International Journal on Emerging Technologies (Special Issue on *RTIESTM-2016*) **7**(1): 33-40(2016)

ISSN No. (Print) : 0975-8364
ISSN No. (Online) : 2249-3255

Zigbee- Effect of Zigbee End Devices Failure on Hybrid Topology by using Different Trajectories

Deepinder Singh*, Puneet Jain** and Pankaj Sharma***
**Research Scholar, Department of Electronics and Communication Engineering, AIET, Faridkot, (PB), INDIA*
***Assistant Professor, Department of Electronics and Communication Engineering, AIET, Faridkot, (PB), INDIA*
***Assistant Professor, Department of Electronics and Communication Engineering, AIET, Faridkot, (PB), INDIA*

(Corresponding author: Deepinder Singh)
(Received 04 October, 2015 Accepted 04 November, 2015)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The aim of this paper is to analyze the performance of Hybrid Topology under Zigbee End Devices failure by moving under different trajectories. The performance is analyzed by using OPNET modeler version 14.5. The parameters which are used to evaluate are Data Traffic Received, Media Access Delay and Throughput. Results shows that from all trajectories, the trajectory 1 gives better value in each parameter while overall performance of st, mt and sm topologies remains same.

Keyword: Zigbee, OPNET modeler 14.5, Hybrid topology, Mobility, Trajectories

I. INTRODUCTION

Zigbee is a type of wireless sensor network(WSN) works on the basis of standard IEEE 802.15.4. The standard IEEE 802.15.4 suggests Physical and MAC layer while along with these layers recommended by Zigbee alliance are Network and Application layers. The other standards proposed by IEEE are IEEE 802.15.1 for Bluetooth, IEEE 802.15.3 for (High Power WPAN/UWB),IEEE 802.15.5 for Mesh Networking, IEEE 802.15.6 for Body Area Network and IEEE 802.15.7 for Visible Light Communications. Wireless Sensor Network is a group of sensor nodes non-dependent on each other communicating with each other over a small range of frequency and bandwidth. Power is provided by battery to these sensor nodes and it is of short range. It is specified for the suite of high level communication protocols requires short, less power radios. IEEE 802.15.4 suggests various types of topologies like star, mesh, tree and cluster tree but Zigbee uses only star, mesh and tree. Zigbee are used to transmit data over long distances using mesh topology to pass the data to distant nodes using intermediate nodes. Zigbee like other wireless networks like MANET are non-centralized networks. The variation in number of nodes can takes place according to the requirement. This makes the Zigbee as adhoc network.

II. TOPOLOGIES

Star topology- In this topology a coordinator is located at the centre and all end devices are connected with it. There are no intermediate devices like routers are used in it. Each device can communicate with coordinator only but not with each other . The major disadvantage of this topology is if coordinator stops working than entire topology fails.

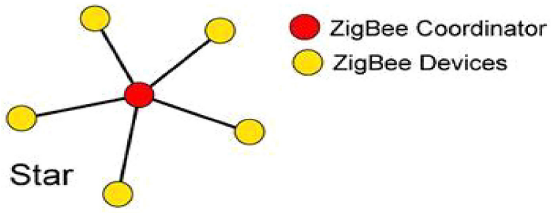

Fig. 1. Star Topology.

Tree topology- In this topology the coordinator acts as a route node. It is present alongwith routers and Zigbee End Devices. Both coordinator and routers acts as a parent nodes in these topology are both coordinators and routers while children nodes are Zigbee end devices. Communication among Zigbee Ennd Devices is possible only through their parent nodes.

The communication is possible by passing the data to the next parent node. It means if any end device tries to communicate with coordinator than it firstly communicates with router than information is passed to coordinator by router. Main drawback of this topology is if one of the full functional devices fails than reduced functional devices cannot communicate with other devices in the network.

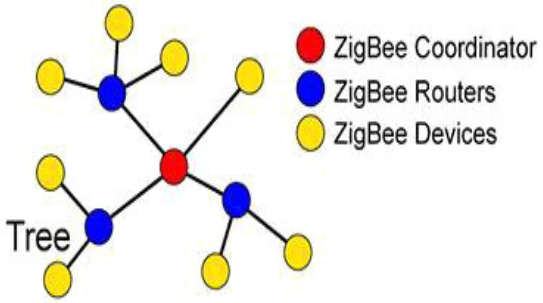

Fig. 2. Tree Topology.

