WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Cognitive Radio in IOT and Network Security

[1]Bhaskar S, [2]Chandan Gowda S

[1]Dept. of ECE, SJCIT, Chickaballapur, India. bhaskar.neethu@gmail.com
[2]Dept. of ECE, SJCIT, Chickaballapur, India.chandangowda2701@gmail.com

ABSTRACT—

Day by day, there is increasing demand for high data rates it causes lack of radio spectrum for the new emerging technologies in the area of wireless communications. So, it must use spectrum efficiently, that is proper spectrum management. Spectrum management is responsible for the spectrum deficiency. In case of spectrum management, it is must to accurate determination of the present licensed users. The Cognitive radio is a type of wireless communication. In this a transceiver can intelligently detect which communication channels are in active and which is inactive. As soon as it detects an unused channel it instantly moves into a vacant channel by avoiding busy channels. This results in optimization of the use of available radio-frequency spectrum with minimization of interference to other users.

Keywords— Compression, Instruction cache, Huffman coding, Arithmetic encoding.

I. Introduction

Traditionally, With the rapid growth of wireless communication, the last decade has seen an extensive amount of growth in demand for wireless radio spectrum. Promoting competitions, innovations, investment and regulations in radio spectrum is handled by The Federal Communications Commission (FCC). The use of cognitive radio (CR) technology has led the FCC to consider more flexibility in the usage of available spectrum. In the current spectrum framework, the spectrum bands are allocated to licensed holders, also known as primary users (PUs), for large demographical regions, on a long-term basis. However, there is partial utilization of the allocated spectrum. This inefficient utilization of spectrum necessitates development of dynamic spectrum access techniques (DSA). The DSA allows users with no spectrum license, called secondary users (SUs), to temporally use the unused licensed spectrum. The priority users have priority in using the spectrum, SUs need to constantly perform real time monitoring of the licensed spectrum which can be used. In doing so the SU should not violate the interference temperature. The SUs should be aware of the PUs reappearance. The technique used for sensing the PUs presence is called spectrum sensing. There are various sensing techniques such as energy detection, cyclo-stationary feature detection, matched filter, central cooperative sensing and distributive cooperative sensing. In spectrum sensing the SU constantly senses the transmission channel for the presence of the primary signals in the channel. After sensing the spectrum, the CRs allocate the spectrum to the SUs and the SUs need to reconfigure themselves in order to use the newly allocated spectrum. The block diagram of CR cycle is shown in fig 1.

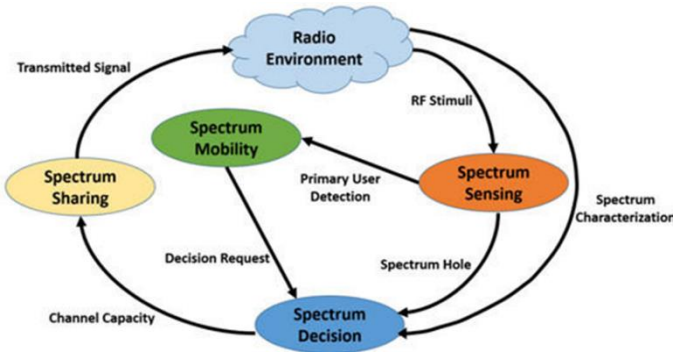

Fig 1: Cognitive Radio Cycle [1].

Security issues are a very important aspect of cognitive radio networks. Behaviour of the Network Attackers Leave adverse effect on the performance of the network. On the other hand there are many security requirements should investigate the network to ensure communication security, so many security models proposed in recent years to resolve the security issues for such behaviours. In general, most of these models have focused on the importance of security, regardless of the other things such as energy or the complexity of the design model, especially matters related to the sensors limitations. Result of this CRNs has become a hot spot of researchers for continuous development and providing a new model with specific feature doesn't found in previous trend.

