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Rotatory Shortcut Tree Routing In ZigBee Networks

N. Durga Prasad[1*], D.Sai Ganesh [2]

[1*]Dept. of CSE, Gayatri Vidya Parishad College of Engg. (Autonomous), Visakhapatnam, India
[2] Dept. of CSE, Gayatri Vidya Parishad College of Engg. (Autonomous), Visakhapatnam, India

[*]*Corresponding Author: dp.prasad10@gvpce.ac.in, Tel.:+91- 9491385783*

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***Abstract*—** The shortcut tree routing has been advised to provide near prime routing path as well as maintaining the benefits of the ZigBee tree routing like low memory utility multi-hop routing capacity .But, in spite of the efforts to provide an efficient and reliable protocol, the unicast routing itself has the fundamental limitation in wireless environment due to loose, time period varying, and broadcast way of wireless medium. Such as, even one loose link on a path may result in the miscarriage of end-to-end packet delivery in wireless network setting. In this paper, we propose the rotatory shortcut tree routing that combines shortcut tree routing and rotatory routing. Instead of identifying a next hop node, this rotatory shortcut tree routing allows receiving nodes to compete to forward a packet with the primacy of remaining hops. Because it has acquired advantages of each protocol, it may offer reliable parcel conveyance benefit without any approach for multi-hop routing and forwarder candidate selection for rotatory routing.

***Keywords*—** ZigBee, Tree Routing, Hierarchical addressing, STR

I. INTRODUCTION

ZigBee is one of the worldwide standards for developing internet of things (IoT) [1]. Past non-public area community applications along with smart usage, building mechanization, and fitness care, ZigBee extends its use place to smart metropolis and smart grid with the aid of attaching tens of million gadgets. The ZigBee Union additionally described extra hundred thirty sorts of gadgets to help diverse application ideas [2]. Similarly, network stage standard offers scalable and dependable multi-hop mesh networking for battery-operated gadgets. When you consider that ZigBee network description has launched, the ZigBee tree routing (ZTR) [5] has attracted giant interest because of its resource-loose multi-hop routing capability. In other words, it does not require any routing table and course discovery overhead to ship a packet to the destination through using distributed and hierarchical addressing structure. As an extension of ZTR, the shortcut tree routing (STR) has advanced the performance of multi-hop routing direction in addition to alleviated the site visitors load focused on tree links. To preserve lasting the benefits of ZTR inclusive of no course detection overhead and additional memory intake for routing desk, STR utilizes the characterized addressing scheme and the 1-hop neighbor table [6] in ZigBee.

Notwithstanding such efforts to offer an efficient and reliable routing protocol in aid-restricted gadgets, the unicast routing itself has fundamental challenge in wireless surroundings because of free, time-fluctuating, and broadcast nature of Wi-Fi medium [4]. those problems of unicast routing protocols in wireless community were addressed in the opportunistic routing (OR) protocols, and the OR protocol [9] make use of the cooperative range that takes gain of broadcast nature of wireless medium to send a packet through a couple of forwarder candidates.

No matter such efforts to provide an efficient and reliable routing protocol in resource-constrained devices, the unicast routing itself has fundamental limit in wireless condition due to loose hyperlinks [11], time-fluctuating, and broadcast nature of Wi-Fi medium. These issues of unicast routing protocols in Wi-Fi device were addressed in the opportunistic routing (OR) protocols, and the OR protocols [7] make use of the helpful variety that takes advantage of broadcast environment of Wi-Fi mild to send a packet through multiple forwarder candidates.

The rotatory shortcut tree routing set of rules that combines OR and STR [6]. In element, like STR, the proposed set of rules utilizes a routing metric with the ultimate hops to the vacation spot, which can be calculated with the hierarchical addressing scheme in ZigBee. However, in preference to labelling a subsequent hop node, a sender node definitely pronounces a packet and receiver nodes compete to forward a packet with the significance of the last hops.

