AN ASSESSMENT ON TOPOLOGIES AND NODE ARCHITECTURE-WIRELESS SENSOR NETWORKS

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Abstract: This review study is divided into two sections, the first of which focuses on the existing topologies used in wireless sensor networks and the second on the design of the node. As we all know, wireless sensor network technology is application-oriented, hence the network's topology and architecture will always alter from application to application, making it dynamic in nature. The creation and deployment of nodes always differ from old technologies; while traditional technology was utilized originally, its excessive use altered the situation. These topologies are now employed with hybrid methodologies, which include additional features and advantages, as is the case with node architecture. Many WSN applications require networking alternatives to improve cost reduction, efficiency, and security, so in this review report, we will discuss all of the topologies used and hybridized changes that have been made in the past and can be made in the future to the architecture of the WSN node.

Index Terms **- Data Dissemination, Topology, Node Architecture, Hybrid Changes and Cost Reduction.**

I. INTRODUCTION

Wireless Sensor Networks [1] are the networks which consist of a group of large number of sensor nodes. The objective of these networks is to collect data from the environment or the area in which they are deployed. Sensor nodes are usually deployed over a desired area where they wake-up, self-test and establish dynamic communications among them, composing a dynamic network. These networks are intended to support a variety of applications provided with flexible nodes design will make possible to support a variety of applications and have been used in many domains such as habitat monitoring [2], infrastructure protection [3], and scientific exploration [4]. The accuracy of individual nodes' readings is crucial in these applications, e.g., in a surveillance network [5], the readings of sensor nodes must be accurate to avoid misleading results, false alarms and missed detections. Moreover some applications are designed to be fault tolerant to some extent, removing nodes with faulty readings from a system with some redundancy or replacing them with good ones can still significantly improve the whole system's performance and at the same time prolong the lifetime of the network. Some of the most important application areas of sensor networks include military, natural calamities, health, and home. The technology of wireless sensor networks is at its full pace now a days. A few years back the technology started with the development of a sensor node and after that the evolution and enhancement of new technologies, this technology is used in many areas now. When compared to traditional networks, the most noticeable point about sensor networks is that, they are limited in power, computational capacities, and memory and this is main reason of the popularity of these networks these days.

Wireless Sensor network is the important aspect of the hybridization of various technologies which include the technologies like ULSI (Ultra Large Scale Integration) [6,7], Networking, Data Dissemination [8], Mobile

Communication [9], Clustering [10], Nano Technology [11] and many more. As wireless sensors become real commodities in electronic market therefore new arguments for old techniques are causing engineers, researchers and IT professionals to consider network strategies once ruled out.

