Capacity Calculated Coordinator Selection For Node Deploied Cluster Tree Topology in WZNs

Ajeesh S[1], Angel Mary Mathew[2]

[1, 2] M.Tech Student, Department of Electronics and Communication Engineering,
Mount Zion College of Engineering, Kadammanitta, Pathanamthitta, Kerala, India

Abstract: ***A ZigBee network usually uses a tree topology to construct a wireless sensor network for data delivery applications. There are 3 types of nodes in ZigBee networks; coordinator, router and mobile end devices. Coordinator performs the initialization and maintenance functions in the network. A router is responsible for routing data between the coordinator and mobile end device. In order to avoid the delivery failures occurs due to node movements and network topology changes, the existing system collect and analyze data about device movement and gives ZigBee node deployment and tree construction framework, which uses three algorithms ZND(ZigBee node deployment), ZCD(ZigBee coordinator decision) and ZTC(ZigBee tree construction). In the proposed system we improve the data delivery by introducing the capacity calculation. If any two nodes have same number of in degree or out degree, we select the node with maximum capacity.***

Keywords: ZigBee node deployment(ZND),ZigBee coordinator decision(ZCD),ZigBee tree construction(ZTC), Wireless ZigBee networks (WZNs)

1. Introduction

This ZigBee is a typical wireless communication technology, which is widely used in wireless sensing networks. ZigBee wireless sensor network is widely used in military security, environment monitoring, and home automation. Various progressive wireless communication standards were developed and implemented into practice during the last decade. GSM, Wi-Fi and Bluetooth are well known amongst people in the modern society. These standards have penetrated into their daily routine with outstanding popularity. "An Internet of people" has become ordinary for everyone who wants to have everybody and everything within reach. Even though it seems that all peoples' wireless requirements have fulfilled, it turns on, that they lack of something like "an internet of things" especially in mainstream Home Automation (HA). As a new technology, in the practical application the advantage of the ZigBee wireless sensor network was not very ideal, especially in a large scale wireless ZigBee sensor network, because the coordinator processing ability is limited. In the large scale ZigBee wireless network the coordinator should deal with too much message, so some shortcomings come out, such as information time delay, data packet loss, and sensor node out of control.

In ZigBee networks, we often use the tree topology to construct a wireless sensor network for data delivery applications. Due to the node movements and Network Topology changes, the delivery failures are occurring constantly in ZigBee Wireless Networks. The location of the mobile end device is recognized by the network and maintained by the coordinator, which identifies the last router that was used to forward the end devices uplink data packets. When a downlink packet is sent to a mobile end device, the coordinator delivers the packet to the last recorded location, i.e., the last router that received the uplink packet from the mobile end device. Upon the reception of the downlink packet, the router simply forwards it to the mobile end device and waits for an acknowledgement message from the end device. If the mobile end device has moved from the last known location, the data delivery fails, and the coordinator starts a search by broadcasting a message that asks for information about the mobile end device's current location. Broadcast operations are expensive in terms of bandwidth and power consumption, particularly when mobile end devices frequently move between different routers' coverage areas.The conventional route reconstruction method is designed to mitigate the effects of topology changes, but it consumes a large amount of resources. So the positions of the routers are determined and design the tree topology so that most movements are directed towards the root of the tree. To achieve our objective, we gather information about node movements in the environment and construct a ZigBee tree topology framework.

2. Related Work

ZigBee is a specification formalized by the IEEE 802.15.4 standard for low-power low-cost low-data-rate wireless personal area networks. A ZigBee network comprises the following three types of devices:
1) A coordinator;
2) Multiple routers;
3) Multiple end devices.

The coordinator performs the initialization, maintenance, and control functions in the network. A router is responsible for routing data between the end devices and the coordinator. An end device is not equipped with forwarding capability, and its hardware requirements are minimized to control costs.

In ZigBee networks, a tree topology is often used to construct a wireless sensor network for data delivery applications. in cluster tree and mesh networks, the devices communicate with each other in a multi hop fashion A *device discovery* procedure is triggered if the central server cannot locate a certain mobile end device. During the procedure, the central server simply floods the whole network with messages to locate the displaced end device. However, flooding the network is costly in terms of resources, and during the procedure, the network cannot accommodate multiple instances of rapid node mobility. Thus, we need a more efficient and automatic approach for locating mobile end devices. In many applications, the mobility patterns of sensor nodes are inherently regular due to the geographical structure of the network or physical constraints. The regularity provides useful information that can be exploited to construct a proper routing topology for sensing data deliveries.

