International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 12 | Dec 2021 www.irjet.net p-ISSN: 2395-0072

A Survey on Cost-Effective Resource Allocation for Multitier Mobile Edge Computing in 5G Mobile Networks

Ragasriswathi M[1], Nithya Kalyani S[2]

[1]PG Scholar, Department of Information Technology, K.S.R. College of Engineering, Tiruchengode, India
[2]Associate Professor, Department of Information Technology, K.S.R. College of Engineering, Tiruchengode, India

---

Abstract: *Traditional enterprise WI-FI is flexible and cost-effective, but it has reliability, coverage, and performance issues. These enterprise difficulties can be addressed with a solution that combines cellular 5G technology with mobile edge computing (MEC). However, the computation resource allocation procedures required by services are thought to be extremely complex. A wide range of spectrum is necessary to accommodate the growing demand for applications. Cognitive radio is an intelligent radio that allows for more effective spectrum utilization. The core technology powering CR is spectrum sensing, which discovers empty slots for secondary users in order to improve radio resource allocation efficiency. Cognitive radio networks will be widely deployed in the near future, and this paper discusses some of the key characteristics of them, as well as optimization methodologies for Resource Allocation and Spectrum Sensing in CRNs. Researchers in the field will benefit from the details offered in the study.*

Keywords: 5G network, Mobile Edge Computing, Cognitive Radio, Spectrum, Primary Users, Secondary Users

1. INTRODUCTION

Various immersive services such as virtual/augmented reality, ubiquitous computing, online gaming, and the internet of things are penetrating into our daily routines as a result of the expansion of 5G mobile networks. Businesses may expand their reach into previously underserved areas by combining 5G and edge computing, while still providing massive volumes of data at lightning-fast rates. Because the number of users continues to grow, the available radio spectrum, which is a limited resource, is constantly in demand. As a result, there is always a need to maximize the use of the available spectrum at any given time.
Three distinct characteristics describe 5G networks: universal connectivity, extremely low latency, and exceptionally high data transmission speeds.

Cognitive Radio (CR) is an adaptive, intelligent radio and network technology that can detect available channels in a wireless spectrum and change transmission parameters to allow more communications to occur at the same time while also improving radio operating behavior. Cognitive radio employs a number of technologies, including adaptive radio (in which the communications system monitors and adjusts its own performance) and Software Defined Radio (SDR), in which old hardware components such as mixers, modulators, and amplifiers are replaced with intelligent software.

- **Full cognitive radio:** also known as Mitola radio, is a type of radio that considers all of the radio's available parameters at the same time as making a decision about how it operates.
- **Spectrum Sensing cognitive radio:** this method finds the best frequency (RF) spectrum and uses it to make decisions.
- **Cognitive Radio with Certified Bands:** the tool is capable of mistreating permitted and unaccredited spectrum equally.
- **Cognitive Radio in the Unlicensed Band:** the device is only allowed to use license exempt and/or unfastened license spectrum.

A cognitive radio monitors spectrum bands, collects their information, and then discovers spectrum spaces in a cognitive radio cycle.
The spectrum spaces observed by spectrum sensing have their features assessed. Then, based on its characteristics and user requirements, the appropriate spectrum band is selected.
Communication can take place across this frequency band once the operating spectrum band has been determined.

Spectrum sensing is the process of detecting unused spectrum and sharing it with other users without causing detrimental interference. Detecting primary users is the most efficient technique to detect spectrum holes, which is a crucial requirement of the Cognitive Radio network.
Spectrum management refers to the process of capturing the best available spectrum in order to suit user communication needs.
Spectrum Mobility is the process through which a cognitive user switches their frequency of operation.

Spectrum sharing refers to the provision of a fair spectrum scheduling technique for all users. In open spectrum utilization, sharing is a key difficulty.

