WIRELESS SENSOR NETWORKS: COMPRESSION WITH AD-HOC NETWORKS AND BENEFITS WITH CLASSIFICATION OF COVERAGE ALGORITHMS

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ABSTRACT

Wireless Sensor Networks are those networks that bind various sensors which are distributed in an ad-hoc manner. These sensors work with each other to sense some physical phenomenon and then the information gathered is processed to get relevant results. Wireless sensor networks bind a protocols and algorithms with self-organizing capabilities. A sensor node is made up of four basic components are ensign unit, a processing unit, a transceiver unit, and a power unit. In This paper we are presenting an introduction of wireless sensor networks with distributed system.

Keyword: - *Wireless Sensor, Network, Distributed, Ad hoc networks etc.*

1. INTRODUCTION

A wireless ad hoc network [1] (WANET) or MANET is a decentralized type of wireless network [2][3]. The network is ad hoc because it does not rely on a pre-existing infrastructure such as routers in wired networks or access points in managed wireless networks [4]. Instead each node participates in routing by forwarding data for other nodes so the determination of which nodes forward data is made dynamically on the starting point of network connectivity and the routing algorithm in use [5].

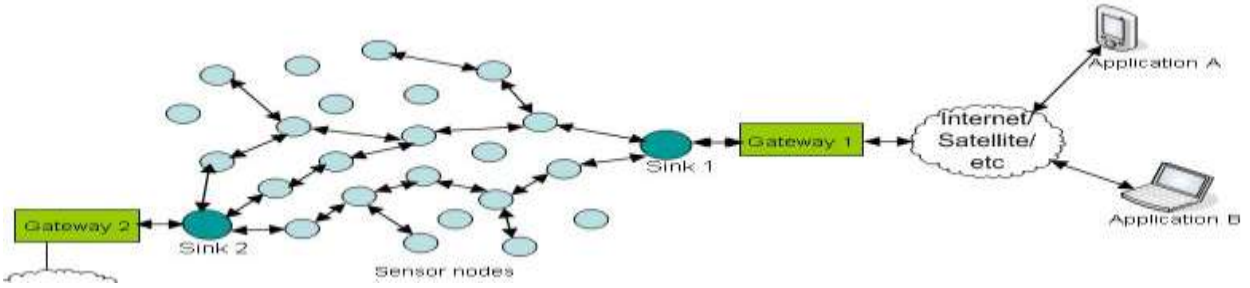

Fig – 1: Wireless Sensor Network

Sensors are helpful devices that gather information related to a specific parameter, such as noise, temperature, humidity, pressure, etc. Sensors are increasingly connected via wireless to allow large scale collection of sensor

data. With a large sample of sensor data, analytics processing can be used to make sense out of these data. The connectivity of wireless sensor networks rely on the principles behind wireless ad hoc networks, since sensors can be now be arrange without any fixed radio towers, and they can now form networks on-the-fly. "Smart Dust" is one of the early projects done at U C Berkeley, where tiny radios can be used to interconnect smart dust [6]. Most wireless ad hoc networks do not implement any network access control, leaving these networks vulnerable to resource consumption attacks where a malicious node injects packets into the network with the goal of depleting the resources of the nodes relaying the packets [7]. To thwart or prevent such attacks, it was necessary to employ authentication mechanisms that ensure that only authorized nodes can inject traffic into the network [8]. Even with authentication, these networks are vulnerable to packet dropping or delaying attacks, whereby an intermediate node drops the packet or delays it, rather than promptly sending it to the next hop.

2. EXAMPLE OF WIRELESS SENSOR NETWORK

3. COMPRESSION WITH AD-HOC NETWORKS AND BENEFITS

3.1 Compression with Ad-Hoc Networks

- The number of nodes in a sensor network can be several orders of magnitude higher than the nodes in an ad hoc network.
- Sensor nodes are densely deployed.
- Sensor nodes are limited in power, computational capacities and memory.
- Sensor nodes are prone to failures.
- The topology of a sensor network changes frequently.
- Sensor nodes mainly use broadcast, most ad hoc networks are based on p2p.
- Sensor nodes may not have global ID

3.2 Benefits

- Easy to deploy
- Enhanced flexibility
- Reduced cabling
- Mobility and ease of network configuration,
- Remote operation,
- Improving operability, visibility for energy management and occupancy,
- Location tracking of mobile equipments,
- Increased assets utilization and Low power,
- Reduced inventory,
- Reduced deployment costs, and
- Decreased maintenance costs.

