

A QoS Based Stable Routing Protocol for Multihop Cognitive Radio Adhoc Networks

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Abstract: Recent advances in wireless sensor networks have led to many new protocols specifically designed for sensor networks where energy awareness is an essential consideration. Most of the attention, however, has been given to the routing protocols since they might differ depending on the application and network architecture. However, in cognitive radio (CR) ad hoc networks, unlicensed users may observe heterogeneous spectrum availability, which is unknown to other unlicensed users before the control information was broadcast. Transmission of video and imaging data requires both energy and QoS aware routing in order to ensure efficient usage of the sensors and effective access to the gathered measurements. In this paper, we propose an energy-aware QoS routing protocol for sensor networks which can also run efficiently with best-effort traffic. Moreover, the throughput for non-real-time data is maximized by adjusting the service rate for both real-time and non-real-time data at the sensor nodes. Simulation results have demonstrated the effectiveness of our approach for different metrics.

Keywords: Broadcast protocol, cognitive radio (CR), multihop communications, quality-of-service (QoS).

I. INTRODUCTION

Recent advances in miniaturization and low-power design have led to active research in large-scale, highly distributed systems of small-size, wireless unattended sensors. Each sensor is capable of detecting ambient conditions such as temperature, sound, or the presence of certain objects. For the improvement of modern and advanced technological world, the computers are contributed more optimality and ease of implementation. Especially the computer networks provide more dominant and powerful way for resource sharing and data transmission. The computer network starts with wired technologies and spreads its wings using wireless components and now it advanced using sensor elements.

Wireless sensor networks (WSNs) are deployed to an area of interest to sense phenomena. Wireless sensor network is a type of ad-hoc networks

that has the ability of sensing A number of multichannel MAC protocols compares through analysis and simulation. The process starts with classification of protocol into four categories based on their principles of operation: Dedicated Control Channel, Common Hopping, Split Phase and Parallel Rendezvous protocols. Then examine the effects of the number of channels and devices, channel switching times, and traffic patterns on the throughput and delay of the protocols [1]. The results show that our distributed resource-management approach improves the peak signal-to-noise ratio (PSNR) of multiple video streams by more than 3 dB, as opposed to the state-of-the-art dynamic frequency channel/route selection approaches without learning capability, when the network resources are limited. The information horizon is assumed to be fixed in this paper for different priority classes over the whole wireless networks [2]. This paper examines how cognitive radios initially find one another among the expanse of ever-changing open spectrum, termed the rendezvous problem. Specifically, it addresses the problem of rendezvous under varying levels of system capabilities, spectrum policies, and environmental conditions. The focus is on rendezvous when there are no control channels or centralized controllers, which we term the blind rendezvous problem [3].

The goal of this system is to minimize the required network-wide resource to support a set of multicast sessions, with a given bit rate requirement for each multicast session is studied. The unique characteristics and complexity associated with CR distinguish this problem from existing multicast problems for adhoc networks [3].

Based on simulation results, the proposed algorithm offers competitive solutions are demonstrated. The solution in this paper is centralized and can be used as a performance benchmark for any distributed solution to this problem. A distributed solution will be studied separately in our future work [4].

Typically, control messages are broadcasted on a preassigned common control channel, which can be realized as a separate frequency band in multichannel systems, a given time slot in TDMA systems, or a frequency hopping sequence (or CDMA code) in spread spectrum systems. However, a static control channel allocation is contrary to the opportunistic access paradigm. Since both problems are known to be NP-complete, two greedy heuristics for finding bicliques that satisfy our requirements. Further a control channel rotation mechanism that enables control channel migration in case of PR activity, intercluster communication, and adaptation to the temporal variations of spectrum availability [5].

Due to the randomness of the appearance of licensed users, disruptions to both licensed and unlicensed communications are often difficult to prevent, which may lead to low throughput of both licensed and unlicensed communications. In this paper, a proactive spectrum handoff framework for CR ad hoc networks, ProSpect, is proposed to address these concerns [6]. Furthermore, our distributed channel selection can achieve higher packet delivery rate in a multiuser spectrum handoff scenario, compared with existing channel selection schemes. Simulation results show that network coordination is crucial to the performance of spectrum handoffs. Performance results also indicate that our proposed channel selection scheme outperforms the existing methods in terms of higher throughput and shorter handoff delay in multi-SU scenarios [7].