6G CR networks will provide maximum higher spectral, cost efficiency, energy, maximum data rate about in tbps, about ten-time lower latency, connection density about 100 times improved, and maximum intelligence for automation. Latest transmission and spectrum sensing technologies and air

interference are mandatory to gain energy efficiency and high spectrum efficiency with fresh waveforms, channel coding methods, multiple access approaches, and multiantenna technologies are the proper combination of all such techniques. Meanwhile, such network architecture requires dynamic network slicing, software-defined network, cognitive service architecture, service-based architecture, and free of cell architecture. Although, the software comes at a point as we acknowledged from 5G progress. A commercial use server versus domain particular chips in the virtualized radio access network (VRAN) suggests a massive amount of energy consumption enhancement and measure to better energy efficiency. The current statistic shows that power consumption in 5G is more than 4G networks but at higher bandwidth [2].

II. Methodology

Spectrum allocation typically happens through a licensing process. However, many parts of licensed spectrum are not optimally utilized. Fig 2, shows spectral inefficiency where certain bands are overcrowded while other bands are relatively unused.

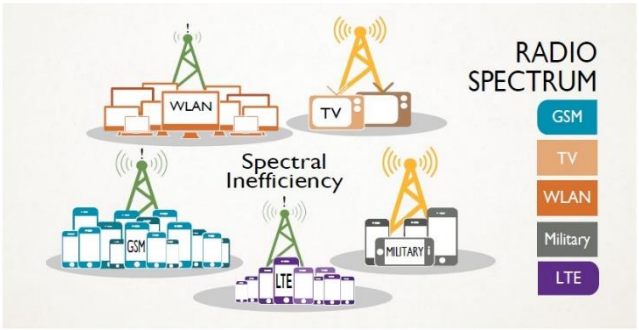

Fig 2: Spectral Ineffeciency [4]

Cognitive radio (CR) is a form of wireless communication in which a transceiver can intelligently detect which communication channels are in use and which are not. It instantly moves into vacant channels while avoiding occupied ones. It does not cause any interference to the licensed user. Fig 3 shows a way of spectrum sharing.

Fig 3: Utilisation of the licensed spectrum [4]

Over and Under utilisation of the licensed spectrum 16Node requesting for the allocation of new spectrum bands from another vacant nodes for the full utilisation of the licensed spectrum can be seen in fig 4.

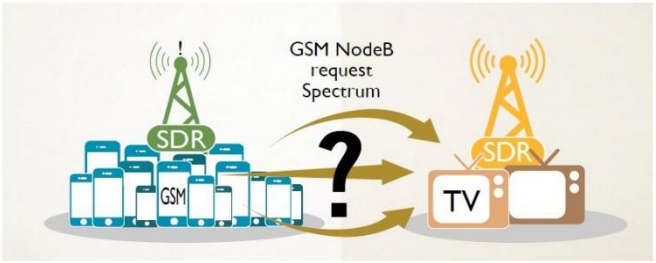

Fig 4: Spectrum negotiation between two bands [4]

Allocation of unutilised spectrum bands to the requested node for limited amount of time which increases the effeciency of the sytsem and full utilsation of the bands can be seen in fig 5.

CR devices closely track all the spectrum bands located in the neighborhood to identify its various primary users and spectrum holes. Federal Communications Commission (FCC) proposed a spectrum database concept to remove complexity of spectrum sensing technique and to use TV white space. All TV stations need to update their next week usage in database maintained by FCC. CR devices can seek free spectrum information from this database. CR devices will have knowledge about free spectrum for use and can negate the need for complex sensing which requires time and money.

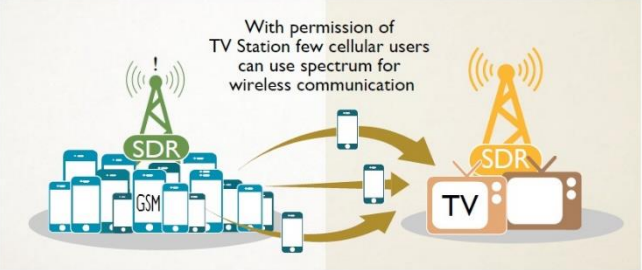

Fig 5: Usage of the underutilised spectrum by underlicensed user [4]

III. Technology

Artificial Intelligence

Usage of the underutilised spectrum by underAI is filling the gap between humans and robots. AI tech will benefit in numerous ways, realistic looking artificial intelligent technology can wonder the internet and interact with us and each other. They could be programmed with their own life stories, motivations and objectives. Depending on the type of virtual world, we could participate in pre-planned scenarios with these characters or create our scenarios.

