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SURVEY ON CLUSTER TREE ROUTING IN ZIGBEE NETWORK

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Abstract: The ZigBee tree routing is widely used in many resource-limited places and applications it doesn't require any routing table and route discovery overhead to send a packet to the destination. science, the ZigBee tree routing has the only one limitation that a packet follows the tree topology; thus, it cannot provide the shortest routing path, however we propose the shortcut tree routing (STR) protocol that provides the near optimal routing path as well as maintains the advantages of the ZigBee tree routing such as no route discovery overhead and very low memory consumption. The main goal of the shortcut tree routing is to calculate remaining hops from a random source to the destination using the hierarchical addressing scheme in ZigBee, and each source and intermediate node forwards a packet to the neighbor node with the smallest remaining hops in its neighbor table. In the performance evaluation, we will see that the shortcut tree routing achieves the comparable performance to AODV with limited overhead of neighbor table maintenance as well as overwhelms the ZigBee tree routing in all the network conditions such as network overhead, network configurations type, and the network traffic. Taking into account of low efficiency and high power consumption caused by flooding of RREQ in AODV algorithm, the paper proposes a Cluster-tree routing algorithm to reduce network traffic and enhance efficiency of the whole network.

Keywords: Relays, Wireless Networks, Beamforming, Secrecy Capacity, Eavesdropper

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INTRODUCTION

ZIGBEE [3] is a worldwide standard of wireless personal area network targeted to low-energy consumption, cost-efficient, reliable and scalable products. Different from the other personal area network standards such as Bluetooth, infrared, and Wireless USB, ZigBee provides the low power wireless mesh and tree networking and supports up to thousands of devices in a network. ZigBee tree routing (ZTR) prevents the routing discovery overhead in both memory and bandwidth using the distributed block addressing scheme. In ZigBee tree routing, since each node is assigned a hierarchical address, a source and an intermediate node only decides whether to forward a packet to the child or one of the parents by comparing its address with the destination address. The most benefit of ZTR is that any source node can send a packet to a random destination in a network without any route discovery overheads. In ZTR, Data is transmitted along the tree topology to the destination even if the destination is located nearby. ZTR does not provide the optimal routing path, since it does not require any route discovery overhead. Objective is to provide the near optimal routing path like the reactive routing protocol as well as to maintain the advantages of ZTR such as no route discovery overhead and little memory consumption for the routing table. We propose the shortcut tree routing (STR) that easily enhances the path efficiency of ZTR [6] by only adding the 1-hop neighbor table information. Whereas ZTR only uses tree links connecting the child and parent nodes, STR exploits the neighbor nodes by focusing that there exist the neighbor nodes shortcutting the tree routing path in the tree topology. In STR, a source or an intermediate node selects the next hop node having the smallest remaining tree hops to the destination regardless of whether it is a parent, one of neighboring, or child node. The routing path selection in STR is decided by individual node in a distributed manner, and STR is fully flexible with the ZigBee standard that applies the different routing strategies according to each node's status. It requires neither any additional cost nor change of the ZigBee standard including the creation and maintenance mechanism of 1-hop neighbor information. The main idea of this paper are (1), we propose STR to resolve the main reasons of overall network performance degradation of ZTR, which are the detour path problem and the traffic concentration problem. (2) We prove that the 1-hop neighbor nodes used by STR increase the routing path efficiency and alleviate the traffic load concentrated on tree links in ZTR. (3) We compare the performance of STR, ZTR, and AODV by differentiating the network parameters such as network density, ZigBee network constraints, traffic types, and the network traffic.

Overview of Existing Methods

Zigbee [3] is a new Wireless sensor network technology based on the IEEE 802.15.4 standard [ZigBee Alliance (2004)]. Its use in Wireless Sensor Networks (WSNs) has aroused a great interest in the research community and its deployment will be increasing in the near future. The lifetime and the scalability are the most frequent issues in its deployment. In order to increase the efficiency and scalability of communication, we have improved the ZigBee routing protocol in the large scale network. The new proposed protocol called ZBR-M computes the shortest path between source and destination nodes by requesting the neighbor table information instead of following the tree topology.

AODV (Ad hoc On Demand Distance Vector) Protocol

AODV [1] is a reactive protocol, i.e., the node stays silent until a connection is requested .If a node wants to send the data to another one, it broadcasts a request to its neighbors who re-route the message and safeguard the node from which they received the message. If a node receives a message and it has an entry related to the destination in its routing table, it returns a route request reply through the reverse-path to the requesting node. The source sends the data through given path to the destination with the less number of hops.