For this reason, it's far designed in order that the node closest to the destination among receiver nodes

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forwards a packet. In addition, the set of forwarder candidates and prioritization are decided based totally on the last hops and the remaining hops without any centralized or separate mechanism.

II. LITERATURE SURVEY

A. *ZigBee network overview:*

As mentioned in the network diagram, ZigBee network is comprised of coordinator(C), router(R) and end devices (E). ZigBee supports mesh-routing and tree routing. For in depth information on routing protocol active in ZigBee, one may refer Ad-hoc on-demand Distance Vector Routing protocol (AODV protocol) which is mostly used in mesh topology [9].

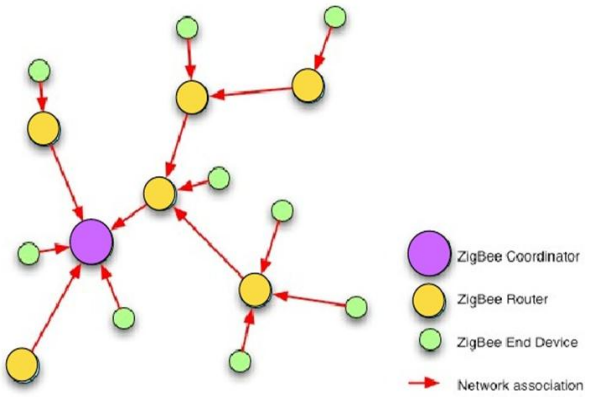

Figure 1. ZigBee network in tree topology

Coordinator**:**

Always first coordinator wants to be established for setting up ZigBee network service[3], it begins a new PAN (personal location community), once began different ZigBee components viz. router(R) and end devices (E) can join the community (PAN).

It is responsible for choosing the channel and PAN identification. It may assist in routing the data via the mesh network and lets in join request from R and E.

Router**:**

First router needs to join the network then it can allow others devices to join the PAN with help of coordinator.

End Devices**:**

It cannot permit different gadgets to sign up for the PAN nor can it assist in routing the records via the network

B. *Related works*

The OR protocol in Wi-Fi ad-hoc networks is first off seasoned-posed by ExOR [7]. ExOR has addressed the troubles of unicast routing protocols in Wi-Fi ad hoc networks, and it proposes to make the most cooperative variety because of broadcast nature of Wi-Fi medium. In ExOR, a sender announces a packet without determining the next hop node, and the nodes that sincerely obtain the packet ahead the packet. However, ExOR prevents the forwarders from exploiting spatial reuse and calls for international scheduler that is hard to apply in reality. Motivated with the aid of this, extra [8], MAC-unbiased OR protocol, has been proposed to mitigate the disadvantage of ExOR by randomly mixing packets before forwarding them. As a result, more does now not want the exceedingly based international scheduler as in ExOR. Bounce employs adaptive forwarding direction chooses nearby loss recuperation [9], and adaptive charge manipulate. Jump units forwarding timer proportionally to node precedence, and the forwarder node with lower precedence cancels its packet for-warding by overhearing the packets. This is distinctive from ExOR in that jump affords fully disbursed forwarding scheduling in preference to the worldwide scheduler of ExOR.

III. EXISTING SYSTEM

Right from starting of ZigBee network the ZigBee tree routing [4] has gained considerable attention as it is simplest routing protocol. Due to its limitation as it follows tree topology and to overcome it shortcut tree routing is introduced which use optimal routing. It also maintains the advantages of the ZigBee tree routing such as no route discovery overhead and low memory consumption as it uses 1-hop neighbor table [6] in ZigBee network.

