An improved AODV routing protocol based on tower structure

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Abstract. The paper proposed a new routing protocol(IAODV) based on tower structure in the Ad Hoc network for the problem which Location Routing Protocol need hardware and Complex algorithm. By the simulation, The complexity of the new routing protocol is reduced without reducing the performance of the network.

1 INTRODUCTION

There have a category called routing based on geographic location Among many routing protocols, which use the sensor node location information to guide the discovery of routing, maintenance, and data forwarding, realize the directional transmission of information, avoid blind flooding routing probe packets, and reduce control overhead caused by routing protocols; Using the node location information to construct the network topology, easy for network management, realize the global optimization of network, has good network scalability and robustness. GPSR protocol is a kind of typical location-based Routing protocol, it forwards the greed of grouping and Stateless detour around. NADV is an improved routing protocol based on geographic location, by estimating the link cost improvement over a period of time greedy forwarding mode. EPD algorithm by using expectation transmission time ETT and geometric Distance criterion to construct EPD as the next hop node selection criterion.

These protocols are usually on the flooding mechanism of simple improvements and have higher routing efficiency. Its limitations are typically require positioning device and the antenna and other hardware to support, or need to be calculated according to the situation of peripheral node's own location coordinates, and also need to calculate the launch point of view, the complexity of the algorithm is quite high. This paper proposes a tower type network topology structure, the structure can reflect its location information by node address, and put forward an improved method of AODV protocol. Depending on the address of the neighbor node and the distance from itself, The new net nodes determine its own address. In the broadcast, It can do not rely on the location of the location of the directional broadcast information, to avoid the whole network broadcast!

2 PROTOCOL DESCRIPTION

2.1 The topological tower structure

According to the communication relationship between nodes, we divide the wireless ad-hoc network topology. The general three kinds of topology are a star network, mesh network and cluster tree nets, as shown in figure 1. The star network structure is simple, convenient organization; The expansion of the mesh network performance is the best, suitable for all kinds of complicated network environment; Cluster Tree network is a special case of the mesh network, support Cluster - Tree routing algorithm, there is no route discovery process, and the nodes do not need to maintain the routing table. Type topology structure, this paper proposes a tower structure of the node addresses can be mapped in the hierarchy, which effectively support the routing protocol based on location information.

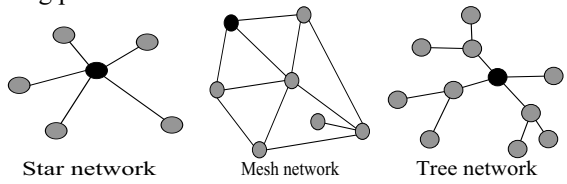

Figure1. three kinds of network topology

Definition 1: tower structure topology. Using specific address allocation algorithm, the wireless ad-hoc network node will be organized into a hierarchy of pagoda form of node address to map out what is the layer information. The characteristics of the structure is that node location and its level are one-to-one relationship, the more to the lower network can hold the more the number of nodes.

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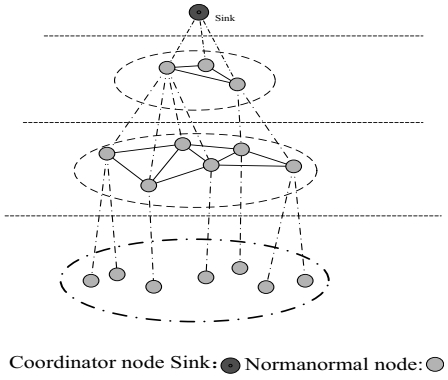

Figure 2. tower structure topology

2.2 Distributed dynamic address assignment algorithm based on four point method

There have a 16-bit network address and 64 - bit IEEE extension in mobile ad-hoc network node , which is 64 - bit IEEE extension address equipment factory set of unique identification number, 16-bit network address assigned by the use of address allocation algorithm.

Distributed dynamic address assignment algorithm based on four points method (hereafter referred to "four points method"), for construct the tower structure topology network , a distributed address assignment algorithm is put forward. Algorithm has low complexity, there is no conflict, address assignment and uniform, the communication overhead is small, time delay is little, realized the address mapping relationship between node position and meet the requirements of increasing number along with the network address radius.

The four method divides the N (N) address ADDr () into the segment address (dN) and the layer node address (N) in two parts, as in table 1. The layer segment address is prefix code, and the node address in the segment is dynamically allocated by the upper layer node. Network internal in addition to the tower base node, and the rest of the nodes have the ability to allocate nodes in the next level node address, the address pool Ac calculated by its own address, the formula 1.

Ac=(ADDr(A)*22 ,(ADDr(A)*22+4)) (1)

Tower cross-section shape by the shape of the spire decision method in addition to the network only the coordinator node set another address auxiliary nodes constitute spire layer, the address 0 and 1, respectively, the possession of a 32 address address pool. HM said tower height of Hm<=6, FN said node n the floor height.