To improve the data delivery ratio, an approach is used that exploits the aforementioned information to optimize the locations of routers and construct a mobility robust tree topology in a ZigBee wireless network. The approach deploys routers and constructs a topology with the property that mobile nodes will move along the constructed data-forwarding path with high probability. Data will reach the target mobile nodes as long as they are within the transmission range of any router on the forwarding path. In other words, We choose the positions of the routers and design the tree topology so that most movements are directed toward the root of the tree. To achieve this objective, WE gather information about node movements in the environment and construct a ZigBee tree topology framework. In particular, the framework considers the regularity of the mobility patterns during the construction of the tree and deployment of the routing nodes, and it heuristic and low-complexity algorithms for node deployment and tree construction and analyzes their performance in ZigBee networks

When constructing the tree topology, the nodes having maximum indegree are selected. So if there are two nodes having same indegree the nodes will be selected randomly. This will reduce the efficiency of the system. To overcome this disadvantage the proposed system introduces capacity calculation of nodes to find the best node, when two or more nodes have same indegree

3. Problem Definition and Objective

A mobile end device simply sends a packet, which is then forwarded to the coordinator through the routers. Upon the reception of the downlink packet, the router simply forwards it to the mobile end device and waits for an acknowledgement message from the end device. If the mobile end device has moved from the last known location, the data delivery fails, and the coordinator starts a search by broadcasting a message that asks for information about the mobile end device's current location. Broadcast operations are expensive in terms of bandwidth and power consumption. So the existing system deploys routers and constructs a topology with the property that mobile nodes will move along the constructed data-forwarding path with high probability. The nodes are selected in such a way that the nodes having maximum indegree are included.

If two or more nodes have same indegree the nodes will be selected randomly. So in the proposed system we introduce capacity calculation to find the best node. When two or more nodes have same indegree, the capacity of each node is calculated and the node with maximum capacity will be choose. This will allows to choose the best node when two or more nodes ,which has maximum connectivity, have the same in-degree. It will allow the network to find the best path by which the data will be delivered to the destination. This Model Consist of Three Phases namely.

- ZigBee Node Deployment-which determines the number and locations of router nodes;
- ZigBee Coordinator Decision- which selects one of the router nodes as the coordinator by calculating its in-degree connectivity. A router node which has the maximum number of in-degree is considered as coordinator for the entire data transfer;
- ZigBee Tree Construction- constructs a mobility robust ZigBee tree based on the deployment in the previous two phases

4. Architectural Representation

ZigBee networks, a device discovery procedure are triggered if the central server cannot locate a certain mobile end device. During the procedure, the central server simply floods the whole network with messages to locate the displaced end device. Flooding the network is costly in terms of resources, and during the procedure, the network cannot accommodate multiple instances of rapid node mobility. In many applications, the mobility patterns of sensor nodes are inherently regular due to the geographical structure of the network or physical constraints. The regularity provides useful information that can be exploited to construct a proper routing topology for sensing data deliveries. The approach deploys routers and constructs a topology with the property that mobile nodes will move along the constructed data-forwarding path with high probability. WE also design heuristic and low-complexity algorithms for node deployment and tree construction. There are three such algorithms. The algorithm is implemented in the following three phases: 1) ZigBee node deployment (ZND); 2) ZigBee coordinator decision (ZCD); and 3) ZigBee tree construction (ZTC). The ZND phase determines the number and locations of router nodes, the ZCD phase selects one of the routers as the coordinator, and the ZTC phase constructs an MRZT based on the deployment in the previous two phases.

The nodes with maximum Indegree are selected for forwarding the packet. The disadvantage of this system is that when two or more nodes have same indegree any node will be selected randomly. This may reduce the efficiency. To overcome this drawback we introduce capacity calculation. This algorithm calculates the capacity of each node and compares it. Capacity means the ratio of packets that the node sends successfully out of which it receives. Nodes having highest ratio is said to have highest capacity. This will improve the efficiency of the system and improve the data delivery ratio.