Mesh topology- One coordinator, some routers and many end devices are used in this topology. In this topology if one fully functional device fails than message is passed to next fully functional device. If one node fails message is passed to the other node. The variation in number of nodes can be done according to the need.

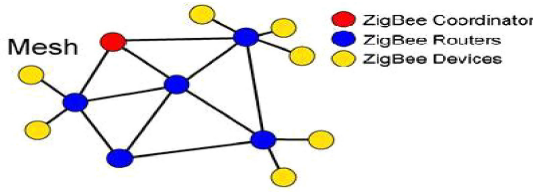

Fig. 3. Mesh Topology.

III. ZIGBEE DEVICES

Zigbee Coordinator-It is one of the most effective or efficient device. The parameters including packet size, the topology to be used whether its star, mesh or tree is all decided by the Zigbee Coordinator.

Zigbee Router-It acts as a intermediate node between the coordinator and end device. Path which is to be followed by the packet on the way from source to destination is all decided by routers.

Zigbee End device-It has abiliy to communicate only with parent node whether it is coordinator or router. They remain asleep during the remaining time providing the long battery life.

Fig. 4. Zigbee devices.

IV. EXPERIMENTAL SETUP

In this paper the effect of Trajectories on Hybrid Topology under Zigbee end devices node failure is analyzed. Hybrid topology is made by using star-tree, mesh-tree and star-mesh. To analyze the effect on Hybrid topology different scenarios are made by using different trajectories as shown in fig. 5,6,7,8,9. In these scenarios 70 nodes, 4 routers and 2 coordinators are used. In each scenario 20 Zigbee end devices are failed to analyze the effect of Zigbee node failure. In each scenario 70 nodes are placed randomly at an area of 100*100 by using path random waypoint at the speed of 7m/s. This performance is analyzed by using OPNET modeler 14.5 modeler.

Table 1: Simulation Parameters.

S. No.	Attribute	Value
1.	Topology	Hybrid
2.	Packet Interarrival Time	Constant(1.0)
3.	Packet size	Exponential(1024)
4.	Start Time	Constant(0)
5.	Stop Time	Infinity
6.	Number of Nodes	70
7.	Number of Routers	4
8.	Number of Coordinators	2
9.	Simulation Duration(sec)	192 sec
10.	Mobility	Random waypoint

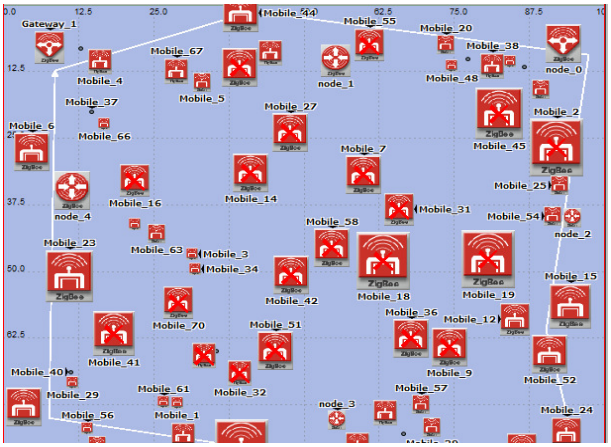

Fig. 5. Scenario1 by using Trajectory 1.

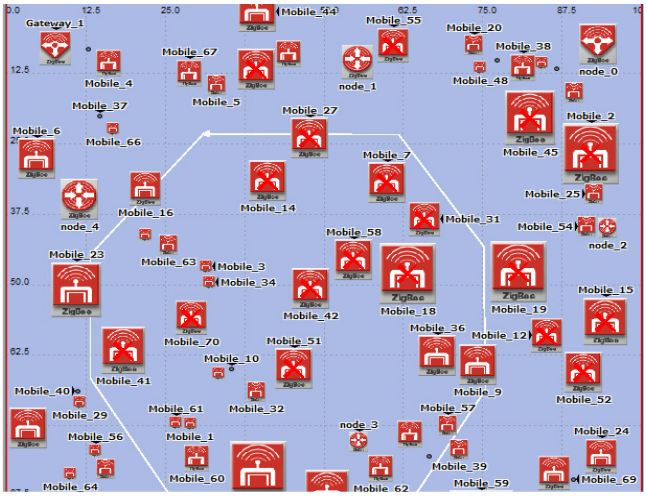

Fig. 6. Scenario 2 by using Trajectory 2.