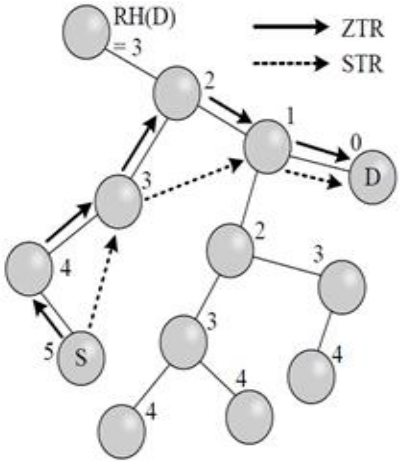

Figure 2. Routing comparison between ZTR and STR

As we can see in the above figure 2 we can observe that ZTR protocol follows only child and parent relation to complete the routing procedure whereas STR algorithm will follow tree structure but maintains table for routing. If there is a possibility of reduce in number hop count it will diverts its next hop

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A. *Disadvantage Of Existing System:*

It shows a tendency to decrease with the increasing distance. It's far due to the fact the opportunity of packet loss increases with increasing the give up-to-stop distance of a multi-hop path. Next, the inherent broadcast nature of wireless medium does now not allow concurrent transmission, on account that they interfere with each different. In other phrases, despite the fact that a sender designates a next hop node in unicast routing protocol, maximum of neighbor nodes has to now not transmit different packets so as not to interfere the packet transmission.

IV. PROPOSED APPROACH

As to increase packet delivery rate even in high traffic load even neglecting distance between nodes rotatory shortcut tree routing which act as optimistic path finder. RSTR provide a better optimal routing path like the reactive routing protocols. It also maintains the advantages of ZTR and STR. Such as no route discovery through parent child link and little memory consumption for the routing. The Shortcut Tree Routing (STR) that significantly enhances the path efficiency of ZTR by only adding the 1-hop neighbour information. In short RSTR is a combination of optimistic routing and shortcut tree routing.

A. *Algorithm explanation*

Let us consider a zigbee network with following tree topology as shown in figure 3 where root node is a coordinator node and rest are joining and end nodes

Source node will broadcast packets to nearby nodes in its range i.e. let us consider following topology as shown in following figure 3 and consider that device "F" as starting point and device "L" as delivery point and F is sending packets to all nearby nodes

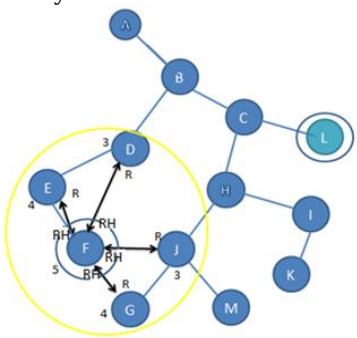

Figure 3. Broadcasting packets to nearby nodes

Among them the most reliable node will give acknowledgement to source node and forward packets to the next nearby nodes most reliable node is selected based in RH (remaining hops) value and unique ID. Procedure is as followed for obtaining RH value

$$RH(S, D) = L(S) + L(D) - L(A[S, D])$$

Where S is source or starting point, D is destination or dead-end point, L is level of node, and A is least common ancestor and RH is remaining hops or rest of hops

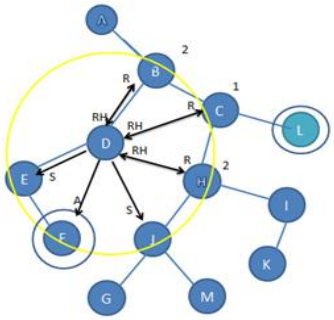

Figure 4. Forwarding packets based on RH values

This process is continued until packets reach its destination point as shown in above and below figure and in return it will send back reply that it received the data

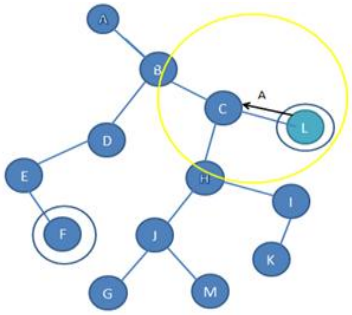

Figure 5. Data reached to destination "L"