Table 1. Division of the address of the four division method

	Segment address (dn)	Address pool (N)
The tower tip	0x0 (coordinator)	0~11111
	0x1(auxiliary ode)	100000~111111
The sixth layer odes	0000000011	$0\sim2^{8}-1$
The fifth layer odes	00000011	$0\sim2^{10}-1$
The fourth layer nodes	000011	$0\sim2^{12}-1$
The third layer nodes	0011	$0\sim2^{14}-1$
The second node	11	2^{16}
Tower base	without	without

The basic idea is as follows:

(1)At the beginning, there are only the coordinator node and secondary nodes in a network. There have a fixed address and pool, as see table 1.

(2)A node which is not configured wants to join the network, A request at the top of its adjacent node B for distribution within A free layer node address, the address B in the pool is A free address assigned to A and recorded, A computing their height FA = FB - 1,

ADDr (A) = FA * 22 (FA - 1) + (A).

(3)Nodes can be normal to take off the net. When a node is normal to take off the net, its address was returned to the parent node, and send the information to their child nodes to select the parent node. When the nodes to take off the net, The hole problems of address will arise. To deal with this kind of situation , it can only wait for the node synchronization.

(4)node synchronization. Auxiliary node synchronization service depend on beacon messages by the coordinator node and address radio Beacon information .Message to the coordinator node and address secondary node as the center, the edge of the ripple effect to network began to spread, if a node is as a parent, it should be in every HELLO_INTERVAL (namely the HELLO message cycle) to check whether they have sent a radio message (in a RREQ packet, or forwarding data needle). If inspection failed to send, then the nodes in a Beacon news must be forwarded to the upper nodes. Once the node as the parent node address change, it must immediately notify its nodes, modify child node address needs to be modified immediately. HELLO_INTERVAL cycle is used to control response to the mobile node sensitivity.

According to the algorithm constructs the tower type and distribution of basic ideas of topology network structure diagram as shown in figure 3, in the node location information and address into one-to-one correspondence relationship, each layer holds the number of nodes from the top down approximation into geometric sequence. Address of f1 is 0000000011000001, its address pool Ac is [00000100,0000011] 1, S1 as the fifth layer of segment address (dS1) = 00000011, from formula one assigned to layer inside the node address (S1) for 00000100, S1 node address ADDr (S1) = 0000001100000100.

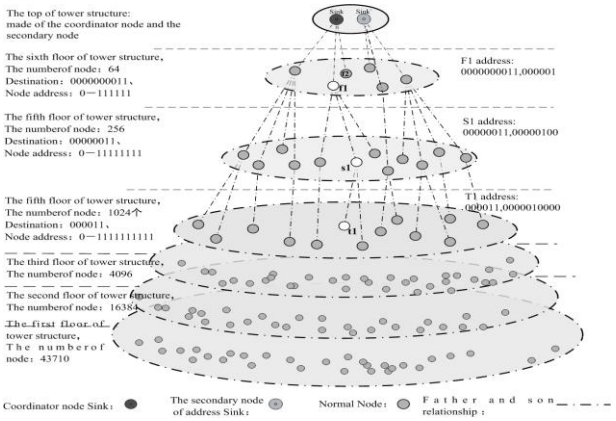

Figure 3. tower robot structure

2.3 Improved AODV routing protocol based on the structure of Tower (AODV in Tower)

This paper puts forward the improved AODV routing protocol based on the tower structure, on the basis of tower structure under the node address and level there is a one-to-one relationship between the characteristics of the existing AODV routing protocol RREQ packet forwarding mechanism and routing maintenance query mechanism and link mechanism is improved, the improved protocol can without a peripheral global position service equipment, do not use directional antenna under the condition of implement roughly broadcast-oriented, greatly reduce the consumption of the radio news of network resources.

2.3.1 Forwarding mechanism of RREQ

Protocol fully use the existing AODV routing request message of frame format, the production of its frame , the maintenance of serial number, and the establishment of reverse routing techniques such as completely the same, the RREQ forwarding mechanism was improved, which inherits the advantages of the original AODV routing protocol on the basis of further performance improvement.

The intermediate node Received RREQ packet, according to the destination address of the packet network segment address of a source node and network segment address, judge to the forwarding of a message or discard processing. If receive message is processed directly discarded; Address forwarding node and destination node address provided, the forward; Forwarding node address between the source node network segment level and the destination node address segment level were forwarded, or discarded. See the formula 2.

$$\text{Self node of RREQ packet processing} = \begin{cases} \text{farward} & (dS) < (dSelf) < (dD), \\ & (dS) > (dSelf) > (dD), \\ & (dD) = (dSelf) \\ \text{discard} & \text{other} \end{cases} \quad (2)$$

As shown in figure 4, a layer of the source node S request and destination node D build new routing, the RREQ request message will only be 2 parts of the node forwarding, also in three layers is only part of the node forwarding, all nodes forward in the fifth floor. Can be seen from the figure RREQ news is basically a S node center band radio, in the direction of the D nodes effectively implements the network RREQ request message transmission control and reduce the consumption of network resources.

