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Data Gathering in IoT: COOJA Simulation

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Abstract— **Anything which is IP addressable can be included in the new emerging field, Internet of Things (IoT). IPV6 format is used to address the physical objects to Internet. In IoT battery of every sensor node is assigned with IP address. The proposed work uses the cluster concept for data gathering in IoT. Every sensor node sends their data to cluster head and intern cluster head sends their data to sink node. The gathered data is sent to connected client machine through gateway. sensors decides the network lifetime. Data gathering is one of the main challenges in IoT for increasing the network life time. The proposed work is simulated using Cooja simulator. Cooja simulator is one of the tools of Conitiki OS. Some of the performance parameters that are considered are data gathering time, packet delivery ratio and energy consumption.**

***Keywords*: IoT, cooja, WSN, data gathering**

I. INTRODUCTION

Internet of Things (IoT) is nothing but the networking of things. The first phase of the IoT is the current revolution in Internet, mobile and more technologies. By adding intelligence to the physical objects, object can communicate each other to perform the desired job which reduces the human applications. IoT can transform the physical objects to smart objects that can sustain the limitations of embedded devices, sensor networks, Internet protocols etc. Applications of smart objects can be applied in many fields like Military applications, medical applications industrial applications etc. [1]

The battery of the sensor node is very limited or critical and it is not easy job to replace the sensor nodes in the network. With this limitation increasing the lifetime of the WSN is the critical issue[2]. To prolong the network life of WSN one of techniques that is used to suppress the redundant information by using the suitable data aggregation techniques. In WSN, while transmitting the data from multiple sensor nodes to sink node using in network data aggregation technique lot of redundant information can be suppressed their by prolonging the network life time of WSN.

Many approaches are used to find the minimum aggregation points between the nodes and sink node/Base station (BS). In cluster based routing, information from the many sensor nodes are gathered at the cluster head and only relevant information from the gathered data is sent to the sink node.

Some of the related works are as follows In TAG (Tiny Aggregation) approach, each epoch divides to some time slots. Each node is allotted with a particular time slot to send its data. The node synchronization of this approach for sending and receiving data could effectively reduce the average energy consumption[1]. In Directed Diffusion Approach, receivers uses some resources for recognizing information. Information gathering takes place by clustering the entire network. The goal of this approach is finding an efficient multi way route between senders and receivers [2]. LEACH (Low-Energy Adaptive Clustering Hiera- rchy) protocol, uses a random approach for distributing energy consumption among the nodes. In this approach, the nodes organize themselves as local clusters and one node roles as a local base station or a cluster head [3]. In EEMC (An Energy Efficient Multi Level Clustering), CHs at each level are elected on the basis of probability function which takes into consideration the residual energy as well as distance factor. In this scheme whole information is sent and received by sink node for cluster formation [4,5]. [6]. VLEACH, is the new version of the LEACH, which aims to reduce energy consumption within the wireless network. In this approach, by selecting a Vice-CH, cluster nodes data will always reach the BS; no need to elect a new CH each time the CH dies. This will extend the overall network life time[7,10].

Rest of the paper is organized as follows section 2 presents the system environment, proposed work. Section 3

presents the simulation and results and section 4 finally concludes the work.

II SYSTEM ENVIRONMENT

System environment for the proposed scenario is shown in figure 1. Sensor nodes are randomly distributed. Sensor network comprises of heterogeneous sensor nodes, which sense, collect the heterogeneous data, collected data is sent to the cluster head. Intern cluster head transmits their data to sink node using multi-hop communication.

Cluster head is selected based on the residual energy of the nodes and Euclidean distance between the node and sink node. It is assumed that every sensor node have full energy and Global Positioning System (GPS) during the deployment phase.

2.1 Data Gathering model in IoT.

In IoT each and every device is IP addressable.IPV6 is used to address the nodes. Data gathering model in IoT includes the collecting of data from the different devices.

