



A Survey on Cluster Based Multipath Tree Routing in ZigBee Wireless Network

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Abstract— ZigBee wireless network are ad-hoc network comprised mainly of small number of nodes with limited resources, and rapidly emerging as a technology for large-scale, low-cost, low-power and reliable of different application of interest like smart domestic appliances, building automation etc. Cluster based multipath routing has been proposed for these networks for overcoming routing overhead, low memory consumption, end-to-end delay and provide detour routing path. In this paper, we surveyed the problems of routing in cluster based routing protocols and some of traditional routing protocols for homogenous networks consisting of nodes with several limited resources. Here the routing issue is concerned while sending the packet or data information to node through cluster-based ZigBee network. In this paper we have studied the different parameters for optimal routing path.

Keywords— Cluster based ZigBee network, Routing protocols, WSN, IEEE 802.15.4 standard

I. INTRODUCTION

A ZigBee wireless network is a network system comprised of mainly distributed devices using number of nodes for making data communication in domestic and industrial or business environment. ZigBee makes home network for data communication and Efficient routing path for transmission is one of the most important issues for WSNs. Zigbee Alliance developed technology named Zigbee, which comes under Wireless Personal Area Networks (WPAN). It is based upon IEEE 802.15.4 standard for data communication in domestic and business devices. It connects between device and system. Zigbee device provide specifications Low cost, Low data Rate, require very Low Power and provide long battery life. It makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit. The list of application in which Zigbee works are: Home Automation, ZigBee Smart Energy, Telecommunication Applications, Domestic or Personal Home and relate services. ZigBee wireless network are ad-hoc network comprised mainly of small number of nodes with limited resources, and rapidly emerging as a technology for large-scale, low-cost, low-power and reliable of different application of interest like smart domestic appliances, building automation etc[1].

Cluster based multipath routing has been proposed for these networks for overcoming routing overhead, low memory consumption, end-to-end delay and provide detour routing path. In this paper, we surveyed the problems of routing in cluster based routing protocols and some of traditional routing protocols for homogenous networks consisting of nodes with several limited resources. Here the routing issue is concerned while sending the packet or data information to node through cluster-based ZigBee network. In this paper we have studied the different parameters for optimal routing path.

II. RELATED WORK

The number of literatures specifically targeted to routing of WSN. has grown significantly. Here, we provide a sample of studies based on routing methods, and focus on optimal routing of ZigBee wireless network.

T. Clausen and P. Jacquet [2] proposed an algorithm for routing in cluster based network which is an optimized link state routing protocol (OLSR), protocol is proactive or table driven. Its routing is periodic in nature via source to destination and maintain information of topology at every node. This protocol is better suited for large network topology and comes under efficient flooding in routing. In any network where communication takes place between number of nodes OLSR is adapted but due to excessive control overhead protocol has to suffer. In routing each node uses its updated information for routing a packet to its destination node.

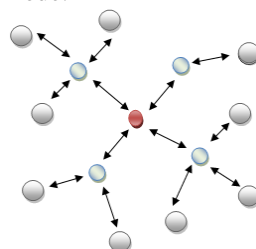


Fig. Cluster Topology

Charles Perkins [3] proposed first algorithm for ad hoc wireless network which is named Destination sequenced distance vector (DSDV) routing. It include table updates for number of tags which avoid looping and problem of count to infinity and for appropriate solution. As it is table routing, all nodes are available with their destination all time. If any change happens in network topology tables are forwarded to respective node. In protocol convergences of delay involved in routing and in ad hoc wireless network protocol is not scalable. Other disadvantage is that, until table updates a node has to wait and create overhead delay.

In Ad hoc on demand distance vector (AODV) routing protocol by Charles Perkins [4] uses an on demand approach for finding routes. when a source node require to transmit and establishing connection to a destination node it transmit data packets. this protocol allocate sequence number to most recent packet and next hop information is stored in intermediate node. It uses a destination sequenced number (dest_seq_num) to determine the updated information of destination path. If the current dest_seq_num is greater than last dest_seq_num then it is node updates its path. Due to intermediate node inconsistency overhead occur.

