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# Efficient Communication Protocols for Improving Performance Optimization in Wireless Sensor and Mobile Ad Hoc Networks

**Mohammad Ibrar, Ritushree Narayan**
Department of Computer Science, Ranchi University,
Jharkhand, India

***Abstract:*** ***In today's era the key challenge in wireless sensor network protocol designs is to provide energy efficient communication, as most of the nodes in sensor networks have limited battery power and it is not feasible to recharge or replace the batteries. The concept of wireless is not new. When the packet switching technology, the fabric of the Internet was introduced by the Department of Defense, the ARPANET ,it understood the potential of packet switched radio technology to interconnect mobile nodes .The DARPA around early 70's helped establish the base of ad hoc wireless networking. Wireless Ad hoc Networks since then is a fast developing research area with a vast spectrum of applications. As we know that the popularity of Wireless Sensor Networks have increased tremendously due to the vast potential of the sensor networks to connect the physical world with the virtual world. Since these devices rely on battery power and may be placed in hostile environments replacing them becomes a tedious task. Thus, improving the energy of these networks becomes important.***

***Keywords: Wireless, Ad hoc networks, sensor, protocol, ARPANET(Advance Research Project Agency Network)***

## I. INTRODUCTION

Ad hoc and wireless sensor networks (WSNs) have recently attracted growing interest in the research and commercial community. Wireless devices are becoming smaller with lots of embedded computing capabilities. In addition, mobile computing, which is the ability to use computing capabilities even when being mobile, has also become the focus of very recent research efforts. The use of this ability has been greatly enhanced by wireless networking[1].

The continued advances in micro-sensor technology have resulted in the development of small, low cost and low power sensing devices with computational "sensing" and communication capabilities. These advances make economically possible the deployment of large numbers of nodes to form a wireless sensor network (WSN) that can monitor a one or more parameters. The key feature of mobile computing technologies is mobility/portability. However, as mobile devices are battery limited, energy efficient communication techniques have become of critical importance. Mobile nodes, typically with similar transmission and computational capabilities, cooperate by forwarding packets for nodes that are not in each other's direct transmission range. The properties of ad hoc networks such as node mobility, limited available bandwidth and the broadcast nature of the wireless medium make the design of efficient routing protocols for ad hoc networks more challenging than for traditional networks[5].

we look at communication protocols, which can have significant impact on the overall energy dissipation of these networks. Based on our findings that the conventional protocols of direct transmission, minimum-transmission-energy, multi hop routing, and static clustering may not be optimal for sensor networks, we propose LEACH (Low-Energy Adaptive Clustering Hierarchy), a clustering-based protocol that utilizes randomized rotation of local cluster base stations (cluster-heads) to evenly distribute the energy load among the sensors in the network. LEACH uses localized coordination to enable scalability and robustness for dynamic net-works, and incorporates data fusion into the routing protocol to reduce the amount of information that must be transmitted to the base station. Simulations show that LEACH can achieve as much as a factor of 8 reduction in energy dissipation compared with conventional routing protocols. In addition, LEACH is able to distribute energy dissipation evenly throughout the sensors, doubling the useful system lifetime for the networks we simulated.

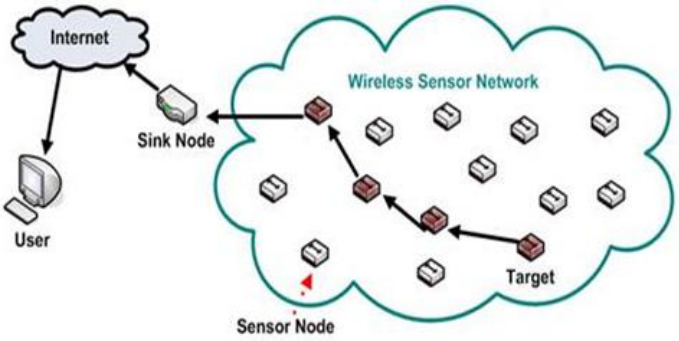


Figure 1. Wireless sensor Network

 

