Review on SME Routing Protocol for Asymmetric Wireless Network

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Abstract: *Asymmetric Wireless sensor network is dynamic in nature and completely operates on infrastructure less environment. It discovers way routes dynamically to reach the destination. Securing a dynamic way route which is not known in before communication is always a challenge. Energy conservation and finding the shortest path is a key challenge. This paper presents design of a shortest path Minimum Broadcast Energy conserving (SME) Protocol for Asymmetric Wireless Sensor Network. It finds the shortest path in minimum broadcasts and conserves energy in asymmetric wireless network. The basic idea behind SME is to improve upon RP, Layhet, Egyhet from the state of the art and achieve performance enhancement with better delivery rate consuming minimum energy and slow sinking with reduction in energy during data routing process for data transmission to destination for the way route selected in an asymmetric environment. Asymmetric indicates where two end nodes may not use the same path to communicate with each other. The state of the art had proposed a performance guaranteed protocol achieving the above desirables. We want to improve upon the achievable with our novel SME protocol. A comparative study will be carried out to demonstrate the performance of our strategy over the RP framework from the state of the art.*

Keywords: Asymmetric Wireless Sensor Network, RP, Layhet, Egyhet, SME

1. Introduction

Asymmetric Wireless sensor offer unique benefits and versatility for wireless environments and its applications. The process of route discovery in ASN networks is different from that in symmetric networks. Because a path valid from base station to a node may not remain valid when reversed. Such a path can be discovered in bottom-up fashion only. So a node which needs to find a path to base station start broadcasting to all its neighbour nodes [1][2][3]. Other nodes on receiving packets put their node id and rebroadcast them until it reaches to base station. Base station replies directly to the reque sting node with the identity of preferred neighbour [1][2][3].
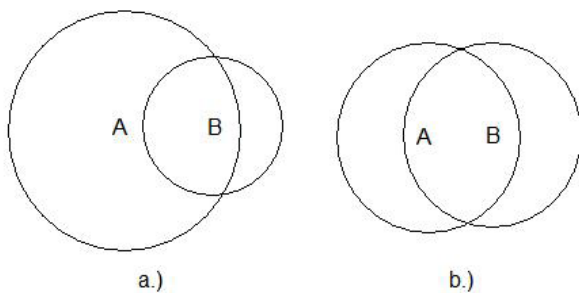
Figure 1: a) Asymmetric Link b) Symmetric Link

As shown in Fig 1(a) node B is in transmission range of A, but node A is not in transmission range of node B because both have different transmission range. Cause of ASN: Noise, power degradation, barriers and environmental conditions [4][5][6][7]. Challenges in Asymmetric Wireless Sensor Networks: No feedback from the neighbouring node such as delivery probability, chances of network choke because of flooding with broadcast during route discovery [7]. In this paper, we focus on designing a shortest path Minimum Broadcast Energy conserving (SME) Protocol for Asymmetric Wireless Sensor Network. It finds the shortest

path in minimum broadcasts and conserves energy in asymmetric wireless network. The basic idea behind SME is to improve upon RP, Layhet, and Egyhet from the state of the art and achieve performance enhancement with better delivery rate consuming minimum energy and slow sinking with reduction in energy during data routing process for data transmission to destination for the way route selected in an asymmetric environment. Asymmetric indicates where two end nodes may not use the same path to communicate with each other.

The rest of the paper organized in sections, Section-II, describes the related work which provides an overview on state-of-the-art routing protocols. In Section-III, we describe the SME routing protocol architecture, Section-IV describes the algorithm and Conclusions in Section-V.

2. Related Work

In recent years, the research on design of routing protocol is done with an implicit assumption of links being symmetric [8]. The asymmetric nature leads to more overheads and less throughput. The need of the hour is designing protocols considering the asymmetric nature of links. Ramasubramanian et al proposed BRA protocol considering asymmetric nature of links. Their protocol design involved building reverse path for asymmetric links [7]. BRA maintains multihop reverse routes. Multihop protocols not only reduces the congestion but also leads to better utilization of energy resources as individual nodes can operate with low transmission power. Xio Chen et al. proposed reverse path protocol using source based routing [13][14]. Prohet is a reverse path protocol reactive algorithm which is suitable for large and dynamic networks. Their proposals are proactive algorithms for ASNs in static environment for efficient delivery routing. Few of the known routing protocols handling asymmetric links are: Proactive Link State protocols such as OLSR [9] having complete view

of network at nodes but implement with partial view. Few maintain link and reverse route leading to reverse route leading to more overheads. Proactive distance vector protocols such as DSDV [10] are better than [9] but assume that links are bidirectional and fail in asymmetric links. Prakash's modified protocol of broadcasting unidirectional increases the worst case message size [11]. On demand protocols such as AODV have the inherent limitation of not being able to resolve unidirectional link issues [12]. The IETF working group on Unidirectional Link Routing (UDLR) proposes a protocol [15] that invokes tunnelling and encapsulation to send multi-hop acknowledgments a the link layer and Nesargi and Prakash propose a similar tunnelling based protocol where control packets are tunnelled through multi-hop reverse routes to the upstream nodes of unidirectional links [16]. However, the protocols do not specify what routes are used for the multi-hop tunnels.

