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Analysis of Different Routing Protocols for Wireless Sensor Networks

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ABSTRACT: *Wireless Sensor Networks (WSN) are an emerging and very interesting technology applied to different applications. They are formed by small, self organized devices that cooperate to form a large scale network with thousands of nodes covering a large area. The independent operation of the devices and the self-organization feature of the network present some challenges related to security, particularly regarding the security of the processed and routed data over the network. WSN are generally used to monitor activities and report events, such as fire,overheating etc. in a specific area or environment. It routs data back to the Base Station (BS). Data transmission is usually a multi-hop from node to node towards the BS. Sensor nodes are limited in power, computational and communication bandwidth.Primary goal of researchers is to find the energy efficient routing protocol.This study highlights the different routing protocol with advantages and limitations.*

Introduction

I. ENERGY EFFICIENT PROTOCOLS FOR WIRELESS SENSOR NETWORKS

SPIN (Sensor Protocols for Information via Negotiation)

- SPIN [18,22] is among the early work to pursue a data-centric routing mechanism. The idea behindSPIN is to name the data using high-level descriptors or meta-data. Before transmission, metadata are exchanged among sensors via a data advertisement mechanism, which is the key feature of SPIN. Each node upon receiving new data, advertises it to its neighbors and interested neighbors,i.e. those who do not have the data, retrieve the data by sending a request message.
- SPIN_s meta-data negotiation solves the classic problems of flooding such as redundant information passing,overlapping of sensing areas and resource blindness thus, achieving a lot of energy efficiency.There is no standard meta-data format and it is assumed to be application specific, e.g. using an application level framing.
- There are three messages defined in SPIN to exchange data between nodes. These are: ADV message to allow a sensor to advertise a particular meta-data, REQ message to request the specific data and DATA message that carry the actual data.

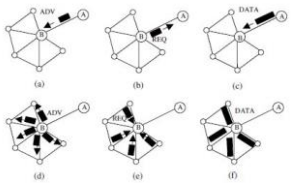

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Fig 3.SPIN protocol.Node A starts by advertising its data to node B(a).Node B responds by sending a request to node A (b).After receiving the requested data(c).Node B then sends out advertisements to its neighbors (d),who in turn send requestsback to B (e–f).

- One of the advantages of SPIN is that topological changes are localized since each node needs to know only its single-hop neighbors.SPIN gives a factor of 3.5 less than flooding in terms of energy dissipation and meta-data negotiation almost halves the redundant data. However, SPIN_s data advertisement mechanism cannot guarantee the delivery of data. For instance, if the nodes that are interested in the data are far away from the source node and the nodes between source and destination are not interested in that data, such data will not be delivered to the destination at all. Therefore,SPIN is not a good choice for applications such as intrusion detection, which require reliable delivery of data packets over regular intervals.
- The simplest version of SPIN, referred to as SPIN-PP, is designed for a pointtopoint communications network. The three-step handshake protocol used bySPIN-PP is depicted in Figure 4(b). In step 1, the node holding the data, node A,issues an advertisement packet (ADV). In step 2, node B expresses interest inreceiving the data by issuing a data request (REQ). In step 3, node A responds tothe request and sends a data packet to node B[29].

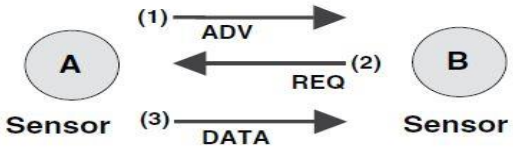

Fig 4 SPIN-PP three-way handshake protocol.[29]

- In point-to-point networks, the sender announces that it has new data with an advertisement message to each neighbor. When the neighbor receives the message, the node checks the metadata to know if it already stores the data item. If the neighbor is interested in the information, it responds with a request message. Upon receiving it, the sender transmits the information in a data message. The neighbor that receives the data, inform about its availability to its own neighbors with an advertisement message[28].
- The algorithm SPIN-EC introduces a technique in the nodes so when their current energy resources do not exceed a predetermined threshold that allows them to complete the three hand-shake protocol, they do not participate in the process. The SPIN-BC and SPIN-RL variants extend the algorithm to support broadcast transmissions. In this way, one advertisement message can reach all the neighbors. In this case, the neighbors do not respond immediately with a request message but they must wait a random time. To optimize the process, a node different from the advertising one cancels its own request message when it detects another similar message. Taking into account the broadcast transmission, the advertising node also responds with just one data message even when it has received multiple request messages[28].
- Additionally, SPIN-RL incorporates some reliability functionalities. Specifically, nodes keep track of the advertisement messages that they receive and their corresponding originators. If they send a request message, but the announcing node does not respond in a given interval, the node asks again for the data with a request message[28].

