Optimization Design of Wireless Routing in Embedded Condition

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Abstract: **In the embedded condition, the wireless network has the race condition, race condition mechanism leads to the fluctuation of sharing resources and implementation of wireless routing processing, the wireless routing process falls into abnormal status, equilibrium of wireless network decreases. In order to solve this problem, an improved a routing optimization algorithm is proposed based on race condition and game theory. The execution sequence model of wireless routing is established, and related race condition is described accurately. The race condition analysis algorithm is proposed, it can effectively deal with the fluctuation problem of embedded wireless routing in execution of resource selection process. The game theory is introduced into the dynamic source routing algorithm, and the non related routing is increased from the source node to the destination node. The link bandwidth of wireless routing in embedded condition is analyzed, and the optimal routing is obtained. Analysis and simulation results show that the routing optimization method can reduce network delay, enhance the data transmission efficiency. The service quality of the wireless network transmission is improved.**

Keywords: Embedded conditions; Wireless router; Optimization; Race set; Game theory

1. Introduction

The key problems in wireless routing embedded condition is routine selection, the race condition of embedded condition leads to the routing demand response is slow, and it results in wireless network delay, the network congestion occurs. The quality of service of wireless network is reduced seriously. Therefore, we need to seek the effective method to process the selection of the wireless routing for embedding condition optimization. Then, the equalization network source can be guaranteed. How to improve wireless network performance is becoming an important research subject[1].

Traditionally, the wireless network has the race condition, race condition mechanism leads to the fluctuation of sharing resources and implementation of wireless routing processing, the wireless routing process falls into abnormal status, equilibrium of wireless network decreases. In order to solve this problem, an improved a routing optimization algorithm is proposed based on race condition and game theory. The execution sequence model of wireless routing is established, and related race condition is described accurately. The race condition analysis algorithm is proposed[2], it can effectively deal with the fluctuation problem of embedded wireless routing in execution of resource selection process. The game theory is introduced into the dynamic source routing algorithm, and the non related routing is increased from the source node to the destination node. The link bandwidth of wireless routing in embedded condition is analyzed, and the optimal routing is obtained. Analysis and simulation results show that the routing optimization method can reduce network delay, enhance the data transmission efficiency. The quality of service of wireless network can be improved by this method.

2. Analysis of wireless routing race conditions under the condition of the embedded system

2.1 Execution sequence of embedded wireless routing

The embedded wireless routing process is usually a multi task system, the different control methods are used to complete the wireless routing task management and reasonable distribution of resources. Different routing nodes can take the signal processing and small queue method to complete the synchronous communication, the selection process of embedded wireless routing is the set of events for different communication synchronous

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execution[3].

In the embedded wireless routing process, the execution routing event of communication synchronization e can be described as e=<y,p,t,I,b>, where, y shows the event type, it mainly contains collecting, filtering, transmission, receiving signal, etc. p ∈P, it represents the belonged event of execution routing selection event, t perform routing event time, and i perform routing event number in task p, b∈B shows the processing object of routing selection event. Set that e_i and e_j are two execution routing selection events[4], they are sharing a same message queue b_i in the same time, it is described by $< e_i, e_j >$. Assumed that $E = \{e_i | i = 1, 2, \cdots, k\}$, and it represents current routing implementation in all executive set routing events Q, and k is routing events total number.

2.2 Race conditions analysis method in wireless routing selection process

Set Q=<P, I, B, E>, it shows the execution sequence of embedded wireless routing selection process, the collection of all executive routing which is directly related with the race condition selection events are called race condition set, it can be expressed as $R =< E_r, \xrightarrow{hb}, \xrightarrow{rd} >$. Where, $E_r \subseteq E$, it is the routing selection event set which is directly related to the race condition, $\xrightarrow{hb}$ shows the occurrence successive relationship on E_r $\xrightarrow{rd}$ shows the race condition synchronization relationship on E_r.

In the embedded condition, the execution sequence Q is processed with race condition analysis, on the basis of different wireless routing node, the routing event set E are classified. The execution sequence Q of routing nodes selection are classified according to the different routing nodes. Different subsequence set is obtained, Assumed that $Q_c = \{q_k | k = 1, 2, \cdots, m\}$, where *m* is the number of routing nodes, E_k is the event set of the corresponding routing nodes, the synchronization relationship of routing events can be concluded[5].

The race condition analysis algorithm can be used to deal with the fluctuation problem when the embedded wireless routing process the execution sequence and resource selection, the stability of wireless routing selection process is improved, the detailed algorithm can be expressed as follows:

Input：Q=<P，I，B，E>;

Output： $R =< E_r, \xrightarrow{hb}, \xrightarrow{rd} >$

Process：

1.Let R= { } be an empty race set;

2.Get $Q_c = \{q_k | k = 1, 2, \cdots, m\}$ from Q;

3.For $q_k =< b_k, E_k > \in Q_c$

4. For $e_i \in E_k$

5. If y_i= =RM then

6. e_s=the sending event of e_i;

7. For prior RM event e' in the same task

8. If $e' \| e_s$ then

9. e_s' =the sending event of e';

10. Add $e_s' \xrightarrow{rd} e_s$ into R;

11. End if

12. End for

13. End if

14. If y_i= =TS then

15. For prior TS event e'

16. if $e' \| e_i$ then

17. Add $e' \xrightarrow{rd} e_i$ into R;

18. End if

19. End for
20. End if
21. End for
22. End for

End Process.

