ISSN: 2277-9655
Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

TECHNOLOGY

Collision Avoidance Algorithm with Jitter in Multi-hop Cognitive Radio Network

Rakesh Kulkarni[*1], Makarand Jadhav[2], Sanjay Koli[3]
[*1,2] Sinhgad college of engineering,Pune, India
[3]SKN College of engineering,Pune,India
2006.kulkarni@gmail.com

Abstract

Cognitive radio techniques make full use of spectrum resources via dynamic spectrum access technique. This paper presents a collision avoidance algorithm with the addition of jitter in multi-hop cognitive network.
In a multi-hop Cognitive Radio system in which information needs to be relayed over multiple wireless links and secondary users have to co-ordinate themselves in a distributed manner, an improvement in throughput is achieved by reducing packet loss, through the addition of small jitter 1µs at the time of transmission for a network with a set of 6 nodes. Initially we describe the multi-hop cognitive radio network then various issues for Design of system are considered. From the result it is observed that the throughput for a multi-hop cognitive radio network achieved up to 28x 103 bits/s with the set values of 6 nodes.

Keywords: Throughput, Cognitive radio, collision, jitter

Cognitive Radio Network

Cognitive radio, which enables secondary users/networks to utilize the spectrum when primary users are not occupying it, has been a promising technology to improve spectrum utilization efficiency. Spectrum sensing to detect the presence of the primary users is, therefore, a fundamental requirement in cognitive radio networks.[1]

Due to high fluctuations in available spectrum as well as the diverse quality of service requirements of various applications. Each CR user in the CR network must determine which portions of the spectrum are available and detect the presence of licensed users when a user operates in a licensed band, select the best available channel , coordinate access to this channel with other users and vacate the channel when a licensed user is detected.[2] This can be realised through spectrum management functions given below:

A. Spectrum sensing: A CR user can allocate only an unused portion of the spectrum .Therefore, a CR user should monitor the available spectrum bands, capture their information and then detect Spectrum holes.

B. Spectrum decision: Based on spectrum availability, CR users can allocate a channel to meet user communication requirements.

C. Spectrum sharing: Because there may be multiple users trying to access the spectrum, CR network access should be co-ordinated to prevent multiple users colliding in overlapping portions of the spectrum.

D. Spectrum mobility: If the specific portion of the spectrum in use is required by a primary user, the communication must be continued in another vacant portion of the spectrum.

The emerging IEEE 802.22 standard-based wireless regional area network (WRAN) technology is based on the single-hop CRN concept, in which a centralized cognitive base station (BS) manages the SUs that opportunistically use the TV bands when they are unoccupied by the incumbent TV services. On the other hand, multi-hop CRNs (MHCRN) have no fixed network infrastructure or central controller with an additional requirement that the information needs to be relayed over multiple wireless links. Thus, the SUs in a MHCRN have to coordinate themselves in a distributed manner

Design of System

A node is an entity which acts as host (eg. A source or destination) and a router (an intermediate node).it receives packets from attached application and forwards them to the attached links specified in the routing table.

The network is made up of two types of components: nodes and communication lines. The nodes typically handle the network protocols and provide switching capabilities. A node is usually itself a computer (general or special) which runs specific network software. For a cognitive radio system, a node can be configured as a primary user (licensed) or a secondary user (unlicensed).A host is connected to the network by a separate communication line which connects it to one of the nodes. In most cases, more than one host may be connected to the same node. Each host has a unique address allocated to it by the network. For a host to communicate with another host, it needs to know the latter's address. All communication between hosts passes through the nodes, which in turn determine how to route messages across the network, from one point to another. The nodes in a network implement only the lower three layers, the reason for this is that the upper four layers are irrelevant to the task of communication between the nodes.

A. Jitter Mechanism

In Communication networks, Throughput or Network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bits/s or bps) and sometimes in data packets per second or data packets per time slot. The system throughput or aggregate throughput is the sum of the data rates that are delivered to all terminals in a network. [3]

Here our aim is to consider the issue of improvement of throughput in co-operative spectrum sensing by reducing Packet loss. Packet loss in a wireless network happens mainly because of two reasons sometimes it is due to Collisions or due to Queue level dropping. The collisions can be avoided if each node adds a random jitter (Delay) to attempt to avoid colliding with other nodes engaged in the same transmission. The jitter is typically much larger than Time for one transmission of a packet, again to minimize the chance of collision.