The ZigBee tree routing (ZTR) follows the tree topology for transmission. The basic problem of the general tree routing protocol is that overall network performance degradation, suffer from optimal routing path and traffic concentration problems like ZigBee[5]. ZTR has the traffic concentration problem due to limited tree links .The root node severe congestion and collision of packets.

Jianpo Li and Xuning Zhu [6] proposed Improved algorithm where Cluster-Tree parameter of ZigBee network and network addresses of destination nodes is been transfered. This combination is used to control the transmission range and restrict its transmission direction. Control overhead is been reduced about a half without influencing packet delivery ratio and path length of ZigBee network.

Table 1 Description and improvements in Protocol

Protocol	Description	Improvements
AODV	Multipath routing, heavy control overhead and unnecessary bandwidth consumption in dynamic-AODV, energy aware-AODV, AODV-fuzzy logic.	Reliable, lower overhead, limited energy use, decrease in end to end delay upto 13.7%, routing efficiency.
ZTR	Tree topology format, detour routing path, route discovery overhead in Fuzzy-Logic based tree routing, Neighbor Tree Routing and Self learning routing	Half of control overhead, limit number of nodes, reduce network cost, reduction in end delay and network time.
STR	1-Hop information of neighbor, follows ZTR, select parent and child as next hop node.	10-20 percent of hop distancs saves as compared to AODV and leads to reduction in routing cost

Antonio M. Ortiz [7] proposed Fuzzy- Logic based Tree Routing (FL-TR) Set-up network time and the number of router nodes in the network get reduced i.e. path length get reduced,here path length represents the number of forwards that a packet needs to reach the coordinator.And which leads in reduction of energy consumed by nodes in the network. Self-Learning Routing (SLR) protocol [8] proposed by Chia- Hung Tsai given overhearing and a caching mechanism, In overhearing neighbors packets, running nodes gradually learn better routing paths to destination. It does not rely on sending any route discovery packets leads to decrease in the end delay. SLR is same as ZigBee tree routing and takes advantage of mesh routes without sending any route discovery packet.

Neighbor Tree Routing (NTR) [9]. It can reduce the network costs and Difference of sending time of a packet and receiving time of a packet including all possible delays, leading to the energy conservation and the real time of the network enhancement. Taehong Kim proposed Shortcut tree routing protocol (STR) [10] It leads to decrease in the routing cost of ZigBee tree routing by using the neighbor table that is originally defined in the ZigBee standards. In tree routing overhead is generated, to reduce this STR is suggest to check neighbor node before sending packet to source or destination node. And results shows that it save 30 percent of less hop count then ZigBee tree routing.

Improved Tree Routing (ImpTR) protocol [11] The new ImpTR protocol determines the shortest path to the sink node depending on the neighbor table instead of following the tree topology. Results show that the proposed algorithm provides shorter average difference of sending time of a packet and receiving time of a packet including all possible delays, increase number of bits passed through a network in one second. Measurement of how fast data can pass through an entity and decrease in consumption of energy from the network when compared to the original tree routing routing protocol.

Below shown some parameters which are used in determination of routing protocol efficiency.

Table 2. List of parameter used in routing

Parameters	Definition
Optimal path length	Ratio of total transmission times to total number of received packets

Average end to end delay	Difference of sending time of a packet and receiving time of a packet including all possible delays
Packet delivery ratio	Delivery of packets successfully received ,to packets transmission ratio in MAC sub layer.
Packet loss (%)	Percentage of failure of more than one transmitted packets to the arrival at their destination
Throughput	Number of bits passed through a network in one second. Measurement of how fast data can pass through an entity
Normalized Routing Overhead	Routing control number required by sending each data packet. More protocols overhead, more will be the network congestion.
Hop delay	Transaction time of passing a packet to a one-hop neighbor, including all processing time
Network Lifetime	More numbers of sensor nodes are dead or shut down at less amount of time during simulations

III. CONCLUSION

In this paper we studied the different protocols for routing using the clustered based ZigBee wireless network. Clustered based ZigBee network has been proposed for the ad-hoc network. In this study the idea getting for an optimal routing and normalized throughput. So in the future work we will implement the network with an efficient protocol efficiency constrains with calculation of bandwidth require in network.

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