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Zigbee-Performance Analyses of Hybrid Topology by Varying Mobility, Load and Traffic Types

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ABSTRACT: Zigbee is a wireless technology which is formalized by IEEE 802.15.4 standard. In this paper the performance of Hybrid topology is analyzed with the variation of Zigbee End Devices and their mobility. This performance is analysis under different traffic types. For analyzing we use OPNET modeler 14.5. The performance is analyzed in terms of Management traffic sent, Management traffic received and Throughput. The results shows that , overall performance is the best of 90 nodes at speed 10 m/s with data traffic type fast normal with sm. Hybrid topology with sm gives the best performance.

Keyword: ZigBee, OPNET modeler 14.5, Mobility, Hybrid topology, PAN

I. INTRODUCTION

ZigBee is a new wireless technology. Zigbee is very widely used communication standard. Zigbee is based on standard i.e. IEEE 802.15.4. Zigbee is also called Low Power-Wireless Personal Area Network. This is a remote system which has short range and less power utilization. It's extent in the region of couple of 100 meters. Zigbee has low power and less preparing capacity remote hubs. In this little power is required which is little for e.g. 1mW. ZigBee gadgets can transmit information over long separations when by going information through a cross section system of halfway gadgets to reach long separation. ZigBee can be used for less data rate applications which requires long battery life. Amid a couple of milliseconds in outflow, a transmitting accepting ZigBee module will possess the medium, then it will anticipate for potentially answer , before the following discharge then it will be in stand by for a long stretch, which will happen at one foreordained minute. It will present intriguing issues of examination on the information's level connection layer and system layer. ZigBee has two sorts of elements system: the FFD is the Full Function Device that actualize the detail's totality and the RFD is the Reduced Function Device which are the elements diminished in a goal of less power utilization and less memory utilized for the microcontroller. RFD is the last hubs of the system in light of the fact that they don't actualize a directing instrument. Ordinarily, a set out sensor will be RFD and supplied with batteries, though a focal handling unit of treatment, supplied with a source not constrained by a vitality contained (hand fueled), is FFD with the capacity of directing.

The standard has two diverse physical layers (PHY), for the 868/915MHz (PHY868/915) and a second for 2,4GHz (PHY2450) executing a spread range tweak. The ZigBee convention was intended for give static, element, or cross section system topologies which are supporting up to 65,000 hubs for the vast regions for the modern use. Numerous impacts are delivered i.e. natural impacts, to evacuate these impacts, the ZigBee convention gives a self-mending capacity to the system to recognize and recuperate from system or correspondence connection flaws without human intercession.

II. ZIGBEE TOPOLOGIES

Star topology: In this topology there is an organizer which is set in the inside and end gadgets (hubs) are joined with focal facilitator as appeared in the figure. In this topology, the end gadgets can just specifically speak with the facilitator and yet not with flip side gadgets. There are trades of parcels between end gadgets can just through the organizer.

Network Topology: In a lattice topology, the facilitator is identified with his switches and end gadgets. In this correspondence are more adaptable on the grounds that the switches can impart specifically between them. In lattice topology there is the substitute path for the spread of bundles when course separate or the blockages.

Tree Topology: In this tree topology, every one of the hubs are associated in structure simply like tree. In this, the end hubs are joined straightforwardly to the facilitator and the switches as further hubs. The switches and the facilitator have further separated. Every end gadget can correspond with its principle hubs i.e. with the organizer and switch. Yet, an end gadget can't partition. An end gadget can speak with another end gadget just through its principle hub and there is no immediate connection between these end gadgets. The principle restrictions of tree topology are that if one of the fundamental hubs has some issue, then the further separated hubs won't work in light of the fact that there is the issue in the primary hub so these hubs can't speak with different gadgets in the system.

