A Survey of Opportunistic Routing Protocol in Wireless Ad Hoc Network

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Abstract— Opportunistic routing (OR) is a recent routing technique for wireless sensor and ad hoc multi-hop networks. OR is a combination of routing protocol and medium access control for a wireless sensor and ad hoc network. Based on the highest priority its works. Transmitted that packet with is closest to the destination. There are no acknowledging packets, and no collisions with them. It broadcasts each packet, choosing a receiver to forward only after learning the set of nodes which actually received the packet but it cannot totally avoid duplications (repeating), it can avoid it in a certain degrees.

Keywords: Ad hoc networks, Opportunistic routing (OR), Wireless Networks

I. Introduction

A wireless sensor and ad hoc routing protocol is a standard that controls how nodes decide which way to route packets between computing devices in networks.

A wireless network is any type of computer network that uses wireless data connections for connecting nodes. In ad hoc networks, nodes are not familiar with the topology of their networks. Instead, they have to discover it. A new node informs its presence and upon hearing for inform broadcast by its neighbors. Each node learns about others nearby and how to reach destination, and may inform that it too can reach them.

Routing protocols are classified they are:

1) Proactive or Table Driven Protocols
2) Reactive or On-demand Protocols
3) Hybrid Protocols

A. Table-Driven Routing Protocol:

Table-driven protocols maintains up-to-date lists of destinations and their routes by periodically distributing routing table's entire the networks.

1) Examples

– Optimized Link State Routing Protocol (OLSR)
– Destination Sequence Distance Vector (DSDV)

B. Reactive or on-Demand Protocols:

On-demand protocol finds a route on demand by flooding the network with Route Request packets.

1) Examples

– Ad hoc On-demand Distance Vector(AODV)
– Dynamic Source Routing
– Flow State in the Dynamic Source Routing
– Power-Aware DSR-based

C. Hybrid Protocols:

This type of protocol combines the advantages of proactive and reactive routing. The routing is initially established with some proactively prospected routes and then serves the demand from additionally activated nodes through reactive flooding. The choice of one or the other method requires predetermination for typical cases.

1) Examples

– ZRP (Zone Routing Protocol)

II. Opportunistic routing (OR)

ExOR, MORE and SOAR is Table-driven (proactive) link state routing protocol. Every node sporadically measures and distributes link quality in terms of ETX. Based on this information, a source node selects the default path and a list of (next-hop) forwarding nodes that are allowed for forwarding the data. It then broadcasts a data packet consists of this information. Nodes closer to the destination use a smaller timer and forward the packet earlier. When it knows transmission, other nodes will eliminate the corresponding packet from their queues to avoid duplicate transmissions

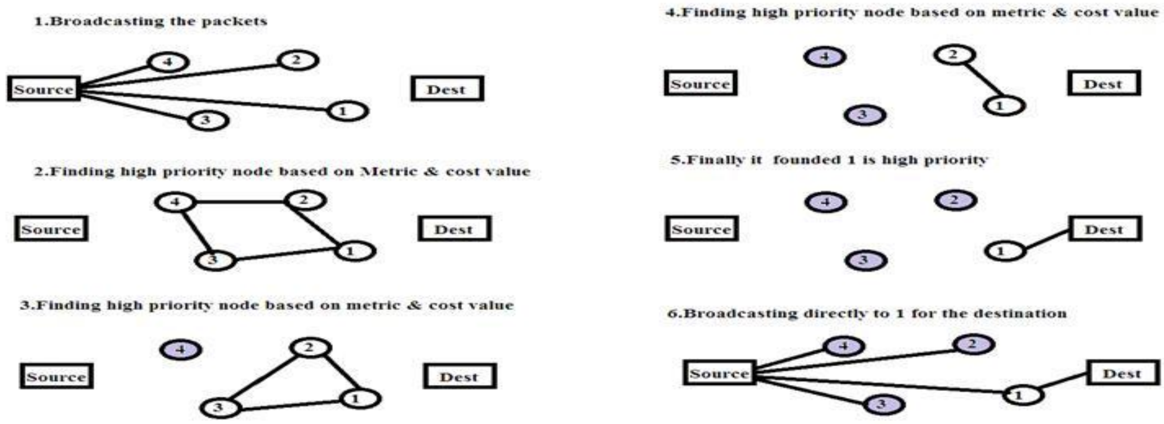

Fig. 1: Diagrams of EX-OR

III. LITERATURE SURVEY on Opportunistic Routing Protocols

Biswas and Moris, [1] proposed ExOR, to describe an integrated routing and MAC protocol that increases the throughput of multi-hop wireless networks. The protocol chooses each hop destination of a packet's route after the completion of the hop. The protocol gives the choice to decide which of the neighboring nodes receives the packet.

