CHAPTER 1

INTRODUCTION

1.1 Wireless Sensor Networks (WSNs)

The wireless sensor network is a collection of sensors, which contain a set of components like transmitter/receiver, processing units, limited power units, and sensing devices. Sensor nodes have some limitations, such as predetermined power units and narrow bandwidth for communication. (Khemapech et al 2005).

Information is wealth, that helps to take a future decision, precisely. The information collected through various mode from different region such as persons on the internet where data directly acquire stale or be not viable. The information can obtain by wireless sensor networks ability to connect users a straight way to deliver facts that is precisely in time and location, rendering to the users’ requirement or demands. A characteristic of the wireless sensor network, all sensor node functions as untethered and which have a microprocessor with an insignificant memory space processing the job. Sensing component may be acoustic audio, video, cameras, infrared, seismic, or magnetic sensors. Node interconnects wirelessly with others by its radio range.

The knowledge potentials to transform the system for the people lives, work and communicate with the environment. Smart device comes with tiny, very cheap that possibly be located / scattered on to the roads, secured place, home applications and remote operation through sensor networks. It senses a diversity
of physical environment by monitoring the road traffic, smart transport grids, information about nature, identify forest fires and intimate the recue team to avoid more damages, emergency reaction and status of job movements and supply chains in modern industrial. (Estrin et al 2002).

The construction of the wireless sensor network has shown in Figure 1.1. The sensor nodes have typically spread in the place where to collect the information. Nodes form networks by organizing among themselves to reachable and great value information from the physical environment. Every node on the networks take decision autonomously and communicates via infrared or radios.

![Figure 1.1 Communication architecture of a wireless sensor network](image)

Each node’s decision is based on the node’s capability in communicate and energy resource. Collectively sensor nodes have the duty to gather data and forward to user through a sink node. Normally sink might be a large range of radio, skilled to linking the sensor network with standing communication infrastructure. The sink can also be a movable node temporary as an information sink, or somewhat other thing vital to mine data from the sensor network. Wireless Sensor Networks (WSNs)
groups the distinctive characteristics that is given below (Hamdola Ghamgin et al 2011).

- **Self-organizing:** The place of sensor nodes never required any human intervention to configure the nodes — the sensor that can able to organized by itself. In a rescue scenario, thousands of nodes could drop from an airplane over a large area. To perform the task on network sensor nodes need protocols and algorithms well defined.

- **Cooperation among nodes:** As node has limited resources, it is necessary for the nodes to cooperate with other. Several nodes may be tasked with sensing the same phenomenon. These nodes may cooperate in a cluster where one node is tasked with compressing the sensor result from all the other nodes in the cluster and produce a collective view of the cluster on the situation, this is called data aggregation.

- **Multi-hop routing:** By the nature of wireless sensor networks, nodes might not be possible to communicate straight to the base station. Therefore, nodes try to talk to the base station through multiple hops. Multiple hop communication is likely to have minimum power compared with the one-hop communication, which is also desirable in order to keep the communication costs at a minimum.

- **Dynamic Nature:** Mostly nodes suffers from error-prone in line for to exacting on the operation. Communication relations of two nodes are not common owing to node errors, untrustworthy, modulations schemes, the agility of nodes, and environmental nosiness.

- **Resource constraints:** Nodes has designed with small size with limited powered, memory and bandwidth resource.
WSNs could be taken as a precise subset of ad hoc networks where end devices in WSNs can sense physical phenomena. However, there are great differences between ad hoc networks and WSNs as listed below (Kim Boon Chia et al. 2006).

- **Energy Source:** Normally nodes have positioned in inaccessible or unreceptive environments, whereas ad hoc networks are not. Consequently, replacing the batteries of these WSN nodes is more of a problem. As a result, the energy consumption of any solution designed for WSNs should be carefully considered at the design time.

- **Node Density:** The nature of WSNs is that they are deployed in large scale environments, and each sensor has a limited transmission range. Therefore, dense deployment is necessary to achieve stable connectivity and to overcome the limited transmission coverage.

- **End Device:** In ad hoc networks, the end node device is less constrained than sensor nodes. For example, the end device in ad hoc networks, a laptop, has a larger memory and battery, and has a more powerful processor.