III. EXPERIMENT SETUP

In this research paper the effect of Mobility and variation of Zigbee end devices (ZED) on hybrid topology under different traffic type is analyzed. Hybrid topology which is the combination star-mesh (sm) and star-mesh-tree (smt) is analyzed. In this to show the performance of hybrid topology use the OPNET modeler 14.5. OPNET modeler is gives better simulation results, data analysis and collection. To analyze the effect different scenarios are made firstly by using 90 nodes by applying Poisson then with Fast normal traffic patterns for sm hybrid topology and then repeated for smt hybrid topology as shown in fig 9, Secondly 75 nodes with Poisson then with Fast normal with sm hybrid topology and then repeated for smt hybrid topology as shown in fig 10, thirdly 65 nodes with Poisson then with Fast normal with sm hybrid topology and then repeated for smt hybrid topology as shown in fig 1. These scenarios are made firstly at speed of 8m/s and then at 10 m/s. In each scenario 4 routers, 2 coordinators are used for sm hybrid topology and for smt scenarios 4 routers, 3 coordinators. All the nodes are moves randomly under the random way point model. To simulate this experiment different parameters are used as shown in Table 1.

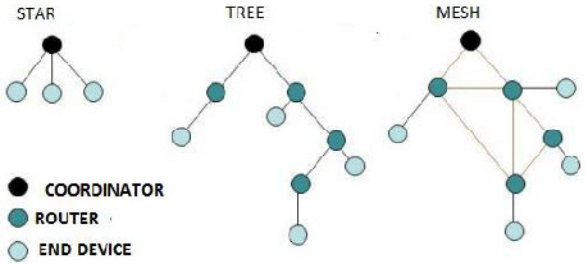

Fig. 1. Star, Mesh and Tree Topology.

Table 1: Simulator Parameters.

SR. No.	Attribute	Value
1.	Topology	Hybrid
2.	No. of nodes	65,75,90
3.	Speed	8,10
4.	Packet Size	2048
5.	Packet Interarrival time	Constant(.1)
6.	Start time	Constant(0)
7.	Stop time	Infinite
8.	No. of Routers	4
9.	No.of Coordinators	2,3
10.	Mobility	Random way point
11.	Traffic type	Poisson and Fast normal

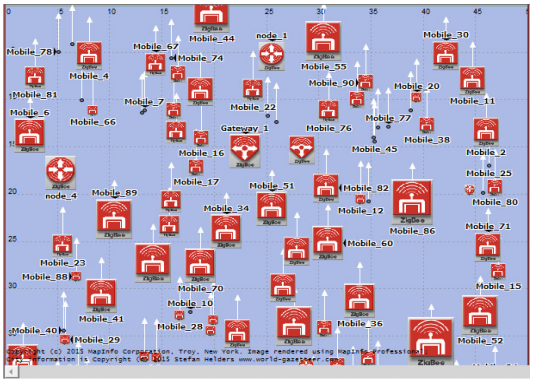

Fig. 2. Scenario 1 of 90 nodes.

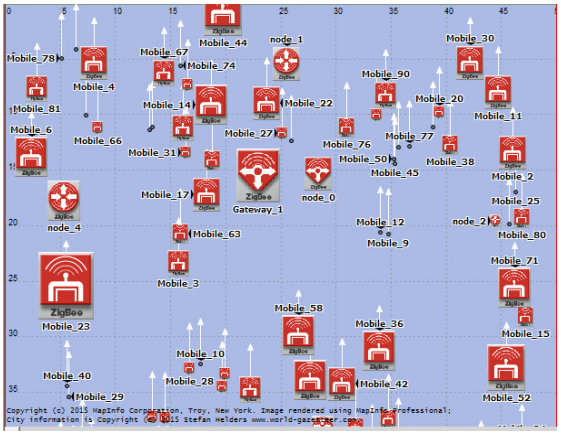

Fig. 3. Scenario 2 of 75 nodes.

