Reliable and Energy Efficient Reactive Routing for Industrial Wireless Sensor Networks (IWSN)

Ranjan Venugopal¹ Dr. Prabhudeva S²
¹PG Student ²Professor & HOD
1Department of Network and Internet Engineering 2Department of Information Science and Engineering
1,2JNNCE, Shimoga, Karnataka

Abstract— Providing energy efficient and reliable communication under weak channels is one of the major technical challenges in industrial WSNs (IWSNs) with dynamic and harsh environments. In this paper, we presented the reliable and energy efficient reactive routing to increase the flexibility of link dynamics for WSNs/IWSNs. It is designed to boost the existing reactive routing protocols to provide reliable and energy-efficient packet delivery against the unreliable wireless links by utilizing the local path diversity. Specifically, we tend to introduce a biased backoff scheme during the route-discovery phase to find a robust guide path, which can provide more co-operative forwarding opportunities. Along this guide path, data packets are ravenously advanced toward the destination through nodes cooperation without, utilizing the location information. Through extensive simulations, we demonstrate that compared to other protocols reliable reactive routing protocol amazingly improves the packet delivery ratio, while maintaining high energy efficiency and low delivery latency.

Key words: Industrial Wireless Sensors (IWSN), Reliable Routing, Opportunistic Routing (OR), Co-Operative Forwarding, Guide Nodes

I. INTRODUCTION

Traditional wired communication systems are replaced by wireless sensor networks offers several advantages [1] and applications such as factory automation, industrial process monitoring and control, plant monitoring needs reliability and timeliness in forwarding messages among the nodes [2]. Traditional routing protocols like AODV [3], AOMDV [4] and DSR [5] might realized their limitations in industrial installations due to the harsh environmental conditions, interferences and other constraints that challenge the network performance [6]. Therefore, the reliability, timeliness and energy efficiency of data forwarding are significant to guarantee the best possible working of an IWSN. Opportunistic routing (OR) [7] has been proposed as an effective cross-layering technique to combat fading channels to improve the energy efficiency and robustness in industrial wireless networks.

II. RELATED WORK

The traditional routing protocols are also known as table driven protocols in these traditional approaches the route between the source and destination are fixed if in case of link failure the routing cannot be done. To overcome this reactive routing protocol [5] has been proposed to reduce the bandwidth and storage cost consumed in table driven protocols. On-demand procedures are used to dynamically build the route between a source and a destination.

In reactive routing protocols routes are created and maintained by two different phases namely route discovery and route maintenance. Route discovery is done by flooding an RREQ through the network and when a route is found the destination sends a RREP to the source which contains the route information.

Routing in DSR [Dynamic source routing] consists of two phases: Route Discovery and Route Maintenance, route discovery broadcast the route request packet to neighbor nodes and so on until it finds a way to reach destination. When intermediate nodes receive a non-duplicate RREQ, it updates the routes to previous node if it satisfies the following conditions:

1) There should be an available entry which has the same destination with RREQ.

2) (And its sequence number is greater than or equal to sequence number of RREQ.

If no, it rebroadcast RREQ, if yes, it generates a RREP message to the source node. The source node will forward the data to destination based on the RREP information.

Opportunistic Routing takes advantage of the broadcast nature and spatially diversity of the wireless medium to forward more efficiently than traditional routing protocols. Some of the variants of opportunistic routing such as, ExOR [7] and opportunistic any-path forwarding rely, on the global knowledge of the network to select candidates and prioritize them.

III. PROPOSED SYSTEM

Reliable and energy efficient reactive routing protocol for wireless sensor networks uses opportunistic routing is normally effective in networks with high node densities. Opportunistic routing is used to utilize the path diversity for cooperative caching. The path with higher spatial diversity may provide more reliable and efficient packet delivery against the unreliable links.

Fig. 1: Illustration of Guide Path

The aim is to find the reliable virtual path to guide the packets to be progressed toward the destination. In Fig.1 the solid lines shows the actual path from source to destination. If the actual path is failed due to fading the data will be progressed through the guide path, in which nodes are called guide nodes. The proposed protocol acts as an interface between the media access control layer and
network layer to increase the availability to link dynamics for IWSNs.