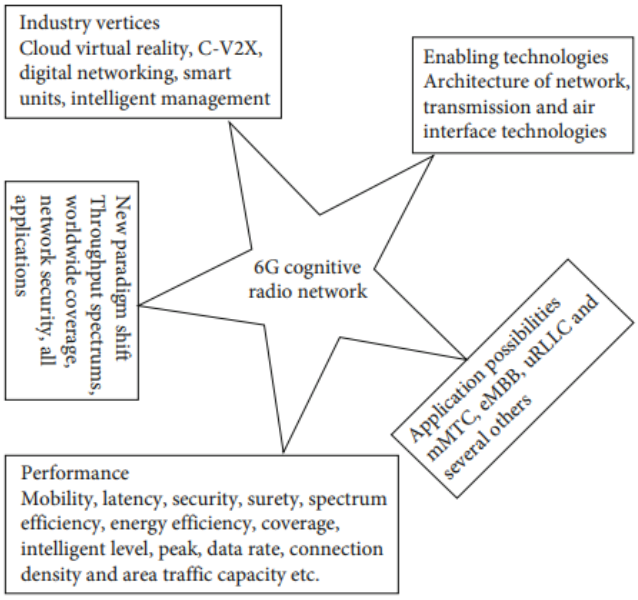

Fig 6: 6G Cognitive Radio Network [6]

Researchers have started planning and envisioning the essential technologies supporting 6G CR network communication in various ways like beyond 5G+ can be seen in fig 6. To gain 1 ms latency order, uRLLC was introduced in 5G for critical applications latency. Mobile edge computing and computing models defined in 5G for delay reduction and network overcrowding are classically met in user equipment to integrate base station CR network communication. Although, fog nodes are unable to act as freely relay and cloud data center on basic cloud. Another derivative of cloud computing is the cloud radio access network (CRAN), in which already present base stations are swapped with distributed remote radio heads and middle baseband unit (BBU). In the cloud radio access network architecture, signal processing computations are performed at the baseband unit. Although this cloud access radio network may complete the 5G requirements, service heterogeneously, communication overhead, and BBU performed computation, six generation 6G network will improve computational complexity and latency [15]. A progressing notation to focus on this is the open radio access network (O-RAN) that holds openness and intelligence as its key idea. O-RAN supplies clearly defined open boundaries between elements applied on universal purpose hardware and the integration of RRHs and BBUs from different retailers. Cell compaction is a primary enabler for accomplishing amplified network capacity [26]. 6G intentions at ultradense network distributions relating to multiple cells within a microcell. Diverse 6G use, such as high accuracy engineering, intelligent homes, and vehicle-to-everything, will involve various devices functioning in a microcell. Though, these 6G applications will include addressing numerous key challenges. The high-frequency operation, heterogeneity, mobility, and dense operation will present a different dimension of propagation, radio resource allocation, spectrum access, security concerns, and scheduling. Such sprints will be worsened with the intended 3D communication infrastructure [12] for 6G joining mobile groun and aerial platforms. Large-scale dense placement strategic for 6G, intelligent physical layer schemes will play a vital role in satisfying the provision requirements.

WIRELESS SENSOR NETWORK

With time, WSN used in IoT is increasing in the intelligent industry and almost covering all sectors of life such as e-health, traffic, smart homes, smart grids, intelligent stations, smart industry, monitoring purpose, and smart agriculture. WSN and CR can be in profit by sharing the process can be seen in fig 7. Progressing installation of WSN can be oppressed by CR by PU channel monitoring, the new business model of spectrum sensing as a service (SSaaS). In another way, a large number of WSN usage increases the requirement of spectral resources. In this, CR is to be supposed as the solution to spectrum sharing.