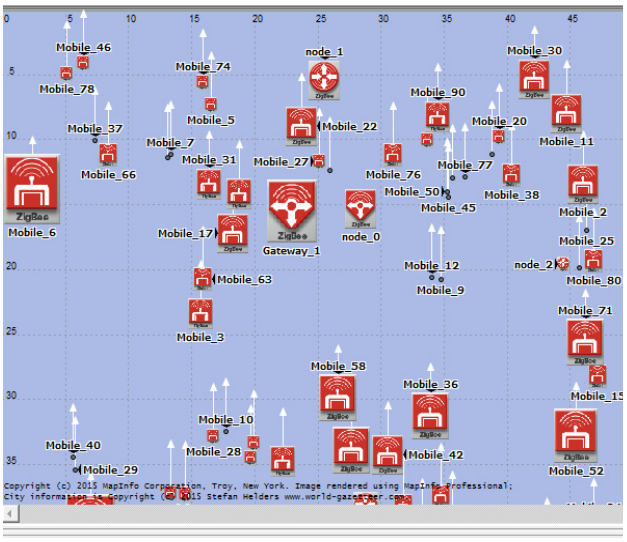

Fig. 4. Scenario 3 of 65 nodes.

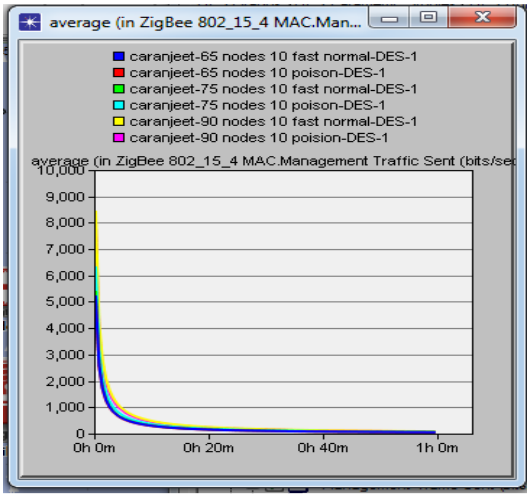

Fig. 6. Management traffic sent in different nodes with 10m/s speed at different traffic with sm.

IV. RESULTS

The simulations are analyzed for the performance of Hybrid topology with the variation of the nodes and by changing the mobility of Zigbee End Devices. This performance is analysis under different traffic types which are Poisson and fast normal. The performance is analyzed in terms of Management traffic sent, Management traffic received and Throughtput. The different nodes are 90,75,65 and speed is 8 m/s,10 m/s and traffic type are fast normal and poisson. The results are as shown below;

A. Management Traffic Sent

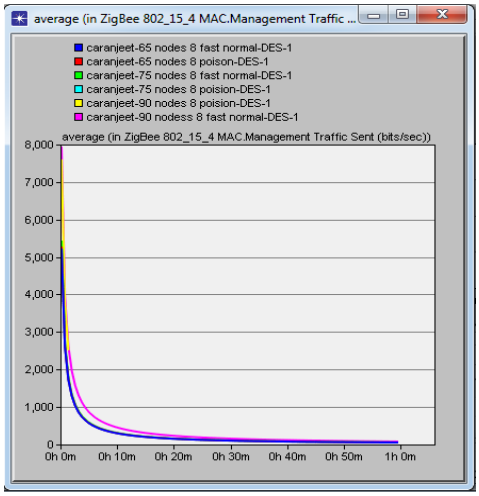

Fig. 5. Management traffic sent in different nodes with 8m/s speed at different traffic with sm.

Fig 5, 6 shows the result for different nodes with different traffic types at different speeds with sm. In fig 5 as shows 90 nodes at speed 8m/s and traffic type is fast normal then the traffic is obtained i.e. 2500 bits/sec, When 75 nodes at 8m/s at fast normal it gives traffic sent i.e. 4000 bits/sec, at 65 nodes at 8m/s at fast normal 5200 bits/sec. At 90 nodes at 8 m/s at poisson gives 7600 bits/s. At 75 nodes 8 m/s at poisson gives the 4000 bits/sec. and 65 nodes at 8m/s at poisson gives 4100 bits/sec traffic sent. The maximum traffic sent at 90 nodes at speed 8m/s and traffic type poisson i.e. 7600 bits/sec.

