Modified Transport Control Protocol for Cognitive Radio Ad Hoc Network

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***Abstract*: A Cognitive radio ad hoc network (CRAHN) is a decentralized network with dynamic spectrum access management. It allows the unlicensed users to take advantages of opportunities to transmit in the Licensed User's frequency bands without the interference of the unlicensed users. Appropriately, this network involves in frequent sensing that would have effect on the osi higher protocol layer performance like transport layer. This paper carries out the disadvantages of TCP newReno in a cognitive radio ad hoc network environment, and introduced TCP CRAHN. This friendly protocol also comprises of spectrum awareness by a merged method of getting clear feedback from the intermediary nodes and the destination node. Protecting sensitive or private data is serious business in the network. The more frequent attack that caused in TCP CRAHN'S is key depletion attack. This attack is been overcome and the simulation results are been produced.**

Keywords: **Cognitive radio, congestion control, unlicensed user, spectrum sensing, TCP**

I. Introduction

Cognitive radio (CR) is a wireless communication in with a transceiver that can detect the communication channels in usages and which are not in usage, and instantly move into empty channels with the avoidance of occupied ones. This brings out the use of available radio-frequency (RF) spectrum with the minimization of other users.TCP is the most friendly transport layer protocol on the Internet. TCP which connects the two applications runs on two hosts. The host that enables the connection is called the sender, and the other host which receives is called the receiver. The sender receives information from the application process and store that in a buffer. The sender frequently collects few chunk of data from the buffer and encapsulates the chunk into segment. Then assigns a sequence number to the segment, and send them to the receiver. The receiver receives each segment and sends an acknowledgement message to the source. The destination uses the sequence numbers to arrange again the received segments sequentially. In cognitive radio networks spectrum sensing affects temporary disconnections that forwards to TCP time-outs. Miserably, TCP consider that the time outs made are caused by congestion in the routing path. Because of this criteria the TCP sender reduces the rate of segments that been send to the receiver.

TCP is indulged to work in cognitive radio ad hoc networks. In addition to the events which leads to the reduction rate in sending. In the previous section, there are some other new events. If the source is been transmitting at a rate, an LU arrived. The source, then look for the another channel and resumes transmission. Anyway, TCP starts transmission at a slower rate. Therefore, arrival of an LU forwards to the reducing rate in sending. Hence, instant arrival of LUs will forwards to instant reduction rate in sending. The next event that forwards to reduction rate in sending is the receiver which is been engaged in spectrum sensing. Meanwhile, the receiver is been assumed by a transceiver. Hence, in sensing mode, the transceiver cannot indulge in transmission. Therefore the source will experience a temporary disconnection which will forwards to timer expiration. Miserably, the TCP sender will assume that the timer expired because of congestion and it reduces the sending rate. In our approach, we will expect a cross layer design. Hence, we expect that information incur from one layer to another layer. We will expect that TCP completely relies on the bottom layers for spectrum sensing and spectrum decision. The bottom layers specify TCP about the channel which to use for transmission and the channel to move to when an LU arrives in the current channel. Hence, TCP does not involve in taking decision based on which channel to sense.

In our approach, the prevention of reducing rate in sending due to LU arrival and involvement of the receiver in spectrum sensing. The source can also indulge in sensing mode. Hence, the prevention of reducing rate in sending when transmission resumes. CR Ad Hoc Networks which do not have a centralized body for receiving the spectrum usage data in the neighbourhood, or external support in the form of a spectrum broker which enables in sharing the available spectrum resource. Hence compared to infrastructure-based networks, which relies on local decisions which is the problem maker in node-coordination and end to-end communication considerably involved. While the mobility of the in-between nodes and the inherent vague in the wireless channel state are the main factors that affects the decisive end-to-end delivery in classical ad-hoc networks. In addition to that several challenges exist in a CRAHN.

