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Review on Routing Optimization Techniques in WSN Using Distance Vector Routing Protocol Approach

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Abstract:

This paper is for reviews on routing optimization for WSN using distance vector routing protocol approach, and identifies problems arises in linking different nodes . Routing optimization provides a means to balance the traffic load in the network with the goal to improve quality of service since we are interested in the following question: What is the issues and requirement arising in the routing optimization in the context of wireless sensor netwoks using distance vector routing protocols.There are various problems arises like link failure, low bandwidth ,the reduced energy resources, the scalability and the resilience etc.

Index Terms—**Routing Optimization , WSN, Distance vector Routing Protocol.**

Introduction

Wireless Sensor Networks (WSN) are intended for monitoring an environment. The main task of a wireless sensor node is to sense and collect data from a certain domain, process them and transmit it to the sink where the application lies. Therefore, the collaboration of nodes to ensure that distant nodes communicate with the sink is a requirement. In this way, messages are propagated by intermediate nodes so that a route with multiple links or hops to the sink is established. Taking into account the reduced capabilities of sensors, the communication with the sink could be initially conceived without a routing protocol. With this premise, the flooding algorithm stands out as the simplest solution. In this algorithm, the transmitter broadcasts the data which are consecutively retransmitted in order to make them arrive at the intended destination. However, its simplicity brings about significant drawbacks. Firstly, an implosion is detected because nodes redundantly receive multiple copies of the same data message. Then, as the event may be detected by several nodes in the affected area, multiple data messages containing similar information are introduced into the network. Moreover, the nodes do not take into account their resources to limit their functionalities. One optimization relies on the gossiping algorithm . Gossiping avoids implosion as the sensor transmits the message to a selected neighbor instead of informing all its neighbors as in the classical flooding algorithm. However, overlap and resource blindness are still present. Furthermore, these inconveniences are highlighted when the number of nodes in the network increases. Due to the deficiencies of the previous strategies, routing protocols become necessary in wireless sensor networks. Nevertheless, the inclusion of a routing protocol in a wireless sensor network is not a trivial task. One of the main limitations is the identification of nodes. Since wireless sensor networks are formed by a significant number of nodes, the manual assignation of unique identifiers becomes infeasible . The use of potentially unique identifier such as the MAC (Medium Access Control) address or the GPS coordinates is not recommended as it forces a significant payload in the messages. However, this drawback is easily overcome in wireless sensor networks since an IP address is not required to identify the destination node of a specific packet. In fact, attribute-based addressing fits better with the specificities of wireless sensor networks. In this case, an attribute such as node location and sensor type is used to identify the final destination. Once nodes are identified, routing protocols are in charge of constructing and maintaining routes between distant nodes. The different ways in which routing protocols operate make them appropriate for certain applications. In the related literature, there are plenty of proposals concerning routing algorithms in wireless sensor networks. This paper aims at describing the most relevant ones in order to facilitate the understanding of the different routing techniques that could be applied into wireless sensor networks. Specifically, the paper explains some attributed-based, geographic, hierarchical and multipath routing protocols.

I. ROUTING OPTIMIZATION

A. Open Shortest Path First (OSPF)

OSPF is a dynamic link-state routing protocol that uses a link-state database (LSDB) to build and calculate the shortest path to all known destinations. It is through the use of Dijkstra's SPF algorithm that the information contained within the LSDB is calculated into routes. Open Shortest Path First (OSPF) was standardized by the IETF in 1998 as a solution for large networks [12]. It belongs to the class of link state protocols. Instead of exchanging distance metrics between neighbor routers, all OSPF routers distribute link state information associated with their interfaces to all other routers in the network. This way, every router builds up and maintains its own topology database, which contains elements representing subnets (stub networks), OSPF routers, transit networks (i.e., subnets that connect several routers), aggregated networks (i.e., areas), and destination networks outside the AS. Based on the global view of the network topology, every router is able to perform shortest path computations independently and determine the relevant outgoing interfaces .

B. Routing Recommendations

Routing control is a significant aspect of wireless sensor network. Routing impacts many of the key performance measures associated with networks, such as throughput, delay, and utilization. Generally, it is very difficult to provide good service quality in a wide area network without effective routing control. A desirable routing system is one that takes communication characteristics and network constraints into account during route selection while maintaining stability.