- **Network Structure:** Whereas ad hoc networks are usually completely distributed networks, WSNs have a central control system, which is the base station. Therefore, most traffic in WSNs is happen when each node sends their data base station, and vice versa. Only in a few cases; one node will send information directly to another sensor node. However, it is normal for end devices of an ad hoc network to connect other devices to the network as part of their normal functionality.

### 1.1.1 Advantages
The benefits of wireless sensor network expertise being lesser installation cost, support for remote communication, easy use of new data sources and better accuracy. WSN mostly focused on event-driven abort from time-driven, which is generally an ineffective method of observing. Data from the sensors can be speedily joint with other data, such as localization. It is also potential to have tasks that can be provided preventive and active. Since the wireless sensor nodes are autonomous, they can be used in areas where human presence is not possible.

The quicker installation, commission and reshape are conceivable with wireless sensor technologies. The qualitative feature of wireless sensor systems and networks is moveable. The further actual giant driver within industrialized and moneymaking organizations is a charge. The value of the setting, preserving and restructuring in great price conditions, comparable nuclear reactors, is real economy (David Nagel 2006).

1.1.2 Applications

WSN applications has categorized into different classes: (Aravind Iyer et al 2008).

- Event Detection: The aim is to identify occasional actions happen in the field convey the information to sink. Example forest fires, land sliding, and detect the enemy intruders.
- Periodic Reporting: The aim of the application has direct frequent apprises to the sink.
- Base Station Querying: Some application all the data from the node is not necessary at that time, so sink has requested the node on the particular node/region to be collected.
• Tracking: Tracking Time/monitor based applications are involved in noticing, concentrating and following targets, which gathered information has conveyed to the sink, appropriately.

1.2 Energy Efficiency In WSNs

The energy optimization methods deliberate WSNs in positions of different layers: physical layer, MAC layer, network layer, application layer, power harvesting layer and operating system.

On the operating system (OS), two main methods take to enhance and achieve the energy feasting. In kernel level, one method for reducing the organism energy feasting is CPU scheduling by Dynamic Voltage Scaling (DVS). Another technique is Parallel thread handling procedures help to energy feasting of the processor. (Sravan et al 2007).

In the physical layer, more energy was spent during the transceiver gets on & off during send & receive data on the channel. The transceiver has operated three ways: idle, sleep and active. Therefore, the important to real energy controlling is to power off the radio channel on idle condition. Also, a less-power heeding style could function on the physical layer via every so often spinning arranged the receiver took sample incoming data. The cyclic-duty tactic moderates the lazy heeding overheads in the network (Halkes et al 2005).

Effective MAC protocols resourcefully decide the routine of the shared channel though targeting to decrease packet accident, idle heeding, protocol overhead, and overhearing. (Halkes et al 2005).

At the network layer, numerous methods to rise the network lifetime. Topology regulator and associated routing methods can be enhanced for the purpose.
Formative the greatest topology between nodes in order to offer a attached network
to direction packets to the end point is a substantial process in WSNs.

Routing is an important and high task in WSNs as it acting a key part in
responsible the network period. routing procedure created node ads, wherever nodes
merely need to see their one-hop neighbors. LEACH (Low-Energy Adaptive
Clustering Hierarchy), the cluster heads are in charge for conveying data and
regulatory the cluster. (Heinzelman et al 2002).

Numerous tools are to extract energy from the situation, such as solar,
thermal, dynamic power, and vibration energy (Wedell et al., 2008). Describe the
gains of energy gathering schemes as the skill to refresh exhaustion afterward, in
addition to observing energy feasting, which might be essential for network
organization systems.

Though determinations to decrease energy feasting take shielded diverse
features of WSNs, several vital problems persist intact:

• Here is not at all a common tactic for formative and elevating the energy-
consuming residents of WSNs.

• Present methods attention happening single facet and might weight drive
depletion in further parts — current tactics failure reckonable dealings of energy
feasting of the complete grid.

• Furthermost of the modern styles remain valid for precise sensor nets by unique
things.

Figure 1.2 displays by what means jobs, processes, actions, deviations,
demands, and directions through that one lifetime spend the energy of a node. This
structure of parts permits raise of the energy feasting of a node if anticipated, permits
optimization of a designated basic for an exact application, and, more prominently, agrees on a complete optimization of the energy feasting of the whole network by seeing the contest among elements. (Najmeh Kamyab Pour and Doan Hoang 2010).