Broadcast is an important operation in wireless ad hoc networks, in which control information is usually propagated as broadcasts for the realization of most networking protocols. In traditional ad hoc networks, since the spectrum availability is uniform, broadcasts are delivered via a common channel which can be heard by all users in a network. However, in cognitive radio (CR) ad hoc networks, different unlicensed users may acquire different available channel sets. This non-uniform spectrum availability imposes special design challenges for broadcasting in CR ad hoc networks. A fully-distributed Broadcast protocol in multi-hop Cognitive Radio ad hoc networks with collision avoidance, BRACER, is proposed [8]. By intelligently downsizing the original available channel set and designing the broadcasting sequences and scheduling schemes, our proposed broadcast protocol can provide very high successful broadcast ratio while achieving very short average broadcast delay. It can also avoid broadcast collisions. Simulation results show that our proposed BRACER protocol outperforms other possible broadcast

schemes in terms of higher successful broadcast ratio and shorter average broadcast delay [9].

II. PROPOSED METHOD

Ad hoc On-Demand Distance Vector Routing (AODV)

AODV is an on-Demand routing protocol which is confluence of DSDV and DSR. Route is calculated on demand, just as it is in DSR via route discovery process. However, AODV maintains a routing table where it maintains one entry per destination unlike the DSR that maintains multiple route cache entries for each destination. AODV provides loop free routes while repairing link breakages but unlike DSDV, it doesn't require global periodic routing advertisements.

Multicast Routing

One of the great advantages of AODV is its integrated multicast routing. In a multicast routing table the IP address and the sequence number of the group are stored. Also the leaders IP address and the hop count to him are stored as well as the next hop in the multicasting tree and the lifetime of it.

To join a multicast group a node has to send an RREQ to the group address with the join flag set. Any node in the multicast tree which receives the RREQ can answer with a RREP. Like this a requester could receive several RREP from which he can choose the one with the shortest distance to the group. A MACT (Multicast Activation) Message is send to the chosen tree node to activate this branch. If a requester does not receive a RREP, the node supposes that there exists no multicast tree for this group in this network segment and it becomes the group leader. A multicast RREP contains additional the IP of the group leader and the hop count to the next group member. The group leader broadcasts periodically a group hello message (a RREP) and increments each time the sequence number of the group.

Load balancing

As stated in one of the reasons for which classical multipath routing has been explored is to provide load balancing. Load balancing can be achieved by splitting the traffic across multiple paths. This use of multipath routing is applicable to WSNs. Load balancing can spread energy utilization across nodes in the sensor network, potentially resulting in longer lifetimes. Furthermore, load balancing helps in avoiding congestion and bottleneck problems.

Reliability and fault tolerance

Reliability means that the probability that a message generated at one place in the network can actually routed to the intended destination. Reliability is a big issue in WSNs, because data transmission is subject to lost due to several reasons: various kinds of interference, media access conflicts, network topology changes, etc. These reasons affect the wireless radios to correctly decode the wireless signals.

One of the reasons behind developing multipath routing is to provide route failure protection, and increase resiliency to route failures. Discovering and maintaining multiple paths between the source destination pair improves the routing performance by providing alternative routes. When the primary path fails, an alternative path will be used to transfer the data.

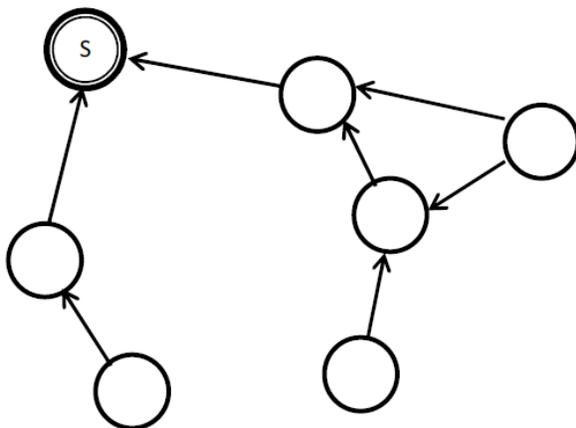


Fig 1. Multi path communication in WSN, in which the S represents Sink

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Energy aware routing

In the proposed process to use a set of sub-optimal paths occasionally to increase the lifetime of the network. These paths are chosen by means of a probability function, which depends on the energy consumption of each path. Network survivability is the main metric that the approach is concerned with. The approach argues that using the minimum energy path all the time will deplete the energy of nodes on that path. Instead, one of the multiple paths is used with a certain probability so that the whole network lifetime increases. The protocol assumes that each node is addressable through a class-based addressing which includes the location and types of the nodes. There are 3 phases in the protocol:

Setup phase:

Localized flooding occurs to find the routes and create the routing tables. While doing this, the total energy cost is calculated in each node. For instance, if the request is sent from node N_i to node N_j , N_j calculates the cost of the path as follows:

$$CN_j, N_i = \text{Cost}(N_i) + \text{Metric}(N_j, N_i) \quad (1)$$

Here, the energy metric used captures transmission and reception costs along with the residual energy of the nodes.

