RELIABLE AND ENHANCED ENERGY EFFICIENT REACTIVE ROUTING PROTOCOL FOR IWSNS

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Abstract

With the upcoming evolutionary technologies, Wireless sensor networks have made and gained worldwide attention in many applications. Sensor nodes are very small and are spatially deployed over the large target area to sense, measure, gather information and finally to transmit the data to the users. Industrial wireless sensor network have many advantages and applications. One of the challenging issues in IWSN is to provide reliable and efficient communication that to especially in dynamic and rough environment. The existing reactive routing protocols have limitations. In this work, secured and reliable reactive routing protocol is introduced to increase the energy efficiency, low delivery latency, to improve the packet delivery ratio. Another important is the introduction of special scheme called biased back-off scheme during the route-discovery phase. The aim of this scheme is to amplify the traversing delays. And along the guide path nodes carry out the transmission. Nodes involved in the transmission uses the nodes co-operation without the help of location information.

***Keywords**: IWSNs, Opportunistic Routing, Security, Unreliable Links.*

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1. INTRODUCTION

With the upcoming technologies, Wireless sensor network (WSN) have made world-wide attention in many applications. Sensor nodes are deployed spatially in the desired target area to sense, gather and to measure the information and finally delivered to the users. Wireless sensor network are replacing the traditional networks. These networks have many applications in many fields. One such application is in the field of Industries. The Industrial wireless sensor network (IWSNs) [1],[2] offers many benefits such as low maintenance, easy configuration and installations. These networks have many applications such as event monitoring, factory automation, process control and maintenance and many more. But these applications require reliability and timeliness in transmitting the data. The existing protocols have their own limitations in solving the network issues.

In IWSNs,[1] node failure or transmission failure results in missing of the data, unwanted delay and many more. This is intolerable to the network performance. The sensed data should be reached to the sink node without any issues in the network. The major technical issue or challenge for setting up of these IWSNs is to provide the reliability, enhanced energy efficiency, timeliness and security.

Usually for all these types of network uses routing protocols. Routing protocols [5] are divided into three types: namely, Proactive routing protocol, Reactive routing protocol and Hybrid routing protocol. Proactive routing protocols are table driven protocols. Each node in the network has to maintain the route information and has to update the route information in certain time interval. When a node wants to send data, route has already been available. Drawback of this type is the consumption of bandwidth and resources made in the network. To overcome this drawback Reactive routing protocols [3] are introduced. These protocols are On-demand routing protocols. They creates route only when the node wants. Generally routes are maintained in two stages – route discovery and route maintenance. When a node has the data to send to the target or sink node it broadcast the RREQ (Route Reply) message. When the intended node receives this RREQ it sends back a RREP (Route Reply) to the source.

2. LITERATURE WORK

To minimize the variation of the channel conditions in wireless networks numbers of routing protocols are introduced in an active research field. One such is the, Opportunistic routing [4][7]. In this each and every node has to measure the topology of the network and has to maintain it. The node has to broadcast the data packets to the prioritized list of forwarding candidate's collection among its neighbors. Next node will be chosen in distributed manner based on the fact that, node which is close to the destination. This improves the throughput. Challenge in this type of the routing protocols is that, selection and assigning the priority to the collection of neighboring nodes.

The most commonly used reactive routing protocol is AODV[3]. It is one of the efficient algorithms which provide the loop free routes. It is self-starting, source initiated and adapts quickly to link conditions. It offers low processing, low usage of resources, bandwidth and improves the throughput, energy and reduces delay. Drawback is – in case of any link failures during the transmission of the data packets, source has to re-initiate the route discovery process again to carry out the transmission. By doing this, unwanted delay and additional energy consumption will happen.

3. PROPOSED WORK

Network Model :

Network consists of dense static nodes deployed in the sensing field. Each node in the network contains many numbers of neighbors since it is dense. We assume that the MAC layer provides link quality estimation service.

Each node in the network periodically sends the "hello" packets to its neighbors. It contains the addresses and PRRs (packet reception ratio) of the respective links. After exchanging of the "hello" packets each node maintains the route information.