In fig 6 as shows 90 nodes at speed 10 m/s at traffic type is fast normal then the traffic type is 8500 bits/sec, At 75 nodes 10 m/s at traffic type fast normal sends 3500 bits/sec, 65 nodes at 10m/s at fast normal gives minimum 5100 bits/sec traffic sent. At 90 nodes at speed 10 m/s at traffic type is poisson sends 4000 bits/sec, At 75 nodes at speed 10 m/s at traffic type is poisson sends 4100 bits/sec, At 65 nodes 10 m/s at traffic type poisson sends 3000 bits/sec. The maximum data traffic sent at 90 nodes at speed 10m/s and traffic type fast normal i.e. 8500 bits/sec.

From the above results the traffic sent at 90 nodes at speed 10m/s and traffic type fast normal with sm i.e. 8500 bits/sec is best.

Fig 7, 8 there are different nodes with different traffic types at different speeds with smt. Fig 7 as shows At 90 nodes at 8m/s at traffic type fast normal then traffic sent i.e.7000 bits/sec, At 75 nodes 8 m/s at fast normal gives the 6500 bits/sec and 65 nodes at 8m/s at fast normal gives 6000 bits/sec data traffic sent. 90 nodes at speed 8m/s and traffic type poisson then traffic sent i.e. 11000 bits/sec. When 75 nodes at 8m/s at poisson it gives traffic sent i.e. 4500 bits/sec. At 65 nodes at 8 m/s at poisson gives 4000 bits/s.

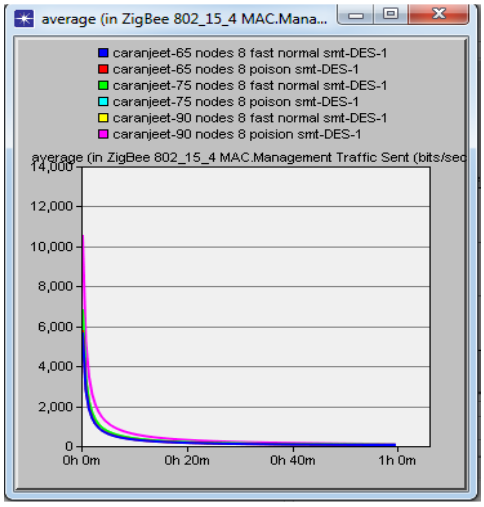

Fig. 7 . Management traffic sent in different nodes with 8m/s speed at different traffic with smt

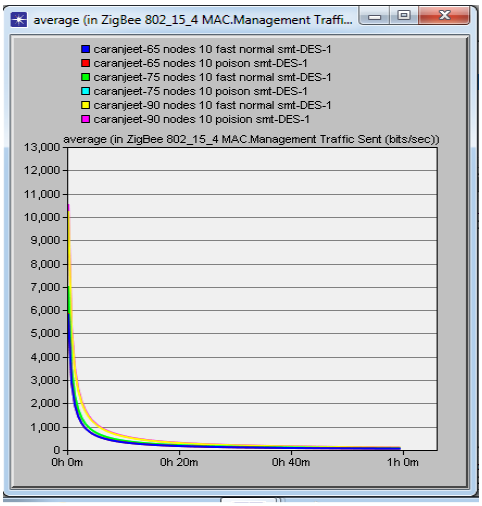

Fig. 8. Management traffic sent in different nodes with 10m/s speed at different traffic with smt

The maximum traffic sent at 90 nodes at speed 8m/s and traffic type poisson i.e. 11000 bits/sec. Fig 8 as shows 90 nodes at speed 10 m/s at traffic type is fast normal then traffic sent i.e. 9000 bits/sec, At 75 nodes 10 m/s at traffic type fast normal sends 6000 bits/sec and 65 nodes at 10m/s at fast normal gives 5900 bits/sec traffic sent , at 90 nodes at speed 10 m/s at traffic type is poisson sends 4000 bits/sec, At 75 nodes 10 m/s at traffic type poisson sends 3000 bits/sec, At 65 nodes at speed 10 m/s at traffic type is poisson sends 4500 bits/sec. The maximum traffic sent at 90 nodes at speed 10 m/s at traffic type is fast normal i.e. 9000 bits/sec.