When a node in communicating with other nodes, it will provide service to each node in a polling fashion. So it will allot particular time period to each of the node. This allotment of time is added with some extra jitter time, so that all packets will be sent back to back without queuing them and hence prevents the queue level dropping.

Jitter = Random Delay/bandwidth

If a node adds a random delay of 1s for a bandwidth of 1 Mbps, then a jitter of 1 µs is added.

If a node is presently receiving a packet at a power level Pa and a packet at power level Pb arrives, the following comparison must be made to determine whether or not capture occurs. Pa/Pb > 10; Since 10 db is capture threshold.

Due to the characteristics of the shared wireless medium, nodes in adhoc networks must often forward flooded packets on the same interface they were received on. Upon reception of a flooded packet, nearby nodes are thus likely to simultaneously forward the packet on the shared wireless medium, and thus systematically cause packet collisions.

In order to reduce the number of such collisions in a distributed fashion, random back-off times are independently scheduled by each node before each transmission, which aims at avoiding synchronized wireless medium access. Such a mechanism, called jitter or jittering, was standardized by the IETF in RFC 5148. Jitter thus decreases the number of collisions at the price of increased delay.

During the time a node waits before transmitting, additional flooded packets may be received. According to RFC 5148, these packets are then buffered and piggybacked in the node's next transmission. This jittering technique also decreases the number of transmissions, at the price of longer transmissions, i.e.bigger packets.[4]

In the context of classical flooding, where each node in the network forwards a flooded packet once, the first time the packet is received. In this context, packet collisions occur when two neighbouring nodes forward the same packet, immediately after its reception, as illustrated in Figure 1 . It is worth to note that collisions in flooding addressed in this memorandum are systematic, i.e. they are come deterministically from the fact that two or more nearby routers take the same decision (to forward a flooded packet) in reaction to the same event (the reception of that packet). Prevention of these collisions, or at least reduction of them to random events with low probability, becomes thus a central issue to be handled for flooding in ad hoc networks.

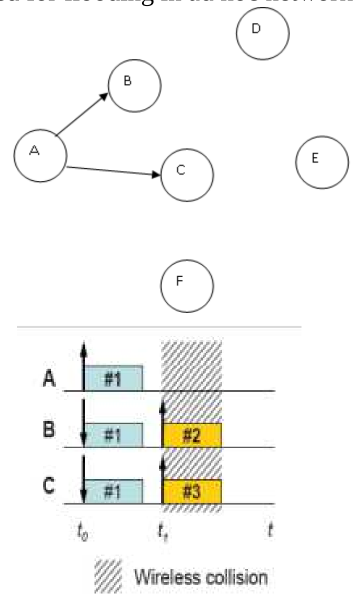

Figure 1: Wireless collision caused by concurrent flooding retransmissions.

ISSN: 2277-9655
Impact Factor: 1.852

The forwarding of a flooded packet (#1) by node A, received by B and C, causes simultaneous transmissions by node B and C (#2 and #3), to forward the flooded packet, which cause a wireless collision.

B. Detection of primary user

For the implemented algorithm, network simulator-2 tool is used for simulation purpose. [5] As MAC/DSA algorithms may need to know the existence of primary user, we also introduce how to implement the packet based primary user detection. The primary user sends out a primary user packet to indicate its existence. Other users that receive this packet can distinguish the existence of primary user from this packet. The primary user packet is controlled by a broadcast timer. As the primary user packet can collide with normal data packet, thus the sending and controlling of this packet should be done in the MAC layer.

The packet module is modified to contain information about primary user. A new broadcast timer primaryusertimer is added in MAC to control the broadcast of this packet. The sendprimaryuserpacket is added to send primary user packet. The recv function is changed to handle the primary user packet.

