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A Survey on Opportunistic Routing Protocols

R. Logesh babu, Dr. P. Balasubramanie

Assistant Professor, Dept. of CSE, Surya Engineering College, Perundurai Road, Erode, Tamil Nadu, India

Professor, Dept. of CSE, Kongu Engineering College (Autonomous), Perundurai, Erode, Tamil Nadu, India

ABSTRACT: Opportunistic routing (OR) is a recent routing technique for wireless multihop networks. It exploits the broadcast nature of wireless medium which is not utilized by traditional routing. The important features of OR is selection of forwarding nodes and co-ordination among the nodes to deliver the packets to their destination. Therefore, OR works well in wireless multihop networks with higher node density such as mesh or sensor networks. OR enables multiple paths and dynamic relay selection, thus it obtains higher link reliability and larger transmission range. This paper reviews some of the OR protocols.

KEYWORDS: Wireless Networks, Mobile ad hoc networks, Opportunistic routing.

I. INTRODUCTION

Instead of (pre) selecting a specified relay node at each transmission, OR broadcasts a data packet to a set of relay candidates. Then, relay candidates, who have successfully received the data packet, run a coordination protocol to select the best relay to forward the packet. In other words, OR is conceptually composed of these three steps:

(a) Broadcast a data packet to relay candidates.
(b) Select the best relay by using a coordination protocol.
(c) Forward the data packet.

Opportunistic routing has the following advantages:

(a) Increase reliability

OR transmits a packet through any possible link rather than one specified link. In other words like OR has additional backup links and the probability of transmission failure is reduced. An experiment in [3] has also shown that OR outperforms traditional routing when loss rates of links are high.

(b) Increase transmission range

OR considers all possible links, including good quality short-ranged links and poor quality long-ranged links, within one transmission; therefore, a transmission may directly jump to the farthest relay which successfully receives the packet. Consequently, performance can be improved. Both theoretical analysis and experiment results have shown that OR has the potential to perform better than traditional routing.

Selection diversity

Compared to traditional routing, one major characteristic of OR is that the next relay is selected dynamically from multiple relay candidates. Another group of routing schemes, called selection diversity, also selects the next relay dynamically; however, these schemes dynamically select one relay from candidates first. Then, the data packet is sent by unicast to the selected relay. Therefore, like traditional routing, these schemes do not utilize overheard packets.

In [7], multiuser diversity forwarding (MDF) is proposed to select the next relay according to current link conditions. Before each transmission, a probe is first sent (broadcast) to relay candidates. A candidate can then determine the current link quality according to the received probe and responds with a probe reply accordingly. Based on the replies

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from candidates, the sender then selects one relay with the best quality. The objective of these selection diversity schemes is to select the next relay according to current conditions. Though these schemes also have multiple relay candidates like OR, they are not opportunistic in nature.

Multiple relay candidates and the timing of relay selection are the two main differences between traditional routing, selection diversity and OR. OR selects the next relay from multiple candidates after data transmission, i.e. a data packet is broadcast to all candidates; therefore, among the three approaches, only OR utilizes overheard data packets.

II. LITERATURE SURVEY

Sanjit Biswas and Robert Mooris [1] proposed ExOR, which differs from traditional routing that it does not use predetermined path for sending packets. Instead it uses broadcast nature of Wireless networks to forward packets through the network. It broadcasts all the packets to the nodes in the network. ExOR uses a potential forwarders list to reach the destination. Upon reception each nodes will check the list available in the header and forwards it. Likewise 90% of the packets will be delivered to the destination; the remaining 10% of the packets will be delivered using traditional unicast routing. Experiment results shows that ExOR throughput performance is (2x) times than traditional routing.

Anatollij zubow et al proposed [2] MCExOR which is a Multi channel protocol and extends ExOR by utilizing multiple RF channels in multi hop wireless networks. Large numbers of transmissions per end-to-end delivery combined with interference are the main reasons for the low capacity of multi-hop networks. It reduces the number of transmissions by opportunistically skipping nodes in a packet's forwarding path. MCExOR needs one RF transceiver per device and selection of RF channels is independent of the routing function. The simulation results show that it outperforms AODV.

Eric Rozner et al proposed SOAR[3] which is a proactive Link state routing protocol. It achieves good results than ExOR by effectively utilizing the following components: adaptive forwarding path to avoid duplicate transmissions, priority based timers, Local loss recovery scheme and adaptive rate control. SOAR effectively supports multiple simultaneous flows by improving both goodput and fairness.