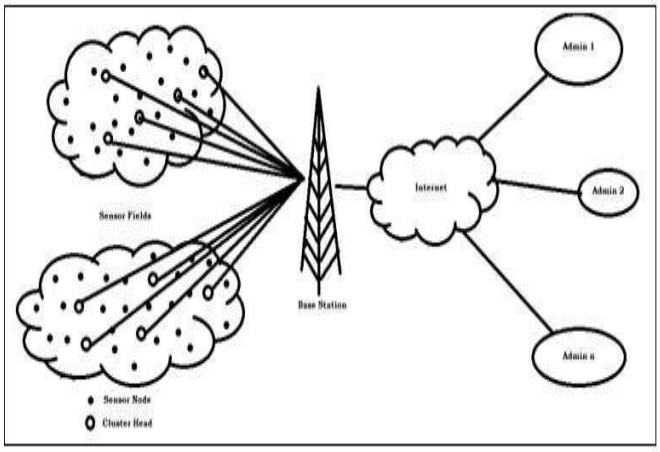


Figure 1: Working of Wireless Sensor Networks

II. REVIEW ON TOPOLOGIES WITH APPLICATIONS

In Wireless Sensor Networks, the topology is crucial element which plays an important role in minimizing various constraints like limited energy, latency, computational resource crisis and quality of communication [12]. The energy consumption in these networks depends upon the number of packets sends and receives. The transmission energy consumption depends upon the distance between sender and receiver nodes on the other hand the packet size also play vital role in this. This can be handled through the use of much efficient routing algorithms but the topology of the network set the initial stage for it. As we know that the sensor networks can be deployed in the remote areas that is why the probability of failure of nodes and data loss is very common; so an efficient topology selection ensures that neighbor nodes are at a minimal distance and reduces the probability of message being lost between sensors. There are the basic topologies that are used in the wireless sensor networks which can be modified as per requirements of the application for which we want to use this technology. Basically these followings are the topologies that are used in the wireless sensor networks.

Wireless networking is used for the communication in the wireless sensor networks. If we talk about the topologies used in this king of networking then the fact that comes into the picture is that these networks use almost every kind of the topology. The research in topology construction and

connectivity has been approached independently along two paths. In one path, researchers aim to determine critical conditions on network parameters (such as the transmission range [13, 14,15], the number of neighbors [16, 17], the minimum total power required, or the node failure probability) to ensure network connectivity with high probability. Following topologies are frequently used in WSNs.

1. Point to Point Topology.
2. Star Topology.
3. Mesh Topology.
4. Hybrid Technology.
5. Tree Topology.

Point to Point Topology [18]:

The point-to-point topology consists of a dedicated long- range, high-capacity wireless link between two sensor nodes. Switched point-to-point topologies are the basic model of conventional networks. This topology was the most common traditional topology used in the wireless sensor networks.

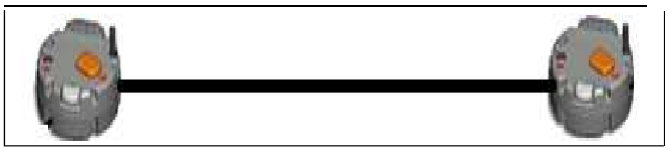


Figure 2. Point to Point Technology.

The main advantage and disadvantage of this topology is single data communication channel. This single channel is advantage as it is a secure path for the communication but the failure of this channel will cut down the communication in between those two nodes.

Star Topology [19]:

It is same as the topology used in the networking in which central server kind of scenario is there. The diagram of this kind of topology is given below: -