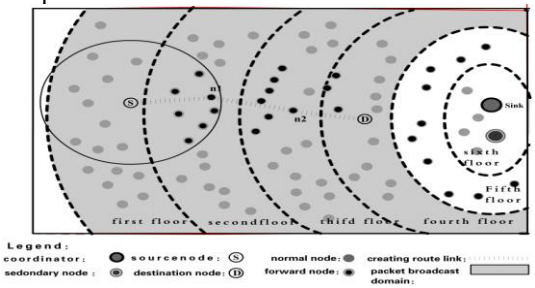

figure 4 RREQ message forward

2.3.2 routing query mechanism

RREQ forwarding mechanism proposed in this last section of route query methods usually can always find an available route, but in some special cases, if can't find available routing, the agreement will forward relaxing constraints, to expand the search scope. After the first route search, modify the RREQ message in the Time domain. Intermediate nodes will be disposed of in accordance with the conditions of the looser the forwarding of a message, by adding a middle node address and the source node layer equals the address forwarding, such as the formula 2.

The RREQ message transmission range will be expanded to all layer between the source node and destination node as shown in figure 5 although the news spread an enlarged than before, but still than simple AODV protocol has better performance.

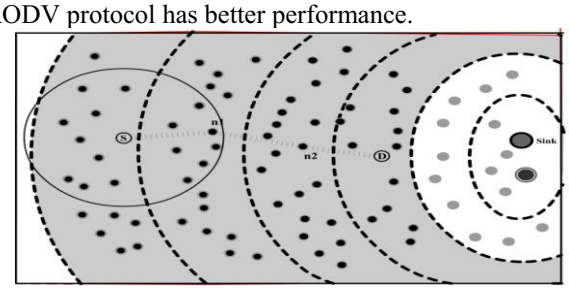

Figure 5 Under the condition of loose forward

3 SIMULATION

The specific parameters of the simulation environment such as the following Table1. The improved AODV(IAODV) protocol's performance is analyzed using NS2 simulator.

Table 1 The results of simulation analysis

application layer	CBR
Transport Laye	UDP
Routing Layer	IADOV 、AODV
MAC Layer	802.11DCF
Wireless transmission model	shadowing mode β =2.4
Wireless transmission frequency	2.4GH
Number of nodes	20，40，60，80，100，120，140，160，180，200
Scene size	500m×500m
simulation time	100 s.

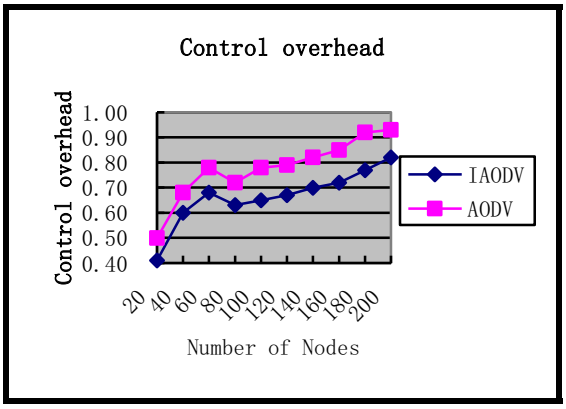

Figure6 The comparison of packet control overhead

As you can see from figure 6, with the increase of the number of nodes, the packet control load of proposed routing protocol is low then the packet control load of AODV routing protocol.

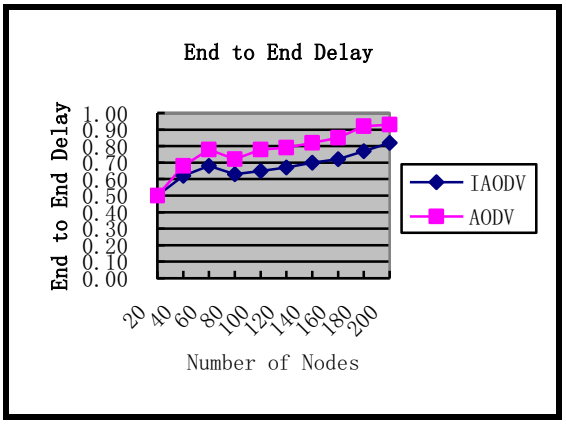

Figure 7 end-to-end delay

Figure7 said IAODV routing protocol of the average end-to-end delay less than AODV, because the cost of control of improved routing protocol and the cost of compute are little.

4 RESULT

Advantages: The network delay and the overhead of control are little, The node does not need to be stored long routing table saves storage space, realize the whole sky broadcast-oriented offline data, improve the channel utilization ratio and reduces the network consumption.

Faults: the route that was fond may not be the shortest routing, the performance is not the most stable routing and time delay is not the smallest routing. Network address is waste, and does not support the concentrated distribution of a large number of nodes and request node distribution is relatively uniform.

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