

# Poster: Performance Study of Clustering of Zigbee Devices in OPNET

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## ABSTRACT

ZigBee, known as IEEE 802.15.4 standard, is designed for Wireless Sensor Network (WSN) due to low power consumption and high reliability. The network layer can support star, tree and mesh topologies. In this work, cluster tree and mesh topologies are simulated in OPNET. Then throughput, delay and packet delivery ratio in direct transmission between source and sink are collected. Further, broadcast packets are simulated to show the influence of the packet interarrival time.

## 1. INTRODUCTION

IEEE 802.15.4 standard uses carrier sense multiple access with a collision avoidance medium access mechanism. The throughput is heavily influenced by the traffic load. The overhead is the critical issue for performance analysis. Interference and collision could obviously decrease the throughput of the global network. In [2], it shows the highest throughput is achieved, when there is only 1 source, at about 38kbps. The highest throughput with multiple sources is about 32kbps. In [1], the difference between delays of the mesh and the tree topology is shown to be small when the number of nodes increases.

## 2. SIMULATION MODELS

In the star topology, the end nodes only have one hop to the PAN coordinator. In the mesh topology, end nodes are Full Function Devices which can communicate with each other. The mesh topology uses AODV routing protocol which is suitable for large scale networks. When the number of nodes increases above a certain level as 200, more collisions will take place. Cluster tree and mesh topologies in the following are deployed in a 4km\*3km square area with 200 end nodes in OPNET.

## 3. SIMULATION RESULTS

In the simulation results, it shows that Mesh topology generates higher throughput when the number of nodes is smaller than 50. Although the throughput in non-cluster topology is higher, the received packet in the sink is much less. With more than 100, the throughput in mesh network shows a dramatic drop due to the large collisions with more hops between sources and sinks. If the packet is compressed into a larger packet at routers, higher packet delivery ratio can be achieved especially with random packet inter arrival

time. While the mesh network shows the opposite behavior. In practical applications, packets in the same cluster may be duplicated so that the routers can discard the redundant packets and aggregate a larger packet. In Figure 1, cluster network with compressed packets has the best performance.

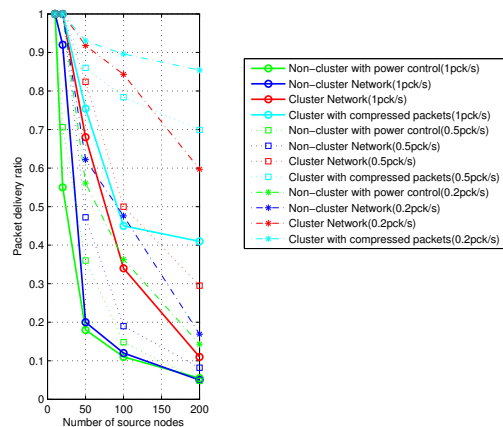


Figure 1: Packet delivery ratio in the four scenarios

The broadcasting result illustrates that as the packet generation rate increases, the packet delivery ratio slightly decreases from 100% and then maintains at around 85%.

## 4. CONCLUSIONS

In the simulation results, cluster topology performs better than the non-cluster topology with 200 end devices. The cluster topology is suitable for sensor networks to meet the requirements of energy and timeline saving. However, the cluster topology still has disadvantages due to the collisions at the cluster head. To solve this problem, the compression mechanism could be used to improve the performance of the cluster topology with fewer collisions and transmissions at the cluster head.

## 5. REFERENCES

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