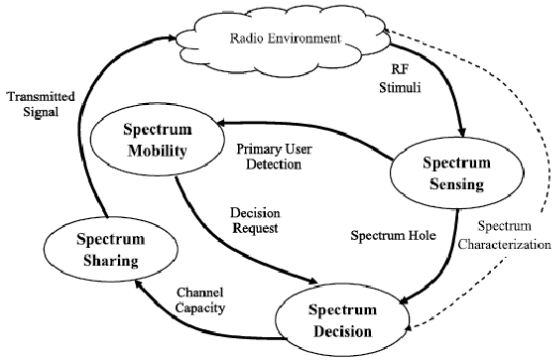

Fig -1: Cognitive Radio Cycle

Cognitive radio is a revolutionary innovation that has applications in a variety of areas. Following are notable applications of cognitive radio: Multimedia Applications, Real-time Surveillance Applications, improving spectrum utilization, Improving link reliability.

2. RELATED WORK

2.1 DYNAMIC SPECTRUM ACCESS

Radio Spectrum has numerous dimensions counting: time, space, frequency, polarization, energy of signal and interference. The static spectrum control has many objections to providing spectrum utilization to specific users in different regions. So, the design of Dynamic spectrum access (DSA) developed in CR's. it's far properly found that spectrum shortage changed into the outgrowth of the antiquated spectrum management and however a large part of top spectrum changed into assigned, allotted, it remained extraordinarily not efficiently used. The static spectrum has a blockade to access in many spectrum or multi-dimensions to give contributions to fast growth 1all for of spectrum. The Wi-Fi networks of these days can be classified into two wide classes: [1] cellular, infrastructure mainly based networks described with the guide of an entity called a base station imparting a centralized switching factor for communication from devices in a geographical area. [2] peer-to-peer or advert hoc networks in which communicating nodes are independent on a centralized node. The standing for the substitute of the current static spectrum management coverage, the time period dynamic spectrum get admission to has wide connotations that encapsulate numerous techniques to spectrum reform. In conclusion, dynamic spectrum access (DSA) is a new spectrum-sharing model that enables secondary users to access abundant spectrum gaps or white spaces.

2.2 DYNAMIC SPECTRUM ALLOCATION AND SHARING

In the time the communication over a cognitive network is established then it isn't feasible for the cognitive network to hold that communication easily because the channel over which the conversation is happening would perhaps belong to a few different number one people and that primary consumer can also demand it again. This kind of situation is certain to stand up in the cognitive radio network. The secondary community then has no option but to give back the borrowed spectrum after which move to another vacant spectrum to keep away from the delaying or termination of the communication. Returning the occupied spectrum and shifting over to a different spectrum is known as SPECTRUM HANDOFF. For a hit spectrum handoff, we need the efficient procedure of spectrum handoff. A few theories likewise are proposed which expresses that for a continuous conversation the secondary networks require to access the spectrum from now not effectual one number one user although other primary sources and different certified resources moreover. This method seems to be more practical than other strategies as in others, there should be a trade-off amongst some crucial parameters.

2.3 SPECTRUM SENSING FOR SPECTRUM SHARING

Spectrum sensing is the capacity to degree, experience and be privy to the parameters determined with the radio channel attributes, accessibility of spectrum and transmit strength, hindrance and noise, radio's operating environment, user precondition and packages, obtainable systems(framework) and nodes, close by regulations and different running regulations. It is done over Time, Geographical space, Frequency, Code and segment. Amidst all unique attributes, Spectrum sensing is prominent as the most important errand to construct cognitive radio systems.

The PU transmitter is transmitting facts to the PU receiver in an accredited spectrum band simultaneously as more than one SUs intends to get to the spectrum. The SU transmitter needs to conduct spectrum sensing to recognize to ensure the PU transmission, whether or not there is a PU receiver inside the extent of the SU transmitter. Spectrum Sensing Detection Strategies (spectrum detection method) is the primary project in the cognitive cycle and the primary mission to the CRs. In spectrum sensing reading the spectrum and locating the unutilized bands and sharing it even as averting the spectrum that is occupied with the guide of PU.