Directed Diffusion

- Directed Diffusion [18,24,25] is an important milestone in the data-centric routing research of sensor networks. The idea aims at diffusing data through sensor nodes by using a naming scheme for the data. The main reason behind using such a scheme is to get rid of unnecessary operations of network layer routing in order to save energy.
- Direct Diffusion suggests the use of attribute-value pairs for the data and queries the sensors in an ondemand basis by using those pairs. In order to create a query, an interest is defined using a list ofattribute-value pairs such as name of objects, interval, duration, geographical area, etc. The interest is broadcast by a sink through its neighbors.Each node receiving the interest can do caching for later use. The nodes also have the ability to do in-network data aggregation, which i modeled as a minimum Steiner tree problem [26].
- The interests in the caches are then used to compare the received data with the values in theinterests. The interest entry also contains several gradient fields. A gradient is a reply link to a neighbor from which the interest was received. It is characterized by the data rate, duration and expiration time derived from the received interest_s fields. Hence, by utilizing interest and gradients,paths are established between sink and
sources.
- Several paths can be established so that one of them is selected by reinforcement. The sink resendsthe original interest message through the selected path with a smaller interval hence reinforces thesource node on that path to send data more frequently.

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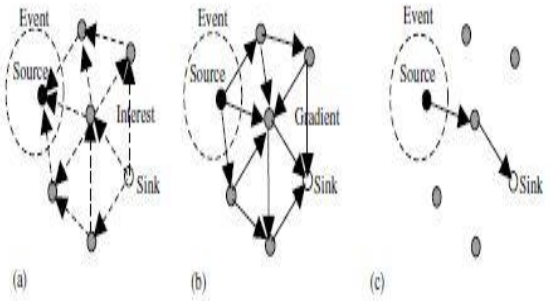

Fig 5. Directed Diffusion protocol phases. (a) Interest propagation, (b) initial gradients setup, (c) data delivery along reinforced

LEACH (Low Energy Adaptive Clustering Hierarchy)

- LEACH is based on a hierarchical clustering structure model and energy efficient cluster-based routing protocols for sensor networks. In this routing protocol, nodes self-organize themselves into several local clusters, each of which has one node serving as the cluster-head. In order to prolong the overall lifetime of the sensor networks, LEACH changes cluster heads periodically.
- LEACH has two main steps: the set-up phase and the steady-state phase. In the set-up phase, there are two parts, the cluster-head electing part and the cluster constructing part. After the cluster-heads have been decided on, sensor nodes (which are chosen as cluster-heads) broadcast an advertisement message that includes their node ID as the cluster-head ID to inform non-cluster sensor nodes that the chosen sensor nodes are new cluster-heads in the sensor networks. They use the carrier-sense multiple access (CSMA) medium access control (MAC) protocol to transmit this information.
- The non-cluster sensor nodes that receive it choose the most suitable cluster-head according to the signal strength of the advertisement message, and send a join request message to register on the chosen cluster-head. After receiving the join message, the cluster-heads make a time division multiple-access (TDMA) schedule for data exchange with non-cluster sensor nodes. Then, the cluster head informs the sensor nodes of its own cluster and the sensor nodes then start sending their data to the base station via their cluster-head during the steady-state phase[31].

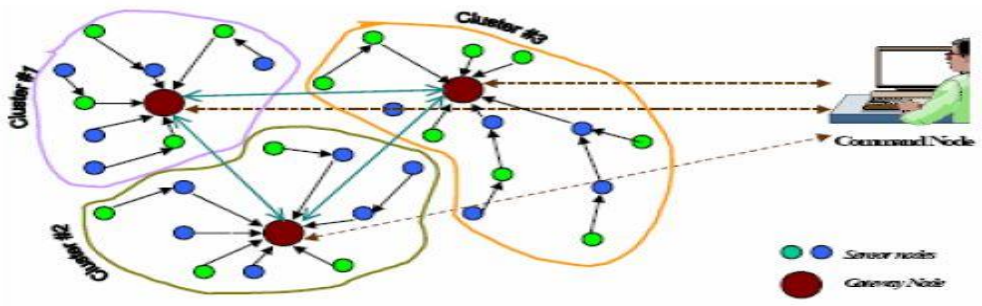

Fig: 6. clusters in LEACH network[13]

II. CONCLUSION

Wireless Sensor Network technology extends numerousapplication domains and it is crucial that WSNs perform in reliable and robust manner. One of the major issuesin the design of routing protocol for WSN is energy efficiency due to limited energy resources of sensors. Thispaper survey several different routing strategies for wireless sensor network. Therefore routing protocolsdesigned for WSN should be energy efficient as possible to prolong the life time of individual sensors..

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