From the above results, maximum traffic sent at 90 nodes at speed 8m/s and traffic type fast normal with smt i.e. 11000 bits/sec is best.

Management Traffic Received

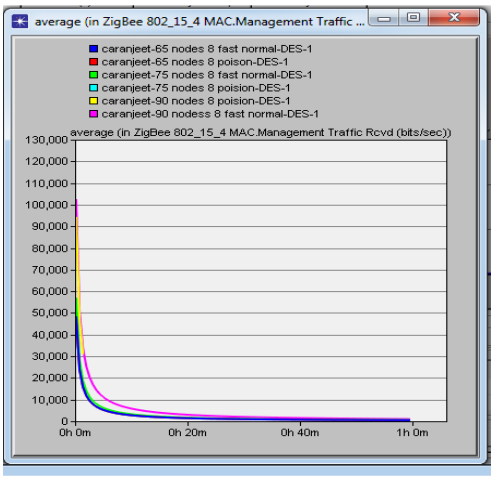

Fig. 9. Management traffic received in different nodes 8 m/s with speed at different traffic with sm

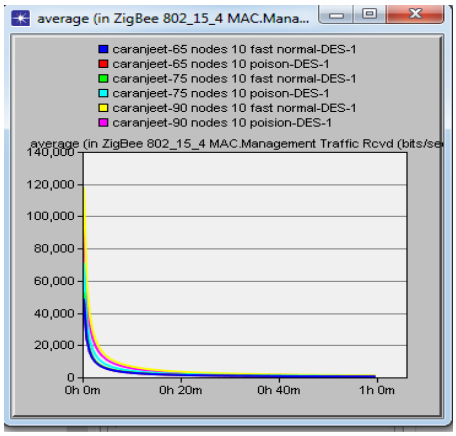

Fig. 10. Management traffic received in different nodes with 10m/s speed at different traffic with sm.

As shown in fig 9, 10 there are different nodes with different traffic types at different speeds with sm.
Fig 9 as shows 90 nodes at speed 8m/s and traffic type fast normal then the traffic received i.e. 10000 bits/sec. At 75 nodes at 8 m/s at fast normal gives 95000 bits/s. At 65 nodes 8 m/s at fast normal gives the 50,000 bits/sec. When 90 nodes at 8m/s at poisson it gives traffic received i.e. 80000 bits/sec. At 75 nodes at 8m/s at poisson 40000 bits/sec and 65 nodes at 8m/s at poisson gives 30000 bits/sec data traffic received. The maximum traffic sent at 90 nodes at speed 8 m/s at traffic type is fast normal i.e. 10000 bits/sec.

In fig 10 as shows 90 nodes at speed 10 m/s at traffic type is fast normal then traffic received i.e. 120000 bits/sec, At 75 nodes 10 m/s at traffic type fast normal sends 60,000 bits/sec, At 65 nodes 10 m/s at traffic type fast normal sends 50,000 bits/sec, At 90 nodes at speed 10 m/s at traffic type is poisson sends 50,000 bits/sec, At 75 nodes at speed 10 m/s at traffic type is poisson receives 40,000 bits/sec, and 65 nodes at 10m/s at poisson gives 45000 bits/sec traffic received. The maximum traffic received at 90 nodes at speed 10 m/s at traffic type is fast normal i.e. 120000 bits/sec.
From the above results, maximum traffic received at 90 nodes at speed 10m/s and traffic type fast normal with sm i.e.120000 bits/sec it is the best.