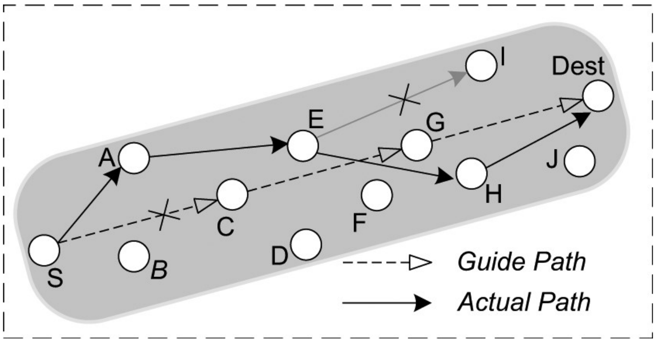

Fig1. Network Model

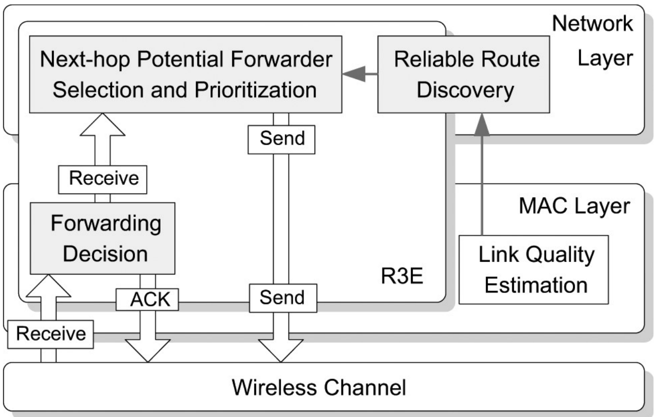

Fig2. Network Architecture

It is the middle-ware design across the network and the MAC layer. The architecture consists of three main modules. Route discovery module, selection and priority module and decision module.

Route discovery module is responsible for finding and storing of the route information. Each node involved in the co-operative forwarding technique. Means the current node already knows the next forwarding node. The other two modules are run time modules. When a node receives the data it checks whether it is the intended receiver. Then it starts the timer to send back an ACK, if not it will send to the upper layer to get the next forwarding candidate. The selection and priority module sends the list of the candidates with their priority to select the next forwarding node.

3.1 Guide Path Discovery

When a node has the data to communicate it first starts up by flooding the RREQ in the network. When a node receives this RREQ, it stores this RREQ's sequence number and ID. Instead of the immediate retransmission in the existing system, here in this work we have introduced a new scheme called biased back-off scheme. The main intention of this scheme is to decrease the traversing delays. So this enables the RREQ to move to the sink node in the preferred path.

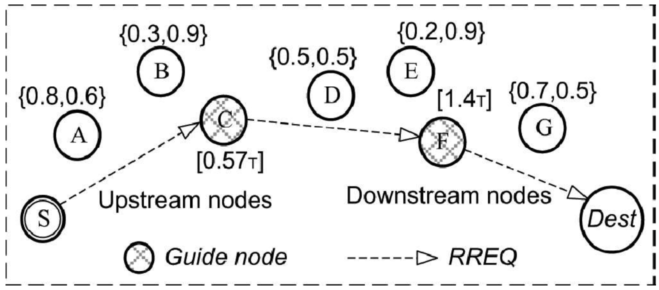

Fig3. Guide path discovery

Back-off delay is calculated by using,

$$t_{ij} = \frac{HopCount}{\sum_k P_{ik}P_{kj} + 1} \cdot \tau, \quad v_k \in H(i,j)$$

For example, If A, B and C receives the RREQ from S. Each node calculates its own back-off delay by considering itself as a guide node. From the fig, Node C calculates its back-off delay, the label made beside node A {0.8, 0.6} indicates that P_{sa} = 0.8 and P_{ac} = 0.6. With the help of back-off delay formula, at node C delay is about 0.57τ. Comparison with A and B, C has the shorter delay so when C's back-off expires it will rebroadcast RREQ with an ACK. In the same way F is selected as next guide node. The RREQ travels in the [S -> C -> F] and reaches the destination.

3.2 Route Reply (Rrep) Propagation

When a node receives RREP, it checks whether it is the intended node. If yes, it realizes it is on the guide path and it is the guide node. After that it forwards the node to the next guide node and creates the forward path setup. And it finally reaches the source node.