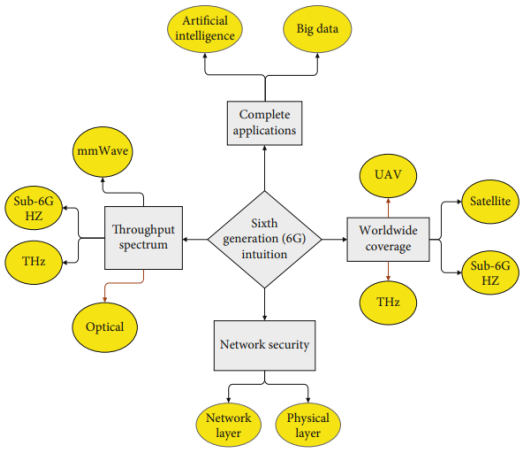

Fig 7: CR in Wireless Sensor Network [8]

WSN Communication Dynamic Spectrum Sharing, Progressing the use of WSN devices requires improved use of limited frequency resources. For WSN, dynamic spectrum sharing WSN node is taken as SUs by CR. Keeping an eye on the PU channel, extra work is beard by WSN nodes, and good energy use requires SS task completion because energy consumption for WSN is vital since under protocols nodes are working for many years extension of a lifetime [9]. The CR procedure is complicated and challenging to WSNs because of many problems like spectrum sensing capability installation, sensing nodes with present frequency band, and node responsibility selection for nodes responsible for spectrum sensing.

WSN Communication Dynamic Spectrum Sharing, Progressing the use of WSN devices requires improved use of limited frequency resources. For WSN, dynamic spectrum sharing WSN node is taken as SUs by CR. Keeping an eye on the PU channel, extra work is beard by WSN nodes, and good energy use requires SS task completion because energy consumption for WSN is vital since under protocols nodes are working for many years extension of a lifetime [29]. The CR procedure is complicated and challenging to WSNs because of many problems like spectrum sensing capability installation, sensing nodes with present frequency band, and node responsibility CR's progressing technique is looking high requirement for frequency resource WSNs. Still, CR-WSN should give spectral efficiency and energy efficiency for industrial usage and applications. Transmission protocols and installation patterns play an essential role in reducing interference and lessing energy consumption between node assisting to improve the energy efficiency of CR-WSN networks. Although, different challenges have been seen as two ways exchange of data in suitable protocols, central object transmitting, and using SU data. The central object should be aware of the sensing channel SUs to be sensed and then give a decision response by these SUs. It executes frequency and time sync, such as the control channel. After detection of the present channel, transmission requires nodes or SUs should be aware by satisfactory channel for circuit configuration.election for nodes responsible for spectrum sensing.

NETWORK SECURITY

Communication is growing changing and increasing subscriber base area can be seen in fig 8. The occurrence of high data throughput application continue to increase the fast growing request for broadband wireless service these have led to the expansion of several wireless technologies which continuously grow with ever-increasing competencies. Under licensed frequency band IEEE has offered multiple standards. While 802.16a/d/e and 802.20 have focused on providing the necessary infrastructure to create wireless metropolitan area networks (MAN) which has the radius of approximately 1km to 5 kms, 802.22 is pursuing to define a standard Capable of serving vast regions up to 100km in size [14]. Frequency band of unlicensed frequency is being utilized by using IEEE 802.22. A typical working group (WG) is working to finalize the standard of 802.22 after the Federal Communication Commission (FCC), which passed the resolution. 802.22 is also called wireless radio area network (WRAN) or cognitive radio network (CRN). Most of the radio function as a software base that run on microprocessor and programmable electronic devices. These technology is referred to software define radio (SDR). Cognitive Radio (CR) is further enhance as compared to SDR by employing software for measurement of the vacant portion of the wireless spectrum which is already there and operate that spectrum in a way that bound the interfering with other devices [11]. In dynamic spectrum Access (DSA) licensed; user is stated to be as a primary / key user or occupants. The user who didn't have any licensed that got the permission for spectrum opportunistically are referred to as secondary user [12].