Transport control protocols incorporate a well measured topic in traditional wireless ad hoc networks, but they are quite uncharted in CR networks. It is been called as that the classical TCP implementations which run over the Internet (e.g., TCP newReno, TCP Vegas], and TCP SACK perform badly over wireless links due to the additional packet losses which is caused by poor channel conditions or by node movement. They are often distorted as indexed of network congestion. In paper [4] the main criteria was that the CR networks are envisioned to solve the problem of spectrum scarcity by making efficient and opportunistic use of frequencies reserved for the use of primary users of the bands. The main protest in CRAHNs is to combine these functions in the layers of the protocol stack. So that, the CR users can exchange information efficiently in a giveaway manner, over a multi-hop/multi-spectrum environment, without involving any infrastructure support. In paper [7] the main criteria of this transport protocol TP-CRAHN, combines as an end-to-end metric, the spectrum sensing and switching advantageousness in a CR network, apart from the classical cares of congestion control, flow control and losses of connection because of node mobility. Hence, by relying on updates from the intermediary nodes and the receiver feedback, the source maintains data about the state of the network and concerns frequently by adjusting its transmission rate. These papers do not give any details on the delay that occur in the mobility of switching and also the drawbacks of TCP NewReno is been modified. The radio behaviour and security threats in cognitive radio ad hoc networks are seen in order to set up successful CR networks and understand its goodness.

II TCP CRAHN

The frequent spectrum sensing, switching of channel functions, and the presence of the Licensed Users (LUs) awareness are few features which should be corporate into the design of protocol. Because of this reasons, the development of the protocol at the top layers of the CR ad hoc networks network stack, which involves in end-to end communication on multiple hops, is always in a promising stage. A friendly spectrum aware transport layer protocol for CR ad-hoc networks, called TCP CRAHN which differentiates in between the several spectrum concerned conditions which in order undertake dependent state recovery functions been put forwarded. At the same time as data transfer CSMA/CA at the Medium Access Control (MAC) layer which has a pre-determined Common Control Channel (CCC) for the arrangement of the spectrum channel and band. The priority queue, Qp for the TCP CRAHN control packets are used in the MAC layer, that may be taken out from intermediary positions in Qp.

CR network, nodes always maintain a series of vacancy channels that might belong to various spectrum bands. In our approach group of channels is detected through sensing of spectrum, which is undertaken by the abandon interval that follows the transmission of packet or receiving at the link layer. Above the specific channel of operation, an authentic idea of the LU activity is been done. Into this, we do not depend on probabilistic times of sensing. These are the states that are involved in TCP CRAHN.

- Connection establishment state
- Spectrum sensing state
- Normal state
- Spectrum change state
- Mobility predicted state
- Route failure state

A. Connection Establishment State

The three-way handshake process is been modified in TCP CRAHN in TCP newReno. The sender can receive schedules of the sensing nodes based on the routing path. Initially, the sender sends a Synchronization (SYNC) packet to the receiver. An intermediary node, say i, in the routing path notifies the following data to the SYNC packet: 1) it's ID, 2) a timestamp, and 3) the tuple. Before the node starts the time being left in the next round of spectrum sensing, are noted from the timestamp will be the consistent duration between two successive spectrum sensing events, and tsi is the time that take to complete the sensing in the current cycle. By receiving the SYNC packet, the destination sends a SYNC-ACK message to the sender. The information of sensing collects at each node is piggybacked over the SYN-ACK.

B. Spectrum Sensing State

Spectrum sensing which is been adapted in TCP CRAHN are propagated through 1) flow control that prevents overflow of buffer for the intermediary nodes meanwhile in sensing and 2) the regulation of sensing time which meet the correspond throughput gives the goal of TCP CRAHN to adapt the mechanism of flow control. TCP in which the prior node that is to the sensing node is not satisfied with the incoming of data packets. The another node j if it has an overlapping sensing of schedule nodes, TCP CRAHN is in use of residual buffer space of the before nod hop that is close to the sender as long as the overlap period, say i. During the completion of the sensing time of the closest node, the node's buffer space j is used in the ewnd calculations. The maximum number of bytes of unauthenticated information that allows at the source is the minimum of the specified congestion window, and the receiver window advertises the destination, rwind. The rwind denotes the vacant space in the receiver's buffer which can accommodate addition of transmitted packets. As long as the duration of sensing, no ACKs were received by the sender and therefore the rwind remains the same.

