CHAPTER 6: CONCLUSIONS AND FUTURE WORK

This thesis focussed on creating efficient cognitive radio networks which will be helpful for decreasing underutilization of spectrum and incorporation of CRNs in future applications. If CRN has to be formed which yields good quality of service, spectrum sensing plays an important role. If sensing of spectrum goes wrong the whole process will be in trouble because of probability of false alarms and missed detections. Hence, Enhanced spectrum sensing is proposed in this work. The major problem in conventional energy detector was more number of false alarms. Little energy variations in the environment will show effect when it is compared with the threshold. Once the decision goes wrong, it not only causes loss to cognitive users but also primary user's communication. This problem was taken care in proposed enhanced spectrum sensing algorithm because of considering Past test statistics. As secondary user always has to sense for the spectrum the past test statistics will be available with it. In order to decide whether free spectrum is present or not we first compare average of past test statistics with the threshold, latest test statistic with the threshold and present test statistic with the threshold then only the decision is made whether primary user is present or not. This way the proposed enhanced spectrum sensing avoided probability of false alarms and missed detections. Later the proposed algorithm is tested on spectrum analyser. It's been observed that the probability of false alarms are decreased by applying the proposed algorithm.

Scope for the Future:

If we observe from Chapter 2 only limited data is recorded and the enhanced algorithm is applied on that data and the sensed spectrum is FM bands. If same kind of experiment is done on the other bands and a reference signal of those bands is generated then it will be very helpful in decreasing the false alarms. If these reference signals are provided to the CUs then it makes a huge difference in CU communications.

It is known fact from CRNs that whenever a PU comes back SU has to vacate the band and look for another band which is free. During this time, the packets may drop and latency also will increase. Spectrum mobility plays a key role here. There are two ways of spectrum mobility, reactive and proactive. In reactive type, cognitive user will always devote some time for sensing the primary user communication to look for any signs of PUs coming back, then immediately next possible route is chosen and communication is transferred. In proactive type, cognitive user will rely on past information of primary user activity and make a decision about route change. In our thesis we worked on both reactive and proactive types of spectrum mobility. Both of them have their own advantages. In this particular work we did reactive type of spectrum mobility and we saw substantial improvements in the QoS of the cognitive radio network. Hence a vehicular and pedestrian networks are simulated and tested for two parameters viz., route sustenance time and connection sustenance time which are very much required when evaluating CRNs performance.

Scope for the Future:

In chapter 3 different traffic patterns are considered and feasible relays are used for communications. It is observed from figures that after having good amount of relay nodes in the network the route and connection sustenance times are almost constant. As we have considered single network we would have arrived to this output. If we work on heterogeneous networks then route and connection sustenance time may differ. If the proposed method is applied on heterogeneous networks and success rate is evaluated then this becomes efficient method. If an optimized number of relay nodes is captured for all types of networks then it will be useful to build the future 5G communication systems.

Next, the study was on the advantage of having collaboration between cognitive enabled small cell network and primary macrocell. In these kind of scenarios spectrum sharing plays a pivotal role. The methods discussed so far are opportunistic based spectrum access, means whenever primary user is not present then only secondary user can pitch in to do his communication and has to leave the band whenever PU arrives which may lead to packet loss and delay will be there. To overcome this in spectrum sharing primary user and cognitive user both can simultaneously communicate with limit on secondary user transmit power. In our proposed algorithm after spectrum is sensed with enhanced spectrum sensing if PU is present, SU will transfer with low power, if not SU will transfer with high power. Power control optimization is introduced in this method to have good QoS. Furthermore, the failed packets of Primary users are taken care by high ranked relays which in turn decrease the average Primary user packet delay.

Scope for the Future:

In chapter 4 we have considered cognitive small cell coexisting with primary macro cell. It is observed from the results that with the power optimization technique and high ranked relays helping PU failed packet transfer has improved PU and SUs throughput. But again this is a simulated platform. In practical scenario of the proposed HSS scheme gives good results then it will be helpful to build good 5G system. If better routing algorithms are applied then there will be good improvement in the overall throughput.

Later all the proposed algorithms and studies are applied on IoT application and developed an efficient routing algorithm for Cognitive radio enabled IoT applications. In this work spectrum quality and spectrum availability based on two parameters called global information about spectrum usage and instant spectrum status information are estimated. Two algorithms for routing are designed for evaluating the performance of routing and it is observed that the bit error rates of proposed algorithms (nodes are dynamic) have decreased a lot when compared to conventional methods (nodes are static) and throughput of proposed algorithm also improved a lot which eventually led to good QoS.

Scope for the Future:

In chapter 5 with the help of local and global spectrum information and with the routing metrics like delivery success probability and transmission time delay there is improvement in the bit error rates and throughput. As it is simulation global spectrum information is assumed. If the substantial work is done towards building global database of spectrum information then it will be very useful in 5G communication. Because in 5G many base stations are installed the database can be easily built and can be used for future applications.

With this we conclude that our thesis will be helpful to build a robust cognitive radio network with good QoS. The every essential component to build CRN is taken into consideration, did the enhancements at each and every step and saw that the QoS of the total network is taken care. Scope of future is given at each and every chapter.