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Optimizing Energy and Delay in Multichannel Cognitive Radios with Link Maintenance

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ABSTRACT— We present optimizing energy and delay in multichannel cross layer cognitive radios with link maintenance by using compression algorithm to compress the data or no. of bits in cognitive radio network (CRN). In compression algorithm, the no. Of bits or data transfer from one node to another node in multichannel cognitive radios (CR) with link maintenance (LM) by using lossless data compression method, In that case same no. Of data transfer without any loss of information called as lossless. In the cognitive radio network, due to the compression of information, time required for transmission period is less and to save the power. Our aim is to optimizing energy and delay in multichannel cognitive radios with link maintenance. Finally we propose that because of cross layer cognitive radio with compression algorithm with multichannel link maintenance, delay required for data transmission is less and to improved energy efficiency in cognitive radio network.

KEYWORDS: Primary users (PUs), Secondary users (SUs), Compression Algorithm (CA), wireless node (WN), Cognitive radios (CR), Link Maintenance (LM), Energy saving (SV).

I. INTRODUCTION

Communication is a transfer of information from one point to another. Today's communication is very advance; we use many new technologies as if Cognitive radio network is latest one. The term Cognitive Radio was first presented by Joseph Mitola and Maguire in 1999. In Cognitive radio network an unlicensed user can use an empty channel in a spectrum band of licensed user. Cognitive Radio Networks (CRNs) is an intelligent network that adapt to changes in their network to make a better use of the spectrum. CRNs solve the spectrum shortage problem by allowing unlicensed users to use spectrum band of licensed user without interference. Licensed users are known as primary users and un-licensed users are secondary users. When information is send through a licensed spectrum band is a primary user, only some channel of band is used, others are empty. Un-licensed user called secondary user uses these empty channels. Secondary users always watch the activities of primary user, and detect the empty channel and occupy the channel without disturbing the primary user. When the primary users are active, the secondary user should either avoid using the channel. An empty channel also known as spectrum holes.

Mean while if a SU detects any PU signal in its currently used band it should vacate this band for PUs and senses another vacant band in its environment and switches to new sensed hole. Essential security mechanisms should be used for successful deployment of cognitive radio networks (CRNs) to prevent misuse of valuable spectrum bandwidth.

A. Two types of Band based on frequency spectrum

1. Licensed Band CR
2. Unlicensed Band CR

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B. Two types of Users of CRNs

1. Primary Radio (PR) user, which operates in its licensed spectrum band.
2. Cognitive Radio (CR) user, which operates either in unlicensed spectrum band or in the licensed spectrum band of PR nodes while ensuring that it does not interfere with PR nodes.

C. Four main functions of CR

- Spectrum sensing: It determines which portions of the spectrum are available and detect the presence of licensed users.
- Spectrum management: It is to select the best available channel. Capturing the best available spectrum to meet user communication requirements, while not creating undue interference to other (primary) users. Cognitive radios should decide on the best spectrum band (of all bands available) to meet quality of service requirements; therefore, spectrum-management functions are required for cognitive radios.
- Spectrum sharing: It coordinates access to this channel with other users. Spectrum sharing cognitive radio networks allow cognitive radio users to share the spectrum bands of the licensed-band users. However, the cognitive radio users have to restrict their transmit power so that the interference caused to the licensed-band users is kept below a certain threshold.
- Spectrum mobility: It vacates the channel when a licensed user is detected. Process by which a cognitive-radio user changes its frequency of operation. Cognitive-radio networks aim to use the spectrum in a dynamic manner by allowing radio terminals to operate in the best available frequency band, maintaining seamless communication requirements during transitions to better spectrum.

A. Link maintenance in multichannel

Link maintenance of CR networks in which one sub-channel carries one packet and the source sends more redundant packets each frame to cope with the PU's re-claim in transmission. Further, they investigate this topic jointly with spectrum sensing and indicate that the sensing inaccuracy can be, to some extent, compensated by an efficient design of the link maintenance However, the interference model, spectrum assignment and access strategy are not considered in their work. As for the multi-user scenario, an efficient MAC protocol with channel sensing and resource allocation is more crucial to link maintenance A common model for multi-channel CCC based MAC protocol is that all CUs broadcast control information on the CCC and transmit on the data channels Limited by the hardware, most devices are with single transceiver, which cannot complete the two processes at the same time due to the half-duplex mode. Hence, the split phase (SP) scheme is designed that the time frame is divided into control phase and data phase, and then the CUs can exchange control information in the first phase and transmit data in the second phase synchronously, the opportunistic multichannel MAC protocol to improve the system efficiency. in cognitive radio network in which data transmitted from transmitter to the receiver by using multipath with maintaining the link and to reduce delay and to improve energy efficiency of the network. By using compression algorithm we can compressed number of bits without loss of data with maintaining the link and transmitted towards base station by using multipath network and to implement the multichannel MAC Protocol.