2.4 SDR AND ITS RELATIONSHIP WITH COGNITIVE RADIO

The Software Defined Radio (SDR) become provided for maintaining of a couple of conversation generation such that with recognize to the software, the terminals can alternate their operation. Nowadays different signaling techniques have been proposed and used in certain verbal exchange technology wherever all through the arena. Earlier to the evolution of cognitive radio, SDR turned into concentrated on multi-mode and multi-general devices. To stay away from analog circuits and additives, SDR offers variable radio functionality. Cognitive Radio is basically an SDR that already is aware of the situation, nation, and role and therefore modifies its characteristics in keeping with the demanded objectives. The SDR is based on virtual sign processing and progressed in software program with mutable Radio Frequency components. SDR is a normal radio platform that has the ability to function in distinctive bandwidths over an extensive sort of frequencies moreover using one-of-a-kind modulation schemes and waveform formats. As an outcome of this, the SDR can support more than one demand along with WCDMA, GSM, WIMAX and multiple access schemes counting TDMA, OFDM and SDMA.

2.5 RELATIONSHIP WITH COGNITIVE RADIO BLUETOOTH

Adaptive Frequency Hopping (AFH) allows Bluetooth to reduce interference between wireless technologies that share the same unlicensed radio spectrum. In this band, IEEE 802.11b/g gadgets, microwave ovens and cordless phones utilize the same Wi-Fi frequencies as Bluetooth. AFH recognizes the transmissions within the industrial, clinical and clinical (ISM) band and keeps away their frequencies. Therefore, slender-band interference might be turned away and higher Bit Error Rate (BER) performance may be finished besides lowering the transmit strength. Through utilizing AFH, collisions with WLAN indicators are prevented in this case. AFH requires a sensing algorithm to determine whether various gadgets are present in the ISM band and whether or not they should be avoided. The sensing algorithm depends completely on records gathered to conclude which channels are engaged and which channels are vacant. Channel data can be packet-blunders price, BER, acquired sign power indicator (RSSI), Carrier to- Interference-Plus-Noise Ratio (CINR) or other metrics. The statistics are used to classify channels as acceptable, terrible, or obscure.

2.6 A DELAY-AND-MULTIPLY DETECTION

Every other sensing approach is the postpone-and-multiply sign detector, which multiplies the accumulated information block with a not on time and conjugated model of itself with the intention to generate an additive sine-wave thing the presence of which may be detected with the aid of the use of Fourier techniques. The presence of the tone implies the presence of the sign, and the precise frequency of the tone offers a parameter estimate for the signal, commonly identical to the image fee (chip charge for direct collection spread spectrum signals). The put-off-and-multiply detector is simple exploitation of Cyclo Stationarity (CS) in that it employs a quadratic transformation to generate a spectral line. That is best possible for CS indicators. The strengths of the delay-and-multiply detector are that it is able to offer advanced sensitivity relative to the electricity detectors, is powerful to uncertainties in the noise strength and interference parameters, and is computationally much less steeply-priced than more thorough techniques that make the most the CS property. Its fundamental weaknesses are that it is not relevant to a big number of signals and that optimum performance calls for knowledge of the optimal postpone, which in flip calls for understanding of the transmitter filtering applied to the signal to be detected. this is, the top of the line postpone for rectangular-pulse alerts is half of the image interval, but for signals which have been filtered with a square root raised-cosine filter out, the top-quality put off is zero

2.7 SWISS ARMY KNIFE SOLUTIONS

It may be possible to implement a spectrum-sensing device in order to improve general sensing overall performance. This entails a very specific detector for each form of sign to be detected: a matched filter for DVB-T, a postpone-and-multiply detector for DSSS, and power detector for GSM, and so forth. This kind of sensing approach is named a Swiss Army Knife (SAK) solution because of the distinct nature, computational necessities, and feasible all-around performance of the diverse sign-unique sensors. A possible method is to select one of the many available detectors based on the frequency band being scanned, which can provide information about the types of licensed signals that are expected inside that frequency range.