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ExOR protocol gives a better throughput compared to traditional routing with the same network capacity.

Eric Rozner Jayesh Seshadri Yogita Ashok Mehta Lili Qiu, [2] propose a simple opportunistic adaptive routing protocol (SOAR) to explicitly support multiple simultaneous flows in wireless mesh networks. SOAR incorporates the following four major components to achieve high throughput and fairness: 1) adaptive forwarding path selection to leverage path diversity while minimizing duplicate transmissions, 2) priority timer-based forwarding to let only the best forwarding node forward the packet, 3) local loss recovery to efficiently detect and retransmit lost packets, and 4) adaptive rate control to determine an appropriate sending rate according to the current network conditions

Zhang S; Li Shuang ; Huang Di [3] propose the optimized NCOR routing methods which are independent of QoS supported MAC protocols, to support high throughput service flows and low latency traffic flows transmit simultaneously based on 802.11 series MAC protocols. We present a load-aware and congestion control method to optimize the MORE protocol. By limiting its over consuming of the network resource it can support the transmission of high throughput service flows. We also propose a delay constrained opportunistic routing protocol (DCOR) based on broadcasting MAC protocol to support low latency service transmission in wireless mesh networks with NCOR routing methods.

Shuai ; Basalama; Song; Shuo; Tobe; Tian, [4] propose a novel link-correlation-aware OR scheme, which significantly improves the performance by exploiting the diverse low correlated forwarding links. We evaluate the design in a real-world setting with 24 MICAz nodes. Testbed evaluation and extensive simulation show that higher link correlation leads to fewer diversity benefits and that, with our link-correlation-aware design, the number of transmissions is reduced by 38%.

Wang; Wu; Wang; La; Lv Bo [5] proposed dual priority cooperative opportunistic routing (DPCOR) forwarding candidates are configured with dual priority, which enables the network to classify forwarding candidates more effectively so as to reduce the back-off time and obtain more diversity gain. Theoretical analysis and simulation results show DPCOR achieves significant performance improvement with less time overhead compared with traditional routings and typical ORs.

Mingjun ; Jie; Liusheng [6] propose a distributed Community Aware Opportunistic Routing (CAOR) algorithm. Our main contributions are that we propose a home-aware community model, whereby we turn an MSN into a network that only includes community homes. We prove that, in the network of community homes, we can still compute the minimum expected delivery delays of nodes through a reverse Dijkstra algorithm and achieve the optimal opportunistic routing performance. Since the number of communities is far less than the number of nodes in magnitude, the computational cost and maintenance cost of contact information are greatly reduced.

Shih ; Kwang [7] propose we that spectrum-map-empowered opportunistic routing protocols for that regular and large-scale CRAHNs with wireless fading channels, employing a cooperative networking scheme to enable multipath transmissions. Simulations confirm that our solutions enjoy significant reduction of end-to-end delay and achieve dependable communications for CRAHNs, without commonly needed feedback information from nodes in a CRAHN to significantly save the communication overhead at the same time.

Bhorkar.A.A. Naghshvar.M. ; Javidi.T. ; Rao.B.D [8] proposed routing scheme jointly addresses the issues of learning and routing in an opportunistic context, where the network structure is characterized by the transmission success probabilities. In particular, this learning framework leads to a stochastic routing scheme that optimally “explores” and “exploits” the opportunities in the network.