V. PERFORMANCE

As per simulation in which RSTR is implemented with network consisting of 50 nodes. As we can see from figure 6 that end to end delay in RSTR is showing no wide deviation in throughout the run time

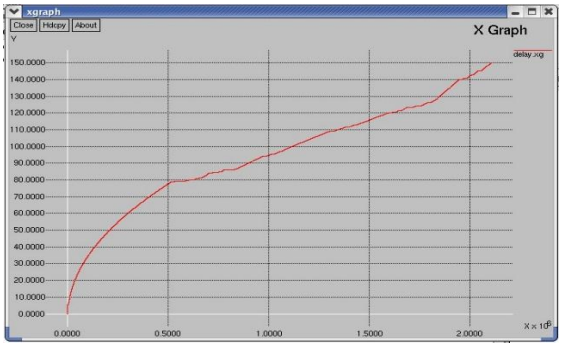

Figure 6. End-to-End delay of RSTR

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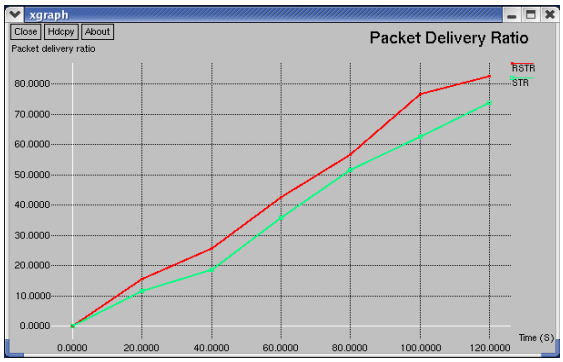

Figure 7. Packet delivery rate comparison between RSTR and STR Algorithms

The packet delivery ratio tends to decrease as the traffic load increases as shown in Fig.7 and it is natural in that contention and collision of packets increase for the higher number of packets. It is interesting to note that the packet delivery ratio of STR decreases to 75% in certain traffic load level in spite of near to the shortest path. On the contrary, RSTR shows nearly 85% packet delivery ratio even in same traffic load

VI. CONCLUSION

On this paper, we advise the rotatory shortcut tree routing mechanism on STR that does not require any direction detection upstairs and memory consumption. While existing routing protocols require extra path discovery to installation the route rate metric or previous understanding to restrict forwarder applicants, RSTR does no longer require any overhead for finding path and forwarder candidate choice. In addition, RSTR diversifies a couple of paths to the vacation spot and mechanically selects the most reliable path in line with the channel situation. And reduces needless packet transmissions as well as shortens the give up-to-cease routing direction of RSTR by using remaining hop values. The performance evaluation proves that the proposed rotatory shortcut tree routing algorithm achieve reliable packet delivery rate with slight stop-to-cease latency regardless of network traffic, and node fault. Therefore, we can expect rotatory shortcut tree routings to be utilized in divorced IoT packages requiring each small resource potential and excessive routing performances.

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Authors Profile

N.Durga Prasad received his B.Tech degree in Computer Science and Engineering from Sri Prakash college of Engineering, JNTU Kakinada, Andhra Pradesh in 2005, M.tech degree in Software Engineering from Avanthi Institute of Engineering and Technology, JNTU Kakinada,Andhra Pradesh in 2011. At present he is working as an Assistant Professor in GayatriVidyaParishad College of Engineering(Autonomous), JNTU Kakinada, Andhra Pradesh with overall teaching experience of 8 years.His research interests include Mobile Ad-hoc Networks, Wireless Sensor Networks and Automata Theory.

D.Sai Ganesh received his B.Tech degree in Information Technology from koushik college of science and engineering,JNTU Kakinada,Andhra Pradesh in 2015. At present he is pursuing M.Tech degree in Computer Science and Engineering in Gayatri Vidya Parishad College of Engineering (Autonomous), JNTU Kakinada, Andhra Pradesh. His research interests include wireless sensor network

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