Paths that have a very high cost are discarded. The node selection is done according to closeness to the destination. The node assigns a probability to each of its neighbors in routing (forwarding) table (FT) corresponding to the formed paths. The probability is inversely proportional to the cost, that is:

N_j then calculates the average cost for reaching the destination using the neighbors in the forwarding table (FT_j) using the formula:

This average cost for N_j is set in the cost field of the request and forwarded.

Data Communication Phase

Each node forwards the packet by randomly choosing a node from its forwarding table using the probabilities.

Route maintenance phase

Localized flooding is performed infrequently to keep all the paths alive. The described approach is similar to Directed Diffusion in the way potential paths from data sources to the sink are discovered. In Directed Diffusion, data is sent through multiple paths, one of them being reinforced to send at higher rates. On the other hand, Shah et al. select a single path randomly from the multiple alternatives in order to save energy. Therefore, when compared to Directed Diffusion, it provides an overall improvement of 21.5% energy saving and a 44% increase in network lifetime.

However, such single path usage hinders the ability of recovering from a node or path failure as opposed to Directed Diffusion. In addition, the approach requires gathering the location information and setting up the addressing mechanism for the nodes, which complicate route setup compared to the Directed Diffusion.

Energy-aware QoS Routing

End-to-end delay requirements are associated only with the real-time data. Note that, in this case we have both real-time and non-real-time traffic coexisting in the network, which makes the problem more complex. We not only should find paths that

meet the requirements for real-time traffic, but need to maximize the throughput for non-real time traffic as well.

This is because most of the critical applications such as battlefield surveillance have to receive for instance acoustic data regularly in order not to miss targets. Therefore it is important to prevent the real-time traffic from consuming the bulk of network bandwidth and leave non-real-time data starving and thus incurring large amount of delay.

Experimental Results

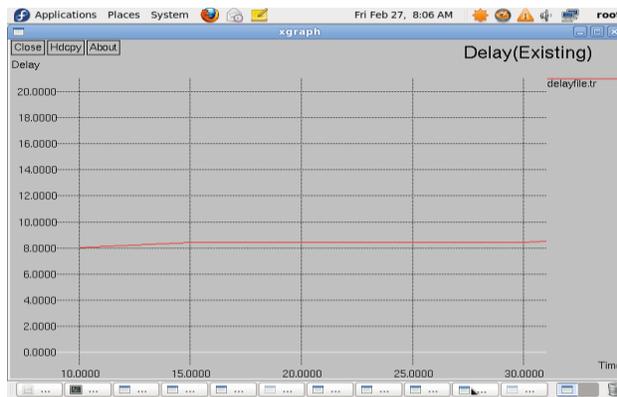


Fig .2 Existing Delay Output

In order to see how the algorithm behaves under stringent conditions, we varied the end-to-end delay and monitored how this change affects the network r -value. The results are depicted in Fig. 5. The network r -value goes down while the end-to-end delay requirement gets looser. Since the delay is not too strict, most of the nodes will be able to find a QoS path.

On the other hand, while we congest the network with more real-time data packets by increasing the real-time data generation rate, more bandwidth will be required for real-time packets.

This will cause the r -value to increase so that each node can serve more real-time packets.

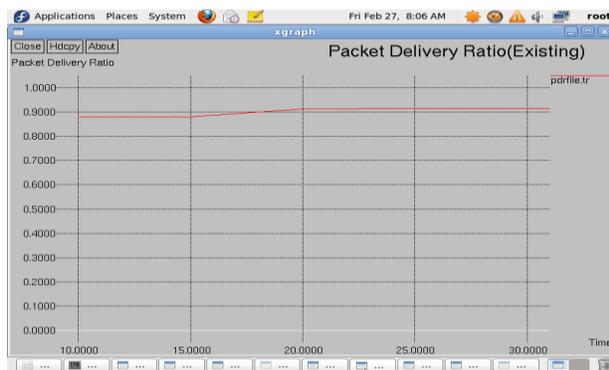


Fig .3 Packet Delivery Ratio

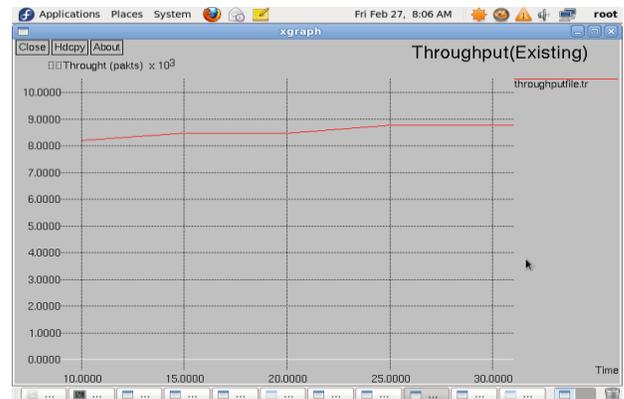


Fig .4 Throughput Output

Multicast using AODV follows directly from the Route request Route Reply message cycle and requires only one additional message type the Multicast Validation Message Nodes in the network that are members of the same multicast group together with the nodes used as routers to connect group members form a bidirectional multicast tree across which multicast data packets are relayed.