Passarell; Kumar; Conti; Borgia [9] proposed during opportunistic contacts, the pairing peers can cooperatively provide (avail of) their (other peer's) services. This service provisioning paradigm is a key feature of the emerging opportunistic computing paradigm. We develop an analytical model to study the behaviors of service seeking nodes (seekers) and service providing nodes (providers) that spawn and execute service requests, respectively. 1) The delays at different stages of service provisioning; and 2) the optimal number of parallel executions that minimizes the expected execution time.

Wang; Liu; Chen ; Li; Huang; Chen [10] propose two opportunistic routing algorithms for intermittently connected mobile P2P networks, which exploit the spatial locality, spatial regularity, and activity heterogeneity of human mobility to select relays. The first algorithm employs a depth-search approach to diffuse the data towards the destination. The second one adopts a depth-width-search approach in a sense that it diffuses the data not only towards the destination but also to other directions determined by the actively moving nodes (activists) to find better relays.

Won; Sae; Lee [11] proposed a parallel opportunistic routing for wireless ad-hoc networks to observe the changes in power, delay and throughput as the number of source-destination pairs increases in the network. A net improvement in overall power-delay trade off is observed as compared to conventional routing since the interference tolerance of receivers is increased in the network.

Yanhua; Mohaisen; Zhi-Li [12] propose the localized opportunistic routing (LOR) protocol, which utilizes the distributed minimum transmission selection (MTS-B) algorithm to partition the topology into several nested close-node-sets (CNSs) using local information. LOR can locally realize the optimal opportunistic routing for a large-scale wireless network with low control overhead cost. Since it does not use global topology information, LOR highlights an interesting tradeoff between the global optimality of the used forwarder lists and scalability inferred from the incurred overhead.

Zehua ; Yuanzhu ; Cheng [13] propose It is a pure network layer scheme that can be built atop off-the-shelf wireless networking equipment. Nodes in the network use a lightweight proactive source routing protocol to determine a list of intermediate nodes that the data packets should follow en route to the destination. Here, when a data packet is broadcast by an upstream node and has happened to be received by a downstream node further along the route, it continues its way from there and thus will arrive at the destination node sooner.

Kai ; Yang; Wenjing [14] propose we present our study on optimizing an end-to-end throughput of the multi-radio multi-channel network when OR is available. First, we formulate the end-to-end throughput bound as a linear programming (LP) problem which jointly solves the radio-channel assignment, transmission scheduling, and forwarding candidate selection. Second, we propose an LP approach and a heuristic algorithm to find a feasible scheduling of opportunistic forwarding priorities to achieve the capacity.

Koutsonikolas; Chih; Hu [15] propose CCACK, a new efficient NC-based OR protocol. CCACK exploits a novel Cumulative Coded ACK scheme that allows nodes to acknowledge network coded traffic to their upstream nodes in a simple way, oblivious to loss rates, and with practically zero overhead. In addition, the cumulative coded acknowledgment scheme in CCACK enables an efficient credit-based, rate control algorithm. Our evaluation shows that, compared to MORE, a state-of-the-art NC-based OR protocol.

IV. LITERATURE SURVEY ON ENERGY EFFICIENT OPPORTUNISTIC ROUTING PROTOCOLS

Xufei; Shaojie; Xiahua; Xiang; Huadong [16] propose, The nodes in forwarder list are prioritized and the lower priority forwarder will discard the packet if the packet has been forwarded by a higher priority forwarder. One challenging problem is to select and prioritize forwarder list such that a certain network performance is optimized. In this paper, we focus on selecting and prioritizing forwarder list to minimize energy consumption by all nodes. The transmission power of each node is fixed or dynamically adjustable. We present an energy-efficient opportunistic routing strategy, denoted as EEOR. ExOR protocol (when adapted in sensor networks) in terms of the energy consumption, the packet loss ratio, and the average delivery delay.

Chen; Lie; Jing; Soon; Hanzo [17] propose, In order to study this problem, a three-dimensional (3D) transmission activation probability space (TAPS) is proposed, which is divided into four regions representing each of the three channels plus an outage region. In a specific time slot (TS), the instantaneous channel fading values may be directly mapped to a specific point in this 3D channel space. The BOR scheme then relies on the position of this point to select the most appropriate channel for its transmission. Both the energy dissipation and the outage probability (OP) are investigated for transmission in this network. The results show that when the system is operated at a normalized throughput of 0.4 packet/TS, the energy dissipation was reduced by 24.8% to 77.6% compared to three different benchmark schemes. Alternatively, our technique is capable of reducing the OP by 89.6%. As in all buffer-aided system, the performance improved with the cost of higher packet delay.

