A Survey on Link Correlation Aware Opportunistic Routing in Wireless Network

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ABSTRACT
Recent empirical studies have shown clear evidence that wireless links are not independent and that the packet receptions on adjacent wireless links are correlated. This finding contradicts the widely held link-independence assumption in the calculation of the core metric, i.e., the expected number of transmissions to the candidate forwarder set, in opportunistic routing (OR). The inappropriate assumption may cause serious estimation errors in the forwarder set selection, which further leads to underutilized diversity benefits or extra scheduling costs. we propose a novel link-correlation-aware OR scheme, which significantly improves the performance by exploiting the diverse low correlated forwarding links basis on various matrices such as link energy no of hope etc. We evaluate the design in ns2-network simulation tool by varying no of nodes. Target of our work is develop a algorithm to find better correlated link.

Keywords- OR, Cooperative Communication.

INTRODUCTION

Multi-hop wireless networks typically use routing techniques similar to those found in wirednetworks. A routing protocol chooses a path of nodes between the sourceand destination, and each packet is forwarded along the path through one node at a time.Cooperative diversity schemes proposed by the information theory community suggestan alternate approach that may yield higher throughput. Cooperative diversity takes advantageof broadcast transmission to send information through multiple relays concurrently[1].The destination can then choose the best of many relayed signals, or combine informationfrom multiple signals. These schemes require radios capable of simultaneous, synchronized repeating of the analog signal, or additional radio channels for each relay.

Opportunistic routing (OR) takes advantages of the spatial diversity and broadcast natureof wireless networks to combat the time-varying links by involving multiple neighboringnodes (forwarding candidates) for each packet relay. This paper studies the properties,energy efficiency, capacity, throughput, protocol design and security issues about ORin multihop wireless networks.First, different from TR(Traditional Routing), OR has its unique nature thatfor each packet transmission, any one of the forwardingcandidates of the transmitter can become the actual forwarder.Thus, effective throughput can take place from a transmitterto any one of its forwarding candidates at any instant. However,for TR, throughput can only happen from a transmitterto a pre-defined next-hop node even if other neighboringnodes overhear the transmission. Therefore, the previous workon the throughput optimization in multi-radio multichannelsystems based on TR cannot be directly applied toOR[2].

Second, multi-radio multi-channel capability raises challengingissues on radio-channel assignment for OR. In asingle-radio single-channel system, OR naturally takes advantageof the redundant receptions on multiple neighboringnodes without consuming or sacrificing any extra channelresource. When a node is sending packets, all of its one-hopneighbors usually cannot send or receive other packets at the same time due to co-channel interference. That is, these onehopneighbors have no other choices but listen to the transmission.However, in multi-radio/channel systems, the one-hopneighbors have two choices: 1) they can operate on the samechannel as the transmitter to improve the diversity gain onthe receiver side, then more effective traffic can flow out ofthe transmitter and the system throughput can be increased; or2) they can operate on other orthogonal channels, thus havechances to transmit/receive packets to/from other nodes, whichmay result in more concurrent effective traffic flowed in thenetwork and can also increase the system throughput. This canbe considered as a trade-off between multiplexing and spatialdiversity. Which choice the neighboring nodes should make isnon-trivial. The radio-channel assignment for optimizing theend-to-end throughput in multi-radio multi-channel systemswhen OR is available deserves careful study.

Third, due to the broadcast nature of the wireless medium, one transmission may interfere with the neighboring linksoperated on the same channel[9]. Therefore, node’s transmissionshould be optimally scheduled in order to maximize thethroughput. Finally, even the radio-channel assignment andtransmission scheduling are given, we still need to optimally(often dynamically) select forwarding candidates and assignrelay priorities among them in order to maximize the end-toendthroughput. How to dynamically assign and schedule theforwarding priority among forwarding candidates has not beenwell studied in the existing literature

In summary, in order to maximize the end-to-end throughputof the multi-radio multi-channel network when OR isavailable, we should jointly address multiple issues: radio channelassignment, transmission scheduling, forwarding candidateselection, and forwarding priority scheduling. In thispaper, we carry out a comprehensive study on these issues.

II RELATED WORK

A. Opportunistic Routing

Opportunistic routing exploits the broadcast nature andspecial diversity of the wireless medium by involving multipleone-hop neighbors for packet forwarding. The increase inpacket forwarding reliability improves throughput and energyefficiency. Existing studies on OR mainly focus on protocoldesign. Some variants of opportunistic routing, such as ExOR and opportunistic any-path forwarding rely on the pathcost information or global knowledge of the network to selectcandidates and prioritize them. In the least-cost opportunisticrouting (LCOR) [3], depending on the cost definition, it mayneed to enumerate all the neighboring node combinations tofind the best forwarding candidates, while in some commoncases it only introduces linear searching. Some other variantsof use the location information ofnodes to define the candidate set and relay priority.

In GeRaF[8], the next-hop neighbors of the current forwarding nodeare divided into sets of priority regions with nodes closer tothe destination having higher relay priorities. Similar to ,in , the network layer specifies a set of nodes by defininga forwarding region in space that consists of the candidatenodes and the data link layer selects the first node availablefrom that set to be the next hop node. [4] discussed threesuppression strategies of contention-based forwarding to avoidpacket duplication in mobile ad hoc networks. [5] revealedseveral important properties of the local behavior of OR, suchas the maximum expected packet advancement (EPA) is anincreasing and concave function of the number of forwardingcandidates. proposed a local metric expected onehopthroughput (EOT) to balance the medium time cost andexpected packet advancement. Recent work combines ORwith network coding to further improve the system throughput.

B. Capacity of Multi-hop Wireless Networks

The theoretical study on the capacity of multi-hop wirelessnetworks can be classified into two directions. One is on theasymptotic bounds of the network capacity . Thesestudies derive the capacity trend with regard to the size of a wireless network or with respect to the number of radios and channels . The other direction on wireless networkcapacity is to compute the exact performance bounds for agiven network. Our work falls into this direction. Jain et alproposed a framework to calculate the throughput bounds oftraditional routing between a pair of nodes by adding wirelessinterference constraints into the maximum flow formulations. Zhai and Fang studied the path capacity of traditionalrouting in a multi-rate scenario . There has been recent work on capacity bound computation in multi-radiomulti-channel networks. However, they are all based on theassumption of using traditional routing at the network layer,where one transmitter can only deliver traffic to one receiver.There is one work [6] addressing the end-to-end throughputof OR in multi-rate wireless networks, and it computes thethroughput bound when opportunistic forwarding strategy isgiven at each node. This paper is based on our recent work oncomputing the end-to-end throughput bound of opportunisticrouting in multi-radio multi-channel multi-hop wireless networks[7]. We advance the state-of-the-art by addressingthe priority scheduling problem in the local opportunisticforwarding to satisfy the rate/traffic demand on each link. Ourstudy is the first integrated work of radio-channel assignment,transmission scheduling, candidate selection and prioritizationfor OR in multi-radio multi-channel multi-hop wireless networks.Our analysis provides insights into the performanceand behavior of OR in multi-radio multi-channel systems.

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