5. Modules and Description

5.1 Node Deployment

A ZigBee wireless sensor network is a collection of nodes cooperates with each other and forms a network. There are three types of nodes in a ZigBee network.1) Coordinator 2) Router and 3) Mobile end device. For Initializing a network first a central server will continuously send beacon signals for finding the neighboring nodes. On receiving this signal the node will send an acknowledgement to the central server. This node will be registered in the network

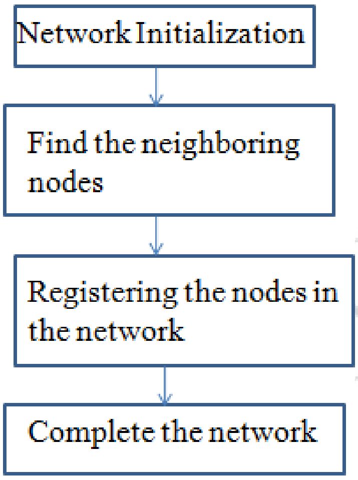

Figure 1: Node deployment

5.2 Coordinator Decision

The coordinator performs the initialization, maintenance, and control functions in the network. This module will select the coordinator node in the network. For this, the indegree of each node will be calculated. The node with maximum indegree will be selected as the coordinator

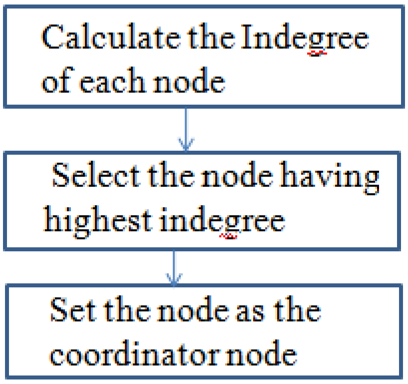

Figure 2: Coordinator decision

5.3 Tree Construction

This module gathers information about node movements in the environment and constructs a ZigBee tree topology framework. In particular, the framework considers the regularity of the mobility patterns during the construction of the tree and deployment of the routing nodes. The tree is constructed in the following three phases:
1) ZigBee node deployment (ZND);
2) ZigBee coordinator decision (ZCD)
3) ZigBee tree construction (ZTC).

The ZND phase determines the number and locations of router nodes, the ZCD phase selects one of the routers as the coordinator, and the ZTC phase constructs an MRZT based on the deployment in the previous two phases.

5.4 Capacity Calculation

The nodes with maximum Indegree are selected for forwarding the packet. The disadvantage of this system is that when two or more nodes have same indegree any node will be selected randomly. This may reduce the efficiency. To overcome this drawback we introduce capacity calculation. This algorithm calculates the capacity of each node and compares it. Capacity means the ratio of packets that the node sends successfully out of which it receives. Nodes having highest ratio is said to have highest capacity. This will improve the efficiency of the system and improve the data delivery ratio.

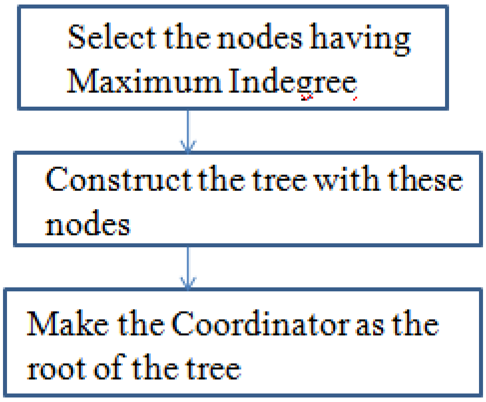

Figure 3: Tree Construction

In this module the data will be routed to the destination. First the sever will route the data to the coordinator. Coordinator then routes the data to the mobile end device. Router will be having the location of the mobile end devices. So the router will forward the data to the mobile end devices

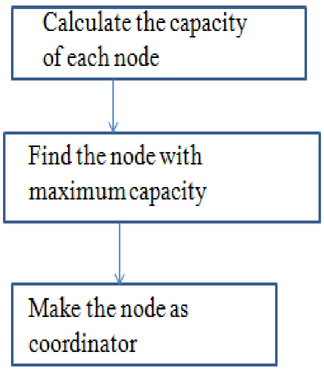

Figure 4: Capacity calculation

6. Simulation Output

The proposed system is implemented in NS2 software by using 100 nodes. All the algorithms are executed in the simulation and obtain the related performance evaluation graph using xgraph application. Figure 5 shows the network throughput when the number of node increase which participating the data transfer. And the figure 6 shows the average packet delivery ratio with respect to time.

