A Research on the dynamic routing of Internet of Things Based on Ant Colony Algorithm

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Abstract. According to the characteristics of the Internet of things such as the irregular Network topology, many node, the more variable network structure, I put forward a new way of using ant colony algorithm to search route, and using the broadcast signaling which is featured with the random sending and the short life cycle to overcome the problem of more network nodes and more variable network structure. The simulation results show that searching route by ant colony algorithm can reduce the broadcast storm effectively. With the number of nodes in the search in routing was increased, the time of route setup was significantly shortened.

Keywords: Internet of things; route search; ant colony algorithm; broadcast storm

1 Introduction

In the environment of Internet of things, information transmission can not do without routing protocol, and routing protocol directly affects the performance of Internet of things. The routing algorithms plays a key role in the routing protocol[1,2]. Different from ordinary Internets which are mostly point to point, or a fixed point for multicast, the Internet of things is a net of irregular multipoint to multi-point communication[3], and communication participants may be immediately join or leave, so we can’t use the common TCP/IP network routing search algorithms. Thus, the design of routing algorithm is very important for Internet of things[4,5].

2 The dynamic routing algorithm in Internet of things

The route of Internet of things should have the characteristics, for instance, using smaller communication overhead and processing power to calculate the optimal path, and adapting to the dynamic change of the topology structure in Internet of things[6,7,8]. This paper tries to study the use of ant colony algorithm to find route, using the random sent broadcast signaling which has a very short life cycle to
overcome the problems of more network node and variable network structure; at the same time, to reduce the network storm in the process of route searching.

3 Routing algorithm based on ant colony algorithm

3.1 Routing algorithm model

We demonstrate the model by the example of finding a solution of a network with \( n \) nodes. Assuming that in order to establish a network routing, \( m \) nodes transmit the searching signaling at the same time. \( d_{ij} (i, j = 1, 2, \ldots, n) \) represents the distance between node of \( i \) and \( j \), \( \tau_{ij} (t) \) represents for the number of effective signaling received during the path between the node \( i \) and \( j \) at the time of \( t \). the number of effective signaling between the node \( i \) and \( j \) is \( \tau_{ij}(0) \), \( p_{ij}^{k}(t) \) represents for the probability that signaling \( k \) transfer from node \( i \) to node \( j \) at the time of \( t \), then:

\[
p_{ij}^{k}(t) = \begin{cases} \frac{\tau_{ij}^{\alpha}(t)\eta_{ij}(t)}{\sum_{k\in \text{allowed}} \tau_{ir}^{\alpha}(t)\eta_{ir}(t)}, & j \in \text{allowed}_k \\ 0, & \text{otherwise} \end{cases}
\]

(1)

The allowed\(_{k}\) = \{0, 1, \ldots, \( n - 1 \)\} - tabuk represents for the nodes set of signaling \( k \) next allowed to pass through, tabuk \((k=1, 2, \ldots, m)\) is used to record the nodes that signaling \( k \) pass through at the present time. Signaling \( \tau_{ij}(t) \) will gradually become valid with the passage of time; \( \alpha, \beta \) separately represent for the accumulated amount of information of signaling in the process of retransmission, and the different roles heuristic factor played in the path selection during the signaling retransmission; \( \eta_{ij}(t) \) stands for expectations degree of the transfer between node \( i \) to the node \( j \). Signaling \( k \) go through all the nodes, and complete a cycle. The amount of information in all paths should be updated according to the following equation:

\[
\tau_{ij}(t+n) = \rho \cdot \tau_{ij}(t) + \Delta \tau_{ij}
\]

(2)

3.2 The simulation process

Step 1  The initialization of the parameter. Let’s make time \( t = 0 \), the times of search \( nc = 0 \); make \( \tau_{ij}(0) \) on each side \( \tau_{ij}(0) = c \), in this equation, \( c \) stands for a constant, and \( \Delta \tau_{ij} = 0 \); and then choose \( m \) nodes from \( n \) nodes randomly.

Step 2  Place the initial starting point of each signaling in the current solution set tabuk(s), move each signaling \( k(k=1, \ldots, m) \), to the next node \( j \) according to the probability \( p_{ij}^{k} \); and place the node \( j \) in tabuk(s).
Step 3 Then we can calculate the total path length $L_k$ that each signaling has passed through, and updated that to find the shortest path.

Step 4 To update the information $\tau_{ij}(t+n)$ on each side.

Step 5 Place $\Delta \tau_{ij} = 0$ on each side; $nc = nc + 1$.

Step 6 if $nc <$ the selected number of times $N_{C_{MAX}}$ which are reserved, then turn Step 2; otherwise, print out the shortest path, terminate the entire program.

4 The simulation results

Take the network 4 by 4 as an example, we make the simulation of searching the route based on ant colony algorithm.

In figure 1, abscissa axis represents for the number of nodes that participate in searching route, vertical axis is the quantity of information retransmission, so it is obvious that searching route through ant colony algorithm can reduce the broadcast storm effective effectively.

In figure 2, abscissa axis represents for the number of nodes that participate in searching route, vertical axis is the time for establishing the route, if we set establishing time of the entire network broadcast routing is 1, we can conclude that...
with using ant colony algorithm to establish routing, the time of establishing the route was significantly shortened with the increasing number of nodes in searching route.

5 Conclusion

This paper studies that we can search the route through ant colony algorithm, and using the broadcast signaling which is featured with the random sending and the short life cycle to overcome the problem of more network nodes and more variable network structure, at the same time to reduce the broadcast storm effectively.

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References