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Adaptive Routing Protocol for Reliable Wireless Sensor Networking

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ABSTRACT*: Routing protocols for wireless sensor networks can be divided into proactive, reactive and hybrid routing. Each routing protocol has its advantages and disadvantages. A service is force-terminated when the working routing protocol can no longer support all sensor network operations. This work describes an adaptive routing protocol based on the redundancy node and the dual routing protocol. By using the redundancy node strategy, a sensor network can be divided into operating and sleeping modes and then services can be delivered using a different routing protocol. Dual routing protocol individually designs two different routing protocols in the sensor node by exploiting the advantages of these two routing protocols to send the data. Simulation results indicate that the proposed mechanism can increase the packet delivery ratio by approximately 44 percent over that of available proactive/reactive routing protocols.*

Keywords: *Destination-Sequenced Distance Vector (DSDV), On-Demand DistanceVector (AODV)****,*** *Dynamic Source Routing (DSR), route request (RREQ), route reply (RREP),Network Simulator(NS2).*

I. INTRODUCTION

Wireless sensor networks consist of numerous sensor nodes. Composed of a transceiver, processing unit, sensing unit, mobilize, location finding system and power unit, a sensor node has the ability to sense, transmit and process information[1]. Additionally, sensor networks accumulate information that depends on the routing protocol and returns to the sink. Many strategies have been proposed to extend the sensor network lifetime by decreasing power consumption . The rout-ing protocol of sensor networking is important in decreasing the power consumption. Sensor networking is classified into flooding, unicast and multicast .

Flooding involves the rebroadcast mechanism. Each sensor node rebroadcasts the packets to its neighbours. This work addresses a situation in which the original routing protocol does not work and the sensor manager changes the routing protocol to extend the sensor network services. The adaptive routing protocol can extend the lifetime of the sensor network.

II. BACKGROUND KNOWLEDGE

Before the proposed mechanism is described, this section introduces relevant knowledge of wireless sensor networks and existing routing protocols.

1) Sensor Network Architecture: The architecture of a sensor network can be classified as either a hierarchical network one or a flat network one . Hierarchical network architecture is separated into several clusters, with each cluster having its own cluster header to take charge of the sensor nodes. In addition to managing the node from the bottom layer, the cluster header obtains the ability of data aggregation and fusion. Moreover, a sink can query information by using the cluster head layer. Management of the cluster head layer handles the information accumulated from the layer and returns it to the sink. Meanwhile, the hierarchical sensor network architecture can effectively manage a large of the sensor node, as well as reduce power consumption [2]. However the routing protocol with this design is complex. Several hierarchical network architectures have already been developed.

2) Routing Protocol: A wireless routing protocol can be divided into a proactive routing one, reactive routing one, and hybrid routing one. A proactive routing protocol, updates the routing table in extinctive circumstance through broadcasts. Different proactive routing protocols adopt various methods to update the routing table; however, they update the time and base themselves on the routing table. Reactive routing protocols establish a routing path when deemed necessary. Reactive routing protocols are highly promising for use in mobile wireless sensor nodes. Hybrid routing protocols are routing protocols integrated with the advantages of proactive routing protocols and reactive routing protocols. This work develops new concepts based on proactive

routing protocols and reactive routing protocols. Therefore, each distinctive routing protocol for the three routing protocols is described as follows.

II. ROUTING PROTOCOL

1. Proactive Routing Protocol:

In this table-driven routing protocol, the memory of a sensor node has a forwarding table. Forwarding table is a routing table, which contains a destination node field, next node field, hop number field, and sequence number field and time adjustment field. The value of sequence number is multiplied and its main function is to indicate the new and old conditions. Thus, the value stored in a sensor is always the largest, ensuring that the routing path is the newest. An advertised table sustains the records of links as long as the status changes; data of the advertised table changes as well. Although various proactive routing protocols have different methods to update the routing table, its characteristics maintain the routing table within a specified time. According to Fig. 1, the wireless sensor network comprises seven nodes, with each maintaining a forward table and an advertised table.

Node 3 is considered as an example Tables 1 displays the forwarding table and advertised table maintained.

The routing table is updated when the moves it. For instance, although originally next to node 3, node 1 moves around node 5 if deemed necessary. Next, the routing table of each node must be updated with relevant information. Node 3 is considered, in which the routing table updates the first row area of table 2 and 3.the next destination node 1 is changed from 3 to 5,hop number is changed from 1 to 2, thereby updating the sequence number and time. The contents of the forwarding routing table have been modified and, simultaneously, the advertised table is updated The main advantage of the proactive routing protocol is that when the sensor node forwards the data to the destination node, the data can be sent to the destination node based on restoration of the routing table in each node. Consequently, the time delay time when sending the data is minimized, as well as the stability elevated when sending the information in a wireless network environment.