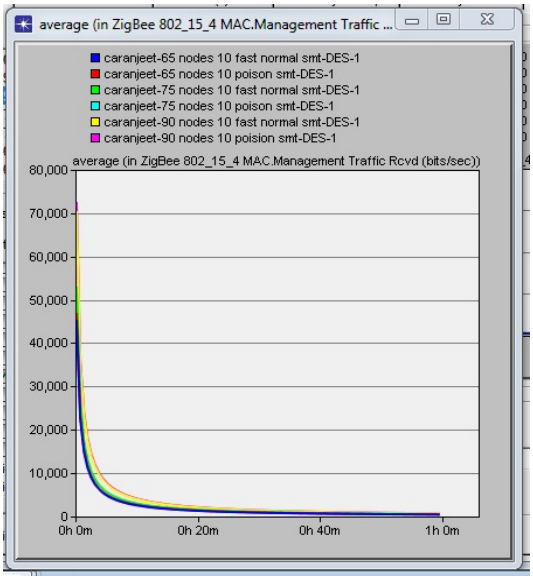

Fig. 11. Management traffic received in different nodes with 8m/s speed at different traffic with smt

As shown in fig 11, 12 there are different nodes with different traffic types at different speeds with smt.
Fig 11 as shows 90 nodes at speed 8m/s at traffic is fast normal then the data traffic received i.e. 55000 bits/sec, At 75 nodes at speed 8 m/s at traffic type fast normal i.e.50000 bits/sec. At 65 nodes at 8 m/s at fast normal gives 45000 bits/s, At 90 nodes at speed 8m/s and traffic type poisson then the traffic received i.e. 74000 bits/sec. At 75 nodes at 8m/s at poisson then traffic received i.e. 35000 bits/sec. At 65 nodes at 8m/s at poisson 25000 bits/sec and. The maximum traffic received at 90 nodes at speed 8 m/s at traffic type is poisson i.e. 74000 bits/sec.

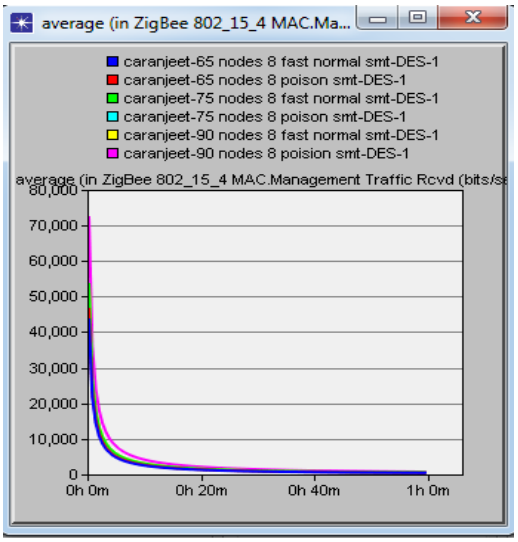

Fig. 12. Management traffic received in different nodes with 10m/s speed at different traffic with smt.

Fig 12 shows at 90 nodes at speed 10 m/s at traffic type is fast normal then traffic received i.e. 70,000 bits/sec, At 75 nodes at 10m/s at fast normal gives 60,000 bits/sec, At 65 nodes 10 m/s at traffic type fast normal sends 43000 bits/sec, At 90 nodes at speed 10 m/s at traffic type is poisson sends 40000 bits/sec, At 75 nodes at speed 10 m/s at traffic type is poisson receives 30000 bits/sec, At 65 nodes 10 m/s at traffic type poisson then traffic received i.e 35000 bits/sec. The maximum data traffic received at 90 nodes at speed 10 m/s at traffic type is fast normal i.e. 70,000 bits/sec.
From the above results, maximum traffic received are at 90 nodes at speed 8m/s and traffic type poisson with smt i.e.74000 bits/sec and it is the best.