3. Objective

The objective of the proposal is to derive SME protocol for routing in asymmetric sensor networks. Although the research on routing protocols for symmetric sensor networks has received much attention, little has been proposed for asymmetric sensor networks. In this project, we propose a novel approach to routing in asymmetric sensor environment with performance enhancement. Moreover, we also propose to evaluate our proposal against various performance metrics.

3.1 SME Routing Protocol Architecture

The proposed protocol has four different stages.
- Initialization of network
- Asymmetric Route Discovery
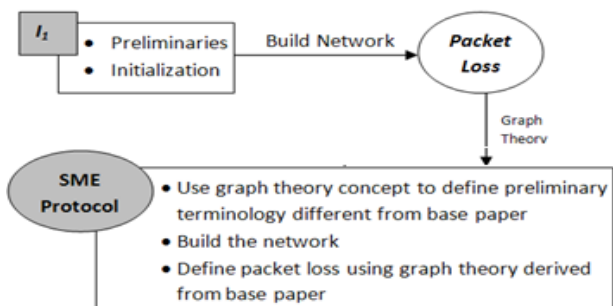- Data Routing
- Metric measure for performance

4. Methodology

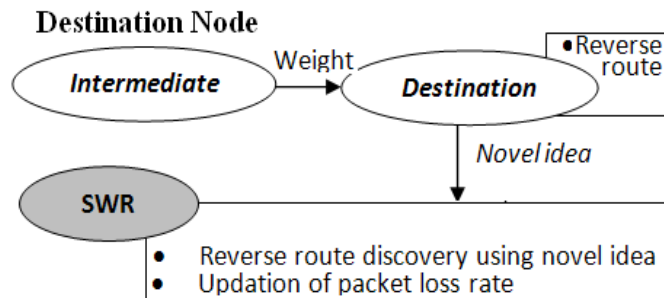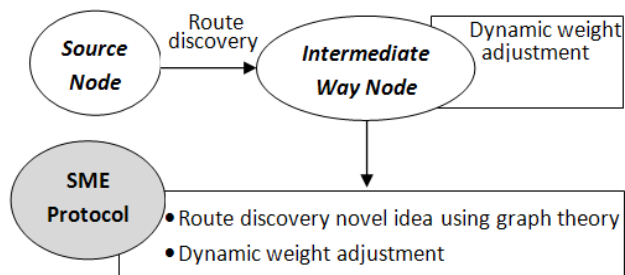**Figure 2:** Initialization of Network
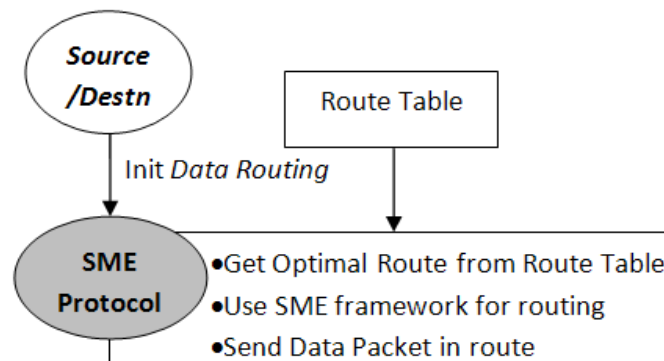

Figure 3: Route Discovery

Figure 4: Data Routing Mechanism

Modified Reactive Reverse Path protocol (M (RP)^2) Modifications: Reactive algorithm instead of Proactive. Destination based instead of source based. Selective broadcast instead of broadcast. Incremental Hop count value 2. The rest of the algorithm are taken as is from the base paper. The algorithm details are at the algorithm section.

Algorithm 1: Modified Reactive Reverse Path protocol (M (RP) ^{2}): Source Node N, Destination node S, "Hello", "ack", Nodes: A, B …

Modifications: Reactive algorithm instead of Proactive. Destination based instead of source based. Selective broadcast instead of broadcast. Incremental Hop count value2.