2. Reactive Routing Protocol:

The routing path is established only when deemed neccessary, representing the main feature of reactive routing protocol DSR by Johnson and Maltz and AODV are two convincing reactive routing protocols. AODV is taken here for illustrative purposes. The AODV design focuses on the dynamic network topology to establish and maintain the routing path in need. AODV distinguishes between unicast and multicast methods, while this study illustrates the former. The unicast includes three procedures of route request, route reply, and route maintenance.

2.1 Rout Discovery:

The route discovery of AODV has two sessions: state route request and route reply. When sending a packet to the desti-nation node, the source node first checks the destination node to determine whether it has its own routing table or forwards to the next node. For any valid record in the routing table, the source node starts the process route request immediately. The source node broadcasts the control packet of RREQ by flooding; the packet contains source node IP, destination node, destination node IP and broadcast ID. Broadcast ID is an increased series number maintained within each node. After broadcasting a RREQ, each node adds one to broadcast ID. Therefore, the integration of broadcast ID and source node IP can ensure the node that receives RREQ to only identify the RREQs sent simultaneously. As the source node complete sits delivery of RREQ, the timer is set to wait for RREP. Importantly, RREQ must establish a reverse route to make RREP return to the source node in alliance with the reverse route. Figure 2 shows the sending procedure ofRREQ

2.2 Route Reply:

During the sending process, if any of the routing tables within the node reaches the information the destination, this node can then be used to respond to RREP based on the reverse route. To wait until RREQ arrives at the destination node, RREP can return from the destination to the source. RREP sends the files by using the unicast. During the process, the forward route is established. The forward route allows the source to send the packet. Figure 3 illustrates the sending of RREQ.

3. Hybrid Routing Protocol:

Hybrid routing protocols are designed to integrate the ad-vantages of proactive routing protocols and reactive routing protocols. Hass and Peralman considered the example of ZRP. In this work, the cluster node adapts the proactive routing pro-tocol to send the information. If the information must be sent to the cluster but receiver out of range, this work address this situation involving a reactive routing protocol. Other related hybrid routing protocols include DDR (Distributed Dynamic Routing algorithm) and HCBM (Hierarchical Cellular-Based Management)the instances or data should attain stability. Stability in the sense it should not transfer from one cluster to another. This reduces the error rate.

IV. PROPOSED MECHANISM

The proposed mechanism is developed mainly by the two applications: proactive and on-demand routing protocols. This section is divided into three parts for illustrative purposes: introduction of a new concept, illustration of a function and discussion of the advantages of the proposed mechanism.

1. Back Routing Path

In order to ensure the data from the source node to destina-tion node is accurate sent. In a wired network, several routing paths can be established to prevent a malfunction in the main path and switch to the backup path manually or by the system itself. Via this mechanism, the system can ensure that the data is forwarded smoothly. In a wireless environment, the multi-path can be identified using the routing protocol. However, the above methods are infeasible for a wireless sensor network. This limitation is because the sensor node often relies on the battery itself while functioning individually. A situation in which the middle node in a certain path malfunctions, e.g., a power shortage, implies that the path is no longer in use. Generally, generates another routing path in the multi-path to ensure communication between the sink and source node. However, two additional problems must be resolved. Inconclusive after the sensor network is adopted for an extended period, all nodes might vary in the power stored. Malfunctions or stops might occur when switching to another routing path. However, another routing path might have contained a malfunctioning node, subsequently disrupting communication between the sink and the source node. Select backup node if the node forwarding the information determines that thesource node cannot complete the forward function, a certain routing protocol gives permission to identify the nearby node in order to establish the routing path, by passing the disrupted node to maintain the smoothness of the path. However, the inability of the system to identify an appropriate node to forward the data makes it impossible to send the data to the destination. This work attempts to resolve the above two problems by adopting the redundancy node and dual routing protocol. The redundancy node is used when deploying the sensor network, which is achieved in two parts while using different routing protocols. One part involves the routing protocol that involves the sensor network stations in the first place, while the second part is the sleeping node, which is awakened only when it is necessary. Dual routing protocol is the design that places two routing protocols in the sensor node of both parts. Incorporating the advantages of these two routing protocols ensures that the data can be forwarded successfully. Our environment is set when the sensor network is adopted for an extended period, and the power within the sensor node is not equal with another. For some nodes, while the power is consumed rapidly, they possibly disappear and the working load is low for other nodes while they contain higher power. For query information in which the routing path of the source node contains more than one node, the node might lead to a power shortage, and can only forward the query information from the sink to the source node. Meanwhile, the source node depends on a situation based on the power stored in the nodes of this path, while the system forwards the query information from the sink to the source node. If, according to estimates, the destination node cannot use the original routing path and send the information back to the sink, then the source node broadcasts a beacon request packet to the nearby node. Notably, the sleeping node is awaken if the nearby nodes are a sleeping node that runs the second type of routing protocol. The awakened sensor node establishes a routing path to ensure that the source node forwards back data to the sink.