II. LITERATURE REVIEW

[1] In this paper, "A MAC Protocol for link maintenance in multichannel cognitive Radio Ad- Hoc Networks", which is published by Jingye Li, Tao Luo, Jing Gao and Guangxin Yue in the year of April 2015, proposed a cross-layer LM-MAC with link maintenance functions. The proposed protocol maintains the cognitive link mainly from three aspects. From the access technique, three access modes provide protection to the continuous users by diversion mechanism, where the QSAA with asynchronous contention could be applied to wireless random access systems. Then benefited from the design of FSL, periodical cooperative sensing obtains a higher sensing accuracy to reduce the MI between the PU and the CU. The most important aspect is in the physical layer, the arrangement of RSC and BSC considerably improves the transmission reliability. Compared with the OMC-MAC protocol, the proposed LM-MAC protocol achieves better system performance in terms of saturation throughput, continuity and access delay.

[2] In this paper, "A Survey on MAC strategies for cognitive radio networks", which is published by A.D. Domenico, E.C. Strinati and M.D. Benedetto in the year of 2012, we have discussed various methods and techniques used so far in the design and development of MAC protocols for MANETs. We also looked into a few protocols developed for WSNs that can be deployed in a MANET environment with minor adjustments. Some of the techniques

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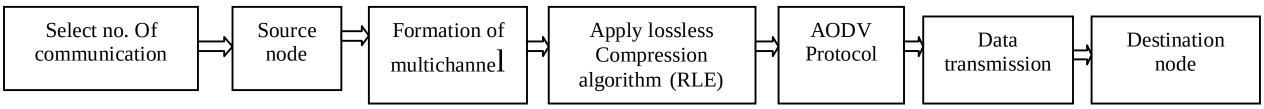
proposed call for interaction between different layers of the protocol stack such as, a MAC solution that works in conjunction with routing. The traditional layered architecture for network communication is rigid and thus limits the ability of nodes to select better routes. We believe that a MAC solution that interacts with the physical layer and network layer (routing) would provide better results compared to a strict layered approach. We also looked into antenna technologies used in MANETs especially the directional or the beam forming antennas. In communication environments where a single radio interface is using a single channel, only one device can transmit whereas the rest of the nodes in its transmission range either receive the data being transmitted or waits for the transmission to end before they can transmit their own data. These enhanced antenna based MAC solutions can achieve better throughput performance by opportunistic transmission without affecting other transmissions in their neighborhood. Specialized antennas based MAC solutions also fall under the paradigm of cross-layer design because beam forming antennas needs instruction from the MAC layer before directing their transmission at particular node or group of nodes.

[3] In this paper, "Link Maintenance protocol for cognitive radio system with OFDM PHY" which published by Q.C. Shietal in the year of April 2017, we describe a new link maintenance protocol which can be used by cognitive radios to achieve reliable continuous communication. Simulation results characterizing the performance of this protocol are provided. A prototype system with a pair of cognitive radios featuring this protocol is also introduced.

[4] In this paper, "Spectrum scanning and reserve channel methods link maintenance in cognitive radio systems" which is published by S. Subramani, S. Armour and D. Kaleshi in the year of May 2008, analyzes bidirectional and dual scanning mechanisms that expands search on multiple regions simultaneously in finding a suitable free-channel. The channel degradation and primary user arrival scenarios and how the proposed adaptive reserve channel and pointer mechanism maintains SU links are also considered. The simulation results of the proposed scanning method clearly show the ability to produce the closest free-channel without compromising complexity. Furthermore, the connectivity performance simulation results show significant impact of an adaptive reserve channel mechanism. Even using an RC proportionality figure of 1% of channels the disconnectivity is improved by 77%. The parameters influencing connectivity and fairness such as *max lease* period and PU arrival rate were also analyzed. The coordination among SUs and timing protocols can be considered in future work. The convergence rate of channel selection, and the dynamic characteristics of the link maintenance mechanism proposed can also be investigated further.

