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# Designing of Advanced and Efficient Tree Routing in Zigbee Wireless Network

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**Abstract**——Zigbee is a distinctive communication criterions principally aimed to be deployed for wireless personal area networks with low rate. It's an IEEE 802.15.4 based usual incurring minimal amount of complexity, cut rate and low strength consumption. Zigbee cluster-tree be good-recognized zigbee topologies especially suitable for WSN's consuming low strength and sustaining cut rate since it supports power rescue operations. When Zigbee cluster network generates more traffic, the performance of the network tends to decline due to lack of bandwidth utilization. The earlier techniques employed for the purpose was providing supple routing and increased bandwidth utilization. But they tend to compromise on an ideally and convergence rage of bandwidth usages. Thereby we propose as Enhanced Distributed Adoptive Parent (EDAP) based structure for Zigbee cluster tree networks that manages changing traffic weight communication at any granted moment. The nodes collecting the sensed data are appropriated depending on the traffic load demands. Such a framework when applied improves bandwidth of the network and in turn improves the overall performance of the network.

***Index Terms*** *— Zigbee cluster tree network, EDAP, bandwidth*

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## I. INTRODUCTION

ZigBee is a current wireless standard based on IEEE 802.15.4 used in Wireless Sensor Networks (WSNs) stimulates many interests. Recent advances in wireless communications and micro electro mechanical technologies have had a strong impact on the development of wireless sensor networks (WSNs). The ZigBee protocol is a worldwide open standard providing low-power, wireless connectivity for a wide range of applications that perform monitoring or control functions ZigBee enhances the functionality of IEEE802.15.4 by providing flexible, extendable network topologies with integrated setup and routing intelligence to facilitate easy installation and high resilience to failure. The features of this wireless connectivity standard allow ZigBee-based products to be installed easily and cost effectively, and its built-in intelligence and flexibility allow networks to be easily adapted to changing needs by adding, removing or moving network devices. The protocol is designed to allow devices to appear and disappear from the network, so devices can be put into a power saving mode when not active. This means that many devices in a ZigBee network can be battery powered, making them self-contained and reducing installation costs. The range of a radio transmission is dependent on the operating environment; for example, indoors or outdoors., from light switches, active tags and security detectors, to solar-powered monitoring. The ZigBee and IEEE802.15.4 protocols are specifically designed for battery-powered applications.

IEEE 802.15.4 committee started working on a low data rate standard a short while later. Then the ZigBee Alliance and the IEEE decided to join forces and ZigBee is the commercial name for this technology. ZigBee is expected to provide low cost and low power connectivity for equipment that needs battery life as long as several months to several years but does not require data transfer rates as high as those enabled by Bluetooth. In addition, ZigBee can be implemented in mesh networks larger than is possible with Bluetooth. ZigBee compliant wireless devices are expected to transmit 10-75 meters ZigBee can be easy to implement and less power required to operate, the opportunity for growth into new markets, as well as the innovation working existing markets, is limitless. The applications supported by ZigBee include home automation schemes, remote control and monitoring systems and healthcare devices too.

## II. LITERATURE SURVEY

ZigBee, which is based on the IEEE 802.15.4 standard, defines the network (NWK) layer and the application layer (APL) in the protocol stack. There are three types of device in a ZigBee network: a coordinator, a router, and an end device. A ZigBee network is comprised of a ZigBee coordinator and multiple ZigBee routers/end-devices. The coordinator provides the initialization, maintenance, and control functions for the network

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| S.N. | Paper Title | Explanation |
|---|---|---|
| **1.** | ”Distributed Throughput Optimization for Zigbee Cluster-Tree Networks”IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, VOL. 23, NO. 3, MARCH 2012 | In this paper, an adoptive-parent-based framework for a Zigbee cluster tree network to increase the bandwidth utilization without incurring any extra message exchange. The results of simulationExperiments demonstrate the significant performance improvement achieved by the proposed framework and algorithm over existingapproaches. |
| **2.** | “A Cluster Based Minimum Battery Cost AODV Routing Using Multipath Route for ZigBee,” | In this paper, a Multipath Energy Aware AODV (ME-AODV) routing to improve the performance of existing ZigBee routing protocol. ME-AODV divides the ZigBee network into logical clusters. |
| **3.** | “Energy Efficient Zigbee Cluster-Tree Wireless Sensor Network Using Modified Distributed Algorithm” | Cluster-tree network is one of the special case of a peer-to-peer network in which most devices are Full Function Devices(FFDs) and Reduced Function Devices (RFDs) may connection a cluster-tree network as a leave node at the bottom of a branch. |
| 4. | “Routing in ZigBee: Benefits from Exploiting the IEEE 802.15.4 Association Tree,” | This paper explores the cross-layer interdependencies between the topology formation and routing mechanisms to set-up energy efficient routing paths towards a sink. |

**Objective**

- Our objective is to provide more flexible routing and increase bandwidth utilization without violating the operating principles of the ZigBee cluster-tree protocol.
- We are using an adoptive-parent-based framework, to increase bandwidth utilization without generating any extra message exchange.
- An improvement in AODV routing protocol to increase the throughput of zigbee wireless network.
- Packet delivery ratio improvement, i.e the ratio of actual power delivered to total power send.
- For extra bandwidth, adoptive parents increase the bandwidth between the source and the sink.