2.8 ENERGY DETECTION

When the number one consumer sign is unknown, the energy detection technique provides a gold standard detection. To establish whether the spectrum is occupied or not, the received radio frequency electricity or acquired signal energy indication is measured and compared to a

pre-calculated threshold. When using an analogue implementation, a constant bandwidth pre-filter is required. However, this solution is ineffective for sensing narrowband and wideband indicators at the same time, a circumstance that is frequently predicted in today's communication systems. Because of FFT-based completely spectrum estimates, a virtual implementation can provide more flexibility. Diverse bandwidth types are supported in this case to allow simultaneous sensing of multiple signals. The power-detection techniques have the advantages of being widely applicable, having low computational complexity, and requiring less prior signal knowledge. The power detection method's most serious flaws are that it's shockingly susceptible to changes in the historical noise spectral density and the presence of in band interference. Another significant disadvantage, which is unique to cognitive radio scenarios, is that the electrical detection technique cannot distinguish between primary and secondary structures that share the same channel. When a couple of top structures are present in the same location where the cognitive radio device operates, this becomes a critical task.

2.9 LOCATION PRIVACY PROTECTION: PROS AND CONS

Making sure that the region privateers' data of SU's is protected has splendid blessings. First and most importantly, it promotes dynamic and opportunistic sharing of spectrum assets, thereby growing spectrum utilization efficiency. Knowing that their place privacy is protected so they do now not ought to worry approximately their whereabouts being tracked and their privateers being compromised, SU's will be endorsed to participate inside the cooperative spectrum sensing technique, and to query spectrum databases for spectrum availability. Ensuring location privacy safety also can be beneficial to PU's. For instance, being concerned that their vicinity privacy statistics can be leaked to spectrum databases, SU's may additionally try to use PU channels without registering and querying spectrum databases for spectrum availability, thereby inflicting dangerous interference to PU's. Offering vicinity privateers maintenance ensures can't, but, be finished without a value. It does introduce extra communication, computation and storage overheads, which may also, in turn, also introduce an extra delay in terms of studying about the availability status of a few channels, and can, in the extreme case, make the spectrum availability facts previous, hence possibly resulting in the use of a channel that isn't always vacant. The problem and construction of supplying vicinity privateers' protection.

3. ANALYSIS AND DISCUSSION

The existing adaptive systems are typically reactive, reacting only when a tangle occurs. This, in turn, inhibits the network's ability to create intelligent and efficient solutions, especially when it comes to inexperienced networking and profitable business models. CRNs (Cognitive Radio Networks) increase spectrum usage by utilizing unused or underutilized bandwidth. Unauthorized users have access to licensed spectrum if the interference observed by authorized users is at a minimum.

A CR can sense a wide bandwidth accurately, determine the available unoccupied spectrum band, and use these empty slots for communication unless the PU requires it. The four major techniques that make up cognitive radio are as follow

Table -1: CR FUNCTIONALITIES

Cognitive radio networks Functionalities	**Types**
Spectrum Sensing	1. Energy detection 2. Matched filter detection 3. Feature detection
Spectrum Sharing	1. Licensed and unlicensed 2.Centralized and distributed 3. Underlay and overlay 4. Co-operative and non-co-operative
Spectrum Mobility	1. Reactive 2. Proactive 3. Hybrid

4. CONCLUSION

In Cognitive Radio Networks the transmission channel is licensed to the primary customers (PUs), at the same time as secondary users (SUs) handiest access the channel in an opportunistic manner whilst the PUs are inactive, i.e., whilst the PUs do now not use the channel. Because the channel is utilized by the SUs opportunistically, a SU transmission needs to be halted each time a PU turns into energetic. In a situation where in a SU wishes to transmit multiple packets (e.g., in a record transmission), or when a packet may be too long, the amount of time required to complete the SU's carrier (carrier Time) depends on the number and length of the PUs' transmissions. To maximize the network utilization and secondary user's capacity, the SUs have to select suitable channels with optimal power transmitted power to avoid interference to primary and

neighbor secondary users. The basic operation of the cognitive radio, network paradigms, and sensing mechanisms are described in this survey paper. Cognitive radio is unique to the application and is considered part of the design's future scope.