A. Architectural Overview:

Fig.2 and 3 illustrates proposed protocol Architecture and overall dataflow of the proposed system respectively and architecture consists of three main modules namely route discovery module, forwarder selection and prioritization module and forwarding decision module. The route discovery module is responsible for finding and maintaining the route information for each node, also each node in the cooperative forwarding process stores the downstream neighborhood information. The forwarding decision module is responsible for checking whether the data packet belongs to one of the intended receivers. If yes incoming packet will be cached and back off timer will start to return an ACK, finally forwarder selection and prioritization module attaches the ordered forwarder list in the data packet header for the next hop and outgoing packet will be forwarded towards the destination.

B. Route Request (RREQ) Propagation

If the source node has a data packets to send to a destination, by using route discovery module the RREQ message is flooded through the network. Upon receiving the non-duplicate RREQ the intermediate nodes stores the upstream node id and RREQ sequence number for reverse route learning. By introducing the effective route discovery scheme at the current RREQ forwarding node, enables the RREQ to travel faster along the preferred path according to a certain defined metric.

C. Bias Back-Off Scheme

Any node that forwards the RREQ will calculate the back-off delay by assuming itself as a guide node, and considering the last-hop node as its upstream guide node. Instead of rebroadcasting the RREQ immediately in existing reactive routing protocols, we use bias back off to intentionally amplify the differences of RREQ’s traversing delays along different paths.

D. Route Reply (RREP) Propagation

The node receives RREP from destination node or intermediate nodes, it checks whether the selected next-hop of the RREP. If yes the node itself marks as a guide node and records its upstream guide node id and forwards it until it reaches the source node via the RREQ message propagated, finally the guided path is obtained from source to destination for forwarding the data packets. In the proposed system Route Reply (RREP) propagation implements the forward path setup and also notifies the potential helpers to perform the cooperative forwarding.

E. Co-Operative Forwarding

In co-operative forwarding [8] source node broadcasts a data packet, which includes the list of forwarding nodes and their priorities. Those candidates follow the assigned priorities to relay the packet. Each candidate, if having received the data packet correctly, will start a timer whose value depends on its priority. The higher the priority, the shorter is the timer value. The candidate whose timer expires will reply with an ACK to notify the sender, as well as to suppress other contenders. Then, it rebroadcasts the data packet toward its downstream link. If no forwarding candidate has successfully received the packet, the sender will retransmit the packet if the retransmission mechanism is enabled.
IV. SIMULATION AND RESULTS

The simulation is performed on Linux Ubuntu 10.04. The experiments are implemented and run in the network simulator ns-2 (version 2.35). The performance metrics chosen for the energy efficient reactive routing are bit-error rate, Throughput, control overhead, packet delivery ratio.

Fig. 4 shows the comparison of Bit-error rate vs. Time for the proposed and existing protocol. Bit-error rate in proposed protocol is minimum compared to existing protocol. The Red line in the graph indicates the bit-error rate of existing protocol. Green line in the graph indicates the bit-error rate of proposed protocol.

Fig. 4: Performance Comparison of Bit-Error Rate Vs. Time For The Proposed And Existing Protocol

Fig. 5 shows the comparison of Throughput vs. Time for the proposed and existing protocol. Throughput in proposed protocol is Maximum compared to existing protocol. The Red line in the graph indicates the Throughput of existing protocol. Green line in the graph indicates the Throughput of proposed protocol.

Fig. 5: Performance Comparison of Throughput Vs. Time For The Proposed And Existing Protocol

Fig. 6 shows the comparison of packet delivery ratio [PDR] vs. Time for the proposed and existing protocol. PDR in proposed protocol is Maximum compared to existing protocol. The Red line in the graph indicates the PDR of existing protocol. Green line in the graph indicates the PDR of proposed protocol.

Fig. 6: Performance Comparison of PDR Vs. Time For The Proposed And Existing Protocol.

V. CONCLUSION

Hence, we provided an energy-efficient and reliable packet delivery against the unreliable Wireless links by introducing a biased backoff scheme in the route discovery phase to find a robust virtual path with low overhead. And also with cooperative forwarding we can provide an energy efficient routing of packets. Simulation results showed that, as compared to existing system, the proposed enhanced DSR protocol can effectively improve robustness, end-to-end energy efficiency and Throughput.

REFERENCES