Throughput

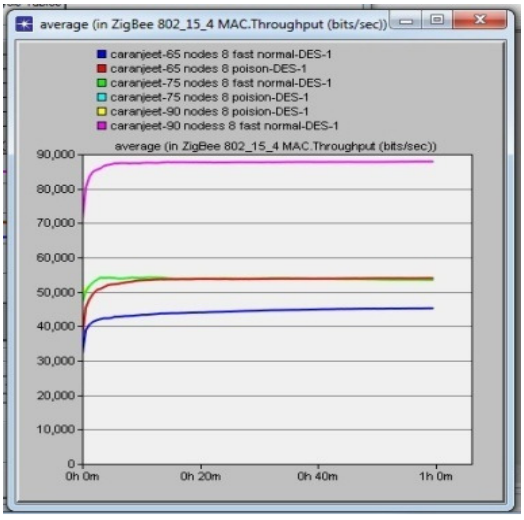

Fig. 13. Throughput in different nodes with 8m/s speed at different traffic with sm.

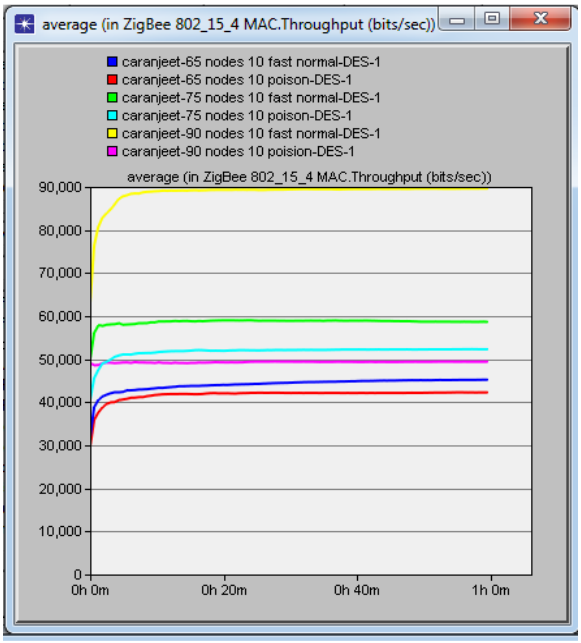

Fig. 14. Throughput in different nodes with 10m/s speed at different traffic with sm.

As shown in fig 13, 14 there are different nodes with different traffic types at different speeds with sm.

Fig 13 shows at 90 nodes at speed 8m/s at fast normal gives throughput i.e. 88000 bits/sec, At 75 nodes at 8 m/s at fast normal gives throughput i.e. 55000 bits/sec and at 65 nodes at 8m /s at fast normal it gives throughput i.e. 45000 bits/sec. At 90 nodes at speed 8m/s and traffic type poisson then it gives throughput i.e. 45000 bits/sec. At 75 nodes 8 m/s at poisson gives throughput 40000 bits/sec and at 65 nodes at 8m/s at poisson 55000 bits/sec. The maximum throughput at 90 nodes at speed 8 m/s at traffic type is fast normal i.e. 88000 bits/sec.

Fig 14 shows 90 nodes at 10m/s at traffic type fast normal gives throughput i.e. 90000 bits/sec, At 75 nodes 10 m/s at traffic type fast normal is 59000 bits/sec , At 65 nodes at speed 10 m/s at traffic type is fast normal throughput is 45000 bits/sec, 90 nodes at speed 10 m/s at traffic type is poisson maximum throughput i.e. 50000 bits/sec, At 75 nodes at speed 10 m/s at traffic type is poisson throughput is 52000 bits/sec, At 65 nodes 10 m/s at traffic type poisson throughput is 42000 bits/sec and. The maximum throughput at 90 nodes at speed 10 m/s at traffic type is fast normal i.e. 90000 bits/sec.

From the above results, maximum throughput at 90 nodes at speed 10m/s and traffic type is fast normal with sm i.e. 90000 bits/sec and it is the best.