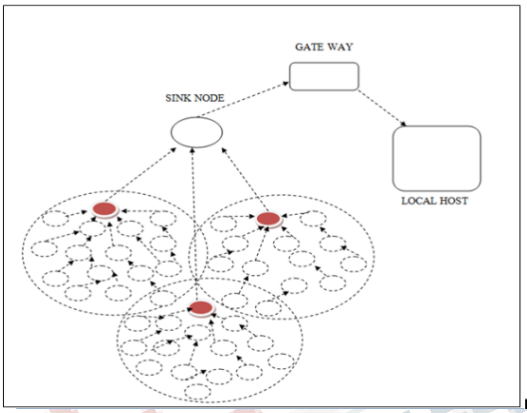

Figure 1: System Environment

The collected data is filtered and sent it to the base station. Data aggregation scenario that is considered for cooja simulation is depicted in figure 2. sensor nodes 1, 2, 3 are sending the sensed data to sensor node 4. sensor node 4 aggregates the data gathered from all the sensor nodes. In this scenario sensor nodes 1, 2, and 3 are cluster members and senor node 4 is the cluster head. This is shown for the simplicity. This process is performed in all the clusters considered. Aggregated data from the head nodes are sent to the sink node.

The steps used for cluster formation and data gathering in IoT through gateway are as follows.

- All the sensor nodes are deployed randomly; every node sends its location information to the sink node through GPS.

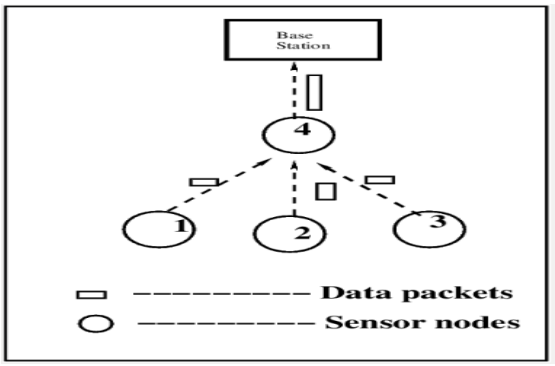

Figure2: Data gathering model

- Group of sensor nodes form the clusters given with cluster radius. Every cluster is selected with one cluster head on the energy and sensor node location.
- Every sensor node in the cluster senses the heterogeneous information and sends it to cluster head.
- Cluster head gathers the information from its cluster members and performs the data aggregation.
- All the cluster heads sends their aggregated data to the sink node
- Border router gateway establishes the connection between the WSN and the local host
- Sink node passes the information to the connected client device through border router gateway.

II. SIMULATION

The simulation of the proposed work has carried out in cooja simulator, which operates on Contiki Operating Ssystem (OS). Cooja simulator is one of the tools of the contiki OS.. In this work simulation is performed using Contiki 2.7 version.

Figure 3 shows simulation environment of IoT with sensor nodes using cooja simulator. The communication between the local host and network is achieved using tunslip6

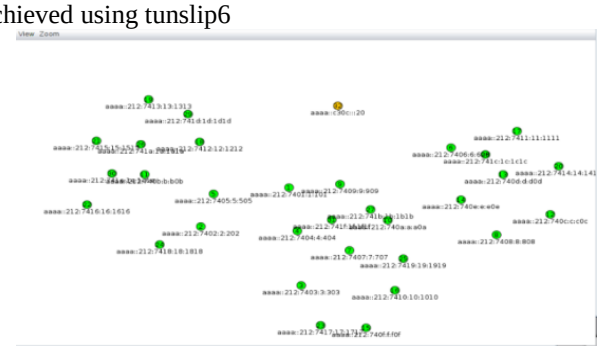

Figure 3 : Cooja Environment for WSN simulation

Some of the simulation input that are considered are L = 200, B= 400 meters, number of nodes N = 20-300, cluster radius = 2000 meters and Tx = 200 – 500, $E_{Initial}$=2 watts. Some of the following performance parameters are analyzed.

- ***Packet delivery ratio*:** It is defined as the ratio of number of packets delivered to the number of packets transmitted.
- ***Data Gathering time*:** It is defined as the time taken by the node to gather/ aggregate the information sent by different neighbouring nodes.
- ***Energy consumption in aggregating data***: It is defined as the total energy consumed by the nodes for aggregating the data.