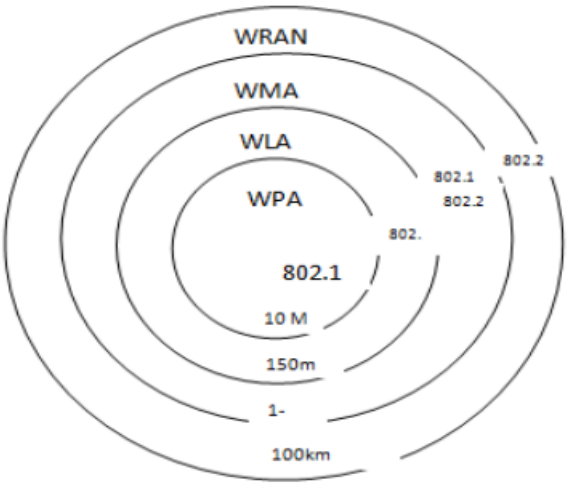

Fig 8: Variation levels [11]

If we compared with the typical radio networks, Cognitive Radio (CR) is more flexible and exposed to wireless network. Therefore more threats and vulnerabilities found then traditional radio environment. For example CR first senses the spectrum which is scanning a certain range of the spectrum to identify unoccupied range / spectrum. During this methodology the secondary user can determine that which spectrum can be used either radio or not. When the result of spectrum sensing in altered maliciously network activities which are normal will be disabled, even whole traffic may be broken down. CR is the main technique which realizes DSA policy. In addition to spectrum overcrowding, one of the major challenges for the wireless medium is security. The WiFi brand was adopted in 1999 based on the 802.11 standard. It was immediately realized that using the electromagnetic wave as the propagation medium made physical security of the transmitted data an impossibility. A conversation made of electromagnetic signals can be intercepted, jammed, or injected with extraneous bits. These actions can cause the release of private information, the inability to send and receive information, or the receipt of false or unreadable data.

5th GENERATION

If we compared with the typical radio networks, Cognitive Radio (CR) is more flexible and exposed to wireless network. Therefore more threats and vulnerabilities found then traditional radio environment. For example CR first senses the spectrum which is scanning a certain range of the spectrum to identify unoccupied range / spectrum. During this methodology the secondary user can determine that which spectrum can be used either radio or not. When the result of spectrum sensing in altered maliciously network activities which are normal will be disabled, even whole traffic may be broken down. CR is the main technique which realizes DSA policy. In addition to spectrum overcrowding, one of the major challenges for the wireless medium is security. The WiFi brand was adopted in 1999 based on the 802.11 standard. It was immediately realized that using the electromagnetic wave as the propagation medium made physical security of the transmitted data an impossibility. A conversation made of electromagnetic signals can be intercepted, jammed, or injected with extraneous bits. These actions can cause the release of private information, the inability to send and recei5G and Cognitive Radio (CR) are the two emerging technologies to meet the heavy mobile data traffic of future wireless networks. The new era of communication will be dominated by 5G in future. As the future mobile broadband will be largely driven by ultra high definition video and as the things around us will be always connected, 5G aims to provide higher capacity and a network speed of 10Gbps. 5G equipment will also be available at lower cost, lower battery consumption and lower latency than 4G equipment. 5G platform can empower the growth of many industries ranging from entertainment, agriculture, IT and manufacturing industries. The need for more capacity will demand more spectrums resulting in integration of CR in 5G networks. The focus of CR is to enable much more efficient use of the spectrum though it adapts itself to provide the optimum communications channel [10].

