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Performance Evaluation of WCETT Routing protocol for CRAHN

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Abstract-Cognitive Radio Networks (CRNs) are new technology that facilitates the opportunistic of using the frequency spectrum. The idea of CRN is permitted secondary user access to licensed spectrum, but without any interference with the primary user and this will lead to good usage of spectrum. Routing protocols used to address the best route choice between the sender and receiver in a Cognitive Radio Ad-Hoc Network (CRAHN) consume substantial amount of energy from the battery which considered one of the serious problems in CRAHN. So a lot of efforts have been spent on enhancing the protocols techniques to improve this valuable energy. WCETT routing protocol is one of the best protocol that used an effective route choice between sender and receiver with a lower cost than other on demand routing protocols in CRAHNS. This paper focuses on the performance evaluation of WCETT protocol in CRAHN based on different issues like number of nodes, traffic, and number of radio in each node using NS3 tool.

Keywords: CRN, CRAHNS, WCETT, NS3

I. Introduction

The development of portable devices, such as smartphones and laptops and other smart communication devices has directed and affected an increase in the demand of different types of wireless network services are sighted an exceptional growth. With such rapid development of wireless devices, the requiring for the radio spectrum are continuously increasing, causing scarce spectrum resources [i]. The report by the FCC (Federal Communications Commission) [ii] was offer that the fixed policy spectrum is becoming unsuitable and ineffective for today's wireless communication systems [iii] Cognitive radios are radio systems that originally organize the using of spectrum and solve the problem of fewer usage of spectrum. They find radio spectrum when it is unused by the current radio system and use this spectrum in a smart way [iv]. The WCETT routing protocol is on demand routing protocols. The WCETT meaning begins by selecting the best path from sender to receiver. The WCETT like AODV that uses RREQ and RREP control packets to start the connection with extra metric for calculating the path such Expected transmission count (ETX) and Expected transmission time (ETT) [v].the WCETT is using to Reduce the numbers of node and to reduce the intra-flow interference and to on the flow path that transfer on the same channel, the WCETT is explained in following equation [vi]

$$WCETT(p) = (1-\beta)\sum_{link\ l\in B} ETT_l + \beta \max_{1\le j\le k} X_j$$

Where: β is a tunable parameter subject to $0 \le \beta \le 1$. Xj is the amount of times channel j is used along path p and captures the intra-flow interference [vii]. j≤k Xj component counts the maximum number of times that the same channel appears along a path. The ETT is Expected transmission time is explained in the following equation ETT (L) =ETX (L) *(S/ B) where B Refer to the average bandwidth of the link L and S is the packet size. The ETX is Expected transmission count [viii].

II. Material and Methodology

CRAHN environment based on NS3.17 simulator [ix] are used to evaluate the performance of WCETT protocol for CRAHN. Assuming that the CRAHN channels are equal four channel, each channel has bandwidth 2Mbps and two active primary users and radio rang of simulation nodes 300 m. The WIFI and internet models inside NS3 were edited to be compatible with cognitive radio network. To calculate performance of WCETT routing protocol in cognitive radio Ad hoc network the following metric are used (throughput, Average End to End Delay, and Packets delivering ratio (PDR)).

The performance of WCETT routing protocol was checked with three scenarios.

1. SRMC without Traffic

In this scenario the performance of the WCETT studies by changing the number of nodes to see what happens to their performance without considering the traffic issues, to get a sense about the inner working of this Routing protocol as shown in Table 1.

2. SRMC with Traffic

This scenario includes running the simulation of WCETT routing protocol under the effect of traffic to see how the heavy traffic affect the performance of WCETT. In this paper, three types of traffic were used: high packet size 1024 byte, high number of packet, multi sources and destinations are sent at the same time and multi hops between source and destination as shown in Table1.

3. MRMC with Traffic

This scenario studies the performance of WCETT protocol by running simulation scenario with added multi radios to each node under the same traffic scenario above which led to improve the performance of WCETT as shown in Table1

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Table1. Simulation parameters of the three scenarios

Parameters	SRMC without Traffic	SRMC with Traffic	MRMC with Traffic
Type of channel	Wireless channel	Wireless channel	Wireless channel
Traffic type	UDP	UDP	UDP
Simulation time	20 second	20 second	20 second
Routing protocol	WCETT	WCETT	WCETT
Number of nodes	10,20,30,40,50	10,20,30,40,50	10,20,30, 40,50
Simulation area	300*300	300*300	300*300
Wi-Fi stander	IEEE802.11b	IEEE802.11b	IEEE802. 11b
Channel numbers	4	4	4
Radio numbers	1	1	3
Number of packets	10	10	10, 20
Packets size	512 byte	1024 byte	1024 byte
Interval	0.2 second	0.2 second	0.2 second
Propagation range	300 m	300 m	300 m
Bandwidth	2 Mbps	2 Mbps	2 Mbps

III. Results and Discussions

1. The Average Throughput in Kbps of WCETT Routing Protocol

The WCETT routing protocol was used to check and evaluate the results of average throughput for cognitive network with three scenarios that show what happened in the routing throughput after adding traffic and then adding multi radios to each node. Figure 1 shows that the Average throughput in Kbps for SRMC without traffic, SRMC with traffic and MRMC with traffic by using different number of nodes. The result shows that MRMC enhanced the performance of throughput more than the SRMC, under the same scenario of traffic. Because in the case of MRMC, each node sends and receives from three radios rather than one radio, for this reasons the average received packet increases therefor the average throughput is also increased.

