

Opportunistic Routing protocols in MANET - A Survey

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ABSTRACT: The key objective of routing protocols in Wireless Mobile Adhoc Networks is to discover optimal path based on highest routing progress. Most of the traditional routing protocols in Wireless Networks employs selection of one or more predetermined nodes before transmission of a packet to destination starts and uses a predetermined neighbor to forward a packet in each hop. The unreliable transmissions in traditional routing can be overcome by adopting Opportunistic routing. Opportunistic Routing (OR) increases the transmission reliability and network throughput. It takes advantage of the broadcast nature of wireless links for packet transmissions. By using Cooperative Opportunistic Routing in Mobile Ad hoc Networks (CORMAN) [2], the problem of opportunistic data transfer can be tackled. The first cooperation-optimal protocol for Multirate OR (COMO) [4] used to achieve social efficiency and prevent the selfish behavior of the nodes. The Context-aware OR (COR) [3] can provide efficient routing in mobile networks. VAPOR [5] further enhances Opportunistic Routing by identifying communication holes prior to transmission in sparse networks. ECORMAN [6] is an enhanced version of CORMAN which incorporates efficient channel reuse based MAC protocol.

KEYWORDS: Opportunistic routing; MANET; style; styling; insert (key words)

I. INTRODUCTION

A Mobile Ad hoc Network is a wireless communication network, where nodes that are not within direct transmission range of each other will require intermediate nodes to forward data. It is infrastructure less, supports mobile users, and falls under the group of multi-hop wireless networking. Such a networking paradigm originated from the needs in battle field communications, emergence operations, search and rescue, and disaster relief operations.

The two most important operations at the network layer, i.e., data forwarding and routing, are distinct concepts. Data forwarding regulates how packets are taken from one link and put on another. Routing determines which path a data packet should follow from the source node to the destination. Routing provides forwarding with control inputs. In traditional routing approaches, overhearing a packet not intended for the receiving node had been considered as completely negative, i.e., interference. Advancements in the field of routing in MANET was to make wireless links as good as wired ones. But most of it ignores the broadcast nature of wireless communication links. Opportunistic routing increases the transmission reliability and network throughput. The opportunistic routing overcomes the drawback of unreliable wireless transmission by broadcasting one transmission which can be overheard by manifold neighbours.

OR consists of a candidate set which is a group of nodes selected as the next-hop forwarders. Hence, each node in OR can use different potential paths to send packets toward the destination. Any of the candidates of a node that have received the transmitted packet may forward it. The decision of choosing the next forwarder is made by coordination between candidates that have successfully received the transmitted packet. Only the one that is closest to the destination will perform the forwarding while the rest will simply drop the packet even if they have successfully received it. Thus, opportunistic routing takes advantage of the numerous, yet unreliable wireless links in the network when they actually deliver. Whereas traditional routing in wireless networks only targets a packet to the preselected next-hop forwarder, which is the node on a preselected path towards the destination of the packet. In OR, the transmission reliability and network throughput can be increased by using a dynamic relay node to forward the packet. Examples of Opportunistic routing include Extremely Opportunistic Routing (ExOR) [7], Cooperative Opportunistic Routing in MANET(CORMAN), Position based Opportunistic Routing (POR), Link Correlation Aware Opportunistic Routing,

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Context-aware OR (COR), Context aware Adaptive OR (CAOR), Cooperation-Optimal protocol for Multirate OR (COMO), Void Aware Position based Opportunistic Routing(VAPOR), Extended CORMAN etc.

II. OPPORTUNISTIC ROUTING PROTOCOLS

A. CORMAN

CORMAN forwards data in a similar batch-operated fashion as ExOR. A flow of data packets are divided into batches. All packets in the same batch carry the same forwarder list when they leave the source node. To support CORMAN, an underlying routing protocol, Proactive Source Routing (PSR) is used, which provides each node with the complete routing information to all other nodes in the network. Thus, the forwarder list contains the identities of the nodes on the path from the source node to the destination. As packets progress in the network, the nodes listed as forwarders can modify the forwarder list if any topology change has been observed in the network. This is referred to as large-scale live update. In addition, non-forwarders are allowed to retransmit data, referred to as small-scale retransmission.

CORMAN is shown to have superior performance measured in PDR, delay, and delay jitter. The challenges faced by CORMAN include :

- 1) Overhead in route calculation - a lightweight solution is needed to reduce the overhead in route calculation.
- 2) Forwarder list adaptation - intermediate nodes should have the ability to update the forwarder list adaptively with their new knowledge when forwarding data packets and
- 3) Robustness against link quality variation. These challenges are solved using Proactive Source Routing, large-scale live update and small-scale retransmissions.