Figure 4 shows the packets deliver ratio Vs. number of nodes. As the number of sensor nodes increases delivery ratio decreases. When the number of nodes is small in number the entire bandwidth is utilised for sending the information. As the number of nodes increases the bandwidth available for sending the data is not sufficient hence the average number of packets received will decrease.

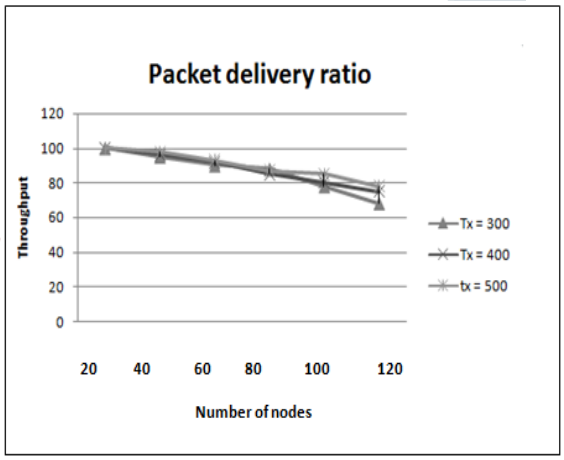

Figure 4 : Packet Delivery Ratio Vs. No. of Nodes

Figure 5 presents gathering time Vs. number of sensor nodes. As the number of sensor nodes increases the gathering time also increases. When there are less number of sensor nodes the information to be gathered is very less hence it takes less amount of time. Figure 6 shows energy consumption for aggregating the data. As the number of nodes increases the amount of data to be processed will be more, hence more energy is consumed for large number of nodes.

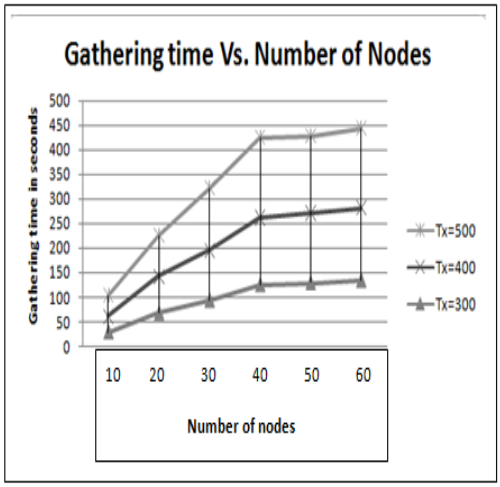

Figure 5: Data gathering time Vs. No. of nodes

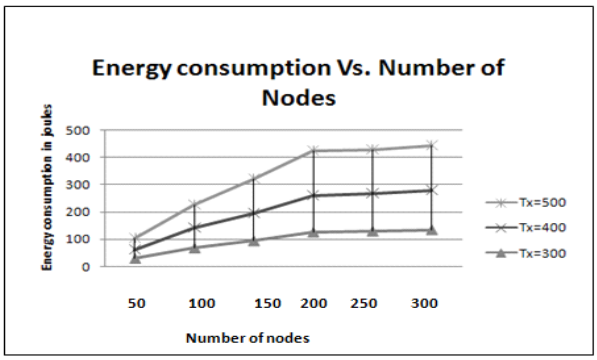

Figure 6: Graph of Energy consumption in aggregating the data

IV. CONCLUSION:

With cooja simulation we have seen that every sensor node in IoT scenario is assigned with IPV6 address. This work presents data aggregation in IoT scenario using cooja simulator. In this work more emphasis is given to usage of Cooja simulator for Iot simulation. Connection between the sensor network and the local host is established through the gateway. Gateway maps the address of the device network to the local host address.. Each device is placed within the communication range of its neighbouring device. Data gathering is performed at the cluster head, the gathered data is sent to sink node from all the cluster heads. Information from the sink node is sent to local host through gateway.

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