4. SENSORS NETWORK COMMUNICATION ARCHITECTURE

The sensor nodes are usually scattered in a sensor field as shown in Figure 2. Each of these scattered sensor nodes has the capabilities to collect data and route data back to the sink and the end users. Data are routed back to the end

user by a multi hop infrastructure less architecture through the sink as shown in Figure The sink may Sink communicate with the task manager node via Internet or Satellite.

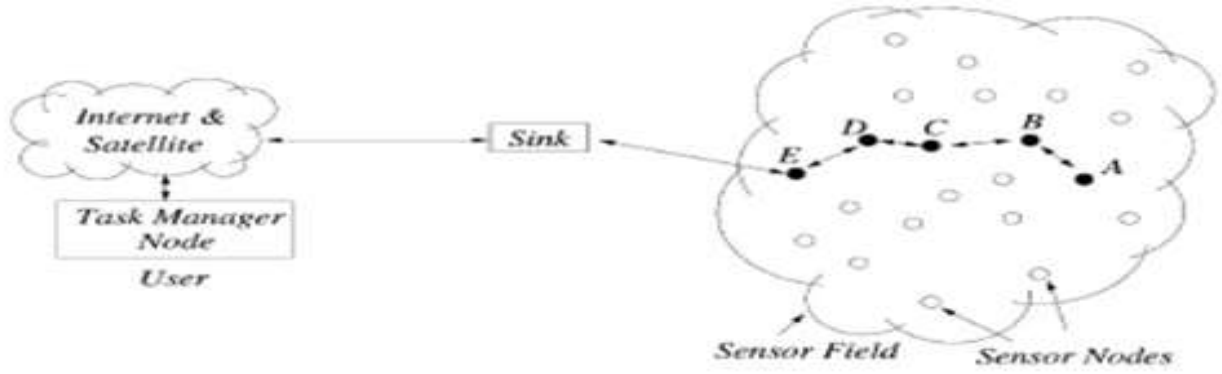

Fig – 2: Sensor Node Scattered in a Sensor Field

5. SENSORS NETWORK COMMUNICATION ARCHITECTURE

- The protocol stack consists of the application layer, transport layer, network layer, data link layer, physical layer, power management plane, mobility management plane, and task management plane.
- Combine power and routing awareness
- Integrates date with networking protocols
- Communicates power efficiently through the wireless medium
- Promotes cooperative efforts among sensor nodes.

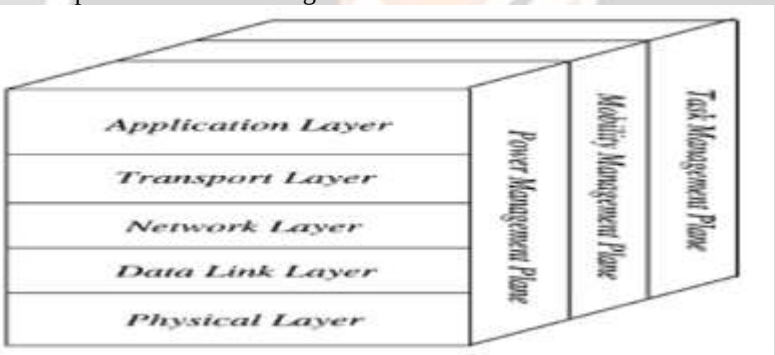

Fig – 3: The Sensor Network Protocol Stack

6. APPLICATIONS OF WIRELESS SENSOR NETWORKS

The applications can be divided in three categories:

- Monitoring of Targets.
- Monitoring of an area.
- Monitoring of both area and Targets.

7. UNIQUE CONSTRAINTS OF SENSORS AND WSNS

- Wireless Sensor Networks mainly consists of sensors. Sensors are -
  - Low power
  - Limited memory
  - Energy constrained due to their small size.
- Limited support for networking
- Energy constraint
- Dynamic topology
- Scalability and heterogeneity

- Limited support for software development
- Prone to failure
- Dynamic Topology
- Limited Supported for software development

8. CHALLENGING ISSUES IN WSNs

- **Heterogeneity**
  - The devices deployed maybe of various types and need to collaborate with each other.
- **Distributed Processing**
  - The algorithms need to be centralized as the processing is carried out on different nodes.
- **Low Bandwidth Communication**
  - The data should be transferred efficiently between sensors
- **Large Scale Coordination**

The sensors need to coordinate with each other to produce required results.

- **Utilization of Sensors**

The sensors should be utilized in a ways that produce the maximum performance and use less energy.