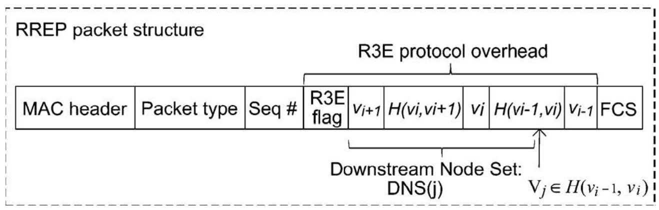

Fig4.RREP packet format

In this work, RREP has two main functions: first it not only creates the forward path setup, it also gives the set of helper nodes along with the RREP for the implementation of the next forwarding candidates in case of any failures.

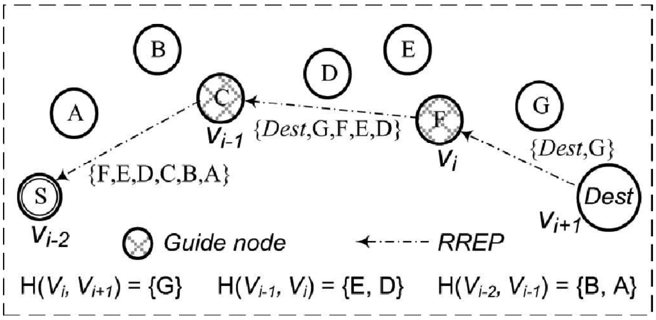

Fig5. RREP path

When guide node F forwards the RREP to C, it will send the H(C,F) and H(F, Dest) along with RREP. At this point if the node D in the helper set overhears this RREP, its stores {Dest, G, F, E, D}. D's one-hop neighbor set is N (D) = {B, C, E, F, G}. The Downstream Node Set will be , DNS = N(D) ∩ {Dest, G, F, E, D} = {G, F, E}.

3.3 Co-Operative Transmission

In the network, due to the varying channel conditions and the node failures it affects the topology of the network and the connections. To transmit the packets effectively at each and every hop requires many re-transmissions. This leads to undesirable delay and high energy efficiency. And one more common problem is the unreliable links in wireless network. So co-operative transmission is introduced as an immediate re-transmission instead of the source to reinitiate the process. The implicit condition of this transmission is, the node's in the helper set would overhear the ACK.

When a source sends the packet, it includes the forwarding candidate's list and helper node with their priority. When a node receives this packet it checks whether it is the selected node. If yes, it starts timer and sends an ACK to the source and to suppress the other contenders. If not, it will check with the forwarding candidate list with the next priority node and carry out the transmission.

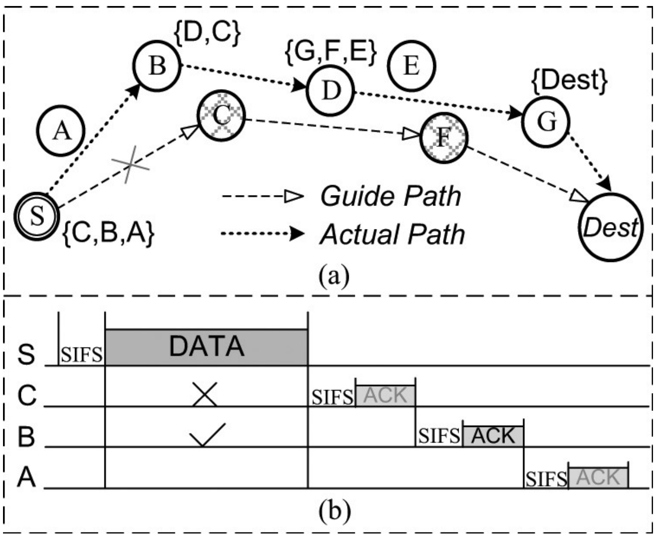

Fig6. Co-operative forwarding

Every node maintains the route information. If node C fails to carry out the transmission, then B takes out the next transmission and updates its routing table with new information. And it continues till it reaches the destination.

CONCLUSION

In this work, we presented the combination of the existing reactive protocol – AODV with our new protocol named AODV-R3E. The benefit of this new protocol increases the packet delivery ratio, energy efficiency, low latency with the introduction of the new scheme called biased back-off scheme. The main intention of this new scheme is to avoid the traversing delays associated with RREQ message. With the help of the co-operating forwarding procedure nodes involved in the transmission finds out their next neighbors with the help of node's co-operation not with the help of the location information of the nodes.

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