C. Normal State

TCP CRAHN's normal state is the default state and it look likes the classical working of the classical TCP new Reno protocol. This protocol propagates this state under the conditions 1) no node should be currently engaged in spectrum sensing, 2) no connection breaks because of LU arrivals, and 3) no approaching route failure should be signalled. Hence, the path to the receiver remains connected and ACKs sent by the last are received at the sender. Feedback through the ACK between the intermediary node of the path are piggybacked the following link-layer data over the data packets to the receiver, that is then sent to the sender through ack's.

D. Spectrum Change State

The effective bandwidth of the TCP connection depends on several factors like contention delays and channel errors in the link layer, without including the raw channel bandwidth. This section, we deliver how TCP CRAHN scales its cwnd in fast manner, say from point B to a different value B'. It also sends back a link layer ACK to node i to render the information of the node of its own choice. All the combination up to this mark always occurs on the previous channel. The next set of Probe and ACK details are then interchanged on the channel that is to be switched, a confirmation and also to analyse the new link delay times of the transmission.

E. Mobility Predicted State

To notify the reasons of route failure notification mobility concluded outwork based on Kalman filter-based estimation uses the Received Signal Strength (RSS) information in the link layer. The set of Kalman equations which is similar to the relocation are used in calculating sensor location. For a simple manner in scalar case, a homo dimension of the received power value is noted. The path nodes watch the connectivity to their upcoming hop downstream node with the measurement of the RSS of the ACKs and the frequent beacon messages. At each era, the prediction value is been compared with the lowest RSS required for receiver's operation. If the condition of possible link failure is found out in the next era, the receiver is informed, and then it sets the Mobility Flag (MF) in the outgoing ACKs. The sender acts to this by restricting the cwnd to the ssthresh and the congestion avoidance phase is not started. The goal of this adjustment, cwnd _ ssthresh, is to restrict the number of packets fused into the route that has a possibility in outage, as the CR concerned function of the nodes that may delay the arrival of the exact link failure notification. If there is no ICMP message is been received at the sender side finally, signalling a route failure has indeed done or the incoming ACKs does not have the MF flag sent, the mobility prediction state is neglected and TCP CRAHN go back to the state.

F. Route Failure State

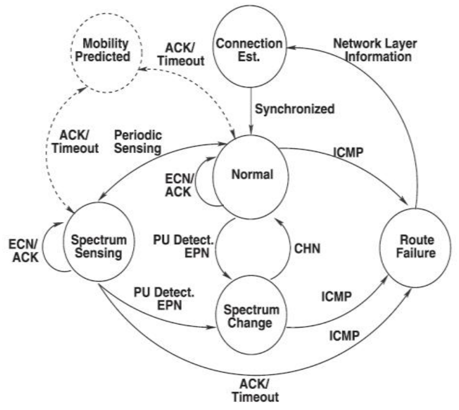
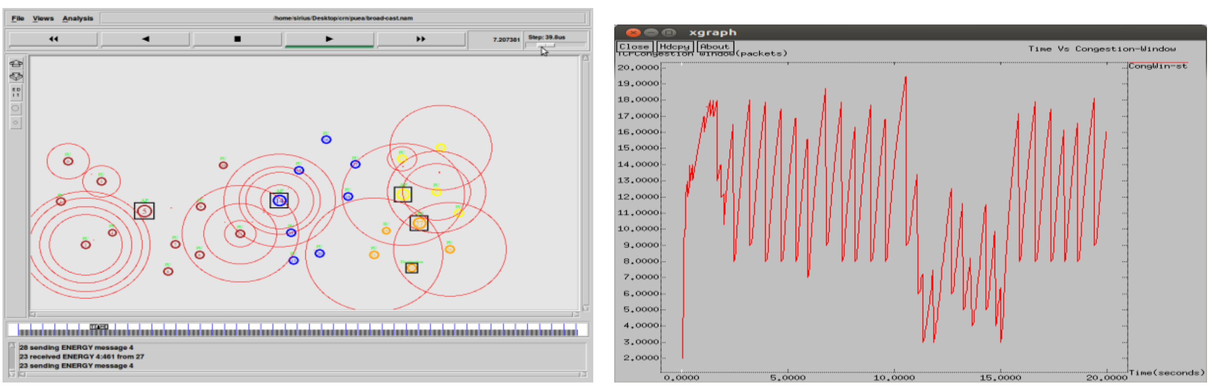