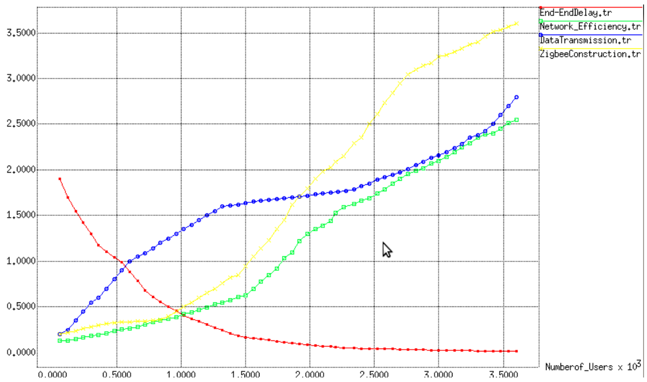

Figure 5: Throughput of the network versus the number of node participating the data transfer in the network

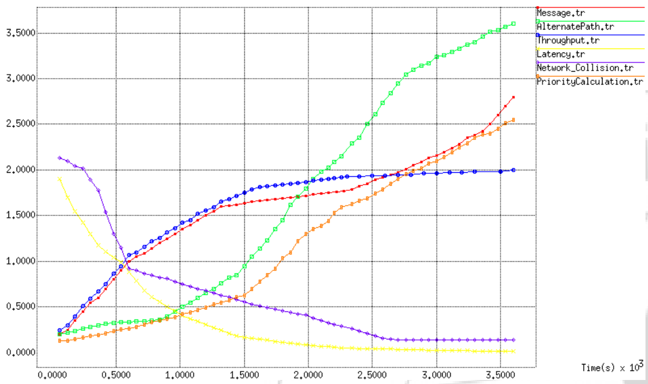

Figure 6: Packet delivery ratio versus time

7. Conclusion

This paper proposes a scheme that exploits the regularity in node movements in wireless ZigBee networks. It proposes three algorithms to construct mobility based ZigBee cluster tree topology. The primary objective of the proposed approach is to deploy the routers and construct a tree topology that enables mobile end devices to move with high probability in the direction of the routing paths. The proposed system implements the capacity calculation to find the coordinator node. When two or more nodes have the same indegree the proposed system will calculate the capacity of each node and selects the node with maximum capacity as coordinator node. It will allow the network to find the best route through which the data will be delivered to the destination

References

[1] Yuan-Yao Shih, and Wei-Ho Chung, "A Mobility-Aware Node Deployment and Tree Construction Framework for ZigBee Wireless Networks," IEEE transactions on vehicular technology, vol. 62, no. 6, july 2013,

[2] W. Chung, P. Hsiu, Y. Shih, A. Pang, Y. Huang, and K. Hung,"Mobilityrobust tree construction in ZigBee wireless networks," in Proc. IEEE ICC, 2011, pp. 1–6.

[3] WE. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "A survey on sensor networks," IEEE Commun. Mag., vol. 40, no. 8, pp. 102–114, Aug. 2002.

[4] WE. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: A survey," Comput. Netw., vol. 38, no. 4, pp. 393–422, Mar. 2002.

[5] A. Mainwaring, D. Culler, J. Polastre, R. Szewczyk, and J. Anderson, "Wireless sensor networks for habitat monitoring," in Proc. ACM WSNA, 2002, pp. 88–97.

[6] K. Akkaya and M. Younis, "A survey on routing protocols for wireless
sensor networks," Ad Hoc Netw., vol. 3, no. 3, pp. 325–349, May 2005

[7] load for the UTRAN LTE downlink," in Proc. 2007 IEEE VTC, pp. 699–703.

Author Profile

Ajeesh S: received the B.Tech degrees in Electronics and Communication Engineering from M.G University, Kerala at Mount Zion College of Engineering in 2012. And now he is pursuing his M.Tech degree in Communication Engineering under M.G University in Mount Zion College of Engineering.

Angel Mary Mathew: received the B.Tech degrees in Electronics and Communication Engineering from Kerala University, Kerala at Baselios Mathews II College of Engineering in 2012. And now she is pursuing her M.Tech degree in Communication Engineering under M.G university in Mount Zion College of Engineering.