Traditional shortest path first (SPF) interior gateway protocols are based on shortest path algorithms The well known issues with pure SPF protocols, which do not take network constraints and traffic characteristics into account during route selection. For example, since IGPs always use the shortest paths (based on administratively assigned link metrics) to make communication, load sharing cannot be accomplished among paths of different costs. Constraint-based routing is desirable to evolve the routing architecture of IP networks, especially public IP backbones with complex topologies. Constraint-based routing computes routes to fulfill requirements subject to constraints. Constraints may include bandwidth, hop count, delay, and administrative policy instruments such as resource class attributes. This makes it possible to select routes that satisfy a given set of requirements subject to network and administrative policy constraints. Routes computed through constraint-based routing are not necessarily the shortest paths. Constraint-based routing works best with path oriented technologies that support explicit routing, such as MPLS. Constraint-based routing can also be used as a way to redistribute load onto the infrastructure. For example, if the bandwidth requirements for path selection and reservable bandwidth attributes of network links are appropriately defined and configured, then congestion problems caused by uneven packet distribution may be avoided or reduced. In this way, the performance and efficiency of the network can be improved.

A number of enhancements are needed to conventional link state IGPs, such as OSPF and IS-IS, to allow them to distribute additional state information required for constraint-based routing.

Essentially, these enhancements require the propagation of additional information in link state advertisements. Specifically, in addition to normal link-state information, an enhanced IGP is required to propagate topology state information needed for constraint-based routing. Some of the additional topology state information include link attributes such as reservable bandwidth and link resource class attribute .The resource class attribute concept was defined in. An enhanced link-state IGP may flood information more frequently than a normal IGP. This is because even without changes in topology,

changes in reservable bandwidth or link affinity can trigger the enhanced IGP to initiate flooding. A tradeoff is typically required between the timeliness of the information flooded and the flooding frequency to avoid excessive consumption of link bandwidth and computational resources, and more importantly, to avoid instability.

This network gives flexibility in the control of packet distribution across the network. It can be very useful for avoiding/relieving congestion in certain situations.

The routing system should also have the capability to control the routes of subsets of traffic without affecting the routes of packets if sufficient resources exist for this purpose. This capability allows a more refined control over the distribution of packets across the network.

C. Distance Vector

The distance vector routing protocol requires that each router simply inform its neighbors of its routing table. For each network path, the receiving routers pick the neighbor advertising the lowest cost, then add this entry into its routing table for readvertisement. Routing Information Protocol (RIP) is a common distance vector routing protocol. Common enhancements to distance vector algorithms include split horizon, poison reverse, triggered updates, and holddown . The RIP specifications in RFC 1058 provide a good discussion of distance vector, or Bellman-Ford, algorithms.

II. PARADIGMS FOR WIRELESS SENSOR NETWORKS

Sensor applications demand the communication of nodes to execute certain procedures or algorithms. In fact, three kinds of algorithms can be executed on wireless sensor networks:

- Centralized Algorithms: They are executed in a node that posses the knowledge of the whole network. These algorithms are quite rare because of the cost of transmitting the data to make the node know the status of the complete network.
- Distributed Algorithms: The communication is supported by message-passing.
- Local based Algorithms: The nodes use restricted data acquired from a close area. With this local information, the algorithm is executed in one node.

The algorithm paradigm is an important factor to take into account when deciding about the routing protocol to employ in the network. If localized algorithms are used, the routing protocol should reinforce and optimize the communication between neighbors. On the other hand, for centralized algorithms, combining the messages that simultaneously go the central node (even when they are generated by different sources) could be an advantage. The distributed algorithms should efficiently support the communication between any two pairs of nodes. Finally, local based algorithms depend on some solution that provides geographic coordinates, like GPS, making the solution more expensive Before you begin to format your paper,

III. Design Constraints for Routing in Wireless Sensor Networks

Due to the reduced computing, radio and battery resources of sensors, routing protocols in wireless sensor networks are expected to fulfill the following requirements:

 Autonomy: The assumption of a dedicated unit that controls the radio and routing resources does not stand in wireless sensor networks as it could be an easy point of attack. Since there will not be any centralized entity to make the routing decision, the routing procedures are transferred to the network nodes.

 Energy Efficiency: Routing protocols should prolong network lifetime while maintaining a good grade of connectivity to allow the communication between nodes. It is important to note that the battery replacement in the sensors is infeasible since most of the sensors are randomly placed. Under some circumstances, the sensors are not even reachable. For instance, in wireless underground sensor networks, some devices are buried to make them able to sense the soil .

 Scalability: Wireless sensor networks are composed of hundred of nodes so routing protocols should work with this amount of nodes.

 Resilience: Sensors may unpredictably stop operating due to environmental reasons or to the battery consumption. Routing protocols should cope with this eventuality so when a current-in-use node fails, an alternative route could be discovered.

 Device Heterogeneity: Although most of the civil applications of wireless sensor network rely on homogenous nodes, the introduction of different kinds of sensors could report significant benefits. The use of nodes with different processors, transceivers, power units or sensing components may improve the characteristics of the network. Among other, the scalability of the network, the energy drainage or the bandwidth are potential candidates to benefit from the heterogeneity of nodes.