TABLE I
SIMULATION PARAMETERS

Parameters	Values
Number of nodes	6
Maximum packets in interface queue	100
Size of simulation area	1000* 1000
Traffic at application	Cbr
Granularity	1s
Simulation time	20s
Mac	Mac/ macngenhanced

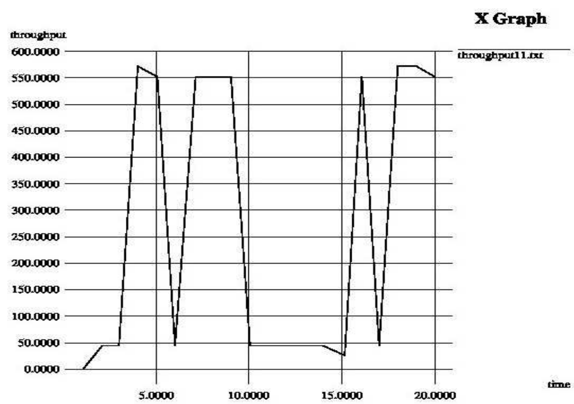

Figure. 2 Throughput obtained for genie system

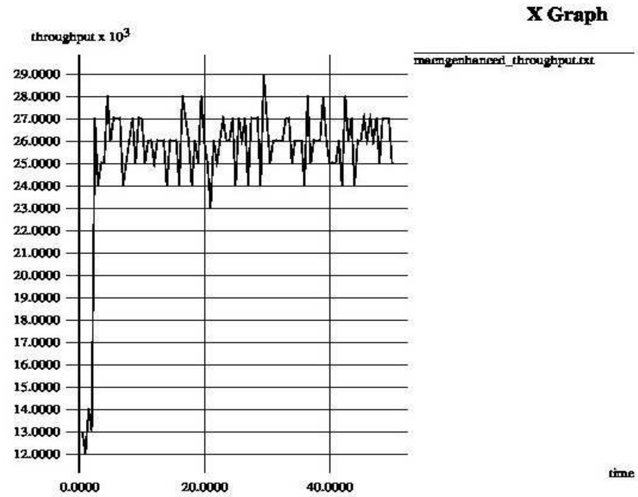

Figure. 3 Throughput obtained with implemented algorithem

TABLE II
COMPARISON OF THROUGHPUT

Time instant (sec)	Throughput for 802.11 (bits/s)	Throughput for implemented system (bits/s)
1	0	13000
2	44	13520
3	44	26048
4	572	26000
5	552	26520
6	44	24960
7	552	26564
8	552	27040
9	552	26520
10	44	28080
11	44	26520

12	44	26520
13	44	25480
14	44	26000
15	26	27040
16	552	27560
17	44	27560
18	572	26520
19	572	27560
20	552	26000

Conclusion

In this paper, an improvement in the throughput of the 802.11 using collision avoidance strategy for cognitive radio is achieved. The throughput of the cognitive users is improved by 24 times as a result of the cooperative sensing strategy, because of reduction in the number of collisions by adding a small jitter of 1µs; but the price paid in increased delay. The timers are also used for sending, receiving and broadcasting information about the primary and secondary users.

For the system proposed & realized, the results achieved for a 802.11 system gives the maximum throughput per user 572 bits/s whereas for a cooperative system is 28x 10^3 bits/s.

References

[1] D. Cabric, S. Mishra, and R. Brodersen., “Implementation issues in spectrum sensing for cognitive radios” in *IEEE Asilomar Conference on Signals, Systems and Computers*, 2004.

[2] S. Haykin. “Cognitive radio: Brain-empowered wireless communications” in *IEEE Journal on Selected Areas in Communications*, 2005.

[3] K.Lee ,A.Yener., “Throughput Enhancing Cooperative Spectrum sensing strategies for cognitive radio” in *IEEE Asilomar Conference on Signals, Systems and Computers*, 2007.

[4] T. Clausen, C. Dearlove, B. Adamson “Jitter Considerations in Mobile Ad Hoc Networks”, in *RFC5148 IETF*, 2008.

[5] P.Lee ,G.Wei, “NS2 Model for Cognitive Radio Networks Routing” in *IEEE International Symposium on Computer Network and Multimedia Technology*,2009