Figure 1.2 Energy Consuming Constituents

1.3 Energy Saving Mechanisms

The categorization of energy-efficient tools has shortened in figure 1.3 (Tifenn Rault 2014).

1.3.1 Radio optimization:

The radio unit is the critical section that roots battery exhaustion of sensor nodes. Toward decrease energy indulgence owing to wireless infrastructures, investigators take frustrated to enhance radio factors such as coding and inflection systems, influence communication and antenna direction.
Transmission Power Control (TPC) takes inspected to improve energy competence on the physical layer by regulating the radio broadcast control. In CTCA (Cooperative Topology Control with Adaptation) (Chu and Sethu 2012), the authors offer to frequently alter the communication control of each node with the intention of yield into deliberation the irregular energy feasting shape of the sensors.

Modulation optimization goals are to discover the best variation parameters that outcome in the least energy feasting of the radio. In energy, exhaustion has produced via the circuit control feasting and the power feasting of the conveyed signal. (Costa and Ochiai 2010) deliberate the energy efficiency of three variation patterns and resultant after this the variety type, and it's best parameters that attain least energy feasting for different spaces among nodes.

Cooperative communications systems take to progress the value of the established signal via manipulating numerous single-antenna strategies that cooperate to make an essential multiple-antenna transmitter. The impression is to
eed the element that adjacent nodes owing to the transmission nature of the channel commonly hear data. Other cooperative nodes can change, (Jung et al. 2011) the investigated in what way supportive transmission can be used to cover the communication range and consequently stability the duty cycling of nodes as typical convey sensors.

Directional antennas permit signals unique way at a time for transmitting/receive, which expands broadcast choice and throughput. Directional antennas might need localization practices to be focused. Nevertheless, numerous communications can happen in nearby juxtaposition, causing in the spatial use again of bandwidth. But, few troubles that are exact to directional antennas taken to be reflected: signal intervention, antenna alterations and deafness issues (Subramanian and Das 2010).

*Energy-efficient cognitive radio:* A cognitive radio (CR) is a smart radio that can with the passion for choosing a communication frequency from the range and able adjust its broadcast parameters consequently. The underlying Software-Defined Radio (SDR) skill is predictable to make completely align the transceivers which dynamically change their communication factors to network loads, which increases context-awareness. (Masonta et al. 2012).

### 1.3.2 Data reduction

The objectives are to decrease the volume of data to has sent to the sink. Two ways can be the yield on together: the restriction of surplus data and the restriction of sensing jobs since information broadcast and gaining are expensive in relations of energy.
Aggregation: In data combination, nodes on the middle way towards the sink do data blend to decrease the volume of data dispatched towards it. Data aggregation methods keen to wireless sensor networks are measured in detail by (Rajagopalan and Varshney 2006) and by (Fasolo et al. 2007).

Data compression converts data in such a technique that the number of bits wanted to denote the preliminary communication is compact. To obtain the energy-efficient as it decreases broadcast periods, by only the minimum packet has transmitted (Kimura and Latifi 2005).

Network coding (NC) is helping to decrease the movement of packets in transmission situations via transfer of a linear mixture of many packets as an alternative for each packet (Wang et al. 2011).

1.3.3 Sleep/wakeup schemes

Idle conditions are the most important bases of energy feasting at the radio module. Sleep/wake-up patterns intention to adjust node action to protect energy by setting the radio unit in the sleep condition.

Duty cycling methods prepare the node radio condition subject to network action in this direction to decrease idle heeding and chances to sleep states. (Anastasi et al. 2009).

Passive wake-up radios: during the duty cycling losses energy owing to unwanted wake-ups, a low-power system is applied to alert a node simply while it required to accept or transfer data (Ba et al. 2013).

Topology control: When sensors have deployed scatter with the demand for more coverage space, it is thinkable to disable random nodes during conserving network processes and connectivity (Misra et al. 2011).
1.3.4 Energy-efficient routing

Routing has taken the problem that can utterly drain energy capitals. Such circumstance in multi-hop preparations, nodes nearer to the sink is a struggle as they gain more packets to a route.

Cluster designs form the network keen on clusters, wherever a selected node is known as the cluster head (CH) manages each group. The CH has accountably used for organizing the associates’ actions and interactive with its member and near CHs.