V.RESULTS AND DISCUSSIONS



Fig .5 Proposed Delay Output

In order to verify that the next hop is receiving data packets, local connectivity must be monitored. Notification of the inability to send data packets to a neighbour is needed to promptly notify the source that a path is broken; otherwise, the source continues to send data packets, wasting resources. The AODV routing protocol uses RERR messages to notify the source and all nodes on the route to the source of the broken link.

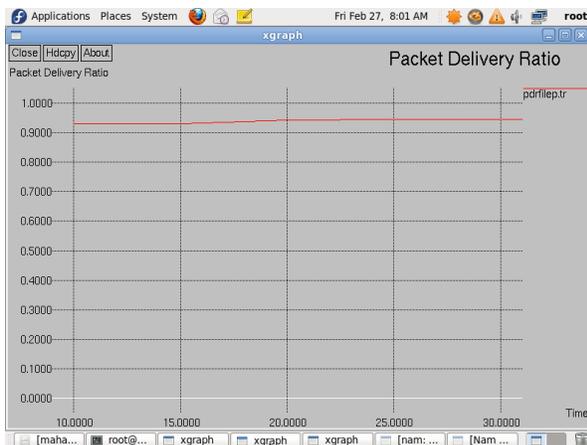


Fig 7. Simulated Packet Delivery Ratio



Fig 7. show the performance of the Throughput Output

VI. CONCLUSION

We first identified the unsupported events needed for AODV to perform routing. We then examined the advantages and disadvantages of three strategies for determining this information. This analysis supported our decision to use small kernel modules with a ser-space daemon. Finally, we presented the design of many publicly available AODV implementations. We hope that the information in this paper aids researchers in understanding the trade-offs in ad hoc routing protocol implementation development.

Further, the description of the design structure and additional features of each implementation can assist users in deciding which implementation best their needs.

References

[1] Y. Song and J. Xie, "BRACER: A distributed broadcast protocol in multihop cognitive radio ad hoc networks with collision avoidance," *IEEE Trans. Mobile Computing*, 2013.

[2] Y. Song and J. Xie, "ProSpect: A proactive spectrum handoff framework for cognitive radio ad hoc networks without common control channel," *IEEE Trans. Mobile Comput.*, vol. 11, no. 7, pp. 1127–1139, Jul. 7, 2012.

[3] Y. Song and J. Xie, "Performance analysis of spectrum handoff for cognitive radio ad hoc networks without common control channel under homogeneous primary traffic," in *Proc. IEEE INFOCOM*, 2011, pp. 3011–3019.

[4] SY. Song and J. Xie, "A distributed broadcast protocol in multi-hop cognitive radio ad hoc networks without a common control channel," in *Proc. IEEE INFOCOM*, 2012, pp. 2273–2281.

[5] C. Gao, Y. Shi, Y. T. Hou, H. D. Sherali, and H. Zhou, "Multicast communications in multi-hop cognitive radio networks," *IEEE J. Sel. Areas Commun.*, vol. 29, no. 4, pp. 784–793, Apr. 2011.

[6] Z. Lin, H. Liu, X. Chu, and Y.-W. Leung, "Jump-stay based channel hopping algorithm with guaranteed rendezvous for cognitive radio networks," in *Proc. IEEE INFOCOM*, 2011, pp. 2444–2452.

[7] C. Cormio and K. R. Chowdhury, "Common control channel design for cognitive radio wireless ad hoc networks using adaptive frequency hopping," *Ad Hoc Netw.*, vol. 8, no. 4, pp. 430–438, Jun. 2010.

[8] Y. Song, J. Xie, and X. Wang, "A novel unified analytical model for broadcast protocols in multi-hop cognitive radio ad hoc networks," *IEEE Trans. Mobile Comput.*, 2013.

[9] R. Gandhi, A. Mishra, and S. Parthasarathy, "Minimizing broadcast latency and redundancy in ad hoc networks," *IEEE/ACM Trans. Networking*, vol. 16, no. 4, pp. 840–851, Aug. 2008.