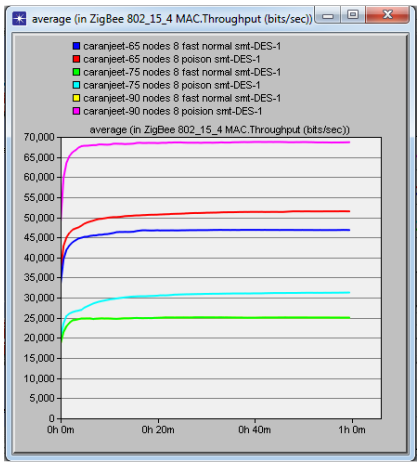

Fig.15. Throughput in different nodes with 8m/s peed at different traffic with smt

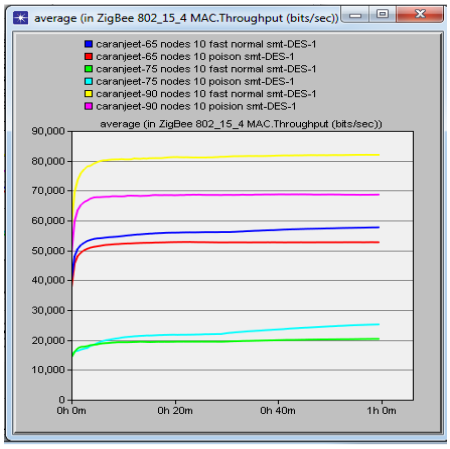

Fig. 16. Throughput in different nodes with 10m/s speed at different traffic with smt

As shown in fig 15, 16 there are different nodes with different traffic types at different speeds with smt.

Fig 15 as shows 90 nodes at speed 8m/s at traffic type is fast normal then throughput i.e. 22000 bits/sec, At 75 nodes at 8m/s at fast normal it gives throughput i.e. 25000 bits/sec, At 65 nodes at 8m/s at fast normal 47000 bits/sec, At 90 nodes at speed 8m/s and traffic type poisson then it gives throughput i.e. 69000 bits/sec, At 75 nodes at speed 8 m/s at traffic type poisson gives throughput 31000 bits/sec. At 65 nodes at speed 8 m/s at traffic type poisson gives throughput 51000 bits/sec. The maximum throughput at 90 nodes at speed 8 m/s at traffic type is poisson i.e. 69000 bits/sec.

Fig 16 as shows 90 nodes at speed 10 m/s at traffic type is fast normal then throughput is 82000 bits/sec, At 75 nodes at speed 10 m/s at traffic type fast normal throughput is 20000 bits/sec, At 65 nodes 10 m/s at traffic type fast normal throughput is 57000 bits/sec, At 90 nodes at speed 10 m/s at traffic type is poisson, throughput is 69000 bits/sec, At 75 nodes 10 m/s at traffic type poisson throughput is 25000 bits/sec and 65 nodes at 10m/s at poisson gives throughput is 54000 bits/sec. The maximum throughput at 90 nodes at speed 10 m/s at traffic type is fast normal then throughput i.e. 82000 bits/sec.

From the above results, maximum throughput at 90 nodes at speed 10m/s and traffic type is fast normal with smt i.e. 82000 sec and it is the best.

V. CONCLUSION

In this paper the effect of mobility and no. of Zigbee end devices (ZED) on hybrid topology under different traffic type is analyzed. The different nodes i.e. 90,75,65 are taken at different speed 8m/s and 10m/s at different data traffic type i.e. Fast normal and Poisson are considered. These results are simulated by OPNET modeler 14.5 in terms of Management traffic sent, Management traffic received and Throughput. The results shows that maximum traffic sent at 90 nodes at the speed of 10 m/s with data traffic type fast normal with sm are obtained and it gives the best performance. The maximum traffic received at 90 nodes at speed 10 m/s with data traffic type fast normal with sm are obtained and it gives the best performance. The maximum throughput at 90 nodes at speed 10 m/s with data traffic type fast normal with sm are obtained and it gives the best performance. Then from all the results, overall performance is the best of 90 nodes at speed 10 m/s with data traffic type fast normal with sm. Hybrid topology with sm gives the best performance.

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