Energy as a routing metric: Prolong the life period of sensor networks is to study the parameter in the structure route phase. Algorithms prepare not only concentration on the length of the minimum path then choose forwarding hop established with remaining energy.

Multipath routing: Routing allows energy to be stable amongst nodes through sending different path on the nodes.

Sink mobility: In WSN constructions that practice with a fixed base station, sensors placed nearby to the base station drain their battery quicker than others, foremost to early interruption of the network. Because of congestion near the sink which rises the load of the nodes nearer to the sink.

1.4 Motivation

Sensor network applications, nodes wisdom information from physical phenomena and convey them to a base station through multi-hops. Nodes are forms a hierarchical tree from the sink as the root node. At that juncture, the relay nodes accelerative data in a hop-by-hop communication. The sink node directs the collected
information to a control center for decision making. Every node must have the energy to accomplish data gathering and communication tasks. Sooner or later, the nodes exhaust their power source. Hence, the objective is the lifespan of WSN be determined by the capability of its energy backup, at the same time in what way energy has spent. Nodes have operated with power sources called battery which is limited. Sensor application used in competitive atmosphere observing, that case replacing power source could not be possible or is highly expensive. So, emerging protocols design to attaining energy efficiency is the most important one.

1.5 Objectives

The Energy efficiency is high level objectives of this thesis are given below. In wireless sensor networks (WSN) there was lacking topological control which increases the energy usage and interference on the networks. Energy efficiency has also decreased due to Cluster formation which is not in distributed nature then energy was not uniformly distributed over the networks. Energy efficiency also gets failed with unselecting suitable cluster heads. Sink node receives the most redundant data, and it has generated by the nodes on the networks.

1. To design and evaluate the virtual backbone based topology control mechanism using connected dominating set for improving energy efficiency in WSNs.

2. To design and evaluate distributed energy efficient routing protocol using cluster based approach for improving energy efficiency in WSNs.
3. To design and evaluate energy efficient clustering based on classical and evolutionary game theoretical modeling for improving energy efficiency in WSNs.

4. To design and evaluate Steiner tree based energy efficient data aggregation algorithm for improving energy efficiency in WSNs.

These objectives are approached via a number of specific problem scenarios using different techniques. In particular, the first objective is to construct a virtual backbone which controls the topology using connected dominating set approach for improving energy efficiency in WSNs. virtual backbone based topology control scheme which builds the virtual backbone with the help of localized information. Initially dominating set is constructed using spanning tree application. The resultant dominating set spanning tree is further optimized to remove dominant act nodes since originally they are the regular nodes. And it forms a small size backbone with sufficient energy capacity nodes are selected. Then ‘3-hop message forward’ algorithm is used to identify the relay nodes. The roles of the relay nodes are to make the dominating set as connected dominating set (CDS). Finally a minimal connected dominating set is formed by heuristic approach to remove redundant sensors from the CDS.

The second objective of the thesis is to design a distributed clustering based energy efficient routing protocol. The two likely energy wounded that a sensor node workouts in a sensor network are energy gone during sensing and communication cost. The energy cost in communication is much higher than the drive less in sensing. Therefore, planned to minimize the considerable communication cost by clustering. The main stages of the offered method are named Distributed Clustering based
Energy Efficient Routing (DCEER) protocol includes Cluster Head Selection, Cluster Formation and Data Transmission.

The third objective is to design energy efficient clustering protocol named Game theory based Energy Efficient Clustering (GEEC). game theory technique has applied for designing the GEEC protocol. The protocol contains two submodules called cluster head selection and formation. Initially classical game theory help to select the suitable cluster heads and it grew through the evolutionary game model. The classical game theory model some time unrealistic in a WSN setting. When the evolutionary game theory can manage the rate of uncertain behavior is more suitable. Therefore, the cluster head selection algorithm increases energy utilization. Also, to prove the efficiency of the equilibrium strategies of the designed game theory, Pareto optimality has been done. Finally cluster formation process is carried out and the data are transmitted from a member node to the sink with least energy depletion.