- **Real Time Computation**

The computation should be done quickly as new data is always being generated.

9. COVERAGE VARIANTS

- Energy Efficiency
- Limited storage and computation
- Low bandwidth and high error rates
- Errors are common
  - Wireless communication
  - Noisy measurements
  - Node failure are expected
- Scalability to a large number of sensor nodes
- Survivability in harsh environments
- Experiments are time- and space-intensive

10. DESIGN REQUIREMENT FOR WSNs

WSN possesses a lot of constraints, protocols designed for them must satisfy many special requirements to overcome those constraints. Some of the most critical requirements are:

- Energy-efficiency
- Robustness
- Fault-tolerance:
- Distributed and parallel algorithms

11. HETEROGENEOUS RESOURCES IN WSNs

In this section, we will present a paradigm of heterogeneous wireless sensor network and discuss the impact of heterogeneous resources There are three common types of resource heterogeneity in sensor node:

- Computational heterogeneity
- Link heterogeneity
- Energy heterogeneity

12. IMPACT OF HETEROGENEITY ON THE WSNs

- Placing few heterogeneous nodes in the sensor network can bring following three main benefits:
- Prolonging network lifetime

- Improving reliability
- Decreasing latency of data transportation

13. TARGATE COVERAGE PROBLEM

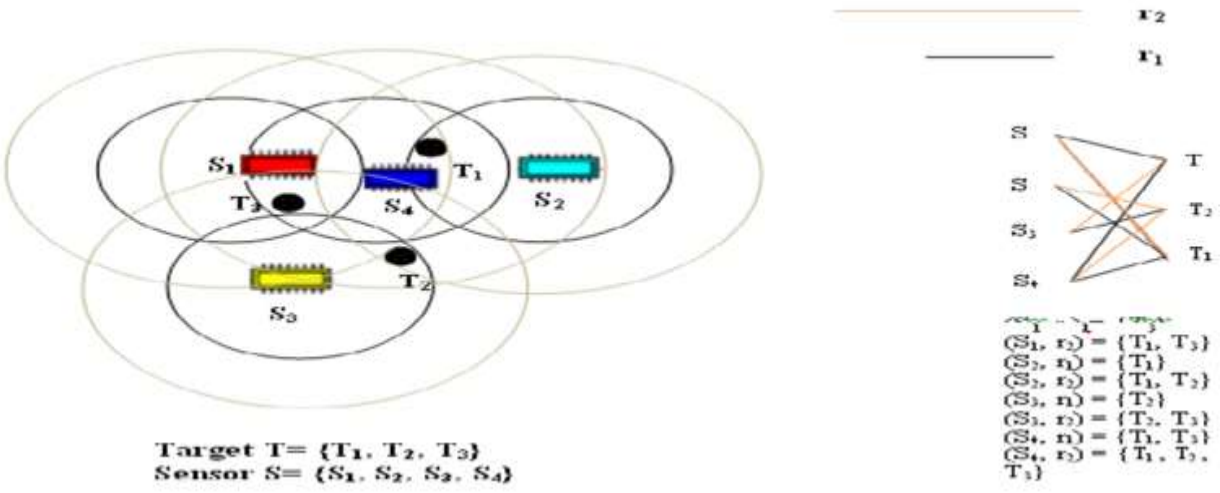

Fig – 4: Sensor Network with Four Sensors and Three Targets and Targets Covered [5]