FIG. 1 MODEL OF TCP CRAHH

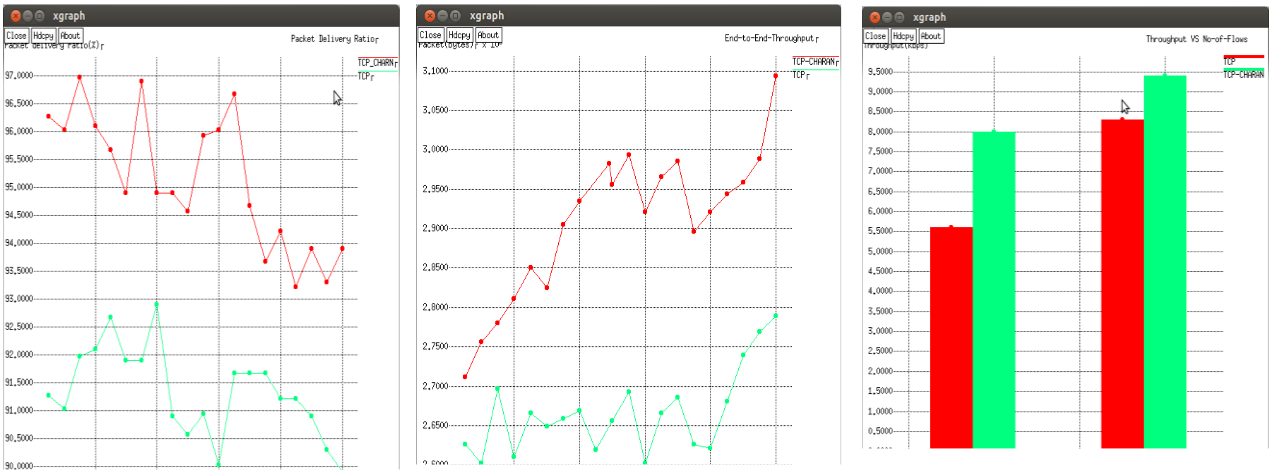
The node i sends a receiver unreachable message in the form of an ICMP packet if 1) the next hop node i-1 is not reachable based on link layer retries, 2) there is no ongoing spectrum sensing which is based on the last known schedule, and 3) no EPN message is received at node i signalling a temporary path disconnection due to LU activity. At this stage, the source stops transmission and a new connection needs to be formed over the fresh route by TCP CRAHN.

III SIMULATION RESULTS



(a) (b)

Fig 2. (a).Transmission and Reception of energy messages: Sending energy messages to the required nodes (b).Time Vs Congestion Window: Variation of the congestion window with time



(a) (b) (c)

Fig.3 (a) Packet Delivery Ratio Vs Time: Both the throughputs of TCP CRAHN and TCP have been compared. Figure (b) End-End Throughput Vs Time: The effect of dynamically changing the duration on throughput is shown for TCP and TCP CRAHN. Figure (c) Throughput Vs No. of Flows: The upper bound on the TCP CRAHN and TCP throughput is shown as a function of varying length.