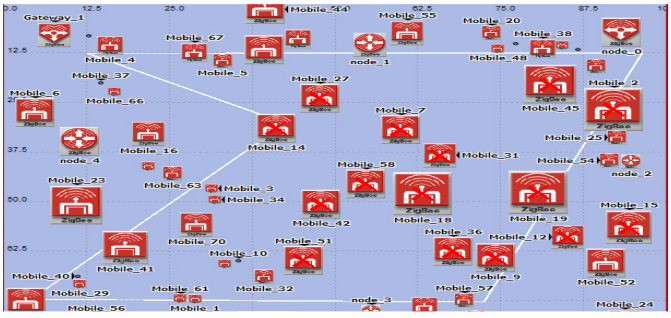

Fig. 7. Scenario3 by using Trajectory 3.

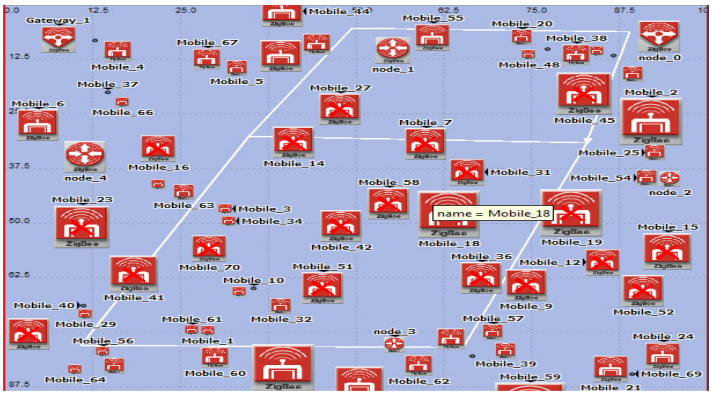

Fig. 8. Scenario 4 by using Trajectory 4.

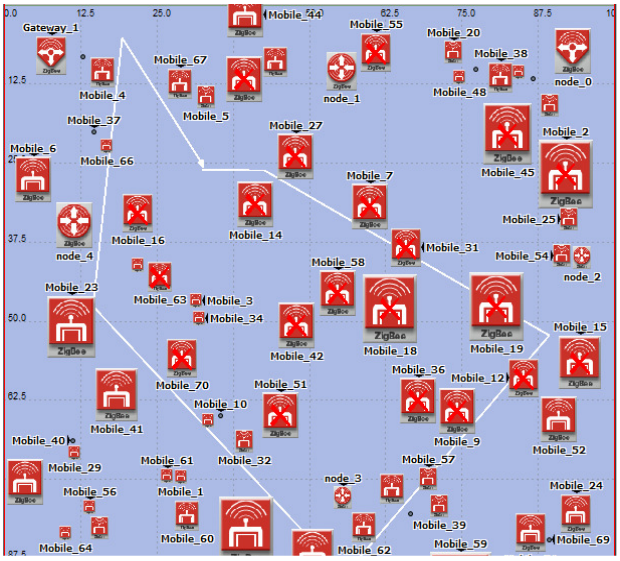

Fig. 9. Scenario 5 by using Trajectory 5.

V. RESULTS

A. Data Traffic Received

In this case highest data traffic received is 5,900,000 bits/sec which is noticed by applying trajectory 1 .By applying trajectory 2 data traffic received is 4,500,000 bits/sec. On the other hand in case of trajectory 3 the data traffic received is 5,100,000 bits/sec. In case of trajectory 4 the data traffic received is 4,200,000 bits/sec .The data traffic received for the trajectory 5 is lowest which is 3,800,000 bits/sec in case of star-tree topology. So, the better value of data traffic received comes by applying the trajectory 1.