Cluster-tree Routing

ZigBee specification introduces two essential algorithms which are applied to different ZigBee networks: the tree routing algorithm used in tree topology and the enhanced Ad hoc On-demand Distance Vector algorithm (AODVjr)[1] used in mesh topology widely. In the mesh network, when the number of nodes increases, the network performance will be reduced. The essence of the AODVjr[1] algorithm is message flooding, so the network scalability will be limited. Aiming at this problem, a Cluster- tree topology [12] [10] is presented, which makes use of the tree routing address assignment mechanism and enhances network scalability. LEE et al presented a ZiCL algorithm of Cluster-tree topology [4], it is to reducing routing discoveries comparing with AODVjr, and enhancing the network performance as well as scalability. Although the routing discovery based on Cluster Label introduced in the ZiCL could reduce RREQ flooding [2] [3], it also needs to initiate the routing discovery process which costs lots of routing overhead and power consumption, with regard to this problem, the paper proposes a method which focuses on reducing the flooding so as to the network traffic, using the gateway node to transfer data packet. The gateway node refers to the node connects with different clusters. ZigBee, a unique communication standard designed for low-rate wireless personal area networks, has extremely low complexity, cost, and energy consumption for wireless

connectivity in inexpensive, portable, and mobile devices. Among the well-known ZigBee topologies, ZigBee cluster-tree is especially suitable for low power and low-cost wireless networks because it provide energy saving operations and fast routing. In a constructed wireless sensor network, the information about some area of interest may require further investigation such that more traffic will be generated. However, the restricted routing of a ZigBee cluster tree network may not be able to provide sufficient bandwidth for the increased traffic load, so the additional information may not be delivered successfully.

Zigbee node has two addresses, 64-bit IEEE address and 16-bit network address. The network address is the unique address could be identified when transfer data and precede routing discovery, the coordinator creates network and can decide on the maximum number of children and depth of network. When a node applies for joining the network, it chooses the parent node with routing capability to join, and then the parent distributes addresses to children. The coordinator is designed as cluster head first, and then assigns every cluster a unique cluster label. The router node with even-depth is regarded as cluster head and the router. A cluster label represents several nodes and the nodes with the same Cluster label share information. The routing algorithm contains intra-routing and inter-routing [12] the source node could choose routing according to computation of the cluster label of the destination. If source node and destination share the same Cluster label, it will choose the intra-routing which is based on tree routing algorithm, the intermediate node transfers data packet to its parent or children. Otherwise when the source and destination are in different clusters, inter-routing is taken into consideration**.**

Zigbee Tree Routing

ZTR is designed for resource constrained ZigBee devices to choose multihop routing path without any route discovery procedure, and it works based on hierarchical addressing method described in [1] and [2]. With the hierarchical addressing scheme, and can easily identify whether the destination is rechable of each source or intermediate node. In ZTR, each source node sends the data to one of its child if the destination is descendant; otherwise, it sends to its parent In addition to the roundabout path problem, ZTR has the traffic conjunction problem due to short tree links. Since all the packets pass via tree links, especially around the root node, severe congestion and collision of packets are concentrated on the limited tree links. This symptom becomes worse as the number of data packets increases, and causes the decrease of the packet delivery ratio, and other network performances.

Short Cut Tree Routing

We propose the STR algorithm that solves the two problems of the ZTR[6] by using 1-hop neighbor table information. The STR [8] algorithm basically follows ZTR, but chooses one of neighbor nodes as the next hop node when the remaining tree hops to the destination can be reduced. STR computes the remaining tree hops from the next hop node to the destination for all the neighbor nodes, and selects the node as the next hop node to transmit a packet to the destination.

The cluster head root head, the remaining cluster heads that are that are within the large cluster or the even-nodes which are cluster heads only those having the permission for communication or transmission of the data. The STR (Shortest Tree Routing) Works under the intra cluster mechanism i.e. the transmission will be the done within sub-cluster only. The ZTR (Zigbee Tree Routing) will be applicable when the destination node and the source node are not in the same cluster or in the different cluster.

CONCLUSION

The main concept of hybrid technique is to use cluster tree routing algorithm along with ZTR and STR technique. By using these two techniques the time taken to reach the packet from source to destination can be less. There are two methods to route the packet in cluster tree that is (i) intra-routing and (ii) inter- routing

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