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

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ABSTRACT

In the current time and next decades, 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. 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.

1. INTRODUCTION

The wireless sensor network is some type of an ad hoc network. Mainly it consists of small light weighted wireless nodes called sensor nodes, deployed in physical or environmental condition. It measure the physical parameters such as sound, pressure, temperature, and humidity. These sensor nodes deployed in large or thousand numbers and collaborate to form an ad hoc network capable of reporting to data collection sink. Wireless sensor network have various applications like habitat monitoring, building monitoring, health monitoring, military survival lance and target tracking.

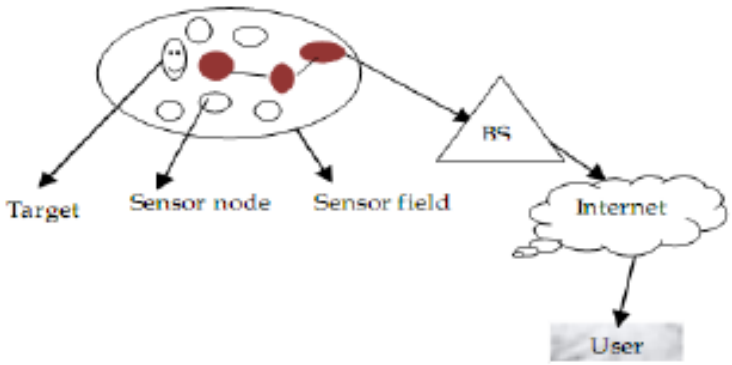


Fig.1. Wireless sensor Network

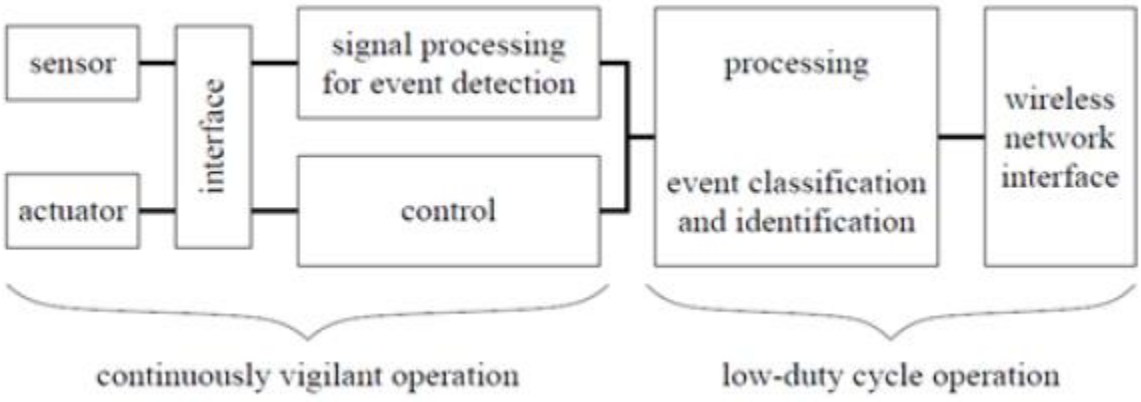
However wireless sensor network is a resource constraint if we talk about energy, computation, memory and limited communication capabilities. Ad hoc and wireless sensor networks (WSNs) have recently attracted growing interest in the research and commercial community. Wireless devices are becoming smaller 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. 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. we look at communication protocols, which can have significant impact on the overall energy dissipation of these networks. orks are defined as base stations. There may be one or more base stations for a wireless sensor network.

2. 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.



Fg.2. Architecture of Wireless sensor Network

In a wireless sensor network, sensing nodes with limited power, computation, communication and storage resources cooperate to fulfill monitoring and tracking functionalities. Compared with conventional sensors, wireless sensor networks have the following advantages: Since the relevant technologies have become technologically and economically feasible, people want to gather much more information from more places in the physical world, which was either impossible due to technological difficulties or formidable due to high cost, in terms of money and human power. Decreasing form factors and costs of micro sensors make deployment of hundreds even thousands of sensors much more feasible than conventional sensors that are too cumbersome and expensive. Therefore, controlled placement is often pursued for only a selected subset of the employed nodes with the goal of structuring the network topology in a way that achieves the desired application requirements. In addition to coverage, the nodes‟ positions affect numerous network performance metrics such as energy consumption, delay and throughput. For example, large distances between nodes weaken the communication links, lower the throughput and increase energy consumption. 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.

3. WSN ARCHITECTURE PARAMETERS

A typical sensor network operates in five phases: the planning phase, deployment phase, post-deployment phase, operation phase and post-operation phase. In the planning phase, a site survey is conducted to evaluate deployment environment and conditions, and then to select a suitable deployment mechanism. In the deployment phase, sensors are randomly deployed over a target region. In the post deployment phase, the sensor networks operators need to identify or estimate the location of sensors and to access coverage. The operation phase involves the normal operation of monitoring tasks where sensors observe the environment and generate data.

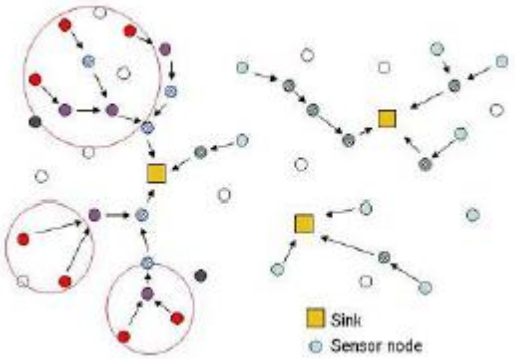


Fig.3. Routing in a sensor network

The post-operation phase involves shutting down and preserving the sensors by settings the sensors to sleep mode for future operations or destroying the sensor network. In a WSN setup, the nodes may be deployed in an ad-hoc manner with no predefined topology. The nodes automatically setup a network by communicating with one another in a multihop fashion. New nodes can malfunction, be added or removed from the network at any time. Newly added nodes must integrate into the network seamlessly and the network must detect and react quickly when nodes are removed to avoid affecting the reliability of message delivery services. The timely detection, processing, and delivery of information are indispensable requirements in a realtime WSN application. In SPEED there are two types of communication associated with data delivery. Any real time protocol should satisfy three design objectives: stateless nodes, load balanced routes and congestion control mechanism. The architectures of WSNs emerged from the experience gained from devising architectures for self-organizing, mobile, ad hoc networks . The latter show emphasis on the need for decentralized, distributed form of organization and this is a shared characteristic with WSNs. They benefit from the evolutions in real-time computing, peer-to-peer computing, active networks and mobile agents/swarm intelligence.

4. 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. The challenge occurs starting at the early stage of nodes deployment. Sensor nodes can be either thrown in a mass or manually placed one by one (e.g., by a human or a robot) in the field.

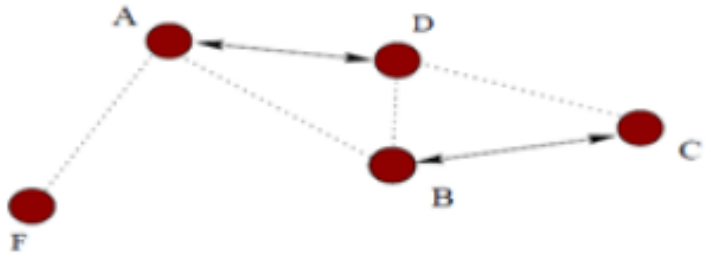


Fig.4. Node topology

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.

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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