## II. OVERVIEW OF WIRELESS AD-HOC/SENSOR

A Wireless Sensor Network (WSN) consists hundreds or even thousands of wireless sensor nodes that are low cost and small in size. The sensor nodes monitor or sense the environment parameters, and the sensed data can be collected by one or a set of central points called sinks, or be processed in a distributed manner. Due to the larger scale of network and more nodes than that of Ad-hoc networks, some high-capacity nodes dedicated to network communication and/or management may be deployed together with sensor nodes. These nodes can take care of data frame relaying, clustering, transmission scheduling, and network diagnosis, etc[1][4].

A wireless ad-hoc/sensor network consists of a number of wireless devices (also called nodes) sharing the same radio interface, thus working in packet-delivery mode. The devices are usually mobile in an area and operated by battery power. The communication between the nodes can be either point-to-point, multicast, or broadcast. The type of communication data can be any format, such as real time sensed information (in small amount), non-real time files/databases (in large size), real time audio or video (in streamed format), etc. Because of the limit of radio signal propagation distance and the purpose of efficiently reusing the radio resource, a wireless ad hoc/sensor network usually works in multi hop mode. In an ad-hoc network, communications between the nodes are distributed and balanced, i.e., communication may happen between any two nodes; while as a wireless sensor network is usually data-collective and thus unbalanced, i.e., sensed data is collected by one or several data sinking nodes. The sinks can be located at the edge or in the middle of the network, or totally random. The number of nodes in wireless sensor networks is usually much greater than their ad-hoc counterparts.

Wireless Sensor Networks (WSNs) represents a new category of ad hoc networks consisting of small nodes with three functions: sensing, computation, and wireless communications capabilities. Many routing, power management, and data dissemination protocols have been designed for WSNs where energy awareness is an essential design issue to improve the overall performance of WSN. There are many approaches and techniques explored for the optimization of energy usage in wireless sensor networks. Routing represents one of these areas in which attempts for efficient utilization of energy have been made. A Mobile Ad-hoc NETwork (MANET) is a peer-to-peer network which is usually comprised of tens to hundreds of communicating nodes which are able to cover ranges of up to hundreds of meters. Each node is envisioned as a personal information appliance such as a Personal Digital Assistant (PDA) outfitted with a fairly sophisticated radio transceiver. The nodes are fully mobile. The MANET aims to form and maintain a connected multi-hop network capable of transporting multi-media traffic between the nodes. By integrating sensing, signal processing, and communication functions, a sensor network provides a natural platform for hierarchical information processing [6]. It allows information to be processed on different levels of abstraction, ranging from the detailed, microscopic examination of specific targets, to the macroscopic view on the aggregate behavior of targets. Any events in the environment can be processed on three levels: node level, local neighborhood level, and global level. On the node level, data collection and processing occurs in each individual node, requiring no communications except for transmission of the results to some distant information sink. On the local and global level, inter-node communication is required for gathering raw or pre-processed data from multiple nodes to a single location for cooperative signal processing such as data fusion or beam-forming[3][5].