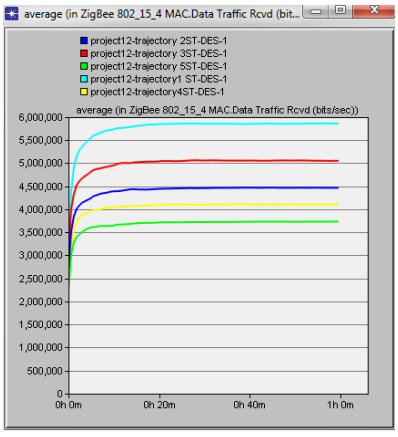

Fig. 10. Data Traffic Received on ST by using different trajectories.

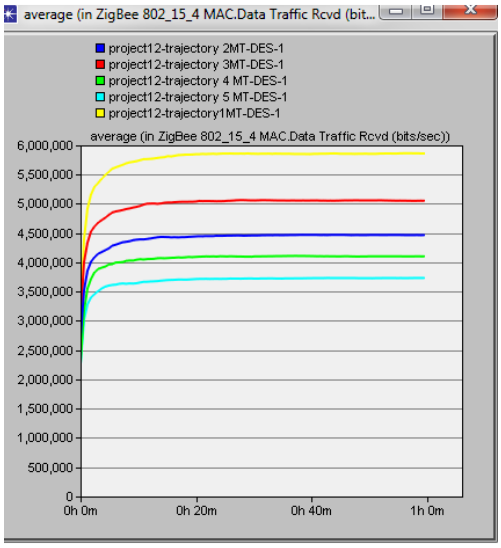

Fig. 11. Data Traffic Received on MT by using different trajectories.

The effect is analyzed on mesh-tree topology. In this case by applying trajectory 1 the data traffic received is 5,900,000 bits/sec which is largest. Than by applying trajectory 2 the data traffic receives is noticed as 4,500,000 bits/sec. Than trajectory 3 is applied. The data traffic received is estimated as 5,100,000 bits/sec. Than trajectory 4 is applied in it. The data traffic received which is calculated is 4,200,000 bits/sec.

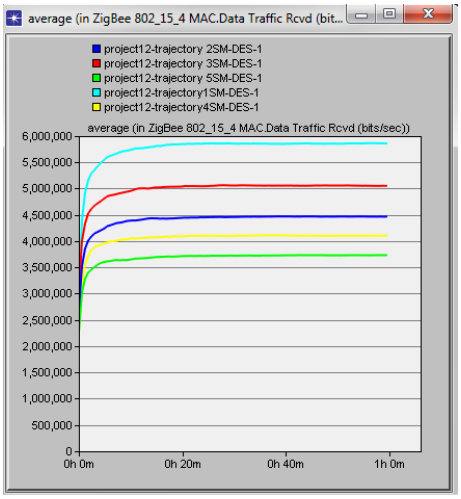

Fig. 12. Data Traffic Received on SM by using different trajectories.

At last trajectory 5 is applied and the data traffic received which is estimated is 3,800,000 bits/sec and is smallest. So, the best value of delay comes by applying the trajectory1. At last results are analyzed on star-mesh topology. By applying trajectory 1 the data traffic received is noticed as 5,900,000 bits/sec. This is maximum value. Then trajectory 2 is applied and the data traffic received is estimated to be 4,500,000 bits/sec. Then trajectory 3 is applied in it. The data traffic received is noticed as 5,100,000 bits/sec. In case of trajectory 4 the data traffic received is analyzed as 4,200,000 bits/sec. At last, using trajectory 5 data traffic received reaches minimum value of 3,800,000 bits/sec. The best value of delay is noticed by applying the trajectory 1.

B. Media Access Delay

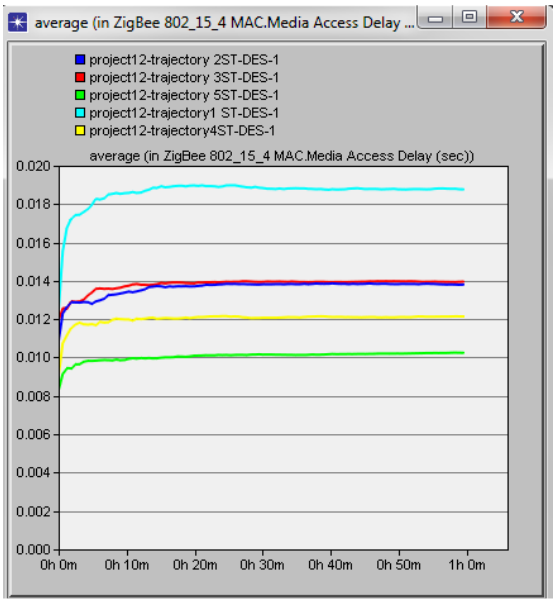

Fig. 13. Media Access Delay of ST by using different trajectories.