 A. **Initialization of network:**

a) Source to destination optimal path identification using Conventional algorithms such as DVR or modified Version.
b) Store optimal path info in routing table of Sink S (Destination).
c) Sink selective broadcasts "hello" message to all its in Neighbours except through whom the optimal path exists.
d) All in-neighbours respond with a "hello" message.
e) If node A receives "hello" message but not the "ack" Then A knows that S is its in-neighbour. Then A will Perform the next step to find a reverse routing path to S.

B. **Finding Reverse route:**

a) Node A tries to find a reverse routing path to each of its in-neighbours by broadcasting a ``Find'' message containing the source ID (``S''), the destination ID (the ID

of the in-neighbour to which it wants to find a reverse path (e.g. ``B'')), and a hop
count of 1.

b) If some node C receives a ``Find'' message, if it is the destination listed in the message, it will add the S to its out-neighbour list; increment the hop count, send the identified reverse routing path to S ``Path'' message containing the reverse route.) if it is not the destination node and the hop count $<= 2$ it will rebroadcast the message after the following modifications:; append its own ID to the message. in all other cases, it will drop the message.

C. LAYHET ROUTING PROTOCOL

In this section, we propose the LayHet protocol that is built on RP. The protocol has two parts: The preparation part which includes assigning layer numbers to the nodes and adjusting layer numbers periodically; And the routing part which includes the sender broadcasting H times and the receivers forwarding messages with probabilities estimated from link states with neighbours. The details are as follows:

Algorithm 2: LAYHET ROUTING PROTOCOL

1. Node u broadcasts an exploration packet EP Containing a hop-count c D 0 and the source ID.
2. **if** a node v receives EP **then**
3. **if** it is the sink node **then**
4. it waits for a while for more copies of EP to arrive. Then it picks an EP with the smallest hop count. It increments the hop count by 1 and generates and Acknowledgement $EPack$ containing the value of the Current hop count c and the path involving all the Forwarding nodes on the path back to the source u The later arrived copies of EP are dropped.
5. When an intermediate node m on the path receives $EPack$, it adjusts its own layer number according to hop count c and its location on the path.
6. **If** m's previous node t is its in-out-neighbour **then**
7. it sends $EPack$ directly to t;
8. **else if** m has a reverse path to t **then**
9. m sends $EPack$ to t via the reverse path of the Asymmetric link $t! m$;
10. **else**
11. m simply drops $EPack$
12. **end if**
13. **else**
14. it increments the hop count by 1, appends its ID to EP and rebroadcasts EP
15. **end if**
16. **end if**
17. After u receives $EPack$, it knows its layer number to the sink is c.

Algorithm 3: Broadcasting H times

1. Except at the beginning when the packet loss Rates are generated randomly, source node u _nds out the packet loss rates $p1$; $p2$; $: : : :$; pK with its K lower layer out-neighbours using Algorithm 5.
2. Node u calculates the number of times H it should Broadcast using Formula (4) in Section VII.

3. Node u broadcasts the message plus its link Packet loss rates $p1$; $p2$; $: : : :$; pK H times.

Algorithm 4 Forwarding Message
1. **repeat**
2. If a node v receives a message from a higher layer Neighbour u along with the packet loss rates of u's Links, it uses Formula (5) in Section VII to decide its probability 0 to forward the message.
3. If it forwards, it becomes the new source and applies the algorithm 3.
4. If it does not forward, it will simply drop the message.
5. **until** the message reaches the sink.

Algorithm 5: Updating Packet Loss rate Periodically

1) Each node u will update the packet loss rate of each of its links with its out-neighbours every T time period.
2) Suppose node u sends out Ns messages to node v during T time period. At the end of T, node u sends a message to v asking ``How many messages out of Ns have you received?''.
3) After v receives the inquiry, it replies directly or through the reverse path with the answer ``Nd ''. Also it attaches to the message its layer number for u to adjust its layer number.
4) After u receives the answer, it updates the packet loss rate of link uv to Pv Also if u's layer number is at least 2 more than v's layer number, u adjusts its layer number to v's layer number C1.

5. Conclusion and Future Works

We presented a shortest path Minimum Broadcast Energy conserving (SME) Protocol for Asymmetric Wireless Sensor Network. It finds the shortest path in minimum broadcasts and conserves energy in asymmetric wireless network. The basic idea behind SME is to improve upon Reverse Path (RP), Layhet, Egyhet from the state of the art and achieve performance enhancement with better delivery rate consuming minimum energy and slow sinking with reduction in energy during data routing process for data transmission to destination for the way route selected in an asymmetric environment. We are anticipating the design post experimental validation will provide a novel contribution in providing shortest path with energy conservation.

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