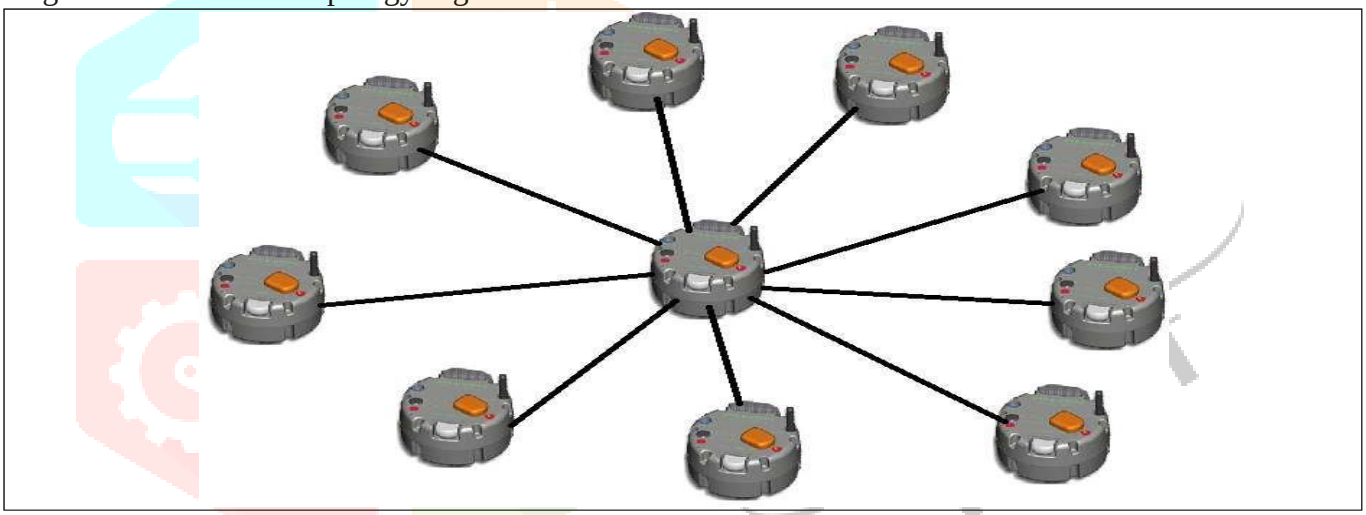


Figure 3. Star Topology

These followings are the advantages of star topology in wireless micro sensor network: -

1) Lowest power consumption in this topology which is good firm the point of view of Wireless Sensor Networks.
2) In this topology is easy to Enlarge the network; in other words we can say that this topology is scalable.

These followings are the disadvantages of wireless sensor network: -

1) No reliable communication due to single point failure in this topology.
2) No alternate path is present there in this structure of any node.

Mesh Topology [20]:

It is a multi-hoping system in which each node can communicate directly. The pictorial presentation of this topology is given below: -

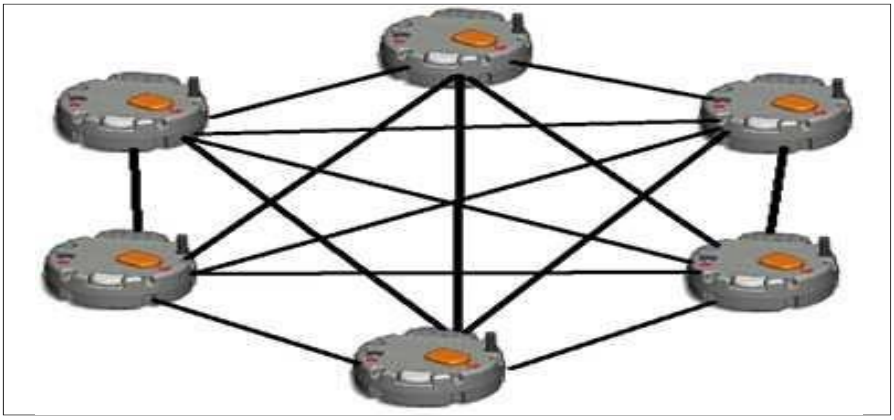


Figure 3. Mesh Topology.

These followings are the advantage of mesh topology inwireless sensor network: -

1) No single point of failure in this case therefore it is amost reliable communication network structure.
2) This is a more scalable network.
3) Alternate path can be there in this type of topology forthe nodes so chances of data loss are really very less.

These followings are the disadvantages of the mesh technology in wireless sensor network: -

1) Higher power consumption in this type of model whichis really bad from the view of Wireless Sensor Networks as these
2) have to be less energy consumptive.
3) Increased latency is the problem of this network.
4) Too many redundant paths is the major problem of this network.

Hybrid Technology [21]:

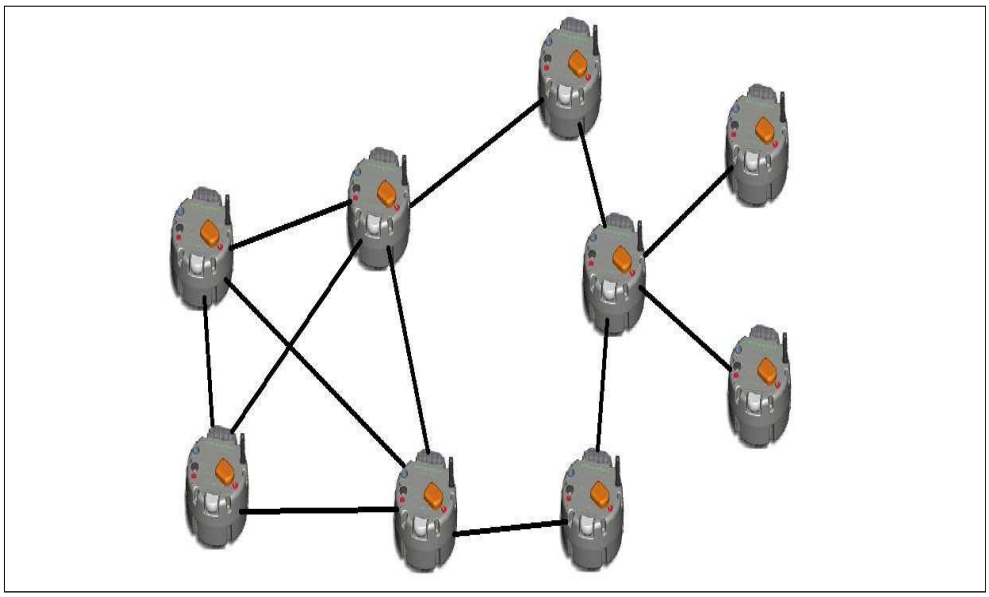


Figure 4. Hybrid Topology

The advantages of hybrid technology in wireless sensornetwork are given below: -

1) Reliable communication as there is no single point offailure.
2) Less power consumption as compared to meshtechnology.
3) Many alternate paths for nodes in this kind of scenario.

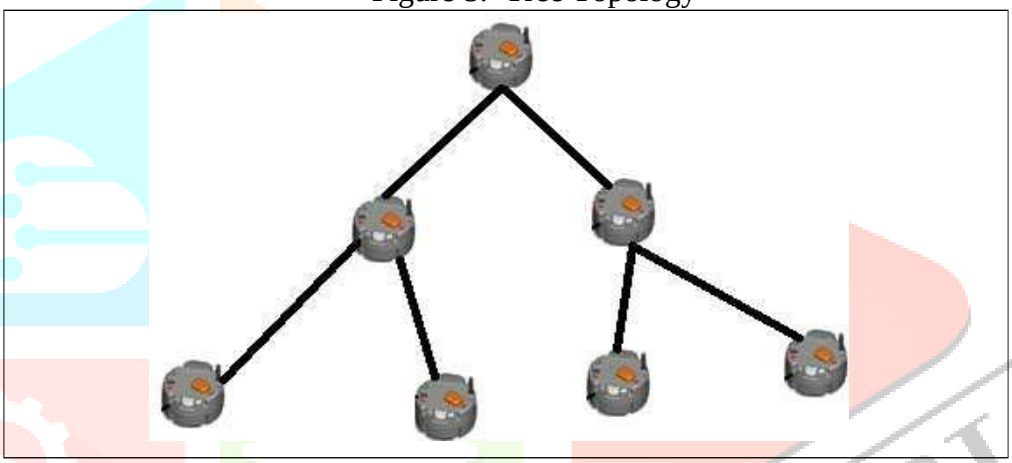
These followings are the disadvantages of hybrid topologyin wireless sensor network: -

1) Scalability becomes an issue when network is extendedafter some limit.
2) Interfacing between different types of topology isdifficult.

Tree Topology [22]:

All the sensors which are deployed in the sensor field construct a logical tree when we talk about Tree Topology. In this we have two types of nodes; one is parent node and other is leaf node. Data packets are passed from a leaf node to its parent nodes. In answer, a receiver node getting data from the child node sends data to receiver's parent node after cumulating data with its own possessed data.

Figure 5. Tree Topology



The advantage of this topology is that it consumes less power than other topologies, as flooding is not necessary for data communication.

The disadvantages of tree topology are:

1) This topology is time consuming and costly as all costdepends upon the formation of the tree.
2) If a parent node fails, then its entire sub-tree is cut off from the base station.
3) Power burning up is patchy across network nodes. The nodes closer to the base station consume a lot of power in forwarding packets from all the nodes in their sub- parts, whereas the leaf nodes in the spanning tree do not have to perform any forwarding at all and consume theleast power.