2. Redundancy Node and Dual Routing Protocol

Redundancy Node can set a portion of the node in the sensor network into the sleeping condition. Since it is in sleeping condition, the power is seldom consumed entirely. Therefore, such redundancy nodes could be viewed as backup or emergency nodes. These redundancy sensor nodes can then be evenly distributed in the whole sensor network to establish a safe and reliable routing path, thus allowing the source node to return query information to the sink. The notion of a redundancy node in important stations in a sensor network must be established to ensure that the query delivered by the sink can gather the data by the source node return to the sink. Dual Routing Protocol After the sensor network is divided into two groups, two routing protocol types are installed in the sensor network of these two groups. The sensor network of the first group installs the proactive routing protocol, in light of the fact that the main advantage of the table-driven routing protocol is that as the sink sends data to the source node, the data is forwarded rapidly with a fairly low time delay. The second group installs the on-demand routing protocol. Notably, the sensor node of the second group is in sleeping mode. Only when the request is received does it awaken and establish the routing path. The advantage of the demand-driven routing protocol is needed, explaining the existence of discovery routing. This feature corresponds to the role of the sensor node in the second group. By integrating the redundancy node and dual routing protocol, the data can be returned back to the sink shown by using figures given below.

2.1 Source Node and Destination Node

2.2 Destination Node Search for Backup Node

V. PERFORMANCE ANALYSIS

This section describes the network simulation based on NS2 network simulator. NS2 takes C++ and OTcl to develop a simulated environment. This work estimates the average latency of the redundancy node and dual routing protocol, the delivery radio and the life time. This section discusses how the proposed mechanism and the conventional DSDV mechanism differs from each other.

1. Simulation Environment

During the simulation, the network consisted of 50,200 sensor nodes in a 1500(m)*500(m) rectangle. These nodes with radio coverage of 250 meters were grid placed in a sensor field. Each packet size was 64 bytes, and the traffic type was CBR. Sources generated one data packet per second and simulation time lasted for 300 seconds. Finally, the DCF of the IEEE 802.11 standard was used as the MAC layer protocol for wireless sensor networks.

2.Packet Delivery Ratio

The packet delivery ratio represents the rate between the number of data packets received by the destination and the number sent by the source. This work compares DSDV and DSDV+AODV individually based on the pause time, as illustrated in Fig. 6. As the DSDV routing protocol is used alone, its packet delivery ratio is quite stable, approximately between 0.8 and 0.82. Before 100 seconds, since no interruption occurs in the path running DSDV+AODV, the DSDV routing protocol is run OR performed. However after 100 seconds, a routing path is interrupted, subsequently initiating the AODV routing protocol and the second set of node. As a reactive routing protocol, AODV searches for the path when the need arises. Thus, after 100 seconds, the packet delivery ratio decreases to 0.55. Nonetheless, after 200 seconds, the delivery ratio approaches to around 0.9 .

2. System Lifetime

Lifetime refers to how long the sensor networks last. The obvious merits and limitations of existing routing protocols and the proposed mechanism are combined to yield the merits of the proactive routing protocol and the reactive routing protocol. Figure 7 illustrates the operations of the DSDV routing protocol, in which the power of the route path is insufficient after 100 seconds. Therefore, the data cannot be returned, and the packet delivery ratio decreases to O After the hybrid mechanism of DSDV and AODV for 100 seconds, AODV searches for another set of sensor nodes. The packet delivery ratio is then the lowest around 0.55. After the AODV routing protocol establishes the route path, the packet delivery ratio is around 0.9. The proposed mechanism can continually have a query with the destination area.

VI. FIGURES AND TABLES

The figures shows the arrangement of the nodes for routing protocols.Also shows the simulation result and also shows the advertised table and powered table for the different nodes. Tables 1 displays the forwarding table and advertised table maintained.