IV. CONCLUSION

There by TCP CRAHN a friendly protocol incorporated with the spectrum awareness technique and an efficient throughput is been stimulated. Even though the throughput is higher it suffers lot in the security threats. Key depletion attack is the main attack in TCP CRAHN. These attacks are overcome by the security mechanisms by involving really simple syndication and round trip time. By analysing the frequent retransmission and notifying the really simple syndication this attack can be reduced.
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REFERENCES

[1] A. Capone, L. Fratta, and F. Martignon (2004), "Bandwidth Estimation Schemes for TCP over Wireless Networks," IEEE Trans. MobileComputing, vol. 3, no. 2, pp. 129-143.

[2] A.O. Bicen and O.B. Akan (2011), "Reliability and Congestion Control in Cognitive Radio Sensor Networks," Ad Hoc Networks J., vol. 9, no. 7, pp. 1154-1164, Elsevier.

[3] G. Holland and N.H. Vaidya (1999), "Analysis of TCP Performance over Mobile Ad Hoc Networks," Proc. ACM MobiCom, pp. 219-230.

[4] I.F. Akyildiz, W.Y. Lee, and K. Chowdhury (2009), "CRAHNs: Cognitive Radio Ad Hoc Networks," Ad Hoc Networks J., vol. 7, no. 2, pp. 810-836, Elsevier.

[5] J. Liu and S. Singh (2001), "ATCP: TCP for Mobile Ad Hoc Networks," IEEE J. Selected Areas of Comm., vol. 19, no. 7, pp. 1300-1315.

[6] K. Chen, Y. Xue, and K. Nahrstedt (2003), "On Setting TCP's Congestion Window Limit in Mobile Ad Hoc Networks," Proc. IEEE Int'l Conf. Comm. (ICC), pp. 1080-1084.

[7] K.R. Chowdhury, M. Di Felice, and I.F. Akyildiz (2009), "TP-CRAHN: A Transport Protocol for Cognitive Radio Ad Hoc Networks," Proc. IEEE INFOCOM, pp. 2482-2491.

[8] L. Brakmo and L. Peterson (1995), "TCP Vegas: End to End Congestion Avoidance on a Global Internet," IEEE J. Selected Areas in Comm. vol. 13, no. 8, pp. 1465-1480.

[9] M. Di Felice, K. Chowdhury, W. Kim, A. Kassler, and L. Bononi (2011), "End-to-End Protocols for Cognitive Radio Ad Hoc Networks: An Evaluation Study," Performance Evaluation, vol. 68, no. 9, pp. 859- 875.

[10] M. Di Felice, K.R. Chowdhury, and L. Bononi (2009), "Modeling and Performance Evaluation of Transmission Control Protocol over Cognitive Radio Ad Hoc Networks," Proc. 12th ACM Int'l Conf. Modeling, Analysis and Simulation of Wireless and Mobile (MSWIM '09), pp. 4-12.

[11] S. Floyd and T. Henderson (1999), The NewReno Modification to TCP's Fast Recovery Algorithm, IETF RFC 2582.

[12] S.M. Kay (1993), Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice -Hall.

[13] T. Dyer and R. Boppana (2001), "A Comparision of TCP Performance over Three Routing Protocols for Mobile Ad Hoc Networks," Proc. ACM MobiHoc, pp. 256-266.

[14] W.Y. Lee and I.F. Akyildiz (2008), "Optimal Spectrum Sensing Framework for Cognitive Radio Networks," IEEE Trans. Wireless Comm., vol. 7, no. 10, pp. 3845-3857.

[15] Y.R. Kondareddy and P. Agrawal (2009), "Effect of Dynamic Spectrum Access on Transport Control Protocol Performance," Proc. IEEE GlobeCom, pp. 1-6.