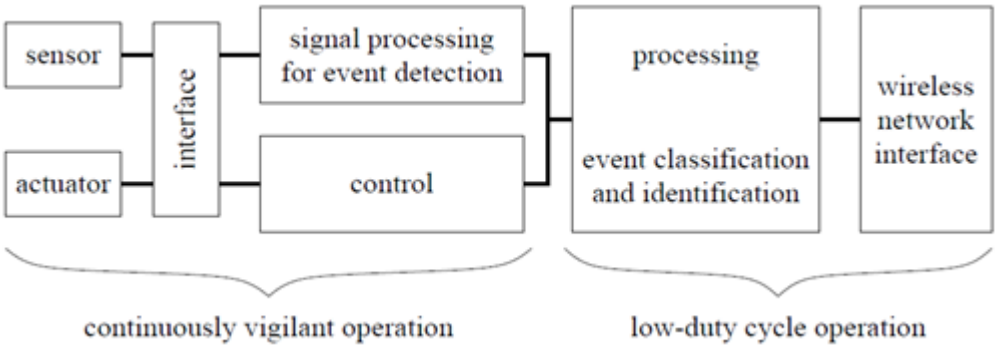


Figure 2. Architecture of Wireless sensor Network

## III. WIRELESS SENSOR PROTOCOLS

When designing network protocols for wireless sensor networks, several factors should be considered. First and foremost, because of the scarce energy resources, routing decisions should be guided by some awareness of the energy resources in the network. Furthermore, sensor networks are unique from general ad hoc networks in that communication channels often exist between events and sinks, rather than between individual source nodes and sinks. The sink node(s) are typically more interested in an overall description of the environment, rather than explicit readings from the individual sensor devices. Thus, communication in sensor networks is typically referred to as data-centric, rather than address-centric, and data may be aggregated locally rather than having all raw data sent to the sink(s)[4]. These unique features of sensor networks have implications in the network layer and thus require a re-thinking of protocols for data routing. In addition, sensors often have knowledge of their own location in order to meaningfully assess their data. This location information can be utilized in the network layer for routing purposes. Finally, if a sensor network is well connected (i.e., better than is required to provide communication paths), topology control services should be used in conjunction with the normal routing protocols.

 

## IV. LOW ENERGY ADAPTIVE CLUSTERING HIERARCHY PROTOCOL

Low Energy Adaptive Clustering Hierarchy (LEACH) is a TDMA-based MAC protocol which is integrated with clustering and a simple routing protocol in wireless sensor networks. LEACH is a distributed clustering protocol which utilizes randomized rotation of local CHs to evenly distribute energy utilization between the nodes of WSNs[6]. The goal of LEACH is to provide data aggregation for sensor networks while providing energy efficient communication that does not predictably deplete some nodes more than others. The LEACH is a hierarchical protocol in which most nodes transmit to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station. Each node uses a stochastic algorithm at each round to determine whether it will become a cluster head in this round. LEACH assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but that using this radio at full power all the time would waste energy

## V. NETWORK TOPOLOGY

In fact the Wireless Sensor Networks are constituted by a huge number of nodes raises the challenge of network topology maintenance and modification[7]. The challenge occurs starting at the early stage of nodes deployment. Sensor nodes can be either thrown in a mass (e.g., from a plane) or manually placed one by one (e.g., by a human or a robot) in the field. Also, after nodes deployment, topology may change due to failures in some nodes, changes in nodes locations, lack of reachability (due to jamming for instance), and huge reductions in power resources at some nodes (which affect their transmission power levels to the limit that they vanish from the vicinity of neighboring nodes). The WSN should be able to adapt to these sudden changes to avoid any degradations in its functionality.

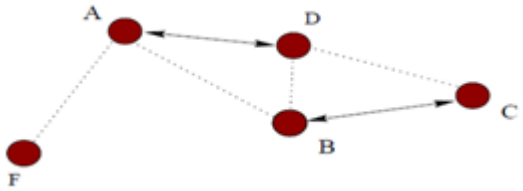


Figure 3. Node topology

## VI. CONCLUSION

In today's era, wireless sensor networks have become very popular. This is because of their low cost, less power requirement, performance and high potential application areas. Although a significant work has been done in relation with wireless sensor networks. As we know that the concept of wireless is not new. When the packet switching technology, the fabric of the Internet was introduced by the Department of Defense, the ARPANET, it understood the potential of packet switched radio technology to interconnect mobile nodes.

Energy Efficiency i.e. utilizing the available limited amount of energy in deploying the network in the most efficient and reliable way is perhaps the greatest challenge faced by an ad-hoc system. Although there have been certain protocols proposed to deal with it, however they do not provide a complete energy-efficient network

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