 Mobility Adaptability: The different applications of wireless sensor networks could demand nodes to cope with their own mobility, the mobility of the sink or the mobility of the event to sense. Routing protocols should render appropriate support for these movements .

IV. Classification of Routing Protocols in Wireless Sensor Networks

Taking into account their procedures, routing protocols can be roughly classified accordingly. Hierarchy Role of Nodes in the Network In the flat schemes, all sensor nodes participate with the same role in the routing procedures. On the other hand, the hierarchical routing protocols classify sensor nodes according to their functionalities . The network is then divided into groups or clusters. A leader or a cluster head is selected in the group to coordinate the activities within the cluster and to communicate with nodes outside the own cluster. The differentiation of nodes can be static or dynamic. Data Delivery Model Depending on the application, data gathering and interaction in wireless sensor networks could be accomplished on several ways. The data delivery model indicates the flow of information between the sensor nodes and the sink. The data delivery models are divided into the following classes: continuous, event-driven, query-driven or hybrid. In the continuous model, the nodes periodically transmit the information that their sensors are detecting at a pre-specified rate. In contrast, the query-driven approaches force nodes to wait to be demanded in order to inform about their sensed data. In the event-driven model, sensors emit their collected data when an event of interests occurs. Finally, the hybrid schemes combine the previous strategies so sensors periodically inform about the collected data but also response to queries. Additionally, they are also programmed to inform about events of interest.

V. Optimization Techniques for Routing in Wireless Sensor Networks

The particular characteristics of wireless sensor networks and their constraints have prompted the need for specific requirements to routing protocols. When compared to mobile ad hoc networks routing protocols, the algorithms in wireless sensor networks usually realize the following specifications:

Attribute-based :

In these algorithms, the sink sends queries to certain regions and waits for the response from the sensors located in this area. Following an attribute-value scheme, the queries inform about the required data. The selection of the attributes depends on the application. An important characteristic of these schemes is that the content of the data messages is analyzed in each hop to make decisions about routing. Energy Efficiency Multiple routes can communicate a node and the sink. The aim of energy-aware algorithms is to select those routes that are expected to maximize the network lifetime. To do so, the routes composed of nodes with higher energy resources are preferred. Data Aggregation Data collected in sensors are derived from common phenomena so nodes in a close area usually share similar information. A way to reduce energy consumption is data aggregation. Aggregation consists of suppressing redundancy in different data messages. When the suppression is achieved by some signal processing techniques, this operation is called data fusion. Addressing Scheme Wireless sensor networks are formed by a significant number of nodes so the manual assignation of unique identifiers is infeasible. The use of the MAC address or the GPS coordinates is not recommended as it introduces a significant payload. However, network-wide unique addresses are not needed to identify the destination node of a specific packet in wireless sensor networks. In fact, attribute-based addressing fits better with the specificities of wireless sensor networks. In this case, an attribute such as node location and sensor type is used to identify the final destination. Concerning these identifiers, two different approaches have been proposed . Firstly, the ID reuse scheme allows identifiers to be repeated in the network but keeping their uniqueness in close areas. In this way, a node knows that its identifier is unique in a k-hop neighborhood, being k a parameter to configure. On the other hand, the field-wide unique ID schemes guarantee that the identifiers are unique in the whole application. With this assumption, other protocols such as routing, MAC or network configurations can be simultaneously used.

Location-based

When this technique is used, a node decides the transmission route according to the localization of the final destination and the positions of some other nodes in the network. Multipath Communication With this technique, nodes use multiple paths from an origin to a destination in the network. As multipath communications are intended to increase the reliability and the performance of the network, these paths should not share any link. Multipath communications can be accomplished in two ways. Firstly, one path is established as the active communication routing while the other paths are stored for future need, i.e. when the current active path is broken. On the other hand, it is also possible to distribute the data packets among the multiple paths.

Quality of Service

The network application business and its functionalities prompt the need for ensuring a QoS (Quality of Service) in the data exchange. In particular, effective sample rate, delay bounded and temporary precision are often required. Satisfying them is not possible for all the routing protocols as the demands may be opposite to the protocol principles. For instance, a routing protocol could be designed to extend the network lifetime while an application may demand an effective sample rate which forces periodic transmissions and, in turn, periodic energy consumptions.

VI. CONCLUSION

In this paper, routing optimization in Wireless sensor networks using distance vector approach have been discussed Concerning the routing protocols, the reduced energy resources, the scalability and the resilience arise as the main limitations in wireless sensor networks . It presented an overview of some of the basic issues Wireless sensor networks. A brief historical review of pertinent developments related to routing optimization in Wireless sensor networks is provided. Additionally, the document specified a set of generic requirements, recommendations, and options for better in area of routing optimization based in wirelwss sensor networks using distance vector approach.

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