Chih; Ming; Shi; Cheng [18] propose path diversity and the improvement of transmission reliability, are exploited to develop a lifetime-extended opportunistic routing for wireless sensor networks. Hence, we propose a joint design of asynchronous sleep-wake schedules and opportunistic routing, called ASSORT, to maximize the network lifetime. Simulation results show that ASSORT effectively achieves network lifetime extension compared with other routing schemes.

Sung; Yong; Saewoong [19] propose, we investigate the feasibility of OR use in PLC-AN and propose a customized OR for it, named PLC-OR, which uses static geographical information. For doing this, we formulate a bit-meter per second maximization problem and solves it in a distributed manner. Through simulations, we confirm that our proposed PLC-OR successfully reduces packet transmission time compared to the of that has traditional sequential routing while achieving the same level of reliability in packet delivery.

Long;Jianwei; Jiannong; Das; Yu [20] propose, we exploit the geographic opportunistic routing (GOR) for QoS provisioning with both end-to-end reliability and delay constraints in WSNs. Existing GOR protocols are not efficient for QoS provisioning in WSNs, in terms of the energy efficiency and computation delay at each hop. To improve the efficiency of QoS routing in WSNs, we define the problem of efficient GOR for multiconstrained QoS provisioning in WSNs, which can be formulated as a multiobjective multiconstraint optimization problem. Based on the analysis and observations of different routing metrics in GOR. EQGOR selects and prioritizes the forwarding candidate set in an efficient manner, which is suitable for WSNs in respect of energy efficiency, latency, and time complexity. EQGOR significantly improves both the end-to-end energy efficiency and latency, and it is characterized by the low time complexity.

Jing; Chen; Hung; Soon; Lie; Hanzo [21] propose, we exploit the benefits of cross-layer information exchange, such as the knowledge of the Frame Error Rate (FER) in the physical layer, the maximum number of retransmissions in the Medium Access Control (MAC) layer and the number of relays in the network layer. Energy-consumption-based Objective Functions (OF) are invoked for calculating the end-to-end energy consumption of each potentially available route for both Traditional Routing (TR) and for our novel Opportunistic Routing (OR), respectively. We also improve the TR and the OR with the aid of efficient Power Allocation (PA) for further reducing the energy consumption. For the TR, we take into account the dependencies amongst the links of a multi-hop route, which facilitates a more accurate performance evaluation than upon assuming the links that are independent. Moreover, two energy-efficient routing algorithms are designed based on Dijkstra's algorithm.

Chen; Chen; Pingyi; Ben [22] propose, we describe an efficient and energy conservative unicast routing technique for multi-hop wireless sensor networks over Rayleigh fading channels, which we shall refer to as assistant opportunistic routing (AsOR) protocol. During the Numerical results will confirm that the proposed protocol is energy conservative compared with other two traditional routing protocols both in slow and fast Raleigh fading channels and that the method for searching the optimal value N* is efficient.

Juan; Jinyu; Di; Renfa [23] propose, we focus on minimizing energy consumption and maximizing network lifetime for data relay in one-dimensional (1-D) queue

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network. Following the principle of opportunistic routing theory, multi-hop relay decision to optimize the network energy efficiency is made based on the differences among sensor nodes, in terms of both their distance to sink and the residual energy of each other. Specifically, an Energy Saving via Opportunistic Routing (ENS_OR) algorithm is designed to ensure minimum power cost during data relay and protect the nodes with relatively low residual energy.

V. Conclusion

ExOR, MORE and SOAR is a combination of routing protocol and medium access control for a wireless sensor and ad hoc networks. Each node periodically measures and distributes link quality in terms of ETX. When it knows transmission, other nodes will eliminate the corresponding packet from their batches to avoid duplicate transmissions. Comparing with other routing protocols parameter we can get best result like using energy and multi-hop routing protocol with efficiently.

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