REFERENCES

[1] Jai Sukh Paul Singh, Jasvir Singh, A.S. Kang, "Cognitive Radio: State of Research Domain in Next Generation Wireless Networks - A Critical Analysis", International Journal of Computer Applications (0975 – 8887) Volume 74– No.10, July 2013.

[2] Blaine Chamberlain And Geogette Jordan " Applications of Wireless Sensors in Monitoring Indoor Air Quality in the Classroom Environment", Research Experiences for Teachers in Sensor Networks, Summer Internship 2012,University of North Texas,NSF-1132585.

[3] Douglas S. J. De Couto, Daniel Aguayo, John Bicket, and Robert Morris, "A high-throughput path metric for multi-hop wireless routing", Wireless Networks, vol. 11, no. 4, pp. 419–434, 2005.

[4] Prof. B.N. Jagdale and Prof. Pragati Patil, "Analysis and Comparison of Distance Vector, DSDV and AODV Protocol of MANET", International Journal of Distributed and Parallel Systems (IJDPS),Vol.3, No.2, March 2012.

[5] H. Yang, Y. Qin, G. Feng, and H. Ci, "Online monitoring of geological CO2 storage and leakage based on wireless sensor networks," IEEE Sensors Journal, vol. 13, no. 2, pp. 556–562, Feb. 2013.

[6] X. Mao, X. Miao, Y. He, X.-Y. Li, and Y. Liu, "Urban CO2 monitoring with sensors,"in Proc. IEEE INFOCOM, Mar. 2012, pp. 1611–1619.

[7] Zhou Hongqing and Yang Chunying, ``A Mobile Ad Hoc Networks Algorithm Improved AODV Protocol'', 2011 International Conference on Power Electronics and Engineering Application (PEEA 2011).

[8] A. Mainwaring, D. Culler, J. Polastre, R. Szewczyk, and J. Anderson, "Wireless sensor networks for habitat monitoring", Proceedings of the 1st ACM International workshop on Wireless sensor networks and applications, Atlanta, Georgia, USA, 88-97, 2002.

[9] Nor Surayati Mohamad Usop, Azizol Abdullah and Ahmad Faisal Amri Abidin,"Performance Evaluation of AODV, DSDV & DSR Routing Protocol in Grid Environment", IJCSNS International Journal of Computer Science and Network Security, VOL.9 No.7, July 2009.

[10] GodblessSwagarya, ShubiKaijage and Ramadhani S. Sinde"A Survey on Wireless Sensor Networks Application for Air Pollution Monitoring", International Journal of Engineering and Computer Science, vol.3,no.5, ISSN:2319-7242,MAY 2014.

[11] Ozgur B. Akan Osman B. Karli Ozgur Ergul "Cognitive radio sensor networks", Next generation Wireless Communications Laboratory (NWCL), Department of Electrical and Electronics Engineering.

[12] Deepak Kumar Patel, Rakesh Kumar, A.K.Daniel, "Performance Analysis and Behavioural Study of Proactive and Reactive routing protocols in MANET ", International Journal of Advanced Research in Computer Science and Software Engineering, vol. 2, April 2013.

[13] V.Rajeshkumar, P.Sivakumar, "Comparative Study of AODV, DSDV and DSR Routing Protocols in MANET Using Network Simulator-2", International Journal of Advanced Research in Computer and Communication Engineering ,Vol. 2, Issue 12, December 2013.

[14] P. Spachos and D. Hantzinakos, "Scalable dynamic routing protocol for cognitive radio sensor networks," IEEE Sensors J., vol. 14, no. 7, pp. 2257–2266, Jul. 2014.

[15] D. Hatzinakos, P. Chatzimisios and P. Spachos, "Cognitive networking with opportunistic routing in wireless sensor networks", in Proc. IEEE Int. Conf. Commun. (ICC), Jun. 2013, pp. 2433–2437.

[16] PetrosSpachos and DimitriosHatzinakos," Real-time Indoor Carbon dioxide Monitoring through Cognitive Wireless Sensor Networks", IEEE SENSOR JOURNAL, vol.16, no. 2, January 15, 2016.