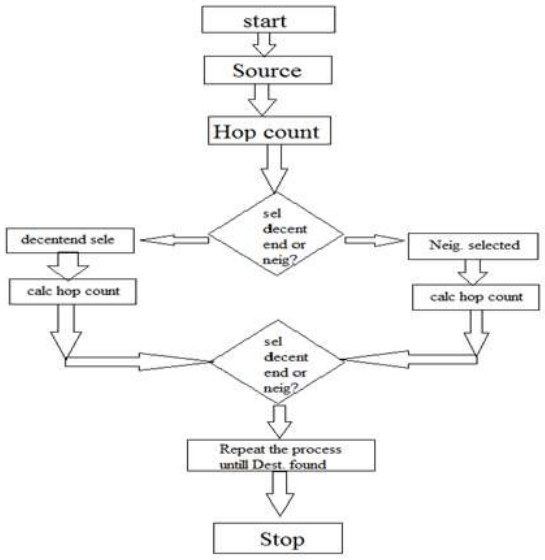


**Fig. Flowchart of the Proposed System**

**Simulation Using NS-2**

**Table 1: Simulation Parameters**

| Parameter | Quantity |
|---|---|
| Channel type | Channel/Wireless Channel |
| Radio-propagation model | Propagation/TwoRay Ground |
| MAC | Mac/802_15_4 |
| Interface queue type | Queue/DropTail/PriQueue |
| Number of nodes | 101 |
| Routing protocols | AODV |
| Type of antenna | Omni- direction antenna |

**Network simulation**

The Network Simulator NS-2 (ns-allinone-2.28) is being used to perform the simulation due its flexibility in simulating the variety of networks and ease of use. We have considered a network scenario consisting of 101 nodes. One is Zigbee coordinator (ZC), 71 nodes are taken as Zigbee Routers (ZR) and 29 nodes are taken as Sensors in an area of 80 meter square. An AODV routing method is incorporated to analyze the behavior of the system. Following are the simulation parameters deployed in the simulation.

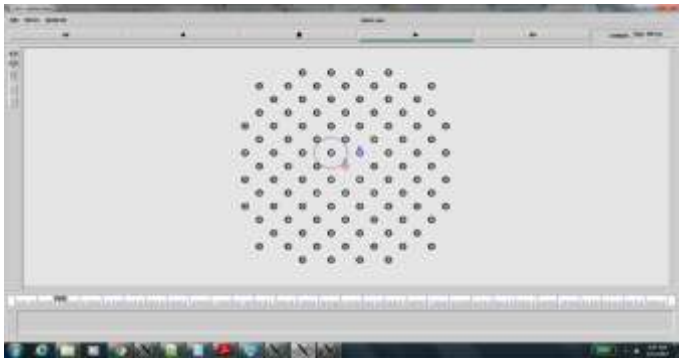

**Fig. Formation of the Zigbee Network**

The above figure shows the formation of the zigbee network. The Zigbee Coordinator sends beacon packets to its neighboring in order to identify the Zigbee Routers and Sensors. The Zigbee Coordinator performs the function of initialization of network operations, maintenance of network and controlling. It sends periodic beacon frames to serve to synchronize the remaining nodes. ZC is the root of the tree structure.

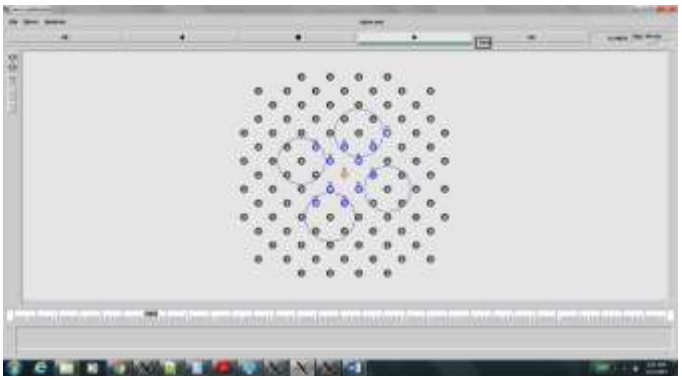

**Fig. Cluster-Tree Network**

In order to form a cluster-tree network, every node other than ZC receives beacon from their parents and sends their own beacons to identify and synchronize the nodes belonging to its cluster. As can be seen in above screenshot of simulation where nodes 21, 22,23 and 24 are sending the beacon packets to their neighbors to identify the nodes belonging to their cluster. They have received the beacon from their parents viz node 10, 7, 8 and 9 respectively. The procedure is followed until leaf of the tree is identified.

