 54 MHz to 862 MHz. The target of WRAN is to provide wireless broadband access with the average coverage radius of 33 km and can go up to 100km. The main target is to make unlicensed access to unused TV spectrum. In particular, 802. 22 WRAN systems will be able to sense the spectrum, identify unused TV channels, and utilize these channels to provide broadband services for fixed wireless subscribers. While doing so, they must make sure that there is no undesirable interference with licensed users.

Figure 2. 4 shows the WRAN standards and application.[8]

### Figure 2. 4: WRAN

IEEE 802. 22 is a standard for Wireless Regional Area Network (WRAN) which uses unused spectrum (spectrum whole) in the TV frequency spectrum on a non-interference basis. This standard is developed with the intent to give broadband internet coverage in rural areas with acceptable performance comparing with performance of DSL and cable modems. The television spectrum was selected for this application due to its propagation

characteristics. Cognitive radios will reuse TV spectrum in an opportunistic way by detecting if the channel is occupied before using it.

## 2. 6 Summary:

Due to the rapid growth of wireless services, various wireless standards have been developed which are becoming a cause of major stress in fixed and limited spectrum. However fixed spectrum results in low utilization of spectrum resources as per the spectrum assignment policy. Now days, applications require more spectrum for efficient services. The fixed spectrum is not convenient for these services. Therefore, this problem can be improved efficiently by allowing unlicensed users to exploit spectrum whenever it would not cause interference to licensed users. The fixed spectrum policy that relies on a static spectrum allocation policy under which each licensed spectrum band is statically assigned to the specific licensed service and its users and its allocation is not allowed to change. In order to solve this issue a new concept of

dynamic spectrum allocation also known as unlicensed spectrum policy has become necessary to overcome critical limitations of the traditional static allocation scheme. To make this concept more efficient, a new technology called cognitive radio technology has been developed. The basic idea behind this technology is to allow secondary users (SUs) to access licensed spectrum bands as far as they do not cause any harmful interference with the primary users (PUs). The unlicensed spectrum has two major advantages i. e., one is they are fast and cheap in deployment and other is unlicensed spectrum is shared. As sharing is essential for wireless networks, many

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wireless communication standards are aimed to use unlicensed ISM band because of complete absence of user restrictions and it is easier to coexist with existing wireless networks than to allocate new empty spectrum.

Cognitive radio technology is being used in WRAN developed by IEEE 802. 22 working group give broadband services in rural areas having the performance statistics comparable to DSL and cable modems by utilizing white spaces on non-interference basis.