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Effect of Mobile Device Number on Zigbee Mesh Network

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Abstract

The purpose of this paper is to analyze the effect of mobile end device on Zigbee mesh network. Shows variation when use several numbers of mobile end devices. The performance is analyzed in term of Throughput, End to end delay and Packets dropped using OPNET simulator.

Keywords: *ZigBee, Mesh topology, Hexagonal Configuration, Mobile end device, Throughput, Delay.*

1. Introduction

In this paper, we perform extensive network evaluation to study the effect of end device mobility on Zigbee mesh network. For accomplishing the aforementioned aim, the assignment begins with the Brief synopsis of Zigbee standard and its topologies. In addition to this, the mobility support in mesh topology and router configuration will also defined. In the latter part of the paper, simulation models and results will represent.

2. ZigBee IEEE 802.15.4 Standard

The goal of the IEEE 802.15.4 standard is to provide a low-power, low-cost and highly reliable protocol for wireless connectivity among inexpensive, fixed and portable devices. These devices can form a sensor network or a Wireless Personal Area Network (WPAN). The standard defines a physical layer and a MAC sub layer. Three different frequency ranges are offered. The most important one is the 2.4 GHz range.

2.1. ZigBee Topologies

A ZigBee network can adopt one of the three topologies: star, tree and mesh topology.

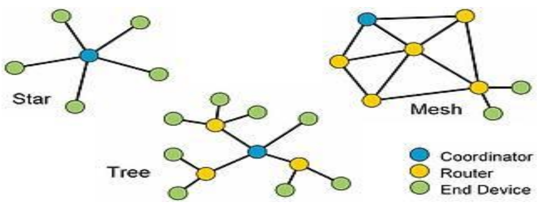

Figure 1: Zigbee Nodes and Topologies

2.2. Mobility Support in ZigBee Mesh Topology

2.2.1. Mobile End Device

When an end device moves out of the range of his parent router,

If this end device is receiver the source nodes will receive a route error message and trigger Device Discovery primitive in the application layer.

If this end device is sender transmission will be temporally disrupted for the duration it takes for the mobile to find a new parent router to associate itself with.

2.2. 2. Mobile Router

Whenever an existing route failed, whether a router is sender or receiver built in route recovery mechanism (via router discovery and route error). ZigBee routers are robust to effects from most mobility cased.

2.3. Arrangement of Routers

To avoid the deviation in the results due to the random arrangement of routers, two specific router configurations are used.

2.3.1. Square Configuration

In this configuration, routers are arranged on the corners of a network field. The position of routers is such as to cover the entire network field. The routers are not in the radio range of each other.

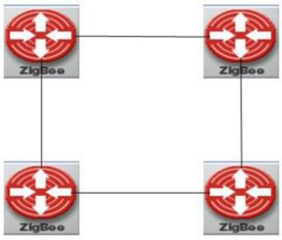

Figure 2: Square Configuration

2.3.2. Hexagonal Configuration

In this configuration, routers are arranged so as to cover the entire network field and forming a hexagon. The vertices of the hexagon represent the routers. The routers are within the radio range of two adjacent routers. From previous projects results, the Hexagonal con-figuration provide best results than Square configuration.

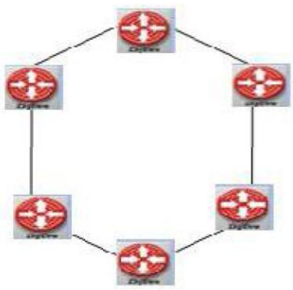

Figure 3: Hexagonal Configuration

3. Simulation Model & Scenario

In this paper, we analysis the effect of mobile end devices in the Zigbee mesh topology by creating the network model and simulation environment using OPNET modeler 14.5. The hexagonal configuration is used. The simulations are performed with 12, 30 and 50 mobile end devices. The basic setups of simulation implemented are router, coordinator and mobile end device. The network field is of size 100 m × 100 m. The basic Network layout is shown in figure (4) when use 12 mobile end devices. Applying the same layout, we added more mobile end devices in a random manner.

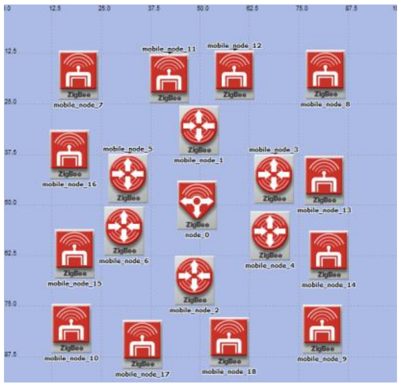

Figure 4: The Basic Network Layout with 12 Mobile End Devices

4. Results

The simulation results concerning the End to End Delay, Throughput and Packets Dropped across the ZigBee network. The simulations are performed with 12, 30 and 50 mobile end devices.

End to End Delay

The result is shown in figure (5), simulations have converged Results. The 12 mobile end device model has the lowest end to end delay compared to 30 and 50 mobile end device.

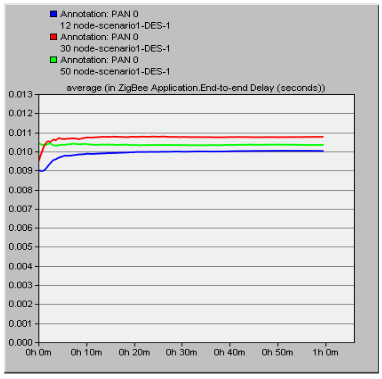

Figure 5: Average End to End Delay in Networks

Throughput

Figure (6) shows the maximum throughput is achieved in the 12 mobile end device.

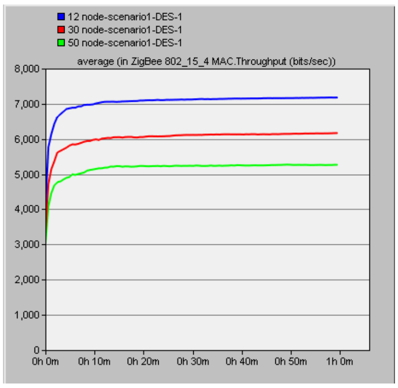

Figure 6: average throughput

Packets Dropped

In the figure (7), 12 mobile end device model has the minimum packets dropped number compared to 30 and 50 mobile end device models.

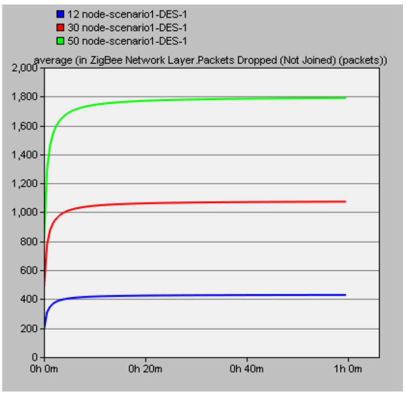

Figure 7: Average Packets Dropped

5. Conclusion

In this paper, the performance of mesh topology is analyzed with the mobility of Zigbee end devices. The performance is compared in term of Throughput, End to End delay and Packets Dropped.

The results show that, lowest number of mobile end devices have best network performance and the performance decrease when increasing the mobile end devices.

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