The final objective is to design an algorithm named Minimum Energy Steiner Tree (MEST) that help to minimize the energy utilization and best shortest route for data delivery in a wireless sensor network. The proposed work has divided into two categories one is Fusion routing Tree and dynamic routing. The FRT algorithm consists of two stages namely Parent & Sibling Selection and Dynamic Routing Tree Construction. A Parent and Sibling Set for each sensor node have identified in the Parent & Sibling Selection process. After this process, all the nodes get to know their levels, parent and sibling nodes of the networks. In dynamic routing tree construction, a query message floods from the root node to entire networks. The data transmission begins from the last node to the root node. Partial aggregation and
packet merge operations take place while transmitting packets from the bottom nodes to reach the root node.

1.6 Contributions

Energy efficiency in wireless sensor networks is inevitable. This thesis contributes a lot in achieving energy efficiency. This work makes four different contributions by improving energy efficiency in topology control, distributed clustering, routing and data aggregation.

The first contribution of the thesis is improving energy efficiency through virtual backbone which controls the topology using connected dominating set approach for improving energy efficiency in WSNs. Virtual backbone based topology control scheme which builds the virtual backbone with the help of localized information. Initially dominating set is constructed using spanning tree application. The resultant dominating set spanning tree is further optimized to remove dominant act nodes since originally they are the regular nodes. And it forms a small size backbone with sufficient energy capacity nodes are selected. Then ‘3-hop message forward’ algorithm is used to identify the relay nodes. The roles of the relay nodes are to make the dominating set as connected dominating set (CDS). Finally a minimal connected dominating set is formed by heuristic approach to remove redundant sensors from the CDS. Also the objective here is to prove that the proposed topology control algorithm is performing well over the other existing protocols. The mechanism is compared with related schemes such as NIDD, LDTC and DACDS. It has been observed that proposed scheme achieved minimum energy consumption.
The second contribution of the thesis is to design a distributed clustering based energy efficient routing protocol. The two likely energy wounded that a sensor node workouts in a sensor network are energy gone during sensing and communication cost. The energy cost in communication is much higher than the drive less in sensing. Therefore, planned to minimize the considerable communication cost by clustering. The main stages of the offered method are named Distributed Clustering based Energy Efficient Routing (DCEER) protocol includes Cluster Head Selection, Cluster Formation and Data Transmission. DCEER provides good result related with existing DEER, DEGRA and LGCA protocols in terms of lesser network energy consumption, maximum number of nodes alive, higher packet delivery ratio in static and mobility conditions, higher throughput and minimum E2E delay.

The third contribution is to design energy efficient clustering protocol named Game theory based Energy Efficient Clustering (GEEC). Game theory technique has applied for designing the GEEC protocol. The protocol contains two submodules called cluster head selection and formation. Initially classical game theory help to select the suitable cluster heads and it grew through the evolutionary game model. The classical game theory model some time unrealistic in a WSN setting. When the evolutionary game theory can manage the rate of uncertain behavior is more suitable. Therefore, the cluster head selection algorithm increases energy utilization. Also, to prove the efficiency of the equilibrium strategies of the designed game theory, Pareto optimality has been done. Finally cluster formation process is carried out and the data are transmitted from a member node to the sink with least energy depletion. Comparison with the previous protocols like CROSS, CORE and LGCA, it
consistently performs better in terms of less network energy consumption, maximum number of nodes alive, higher average residual energy, higher throughput against energy, higher amount of data received by the sink and minimum E2E delay.

The final contribution of the thesis is to design an algorithm named Minimum Energy Steiner Tree (MEST) that help to minimize the energy utilization and best shortest route for data delivery in a wireless sensor network. The proposed work has divided into two categories one is Fusion routing Tree and dynamic routing. The FRT algorithm consists of two stages namely Parent & Sibling Selection and Dynamic Routing Tree Construction. A Parent and Sibling Set for each sensor node have identified in the Parent & Sibling Selection process. After this process, all the nodes get to know their levels, parent and sibling nodes of the networks. In dynamic routing tree construction, a query message floods from the root node to entire networks. The data transmission begins from the last node to the root node. Partial aggregation and packet merge operations take place while transmitting packets from the bottom nodes to reach the root node. To exhibit the effectiveness of this protocol in terms of improving energy efficiency of the network, this protocol is evaluated with the existing protocols in terms of throughput, aggregation latency, total network energy consumption, communication overhead and aggregation accuracy. The work has been compared with some of the other existing and leading protocol such as QBRT, EEDAT, AggreTree and results of the MEST are very promising.
1.7 Organization Of The Thesis

The thesis is organized into seven chapters.