4)Long delay for sending data from leaf to root node as data will go through all the nodes of that group.

5)Tree safeguard expenses are high-ceilinged.

6)In this topology network heavily depends upon types ofradio link.

The topologies of the WSN can be chosen on the basisvarious parameters which are discussed below:

Selection based on Scalability and Self-Organization.

- Selection based on Energy Efficiency.
- Selection based on Reliability.

III. REVIEW ON NODE ARCHITECTURE:

The sensor node is composed of four layers, each one fulfilling a specific functionality of the node. These four layers are communication, processing, power supply and sensing/actuation.

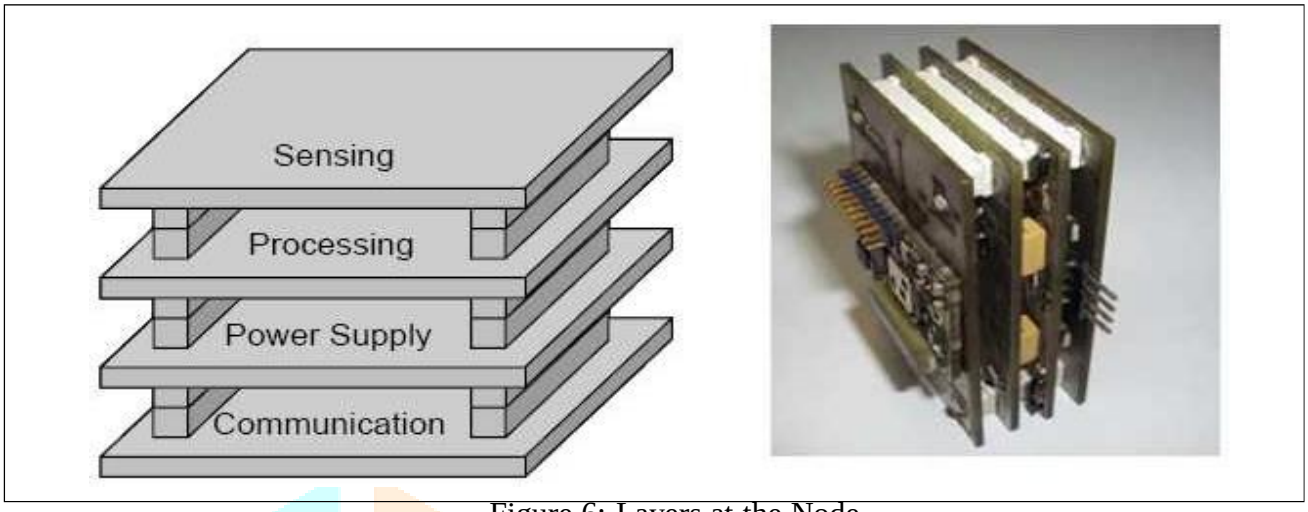


Figure 6: Layers at the Node

As we know that the sensor node is anticipated to communicate process and disseminate sensor data therefore sensor nodes must have processing units as we have central processing units in our computer systems. The central processing unit of a sensor node determines to a large degree both the energy consumption as well as the computational capabilities of a sensor node. Many recent studies [23, 24, 25] find that the surroundings is a dominating factor which affects the sensing and communication characteristics in these networks. The Nodes in these networks consume much lower power which can be achieved by trading off advanced computational features that typically used in every high performance processors. Despite if designing efficient sensor node processors to work in a low power environment, these processor architectures are still not fully efficient to wireless sensor networks applications.

The hardware technologies of wireless sensor network consists of various hardware, first is "System on Chip" which is capable of the integrating whole system on a single chip. There are so many companies which are in this field of integrating chips.

