Node - Link Disjoint Multipath Routing Protocols for Wireless Sensor Networks – A Survey and Conceptual Modeling

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Abstract. There are different ways to classify the routing protocols that are available. The paper presented here discusses different types of multipath routing protocols for Wireless sensor networks based on the parameter "Disjointedness". In this paper, First, WSN routing issues are discussed then listed the advantages of Multipath routing. Further, comprehensive study of different types of WSN Disjoint-multipath routing protocols is given. Finally, some of the WSN multipath routing on-going research issues are listed.

Keywords: Wireless Sensor Networks, Disjoint Multipath Routing Protocols, Node-disjoint, Link-disjoint, Zone-disjoint multipath routing.

1 Introduction

Wireless Sensor Network(WSN) is a collection of large number of low-cost processor, low-power, signal processing and sensing multifunctional wireless sensor nodes with wireless communication and computational capabilities, which are densely deployed either inside the phenomenon or very close to it. Nodes can be deployed either in random fashion or in a pre-engineered way[1][2][3][4].

The WSN's Technology has been applied in many applications like military, agriculture, industry, target tracking, data collection, rescue missions, national security, monitoring disaster prone areas, managing inventories, health care, home security and environmental studies[5][6]. One of the most important concern of WSN is, Design and deployment of an efficient routing protocol, because WSN has very limited resources to be used for the communication. Most of the time these deployed nodes operate without human intervention for relatively longer period. The common difficulties encounter in designing a WSN routing protocol are listed below[7]:

1. Sensor nodes cannot be given for global identification
2. Any Sink can receive data from multiple sources of multiple regions
3. Redundant data may also be delivered from different sources
4. Sensor nodes are tightly constrained with its resources.

2   WSN Routing Issues

When designing a multipath routing protocol one should take all the parameters into consideration, like path length, energy consumption for data delivery, network size etc. WSN routing has tightly coupled constraints because the sensor nodes has its own limitations on network resources. Of course routing issues are application dependent. Here are some of the routing aspects that need to be addressed while designing a routing protocol for WSN in most of the applications[2][3][6][7][8][9][10].

1. **Limited energy capacity:** Since sensor nodes are equipped with limited battery power, we should have efficient routing protocols to use energy as minimum as possible to extend the life of the sensor nodes there by to increase the network lifetime as well.

2. **Node deployment:** Sensor node deployment is application dependent and human unattended. So, this will affect the performance of routing protocol. Therefore, uniformity should be maintained in the sensor node distribution to yield good productivity from designing routing protocol. If the distribution is not uniform, then optimal clustering becomes a critical issue for energy efficient network operations.

3. **Limited hardware resources:** A sensor node is made up of four basic components: sensing unit, transceiver unit, processing unit and power unit. In turn, each unit has sub units again and in that some are application dependent. Small node size is one of the design objectives of WSN. Because of the size constraint and there by having less storage a sensor node can perform limited number of computations because of less processing power. Therefore, one should concern about this issue while defining complex algorithms in routing.

4. **Sensor Location:** As deployment of sensor node is random for most of the applications and it is application dependent, one needs to know the position of sensor nodes for the effective communication.

5. **Unreliable environment or Fault tolerance:** As Sensor nodes communicate in wireless environment, it is clear that the network is unreliable, because the frequent changes in network size causes routes' fail. Therefore, it is necessary to study network topology dynamics and different mobility patterns of nodes in order to meet the application requirement. The routing protocols are usually designed to address the level of fault tolerance in a given WSN. If the WSN has little interference, then there will be a relaxation in designing the routing protocol.

6. **Data aggregation:** Multiple sources will send the data to a sink. So, redundancy should be eliminated by using appropriate data aggregation techniques such as