The value of media access delay which is noticed is maximum of 0.019 seconds by using trajectory 1.Then by applying trajectory 2 the media access delay which is calculated is 0.0138 seconds. Then trajectory 3, is used, in this media access delay is examined to be 0.014 seconds. Then trajectory 4 is applied. The media access delay is estimated as 0.0122 seconds. At last in case of trajectory 5 the media access delay is calculated as 0.0101sec which is the minimum value. The value which is examined best is obtained by using trajectory1.

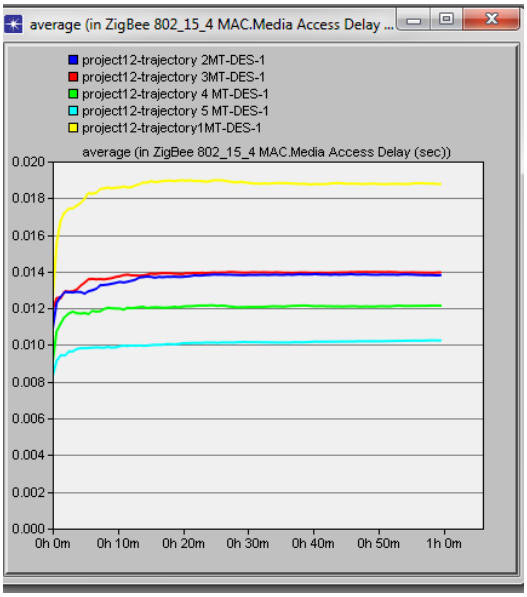

Fig. 14. Media Access Delay of MT by using different trajectories.

The load is analyzed here by using mesh-tree topology. By using the trajectory 1 the media access delay which is calculated is of largest value of 0.019 seconds. In second step trajectory 2 is applied, in which the media access delay estimated is 0.0138 seconds. Than by applying trajectory 3 the media access delay is calculated as 0.014 seconds. Then by applying trajectory 4 media access delay is calculated to be 0.0122 seconds while for trajectory 5 it is calculated to be 0.0101seconds which is of smallest value. The best value is obtained from trajectory 1.

At last star-mesh topology is being used. By using trajectory 1, media access delay calculated is of highest value of 0.019 seconds. Then by applying trajectory 2 media access delay is evaluated to be 0.0138seconds. After that trajectory 3 is applied and the media access delay is estimated to be 0.014 seconds. Than trajectory 4 is applied and the results are evaluated. The media access delay is estimated to be 0.0122seconds while for trajectory 5 media access delay is calculated as 0.0101seconds which is the lowest value. The best value is obtained from trajectory 1.

Firstly the results are calculated by using topology star-tree. By applying the trajectory 1 the throughput which is estimated is 1,08,000 bits/sec. It is the largest value. In case of trajectory 2 throughput is calculated as 88,000 bits/sec.

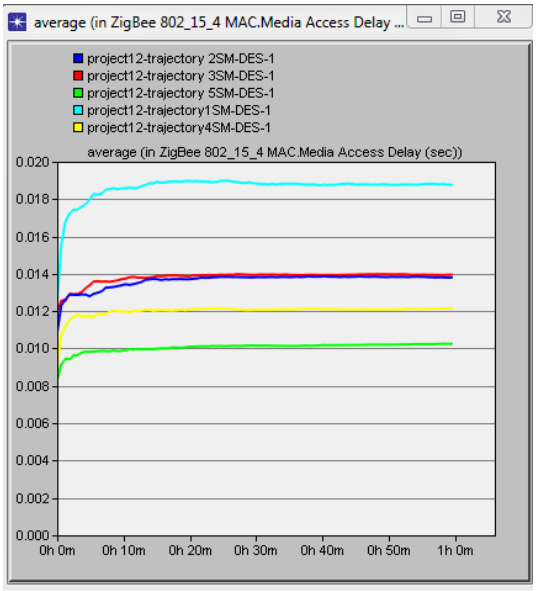

Fig. 15. Media Access Delay of SM by using different trajectories.