B. COMO

The first Cooperation-Optimal protocol for Multi-rate Opportunistic routing and forwarding achieves the social efficiency. The probe messages are incorporated with a cryptographic component to measure the link loss probability. When session starts from source to destination, the source node and the intermediate node sends the probe message. Each intermediate node and the destination node report the received probe messages to the source node. From this probe messages, the source node calculates the link loss probabilities. By comparing the two types of node behaviour such as following and deviating, we can identify the selfish behaviour of the nodes. In following, each node will follow the protocol. In deviating, the selfish node may send the incorrect number of probe messages or it will report only the part of probe messages while measuring the link loss probability.

C. COR

List-based OR feature restrict the freedom of opportunism, since only the listed nodes can compete for packet forwarding. Also the list is statically generated based on a single metric prior to data transmission, which is not appropriate for mobile ad-hoc net-works. The contributions of COR are threefold. First, it uses various types of context information simultaneously such as link quality, geographic progress, and residual energy of nodes to make routing decisions. Second, it allows all qualified nodes to participate in packet forwarding. Third, it exploits the relative mobility of nodes to further improve performance. COR adopts a Beacon Less Routing protocol (BLR) and context aware routing uses multiple context criteria such as link quality, geographic progress, and residual energy of nodes to make routing decisions in order to improve routing performance. Here Forwarding candidates separately calculate a delay timer based on their local observations of the interested context called Dynamic Forwarding Delay (DFD). The node with the shortest DFD is selected as the next relay node and forwards the packets first. The re-broadcasted packet is used as a passive acknowledgement by which the sender knows about the next hop. Thus the sender sends the remaining packets to the selected hop. The duplicates generated during next hop selection are reduced by a notification sent by the sender on receiving a packet by rebroadcasting a message including the sequence number of the received packet.

D. VAPOR

VAPOR is a high performance Protocol that takes into account the dynamic and sparse network topology of MANETs. It enhances the throughput and reliability and provides QoS routing by exploiting the broadcast nature of the wireless

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medium. In dense networks topology it uses 1-hop routing information to take routing decision, but in sparse network topology, 2-hop information is used to detect communication holes in advance. Initially the source node broadcasts the data packets to all candidate forwarders in a single transmission using a MAC. The forwarders are prioritized based on the forwarding probability which is determined using two factors: forwarding score and the connectivity factor. After selecting the best forwarder other forwarding candidates await at the end of the batch to receive all the data packets. The batch map marks all the packets transmitted by the best forwarder and attaches this information to each data packet. The packets unmarked in the batch map are transmitted by the next priority candidates in order, con-currently the subsequent batch of packets is transmitted through the best forwarder selected from the current 2-hop forwarding set. Thus it increases the reliability and the throughput.

E. ECORMAN

ECORMAN is a combination of CORMAN and efficient channel reuse based MAC protocol. It was developed to eliminate the constraint of CORMAN that it uses existing inefficient channel reuse technique by adding a new ECORMAN MAC protocol and use it with CORMAN routing protocol. The new MAC method has functionality of dual sensing strategies in order to identify deafness, avoid unnecessary blocking as well as resolve the problem of hidden terminal. This suggested method is having two wireless channels such as control channel and data channel. The Data channel is utilized for transmitting data, whereas control channel is utilized for controlling the busy tone signal.

Algorithm: Dual Sensing Using Directional Antenna

Initializations:

1. Control Channel - DRTS - DCTS - DDATA - DACK
2. Data Channel - CTS - RTS - ACK - DATA

Step 1: If the packet received channel sends DRTS packets in the required direction and busy tone signal BT1 in other directions.

Step 2: if (sense (node) = BT1)
postpone (DRTS)

else
send (DRTS)

end

Step 3: DRTS receiving node responding to destination node after a period of SIFS with DCTS packet in the required direction.

Step 4: BT2 signal set ON in all directions.

Step 5: if node received data packet, destination node sends DACK packet in the same direction.

Step 6: Busy tone signal BT2 is then set OFF.

Step 7: Stop

The purpose of this algorithm is to execute an efficient

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III. CONCLUSION

Various Opportunistic Routing protocols have been studied and analyzed. Opportunistic routing increases the reliability and throughput by using the source routing protocol. It is found that ECORMAN and VAPOR have higher performance in terms of efficiency and throughput.

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TABLE I. COMPARISON OF OPPORTUNISTIC ROUTING PROTOCOLS

Protocol	Properties			
CORMAN	PSR	Packet delay ratio, delay, delay jitter	Higher performance than ExOR	Opportunistic data transfer
COR	Beaconless based, geographic routing	Packet delay ratio	40% throughput higher than traditional routing	No reliability
COMO	Multirate opportunistic routing	Node utility and end-to-end throughput	Achieves efficiency	Selfish behavior of nodes
VAPOR	Void aware routing	Throughput, reliability and overhead of VAPOR	Superior Qos in sparse and dense network	Communication holes
ECORMAN	PSR	Packet delay ratio, delay	Efficient channel reuse than CORMAN	No channel reuse