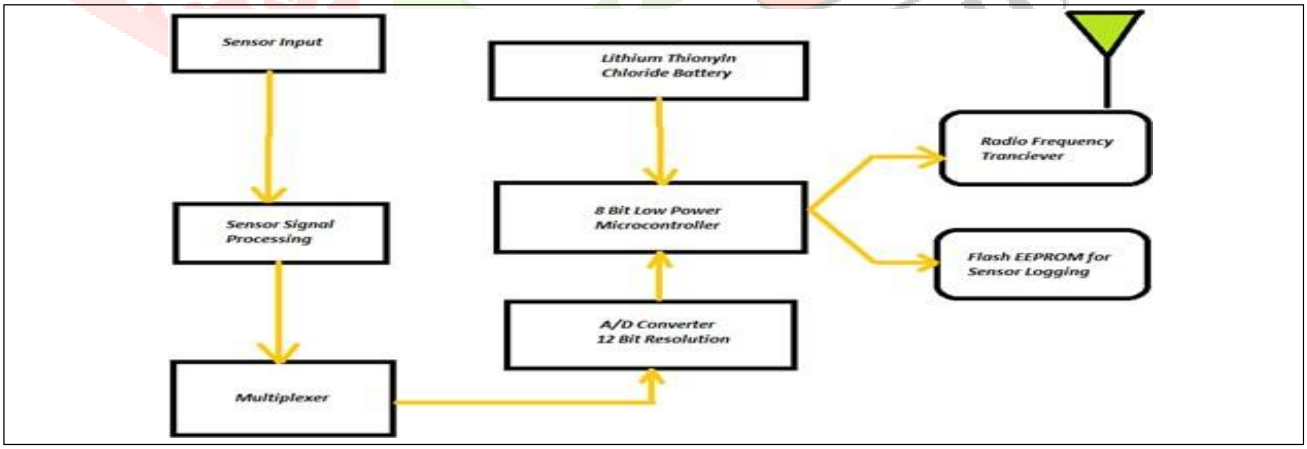


Figure 7: Internal Node Architecture

The hardware in particularly do four things which are described below: -

1) Sensors.
2) Wireless communication.
3) Data protocol and control.
4) Power management.

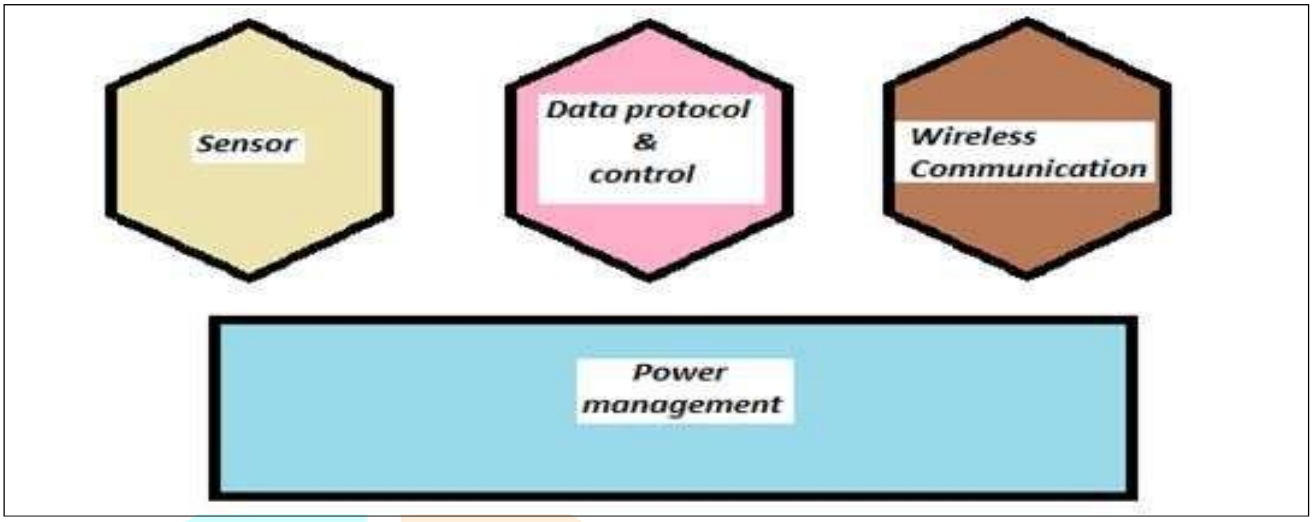


Figure 8: Internal Processing Elements

IV.CORPORATE WHO ARE DEALING IN WSN NODES:

A large number of commercially available microcontrollers, microprocessors and programmable logic are available in market, which allows great flexibility for CPU implementations. Some famous examples for microcontrollers are Intel PXA271 "Bulverde", Texas

Instruments MSP430, Atmel AVR 8bit, Atmel AtMega 1281 and many more.

There are so many sensor nodes available in the market with different configurations. Some of them are MICA, DOT, COT and Rene etc. The following figure is showing some of them:

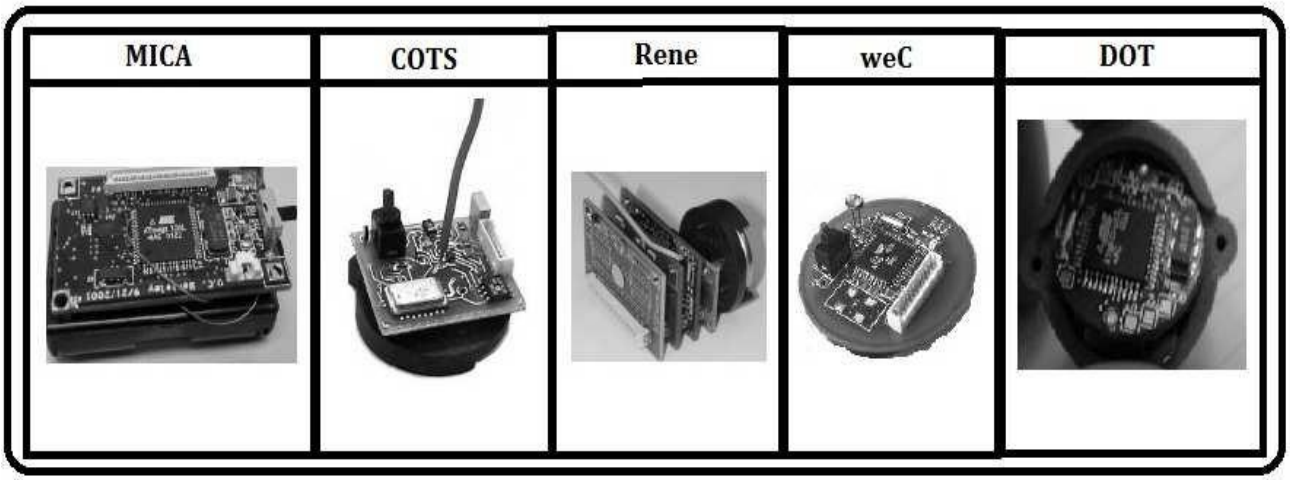


Figure 9: Real nodes from different Corporate

V.CONCLUSION AND FUTURE WORK

The topologies and the internal architecture are two important aspects of the communication in wireless sensor networks. The selection of best topology in accordance with the internal architecture of the wireless sensor node is very critical job so that proper communication can be there in between all the nodes according to the application. Due to the eminent applications of this technology, almost every

aspect of life is using sensors in them. So the evolution of networking in this field was a collaborative initiative for the popularity of these emerging fields. The initial step towards the sensor technology was taken only for the purpose of the use of this in wars, but various advancements in the field of electronics has made its usability almost in every field today and the efforts are still going on. As the field is not only associated to computer Science or electronics industry but with many other technologies; so the advancements in other technologies finally results in advancements in this technology. The scope of the technology is to find the wide range of applications and usability. So future of this technology is very bright due to its multi-disciplinary approach. In future with the evolution to various technologies like ULSI, MEMS, Nano Technology, Secure Networking techniques will lead this technology to the heights of Sky.

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