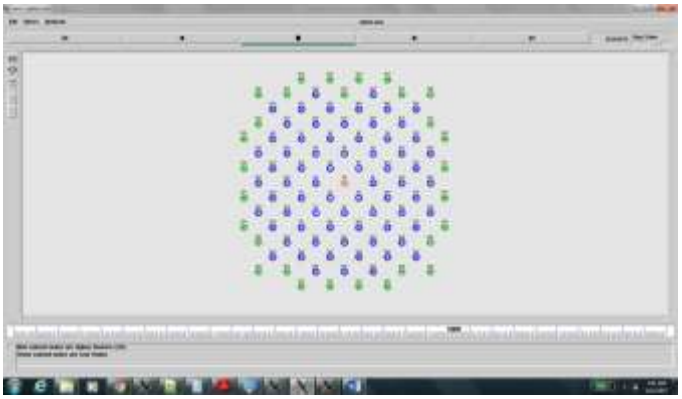

**Fig. Nodes Communicating with each other in Network**

The above figure shows completion of network formation process. The types of devices in cluster tree zigbee network can be clearly distinguished. The red colored node is ZC. The blue colored nodes are ZR which in turn forms a cluster of ZRs and a tree structure rooting from ZC going towards leaf nodes i.e. Sensors which are marked by green color in the simulation.

After formation of the network the bandwidth requirements are calculated in order to serve the network in efficient manner.

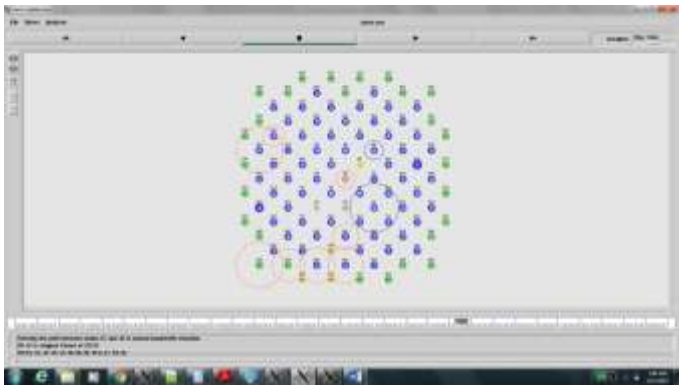

**Fig. Route Discovery Process**

Now leaf node 95 has sensed some data and it needs to send it to the sink node 45 where the requirement of bandwidth is normal i.e. a bandwidth requirement which doesn't exceeds the available bandwidth. The cluster head of the node 95 i.e. node 67 sends a request to its original parent i.e. node 45.

The route discovery process starts as can be seen in the above simulation screenshot where ZRs are sending route discovery packets to their neighbours in order to establish a path between node 67 and sink 45.

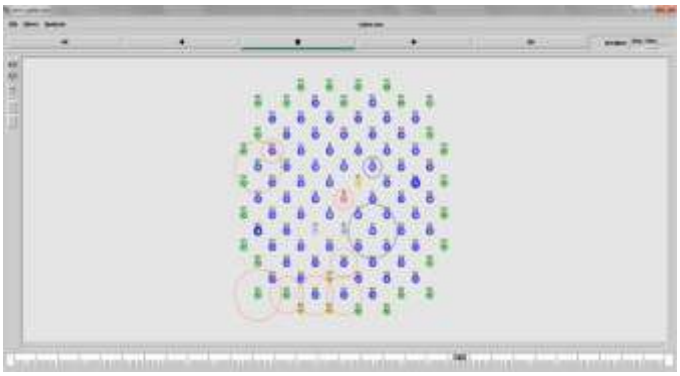

**Fig. Zigbee Cluster Tree Network on Network Animator**

After receiving the Acknowledgement packets from the available nodes, a path between node 67 and 45 is formed as indicated by nodes highlighted with purple circles. The data packets are then sent along with this discovered path i.e. 67-47-35-15-38-58-30-18-6-21-29-45. Node 47 is the original parent of ZR 67.

Now leaf node 87 also sensed some data and needs to send the same to sink 45 through its cluster head ZR 67. This is a scenario where there is requirement of additional bandwidth than the available original parent node of ZR 67 can handle.

In such a case a new parent i.e an adaptive parent with available amount of bandwidth is found. In our simulation the adaptive parent of ZR 67 is 55 through which a new route is discovered and data packets are transmitted towards destination as shown in below figure. The path is highlighted using brown color 67-55-27-58-30-18-6-21-29-45.

## III. CONCLUSION

The simulation studied the behavior of the topologies against throughput, delay, End to end delay, load, data traffic sent, data traffic received and number of hops. We found that PAN 2 coordinator behaved as the best tree among the cluster tree topologies and this was because of the structure of the WPAN devices. The routers in PAN 2 acts as coordinators which lets to speed up the throughput of the network. Also the mobile nodes affiliations were studied

Due increasing network load the network performance of the network is degraded continuously. For improving efficiency of network a new approach of network arrangement is proposed and implemented that is also known as a cluster tree organization. For simulating the performance of the system we create two different scenarios first dense and the second less dense and evaluate the performance for both. After implementation of desired cluster tree network, we conclude that the network is not much affected due to increasing the number of nodes in the network. Actual performance degradation is found when the density of the network is increasing. According to the results, be the newly arranged network perform well than old network.

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