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Improving Speed and Energy Efficiency of Cognitive Radios using Cross layer Multichannel Routing and Compression

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ABSTRACT: We present the Compression algorithm (CA) the number of bits or information in cognitive radio network (CRN) compress by using compression algorithm, and data transfer from source node to destination node without any loss of information by using lossless data compression method and to improved speed and energy efficiency in cognitive radios. in the same way cross layer operation aided multichannel routing protocol specifically, cross layer operation across the physical layer, Data link layer and even the network layer is exemplified for improving the energy efficiency & improving speed in cognitive radios (CR). In the cognitive radio network due to the cross layer multichannel Routing and compression of information, time required for transmission period is less therefore speed of data transmission is fast and to improve energy efficiency. Our aim is to improving speed and energy efficiency of cognitive radios using cross layer multichannel routing and compression. Finally we propose that because of data compression 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), Cognitive radios (CR), Cross layer routing (CLR).

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 network 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.

II. RELATED WORK

[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 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.

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[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 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.

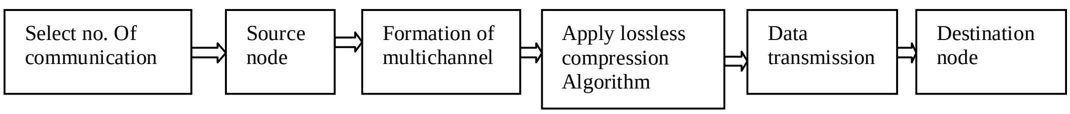

Fig.1 Block Diagram of Proposed method

In the above block diagram select first the number of communication which is depend on node of node, then choose source node and destination node after entering the source and destination node, the number of multichannel are form with the help of multichannel information transfer from source node to the destination node, before that apply the lossless compression algorithm which is used to compress the information and at the time of information transmission time required is less it helps to reduce delay and improve the energy efficiency, after applying the compression algorithm data transfer from source node to destination node.

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.

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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 and energy.

- There are two choice for parameter evaluation-

1. Cross layer Routing cognitive radio.
2. Cross layer cognitive radio with Compression and multichannel.

➢ Total number of nodes is 30

IV. SIMULATION RESULTS

1. Using Cross Layer Routing cognitive radio

No. of communication	Delay using without compression algorithm	Energy using without compression algorithm
1	0.000112	8972.73
2	0.000091	5987.102
3	0.00011	10965.42
4	0.000098	7837.335

2. Using Cross layer cognitive radio with Compression and multichannel.

Number of communication	Delay using with compression algorithm	Energy using with compression algorithm
1	0.000109	2285.91
2	0.000105	7577.387
3	0.00008	2974.72
4	0.000092	17774.15

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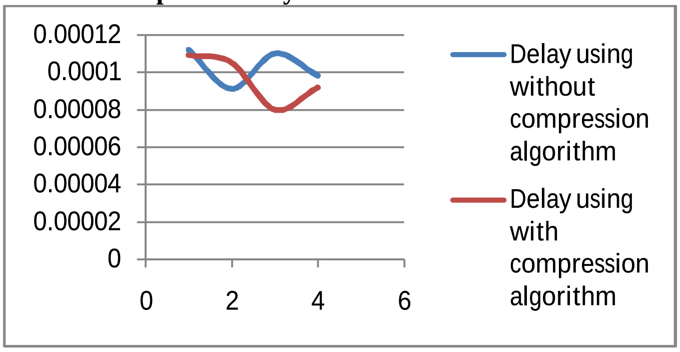
IV. RESULT AND DISCUSSION

Comparison of Result

- **For Delay (Second)**

No. of communicaton	Delay using without compression algorithm	Delay using with compression algorithm
1	0.000112	0.000109
2	0.000091	0.000105
3	0.00011	0.00008
4	0.000098	0.000092

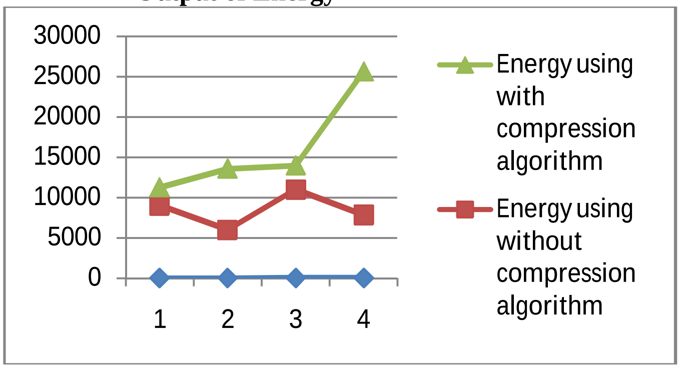
Output of Delay



- **For Energy (joule)**

Number of communication	Energy using without compression algorithm	Energy using with compression algorithm
1	8972.73	2285.91
2	5987.102	7577.387
3	10965.42	2974.72
4	7837.335	17774.15

Output of Energy



Discussion

From the above comparison we see the result of Delay and Energy by using without compression and with compression algorithm, in this case result of compression algorithm is better than without compression algorithm seen clearly.

V. CONCLUSION AND FUTURE WORK

From the above result we came to know that the performance metrics such as delay is minimum and energy is maximum and Improving Speed and Energy Efficiency, so that Cognitive Radios using Cross layer Multichannel Routing and Compression gives the better result. The proposed compression methods can be used for Audio and Video processing just like Videoconferencing, video telephony.

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