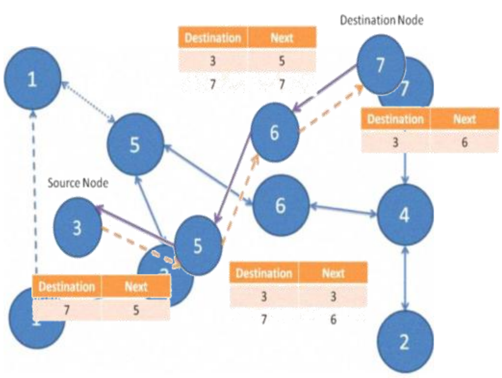

Fig.1.DSDV Routing Protocol

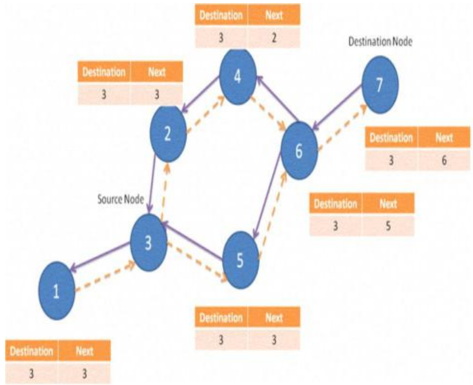

Fig.2. Propagation of RREQ Message

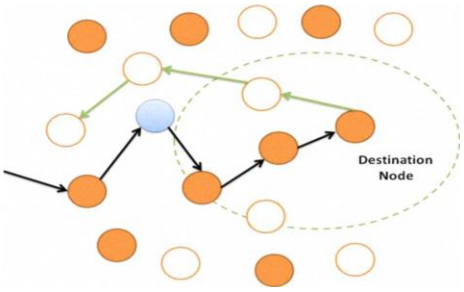

Fig.3. Response of RREP Message

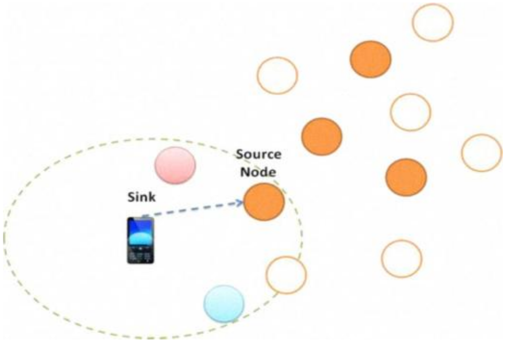

Fig.4.sink search for node

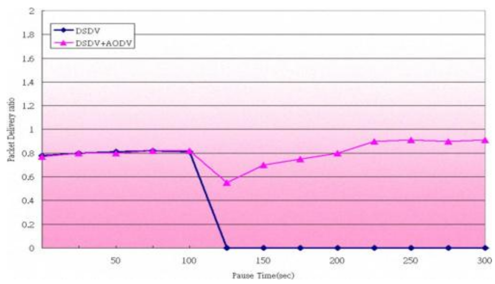

Fig.5. Destination Node Search for Backup Node

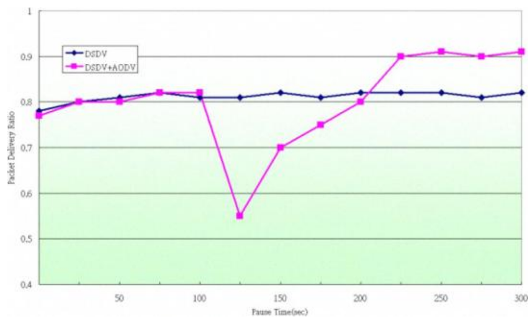

Fig.6. Packet Delivery Ratios with 200 Nodes

Dstination	Next	Hop	Sequence	Time
1	3	1	ID50-1	T01-3
2	5	4	ID36-2	T01-3
3	3	0	ID28-3	T01-3
4	5	3	ID46-4	T01-3
5	5	1	ID15-5	T01-3
6	5	2	ID70-6	T01-3
7	5	4	ID62-7	T02-3

Fig.7. Packet Deliver Ratio with Lifetime

. TABLE I.Advertised Table

Destnation	Next	Hop	Sequence	Time
1	5	2	ID75-1	T07-3
2	5	4	ID36-2	T01-3
3	3	0	ID28-3	TO1-3

TABLE II

Advertised Table

Destination	Hop	Sequence
1	2	ID75-1
2	4	ID38-2
3	0	ID25-3

TABLE III
Powered Table

VII. CONCLUSION

This work developed a new routing mechanism for sensor networking by adopting the redundancy node and the dual routing protocol. In this case, this work attempts to avoid the power shortage of the node when the sink produces a query. We can ensure that the data sent from the sink query can be returned by using the node of the second group. Simulation results indicate that the lifetime of the proposed mechanism exceed that of the sensor network routing protocol. Importantly, while capable of ensuring the return of such important data, the proposed mechanism is demonstrated to be feasible through the simulation results.

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