It is not possible that the backhaul network has optical fiber (OF) connectivity because of inaccessible terrestrial locations and complications. The FSO backhaul network is very encouraging for 5G CR network communication systems. The transmitter and receiver features of the FSO system are similar to those of OF networks. Thus, data transfer in the FSO system is analogous to the OF system. Though, laterally with the OF networks, FSO is an admirable technology to provide backhaul connectivity in 6G communication networks. With FSO, there is the possibility to have pervasive range communications even at a 10,000 km distance. FSO provisions highcapacity backhaul connection for distant and nonremote areas, like outer space, sea, isolated islands, and underwater; FSO also provisions cellular base station connectivity.

Internet of Things

Cognitive radio is promising an enabler communication technology in IOT. Its opportunistic communication is suited to communicating objects having event driven nature, that generate bursty traffic. Cognitive radio can help overcome the problems of collision and excessive contention in wireless access network that will arise due to deployment of several objects connected to infrastructure through radio links. It controls huge amount of data needs to be transmit data without any traffic and needs to give as an input to control system which works correspondingly [11].

Web 3.0

With web 1.0. Content creators were scarce, with the vast majority of users simply acting as content consumers. For the most part, recurrently in the web 2.0 era. Web 2.0 bothers the web as a platform where software applications are built on instead of just desktop computers. These enabled masses of users to participate in content creation on social networks, blogs, sharing sites, and more [12]. However, web 2.0 greatly empowers centralized tech giants and enables surveillance and exploitive advertising. When a web 3.0 has a primary advantage, it enables decentralized blockchain protocol, enabling individuals to connect to an internet where they can own and be properly compensated for the time and data. This is more advantageous than a web where giant centralized companies on the lion's share of the web and can siphon large percentages of the profits. It's expected that a web 2.0 will allow computers to understand the semantics or meanings of sentences to generate, share and connect content do search and analysis thanks to semantic metadata. Web 3.0 will help facilitate greater connectivity between data sources. As a result, the user experience evolves to another level of connectivity that leverages all available information on the Internet.

IV. Applications

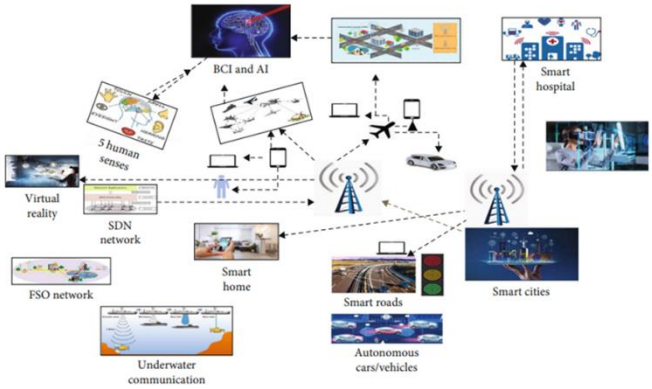

Fig 9: Applications of Cognitive radio

1. Healthcare
2. Military
3. Communications
4. Education
5. Manufacturing

V. Advantages

- Senses RF Environment and modifies frequency, power or modulation.
- Allows for Real Time Spectrum Management.
- Significantly Increases Spectrum Efficiency.
- Overcome radio spectrum scarcity.
- Avoid intentional radio interferences.
- Improves Satellite Communication.
- Improves quality of service (QoS)

VI. Conclusion

With edge computing, things have become even more efficient. As a result, the quality of business operations has become higher. Edge computing is a viable solution for data-driven operations that require lightning-fast results and a high level of flexibility, depending on the current state of things.
IoT devices are gaining momentum from wearables to vehicles to robots. As we are moving to a world with lots and lots of data, and data processing the need of a faster connection is becoming crucial. While a centralized data centre or cloud for data management, processing and storage has its limitations. Edge computing can provide an alternative solution for this. But since the technology is still in its immaturity, it is difficult to predict its success in future. Even though, there will be more opportunities for companies to test and set up this technology. In that there are already, some use cases may prove the value of edge computing more clearly, its potential impact on our ecosystem as a whole.