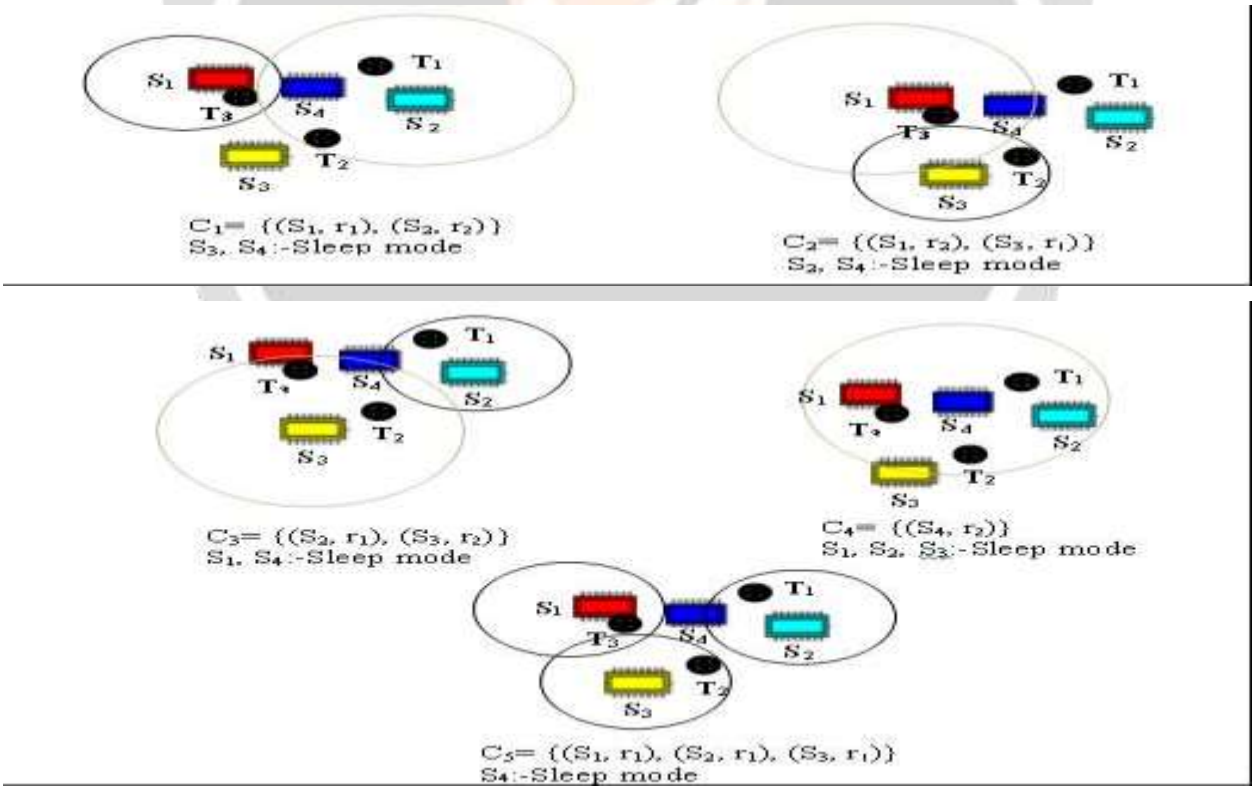

Fig – 5: Sequence of different Set Covers [5]

14. SEQUENCE OF DIFFERENT SET COVERS

C1	**S1=2-0.5=1.5**	**S2=2-1=1**	
C2	**S1=1.5-1=0.5**	**S3=2-0.5=1.5**	
C3	**S2=1-0.5=0.5**	**S3=1.5-1=0.5**	
C4	**S4=2-1=1**		
C5	**S1=0.5-0.5=0**	**S2=0.5-0.5=0**	**S3=0.5-0.5=0**
C6	**S4=1-1=0**		

14. CLASSIFICATION OF COVERAGE ALGORITHMS

The major objective of coverage problem is to efficiently cover an area or a set of points or objects (targets) under various constrains and limitations of sensors and networks such as energy, computational capability, memory, communication etc. while satisfying a requirement such as the maximum lifetime of the networks. The coverage problems for sensor networks can be categorized into three broad types [9] – area coverage (in which, the major objective is to monitor an area), target coverage (where the main objective is to cover a set of targets), and breach coverage (the goal here is to minimize the numbers of uncovered targets or the ratio of uncovered portion to the whole area).The algorithms can be centralized (where the algorithm is executed in a special station and usually requires the global information of the whole network) or decentralized – localized and distributed (where all the sensors simultaneously run the algorithm based upon only local information). The advantage of this type of algorithm is that the energy consumption and some other constraints can easily be taken into account since the sensors can update and then exchange the information (including their residual energy and sensor id) each time carrying out the algorithm.

15. CONCLUSIONS

This paper that has been undertaken for this paper has successfully met the research aims proposed in section. However, the investigated research area of target-monitoring and communication protocols has been highlighted as an interesting and diverse aspect of WSNs and there are many avenues along which additional research could be conducted to further this research. This section outlines some of these areas of future work. The future work may include simulating these algorithms with the combination of other communication protocols. We have considered here three deployments triangular, square and other is hexagonal. More types of deployments can be explored and a comparison of lifetime for all new deployments can be done. We have considered three level heterogeneity but work can be extended to multi level heterogeneity. WSN possesses a lot of constraints, protocols

designed for them must satisfy many special requirements to overcome those constraints. The algorithms can be centralized (where the algorithm is executed in a special station and usually requires the global information of the whole network) or decentralized – localized and distributed (where all the sensors simultaneously run the algorithm based upon only local information).

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