2. The Average Delay of WCETT routing protocol

The WCETT routing protocol was used to check and evaluate the results of the average delay of cognitive network with three scenarios to show what happened to the routing delay after adding traffic and then adding multi radios to each node as shown in figure 2. The results show that when the node numbers are small, SRMC with and without traffic is approximately the same. But when the number of nodes increases the delay is also increased. While MRMC has better delay performance because it uses three radio rather than one radio to send and receive packets.

3. The Packet Delivery Ratio of WCETT Routing Protocol

Figure 3 shows the packet delivery ratio for the WCETT protocol in three different scenarios. In this figure we can see that PDR for SRMC without traffic is good because it does not have to load high traffic in the network. For this, the lost packet without traffic is less. When adding traffic, the PDR decreases, because the lost packet with traffic is high. However, when adding multi radios to each node, the performance is enhanced and PDR with MRMC becomes higher than that in SRMC under the same scenario of traffic.

IV. Conclusion

WCETT routing protocol has ETX metric which chooses routes based on the knowledge of delivery ratio, provides more related information in comparison with other routing protocol metrics. When adding traffic, the average throughput is increased and PDR is decreased due to the traffic conations high packet size 1024 byte, high number of packet, multi sources and destinations are sent at the same time. However, when multi radios per nodes are added, the average throughput and PDR of WCETT routing protocol is increased. Delay decrease will lead to enhanced performance of network because MRMC uses three radios rather than one radio to send and receive packets.

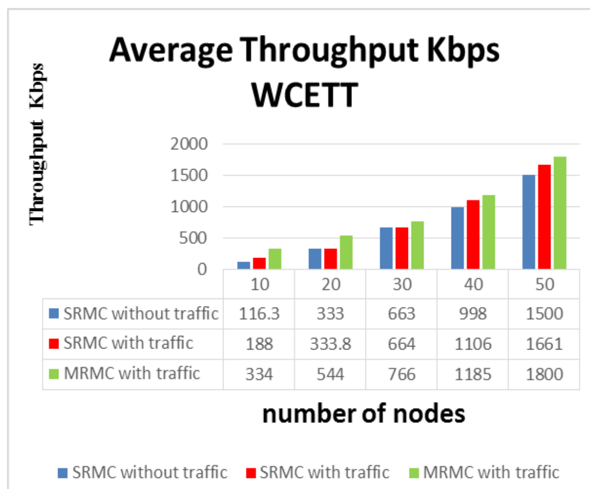

Figure 1: the average throughput of WCETT Routing protocol

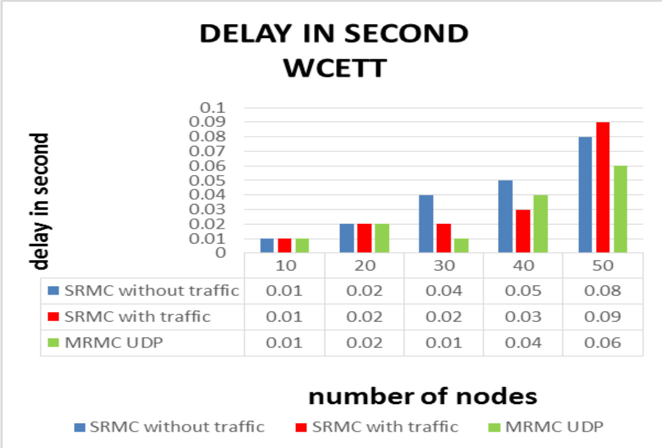

Figure 2: the average delay of WCETT Routing protocol

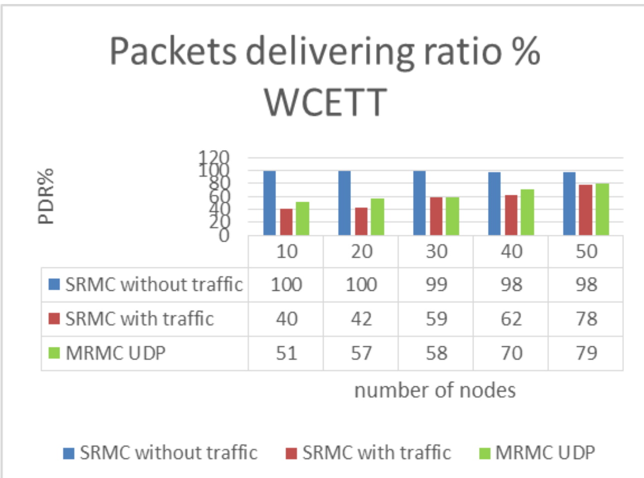

Figure 3: the PDR of WCETT Routing protocol

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