References

1. R. Muraleedharan, Cognitive Security Framework For Heterogeneous Sensor Network Using Swarm Intelligence, Syracuse University, vol. 21, no. 4, May 2020, pp. 382-386.
2. Muheet Ahmed Butt, COGNITIVE RADIO NETWORK: SECURITY ENHANCEMENTS, University Polytechnique Medrid, vol. 24, no. 7,

January 2021, pp. 277-285.

3. K.Dabcevic, Intelligent jamming and anti-jamming techniques using Cognitive Radios, Proceedings of the IEEE Global Telecommun, vol. 10, no. 2, February 2019, pp. 86-91.
4. Samar Kareem Tuama, Cognitive Radio, JOURNAL OF SOUTHWEST JIAOTONG UNIVERSITY, vol. 12, no. 14, Feb 2020, pp.102-106 .
5. Muhammad Muzamil Aslam, Liping Du, Xiaoyan Zhang, Yueyun Chen, Sixth Generation Cognitive Radio Network Application, Requirements, Security Issues, and Key Challenges, Wireless Communications and Mobile Computing, vol. 18, no. 2, July 2021, pp.182-187.
6. Harit Mehta, Recent Advances in Cognitive Radios, IEEE Toronto International Conference, vol. 20, no. 4, September 2019, pp. 166-168.
7. Divya Lakshmi and Rangaiah, Cognitive Radio Principles and Spectrum Sensing, International Journal of Engineering and Advanced Technology (IJEAT), vol. 23, no. 4, August 2019, pp.212-216.
8. Kenan kockaya and Ibrahim Develi, Spectrum sensing in cognitive radio networks, threshold optimization and analysis, EURASIP Journal on Wireless Communication and Networking, vol. 27, no. 8, May 2020, pp.406-412.
9. Prabhat Thakur, Cognitive Radio-IOT, IJAET, vol. 11, no. 3, August 2019,pp. 78-82.
10. Sivagurunathan, Recent Paradigms for Efficient Spectrum Sensing in Cognitive Radio Networks, MDPI, vol. 21, no. 4, July 2020, pp 287-293.
11. R. Wang, M. Li, L. Peng, Y. Hu, M. M. Hassan, and A. Alelaiwi, Cognitive multi-agent empowering mobile edge computing for resource caching and collaboration, Future Gener. Comput. System, vol. 102, Jan 2020, pp 66-74.
12. T. Ding, J. N. Cao, L. Yang, and S. G. Wang, Edge computing: Applications, state-of-the-art and challenges, Zte Technol, vol. 25, no. 3, 2019, pp. 2-7.
13. S. Y. Nikouei, Y. Chen, S. Song, and T. R. Faughnan, Kerman: A hybrid light weight tracking algorithm to enable smart surveillance as an edge service, IEEE Annual Consumer Communication Network, vol. 1, no. 1, Jan 2019, pp. 1-6.
14. Z. M. Xu andY. F. Tian, "The history and application of cloud computing", Inf. Recording Mater., vol. 19, no. 8, Issue 2018, pp. 66-67.
15. M. Chen, T. Wang, K. Ota, M. Dong, M. Zhao, and A. Liu, Intelligent resource allocation management for vehicles network: An A3C learning approach, Computer Communication, vol. 15, no. 6, Feb 2020, pp. 485-494.
16. F. Lu, J. Hu, L. T. Yang, Z. Tang, P. Li, Z. Shi, and H. Jin, Energy efficient traffic offloading for mobile users in two-tier heterogeneous wireless networks, Future Gener. Computer System, vol. 105, Issue. 07, Apr 2020, pp. 855-863.
17. Enrique Cerrillo Cuenca, Marcela Sepúlveda and Zaray Guerrero-Bueno, ICA A statistical approach to the analysis of superimposed rock paintings. Vol. 125, Issue 14, November 2020, pp. 10-19.
18. G. Mellinger, G. Schalk, C. Braun, H. Preissl, W. Rosenstiel, N. Birbaumer and A. Kubler, An MEG-based brain-computer interface (BCI), NeuroImage, Vol 36, Issue 3, July 2007, pp. 581–593.