C. Throughput

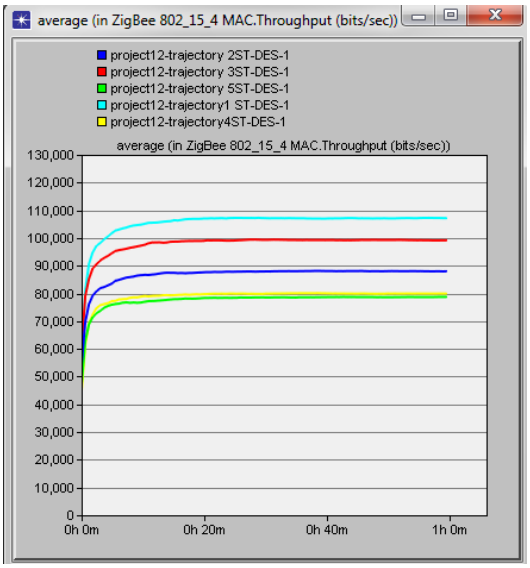

Fig. 16. Throughput in case of ST trajectory.

Than results are evaluated using trajectory 3.The outcome of this is 99,500 bits/sec. After that trajectory 4 is applied. Than results which are examined as 80,000 bits/sec. At the final stage trajectory 5 is applied and the results which are evaluated are to be 79,000 bits/sec which is the smallest value. The best value is obtained by applying the trajectory1.

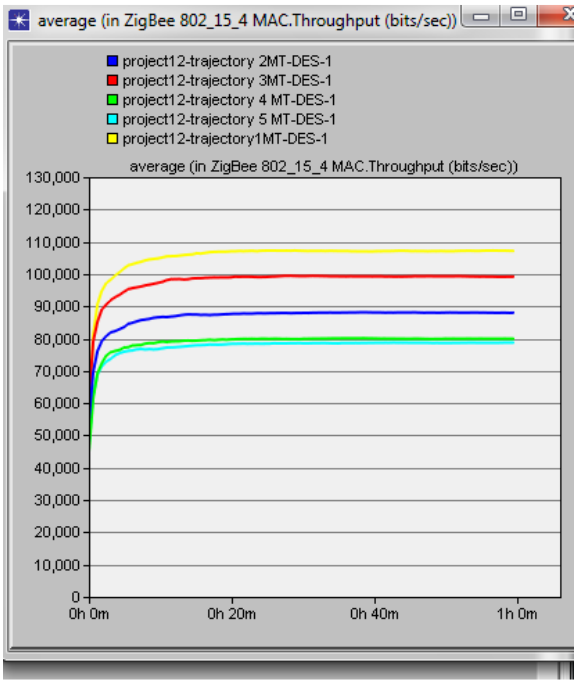

Fig. 17. Throughput in case of MT trajectory.

In the second case results are calculated using mesh-tree topology. In case of trajectory 1 the packets dropped are estimated as maximum of value 1,08,000 bits/sec. By applying trajectory 2 the value of throughput is calculated as 88,000 bits/sec. Than trajectory 3 is applied. The outcome obtained is 99,500 bits/sec. Than trajectory 4 is applied and the result which is evaluated as 80,000 bits/sec. At last step trajectory 5 is applied and the results calculated are 79,000 bits/sec which are minimum in number. The best value is obtained by trajectory 1.

Finally, results are noticed by applying star-mesh topology. By applying trajectory 1 the highest value of throughput is calculated and is 1,08,000 bits/sec. Then trajectory 2 is applied. The results which are evaluated that throughput is 88,000. Then trajectory 3 is applied and the results noticed shows that throughput is 99,500 bits/sec. At next step trajectory 4 is applied and the value of throughput is estimated to be 80,000 bits/sec. Finally, trajectory 5 is applied and lowest value of throughput which is 79,000 is calculated. The best value is obtained by trajectory 1.