Jie Wu et al proposed OPRenu[4] which uses the optimality of OR for a utility based routing. Previous OR protocols does not consider the optimality for end to end performance because it assumes that retransmissions are countless. This protocol proposes both optimal and heuristics solutions to select relays and priorities among them, and implement both solutions in a distributed way. The OpRENU has better performance compared with three other metrics (i.e) minimum hop count, lowest cost and highest reliability.

Yuan yuan et al proposed ROMER[5] which is designed to achieve the following as goals to reduce routing update overhead, resilience against link's loss/failure and improving throughput. The above goals are achieved by reducing routing updates thru building runtime mesh on the fly, improving throughput by exploiting instantaneous channel variations and Randomized forwarding by exploiting different data rate and loss rate.

Kurth et al proposed TDiCOR [6] which is called as Transmit diversity based co-operative opportunistic routing that efficiently exploits multiuser and transmit diversity to improve the overall throughput in wirless multi hop networks. It uses distributed transmit diversity to increase the robustness of acknowledgements as well as data transmissions while preserving the opportunistic nature by using multiple candidates for packet relaying. TDiCOR outperforms traditional routing (i.e. DSR) in typical outdoor scenarios in terms of throughput by 30% and by 50% in indoor scenarios with high shadow fading, without consuming additional bandwidth or additional hardware resources.

Szymon Jakubczak et al proposed MORE[7] which uses network coding approach to opportunistic routing. The OR protocols exploits the broadcast nature of the wireless medium to increase throughput. The important of MORE is that through intermediate nodes forward packets they hear without consulting with each other, they do not generate spurious Transmissions. (i.e.) intermediate nodes forward random linear combinations of packets going to the same destination. This approach does not need any co-ordination among nodes and maximizes network throughput.

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Xinyu zhang and Bochum Li proposed OMNC[8] which stands for Optimized Multipath Network coding in Lossy Wireless Networks. It uses multiple paths to push coded packets to the destination and uses the broadcast MAC to deliver packets between neighboring nodes. The coding and broadcast rate is allocated to transmitters by a distributed optimization algorithm that maximizes the advantage of network coding while avoiding congestion. This protocol gives better results than MORE protocol.

Yunfeg Lin et al proposed CodeOR[9] which is appropriate for real-time multimedia applications through the use of a small segment size to decrease delay. By effectively utilizing the wirless broadcast medium Opportunistic routing improves unicast throughput. Network coding (NC) needs to perform segmented network coding, which partitions the data into multiple segments and encode only packets in the same segment. This CodeOR protocol uses network coding in Opportunistic routing to improve throughput.

Dimitrios koutsonikolas et al proposed[10] XCOR which integrates Interflow Network coding (NC) with Opportunistic routing. For the wireless mesh networks there are many protocols have been proposed so for, but the two important building blocks are Opportunistic routing and Network coding. Both the techniques exploiting the broadcast nature of the wireless medium. The experiment results are compared with SOAR (OR), COPE (NC) and Srcr(traditional routing) and shown that the added benefits from combining the two techniques.

Chen-Jung et al proposed ECONOMY[11], an Opportunistic Routing (OR) protocol that is free from duplicate transmission. OR utilizes overheard packets and takes multiple routes into consideration concurrently. ECONOMY uses token passing along a path that relays can hear one another to eliminate duplicate transmission. When a token arrives, the relay is allowed to transmit unacknowledged packets according to the acknowledgement information within the received token. ECONOMY prevents duplicate transmission while keeping the advantages of OR. Simulation results show that while previous OR schemes suffer from duplicate transmission, ECONOMY can exploit the potential of OR and perform up to 100% better than traditional routing.

Dimitrios koutsonikloas et al proposed CCACK[12] which is a NC based OR protocol. The NC based approach has attracted due to their minimal coordination overhead but they suffer performance degradation in dynamic wireless environments with continuously changing levels of channel gains, interference and background traffic. This scheme allows nodes to acknowledge network coded traffic to their upstream nodes in a simple way, oblivious to loss rates and with practically zero overhead. The experiment results show that compared to MORE this protocol improved throughput and fairness by up to 3.2x and 83% respectively for different number of concurrent flows.

III. CONCLUSION

Opportunistic routing is a promising technique for wireless multi hop networks. The key concepts behind OR is overhearing and co-operation among relaying nodes; therefore, OR works well in wireless multi hop networks with higher node density, such as mesh or sensor networks. OR enables multiple routes and dynamic relay selection, thus it obtains higher link reliability and Larger transmission range. This paper reviewed some of the OR routing protocols. There are certain issues still need to be solved in OR such as Candidate selection, Multi-glow rate control, power control with proper bit rate selection and Multi-channel scenario.

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