[5] In this paper, "A Two level MAC protocol strategy for opportunistic spectrum access in cognitive radio networks" which is published by Q. Chenestal in the year of June 2011, we have proposed a two-level OSA strategy and developed two random-access MAC protocols called the *slotted* CR-ALOHA and CR-CSMA for CRNs. A suitable frame structure has been designed, and closed-form expressions of network metrics, i.e., normalized throughput and average packet delay, have been derived, respectively. For various frame lengths and numbers of SUs, the optimal performance of SUs can be achieved at the same spectrum sensing time, and the maximum achievable performance of the secondary network is affected by the spectrum utilization of the primary network. Moreover, using the interference and agility factors, we have shown that there exists a tradeoff between the achieved performance of the secondary network and the effects of protection on the primary network; therefore, the optimal frame length can accordingly be designed.

III. DESIGN METHODOLOGY



In the existing work, the researchers have work on a multichannel MAC layer protocol, which defines network communication in cognitive radios. The network works perfectly, but can be improved in terms of delay and energy efficiency. Our problem statement is to develop a compression algorithm like RLE to work with the multichannel MAC layer protocol with link maintenance and improve the delay and the energy efficiency of the overall network.The algorithm will reduce the number of bits to be transmitted and hence increase the speed of the network communication, in this way data transmission from source to destination node by using cross layer cognitive radio with lossless compression and multichannel network.

In signal processing, data compression, source coding or bit-rate reduction involves encoding information using fewer bits than the original representation. Compression can be either lossy or lossless. Lossless compression reduces bits by identifying and eliminating statistical redundancy. No information is lost in lossless compression. Lossy compression reduces bits by removing unnecessary or less important information. The process of reducing the size of a data file is referred to as data compression. In the context of data transmission, it is called source coding (encoding done at the source of the data before it is stored or transmitted) in opposition to channel coding.

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1) Lossless Data Compression:-

Lossless data compression algorithms usually exploit statistical redundancy to represent data without losing any information, so that the process is reversible. Lossless compression is possible because most real-world data exhibits statistical redundancy. For example, an image may have areas of color that do not change over several pixels; instead of coding "red pixel, red pixel," the data may be encoded as "279 red pixels". This is a basic example of run-length encoding; there are many schemes to reduce file size by eliminating redundancy.

2) Multichannel Cognitive Radios with Link Maintenance:-

Link maintenance of CR networks in which one sub-channel carries one packet and the source sends more redundant packets each frame to cope with the PU's re-claim in transmission. Further, they investigate this topic jointly with spectrum sensing and indicate that the sensing inaccuracy can be, to some extent, compensated by an efficient design of the link maintenance However, the interference model, spectrum assignment and access strategy are not considered in their work. As for the multi-user scenario, an efficient MAC protocol with channel sensing and resource allocation is more crucial to link maintenance A common model for multi-channel CCC based MAC protocol is that all CUs broadcast control information on the CCC and transmit on the data channels Limited by the hardware, most devices are with single transceiver, which cannot complete the two processes at the same time due to the half-duplex mode. Hence, the split phase (SP) scheme is designed that the time frame is divided into control phase and data phase, and then the CUs can exchange control information in the first phase and transmit data in the second phase synchronously, the opportunistic multichannel MAC protocol to improve the system efficiency. in cognitive radio network in which data transmitted from transmitter to the receiver by using multipath with maintaining the link and to reduce delay and to improve energy efficiency of the network. By using compression algorithm we can compressed number of bits without loss of data with maintaining the link and transmitted towards base station by using multipath network and to implement the multichannel MAC Protocol.

A) Parameters Evaluation-Delay, energy, Throughput, Jitter & Packet Delivery Ratio.

- There are three choice for parameter evaluation-

1. only Cognitive Radio.
2. Cross layer Routing cognitive radio.
3. Cross layer cognitive radio with Compression and multichannel.