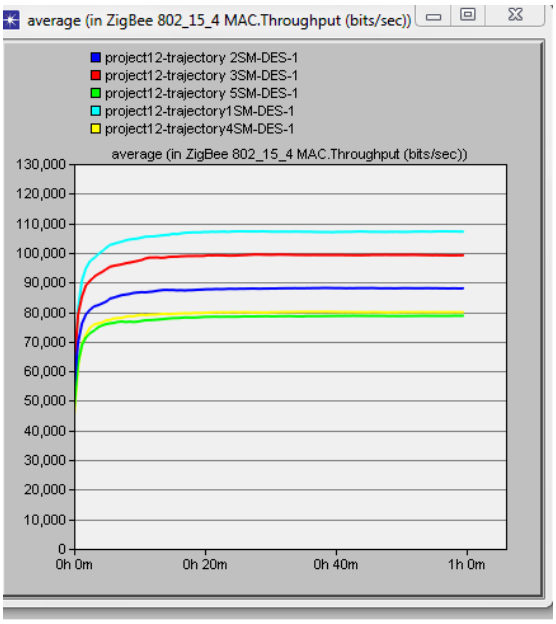

Fig. 18. Throughput in case of SM trajectory.

VI. CONCLUSION

In this paper analyzed the performance of Hybrid topology in mobility of Zigbee End Devices under node failure by using different trajectories. There are trajectories named 1,2,3,4 and 5 which are used. There are 70 nodes placed randomly at the speed of 7m/s using a random way point mobility. The results are calculated in the terms of Data Traffic Received, Media Access Delay and Throughput using OPNET modeler . Results shows that trajectory 1 gives best value from all while the trajectory 5 gives worst value. The overall results of st, mt and sm topologies remains same.

REFERENCES

[1]. Boris Mihajlov and Mitko Bogdanoski, (2011). "Overview and Analysis of the Performances of ZigBee based Wireless Sensor Networks", *International Journal of Computer Applications (0975 – 8887)* Volume **29**– No.12, September 2011.

[2]. Rozeha A. Rashid, Hamdan Sayuti, Nurul Mu'azzah Abdul Latiff, Norsheila Fisal, R. C. Muthu, M. Shanmugaraj and R. Prabakaran, (2011). "Study on Zigbee Technology", *3rd International Conference on Electronics Computer Technology (ICECT),* IEEE, (2011).

[3]. Mohd Adib Sarijari, Abdul Hadi Fikri Abdul Hamid, Rozaini Abd Rahim, (2013). *"Simple Scheduling Scheme for Smart Home and Ambient Assisted Living",* The Second International Conference on Informatics Engineering & Information Science (ICIEIS2013) – Malaysia

[4]. Al-Karaki, J.N., Kamal, A.E., *"Routing techniques in Wireless Sensor Networks: A survey"*, Department of Electrical and Computer Engineering Iowa State University, Ames, Iowa 50011.

[5]. J. Lloret, M. Garcia, D. Bri, and S. Sendra, (2009). "*A wireless sensor network deployment for rural and forest fire detection and verification,"* Sensors, Vol. **9**, No. 11, pp. 8722–8747, 2009.

[6]. Paolo Baronti et al., (2007). *"Wireless sensor networks: A survey on the state of the art and the 802.15.4 and ZigBee standards"*, *Computer Communications* **30**, 2007, pp. 1655–1695.

[7]. Yu-Kai Huang et al., (2012). *"Distributed Throughput Optimization for ZigBee Cluster-Tree Network"*, *IEEE Transaction On Parallel and Distributed Systems,* Vol. **23**, No. 3, March 2012.

[8]. Chong, C., Kumar, P., (2003). *"Sensors Networks: Evolution, Opportunities, and Challenges"*, *Proceedings of the IEEE,* Vol. **91**, No. 8, August 2003.

[9]. M. F. Othman and K. Shazali, (2012). "*Wireless sensor network applications: a study in environment monitoring system*," in *Proceedings of the International Symposium on Robotics and Intelligent Sensors (IRIS '12*), pp. 1204–1210, 2012.

[10]. Francesca Cuomo, Emanuele Cipollone, Anna Abbagnale, (2009). "Performance analysis of IEEE 802.15.4 wireless sensor networks: An insight into the topology formation process*"*, *Computer Networks* **53** (2009) 3057– 3075.