Chapter 1
An Overview of Cognitive Radio Networks:
A Future Wireless Technology

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ABSTRACT

The major hurdle that restricts the efficient utilization of radio spectrum is its inflexible and rigid licensing scheme. This constraint limits the emerging wireless systems to operate in static spectrum band. This deficiency compelled the innovators to introduce new paradigm (i.e., cognitive radio [CR] technique to boost productive spectrum utilization). In this chapter, the authors briefly introduce the CR to exploit wireless spectrum opportunistically. Cognitive radio network architecture is also discussed in detail. Authors also mentioned the software-defined radio (SDR) platform as a support to regulate spectrum reuse. IEEE 802.22, the first worldwide standard for wireless regional area network (WRAN), based of CR technology is presented in descriptive way along with its capacity, coverage, MAC layer frame structure. It has been observed that CR strikes its presence in today's modern wireless systems, applications, various projects, and trends, and become their desire.

INTRODUCTION

Nowadays global market has witnessed a rapid growth in various wireless communication technologies. In our day-to-day life, devices like a TV remote, personal digital assistant (PDAs), cellular phones, satellite TV setup box, all are based on wireless communication technology. This observation shows that the number of users subscribing and demanding for wireless services and applications have surpassed the number of users using traditional wired telephone services. Basically, wireless communication systems are based on the transmission of radio (electromagnetic) wave having the frequency of range 3Hz to 300 GHz. Hence this dramatic growth of mobile users and wireless data causing spectrum crunch problem

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for various upcoming wireless devices and services. Visual networking index (VNI) on February 2017 has reported that mobile data traffic has been raised 18 times over the last five years and the growth rate of global mobile data traffic extended up to estimate of 63% in 2016 (Networking, 2017).

Figure 1 shows the variation in mobile data traffic growth of different regions all over the world, where the Middle East and Africa possess the highest growth in the year 2016 in comparison to the previous year.

VNI also reported that in coming years the worldwide data traffic is expected to raise 49 Exabyte per month by 2021, illustrated in Figure 2.

Therefore, there is a need to make appropriate efforts against the spectrum crunch problem. Traditional spectrum assignment policy, which is defined by the Federal Communication Commission (FCC), is based on command and control model. Under this model, only the authorized user who wins the radio frequency bid can use the spectrum without any interference. However, this static and inflexible spectrum assignment policy which is conducted by the government agencies causes the utilization of radio resource is either inefficient or underutilized. Here, Figure 3 shows the diversity in licensed RF spectrum utilization, the spectrum consumption is cumulated on certain parts of the spectrum while significant spectrum capacity remains unused (Bagwari & Singh, 2012) because the authorized user may not utilize the spectrum at all times in all locations.

Therefore, in 2002, the spectrum policy task force has generated the (Force, 2002) to FCC, which recommended the estimate changes in spectrum policy for public benefits and addressed the several worldwide spectrum issues like, including interference protection, spectral efficiency, effective public safety communications, and international spectrum policies. So, it can be stated that, Data explosion (high dimension data processing) and spectrum underutilization these are the two salient factors to initiates a new communication hypothesis i.e. dynamic spectrum access scheme(DAS), to utilize the existing

Figure 1. Mobile Data Traffic Growth in 2016
Networking, 2017.