III. SIMULATION RESULT

1. Only cognitive Radio:-

- Total number of nodes is 30
- Select the no. of communication is 2

Table1. Result

Sr. No.	Parameter	Optimizing value (opt)
1	Delay	0.000095 sec
2	Energy	2935.0259 joule
3	Throughput	209.32 bps
4	Jitter	0.000003 sec
5	Packet Delivery ratio	99.76 percent

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2. Cross Layer Routing cognitive radios with multichannel :-

- Total nnmber of nodes is 30
- Select the no. of communication is 2

Table2. Result

Sr. No.	Parameter	Optimizing value (opt)
1	Delay	0.000095
2	Energy	2935.025
3	Throughput	209.65
4	Jitter	0.000003
5	Packet Delivery Ratio	99.80

3. **Cross layer cognitive radio with Compression and multichannel**

- Total nnmber of nodes is 30
- Select the no. of communication is 2

Table3. Result

Sr. No.	Parameter	Optimizing value (opt)
1	Delay	0.00010 sec
2	Energy	3469.145 joule
3	Throughput	210.05 bps
4	Jitter	-0.000003 sec
5	Packet Delivery ratio	99.93 percent

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IV. RESULT AND DISCUSSION

Comparison of Result
Table- 4

Parameters	Without Compression Algorithm	With Compression Algorithm
Delay	0.00095 sec	0.00010 sec
Energy	2935 joule	3469 joule
Throughput	209.32 bps	210.05 bps
Jitter	0.000003sec	-0.000003 sec

Discussion

From the above result we came to know that the performance metrics such as delay, jitter, are minimum and the throughput, energy and power delivery ratio are maximum. So the cross layer cognitive radio with compression and multichannel algorithm gives the better result than cognitive radio and Cross layer routing cognitive radio.

V. CONCLUSION AND FUTURE WORK

In our project, we have analyzed the compression Algorithm is best for data transmission. From the above Comparison delay and Jitter are minimum and Energy, Throughput and Packet delivery ratio are maximum. We have concluded that cross layer routing with compression and multichannel method is superior in various aspects such as Delay, Energy, Jitter, Throughput and packet delivery ratio than the other method.Energy, Throughput and packet delivery ratio than the other method.The proposed compression methods can be used for Audio and Video processing just like Videoconferencing, video telephony.

REFERENCES

1. Jingye Li, Tao Luo,Jing Gao, and Guangxin Yue"A MAC Protocol for Link Maintenance in Multichannel Cognitive Radio Ad Hoc Networks",communication and network,vol. 17, no. 2, April 2015.
2. D. Domenico, E. C. Strinati, and M. D. Benedetto, "A survey on MAC strategies for cognitive radio networks," *IEEE J. Commun. Surveys Tuts.*, vol. 14, no. 1, pp. 21–44, 2012.
3. Q. C. Shi *et al*, "Link maintenance protocol for cognitive radio system with OFDM PHY" in *Proc. IEEE DySPAN*, Dublin, Ireland, Apr. 2007, pp. 440–443.
4. S. Subramani, S. Armour, and D. Kaleshi, "Spectrum scanning and reserve channel methods for link maintenance in cognitive radio systems" in *Proc. IEEE VTC*, Marina Bay, Singapore, May 2008, pp. 1944–1948.
5. Q. Chen *et al.*, "A two-level MAC protocol strategy for opportunistic spectrum access in cognitive radio networks," *IEEE Trans. Veh. Technol.*, vol. 60, no. 5, pp. 2164–2180, June 2011.
6. D.Willkomm and A.Wolisz, "Efficient QoS support for secondary users in cognitive radio systems," *IEEE Wireless Communications*, vol. 17, no. 4, pp. 16–23, Aug. 2010
7. D. Willkomm, J. Gross, and A. Wolisz, "Eliable link maintenance in cognitive radio systems," in *Proc. IEEE DySPAN*,Maryland, USA, Nov. 2005, pp. 371–378.
8. S. C. Jha *et al.*, "Design of OMC-MAC: An opportunistic multi-channel MAC with QoS provisioning for distributed cognitive radio networks," *IEEE Trans. Wireless Commun.*, vol. 10, no. 10, pp.3414–3425, Oct.2011.
9. L. Le and E. Hossain, "A MAC protocol for opportunistic spectrum access in cognitive radio networks," in *Proc. IEEEWCNC*, Las Vegas, USA,Mar. 31– Apr. 3, 2008, pp. 1426–1430.
10. J. C. Jia, Q. Zhang, and X. M. Shen, "HC-MAC: A hardware-constrained cognitive MAC for efficient spectrum management," *IEEE J. Sel. Areas Commun.*, vol. 26, no. 1, pp. 106–117, Jan. 2008.
11. M. R. Kim and S. J. Yoo, "Distributed coordination protocol for ad hoc cognitive radio networks," *IEEE J. Commun. Netw.*, vol. 14, no. 1, pp. 51–62, Feb. 2012.