Chapter 1 gives an introduction of sensor networks and the similar works in the minimization of energy dissipation at each layer are reviewed. The need for improving energy efficiency in WSN has been discussed and shortfalls in existing energy efficient mechanisms for WSN have been explained. The main objective of the thesis is explained in detail. The focused objectives are designed and evaluated by improving energy efficiency in topology control, distributed clustering, routing and data aggregation.

Chapter 2, ‘Literature Survey’ presents a literature review to provide necessary background for a general understanding of challenges faced while improving energy efficiency in WSN. This chapter offering a summary of latest literatures in the following areas. Various schemes for improving energy efficiency using connected dominating set that exist in literatures were studied. In the area of improving energy efficiency related papers, in specific energy efficient routing were studied. In improving energy efficiency for clustered sensor networks various papers related with energy efficient clustering have been surveyed and analyzed. Various energy efficient data aggregation protocols are also discussed. The Literature Survey gives a good background for the thesis work.

Chapter 3, “Improving Energy Efficiency in Wireless Sensor Networks through Virtual Backbone based Topology Control Mechanism” presents a novel algorithm named Virtual Backbone based Topology Control (VBTC) which builds
the virtual backbone with the help of localized information. Initially dominating set is constructed using spanning tree application. The resultant dominating set spanning tree is further optimized to remove dominant act nodes since originally they are the regular nodes. And it forms a small size backbone with sufficient energy capacity nodes are selected. Then ‘3-hop message forward’ algorithm is used to identify the relay nodes. The roles of the relay nodes are to make the dominating set as connected dominating set (CDS). Finally a minimal connected dominating set is formed by heuristic approach to remove redundant sensors from the CDS. Also the objective here is to prove that the proposed topology control algorithm is performing well over the other existing protocols. The mechanism is compared with related schemes such as NIDD, LDTC and DACDS.

Chapter 4, “Enhancing Energy Efficiency of Wireless Sensor Network through the Design of Energy Efficient Routing Protocol” presents an energy efficient routing mechanism named Distributed Clustering based Energy Efficient Routing. The two likely energy wounded that a sensor node workouts in a sensor network are energy gone during sensing and communication cost. The energy cost in communication is much higher than the drive less in sensing. Therefore, planned to minimize the considerable communication cost by distributed clustering. The main stages of the offered method are named Distributed Clustering based Energy Efficient Routing (DCEER) protocol includes Cluster Head Selection, Cluster Formation and Data Transmission.

energy saving mechanism. Game theory technique has applied for designing the GEEC protocol. The protocol contains two submodules called cluster head selection and formation. Initially classical game theory help to select the suitable cluster heads and it grew through the evolutionary game model. The classical game theory model some time unrealistic in a WSN setting. When the evolutionary game theory can manage the rate of uncertain behavior is more suitable. Therefore, the cluster head selection algorithm increases energy utilization. Also, to prove the efficiency of the equilibrium strategies of the designed game theory, Pareto optimality has been done. Finally cluster formation process is carried out and the data are transmitted from a member node to the sink with least energy depletion.

Chapter 6, “Steiner Tree based Energy Efficient Data Aggregation Algorithm in Wireless Sensor Networks” presents an algorithm named Minimum Energy Steiner Tree (MEST) that help to minimize the energy utilization and best shortest route for data delivery in a wireless sensor network. The proposed work has divided into two categories one is Fusion routing Tree and dynamic routing. The FRT algorithm consists of two stages namely Parent & Sibling Selection and Dynamic Routing Tree Construction. A Parent and Sibling Set for each sensor node have identified in the Parent & Sibling Selection process. After this process, all the nodes get to know their levels, parent and sibling nodes of the networks. In dynamic routing tree construction, a query message floods from the root node to entire networks. The data transmission begins from the last node to the root node. Fractional data combine processes happen at the place when transfer information to the higher level.
Chapter 7, “Conclusion and future work”, summarizes the outcomes of research work and outlines possible direction for future research. The first work concludes that achieved energy efficient protocol using topology control mechanism. Second study points out energy efficient routing for increase the energy efficiency in clustered networks. In the third study, a game theory based clustering approach for improving energy efficiency is explained. Fourth study discussed energy efficient data aggregation mechanism that apply the shortest communication routing. This work shows to improve energy efficiency with a different aspect of the sensor network.