According to the above analysis process, it can effectively deal with fluctuation problem of the embedded wireless routing selection and improve the stability of wireless routing process. It can provide reliable condition for the following routing optimization process

3. Optimal methods of wireless routing selection in the embedded condition based on game theory

The optimization process of embedded wireless routing is proposed based on game theory in this paper, the optimization process mainly includes three parts such as participants, strategy set and win collection. The participant is defined as source node of embedded wireless routing. It is a finite set. $l = \{1, 2, 3 \cdots k\}$, the source nodes and destination nodes of embedded wireless routing network are single hop or multi hop routing strategy is the set of game theory. The win set is the equilibrium point of the game theory set. The number of non relevant routing can increase the throughput of the source nodes, the delay and routing, network transmission can be optimized. The network transmission efficiency is improved. Embedded wireless routing node is staying in the conditions of competition, and it is a dynamic game process. The analysis of wireless routing optimization can be taken based on game theory.

The link topology structure of embedded wireless network routing between nodes is parallel, the weak convexity conditions are considered to ensure the balanced structure. The delay time of user *i* can be quantified with the formula as:

$$j^i(f) = \sum_{i \in L} j_l^i(f_l) \tag{1}$$

Where, $j_l^i(f_l)$ is the delay time of node *i* on the link 1.

The delay time of the user is the sum of the delay time of each wireless link, and each link occupancy rate has a strong relevance with the link routing traffic flow. Assumed the equilibrium requirements of wireless routing link are:

(1) $j_l^i(f_l) = f_l^i T_l^i(f_l)$

(2) T_l^i is continuously differentiable, and it is a strictly increasing and convex function. T_l^i is the unit flow. It can guarantee that $j_l^i(f_l)$ and $j^l(f)$ are convex function, and then the link occupancy function can be shown as:

$$T_l^i(f_l) = 1/(C_l - f_l) \tag{2}$$

Where, C_l is the bandwidth of wireless link, f_l is the routing business flow rate, we know that $f_l < C_l$, otherwise, $T_l^i(f_l)$ tends to infinity.

For an equilibrium point, that is to find most suitable route of transmission, each routing traffic flow distribution is a best response distribution for all the routing flow. We can get:

$$J^i(\hat{f}) = \min J^i(\hat{f}^1, \hat{f}^2 \cdots \hat{f}^{i-1}, \hat{f}^i, \hat{f}^l) \tag{3}$$

According to the hypothetical conditions (1) and (2) analyzed as above, it guarantees that $T_l^i(f_l)$ is strictly convex with f_l^i, this model is a convex game. In the embedded conditions, the equilibrium characteristics of wireless routing selection can be obtained.

(3) For the embedded wireless routing network, the Diagonal Strict Convexity (DSC) is used to determine the existence of equilibrium point. DSC is a unique method for solving the equilibrium characteristic, in this paper, $\sum_{i=l}^{m} P_i j_i(f)$ can be used to represent the weighted sum of distribution delay time of embedded wireless routing, then:

$$g(f,\rho)=\begin{bmatrix}\rho\dfrac{dj^{i}}{df^{i}}(\bar{f})\\ \cdots\cdots\\ \rho_{m}\dfrac{dj^{m}}{dfm}(\bar{f})\end{bmatrix},(\tilde{f}-\bar{f})[g(\tilde{f},\rho)-g(\bar{f}, \tag{4}$$

If the DSC system exists vector ρ , then the equilibrium is unique, that is to say the matrix $g(f,\rho)Pseudo-Jacobian$ is positive. Then, the equilibrium is existing uniquely.

When routing business flow rate is less than the link bandwidth, according to the equilibrium condition (1) and (2), the best route is found in the game of factors such as delay time and throughput. When the routing business flow rate may be greater than the link bandwidth, the equilibrium condition (3) is taken into consideration, and the factors of flow distribution and delay time are joined in the game. The game of these factors is played, and the optimal routing is obtained.

The non related routing from the source node to the destination node is considered with the new algorithm, consider routing business flow rate less than or greater than the link bandwidth

The above analysis process after adding the non related routing the source node to the destination node, consider two cases such as routing business flow rate less than or greater than the link bandwidth of the two cases, in many alternative routings, the delay time, network throughput and other comprehensive factors are considered. The best transmission route can be found in each game of these factors.

4. Experiment and result analysis

In order to verify the validity of this method, the relevant simulation and experiments are taken based on the PC, the Linux protocol is embedded in the wireless network, and the MAC layer takes the 802.11 protocol, the simulation environment is 1000m × 1000m, 50 random nodes are distributed. The performance of the traditional algorithm and this new algorithm are compared, the factors such as data efficiency, total number of requests (in bytes), total cost, the number of packets, end to end delay time are taken into consideration, the results are shown in Figure 1 to Figure 4.

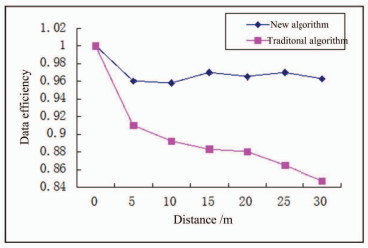

Figure 1. Data efficiency comparison for two algorithms

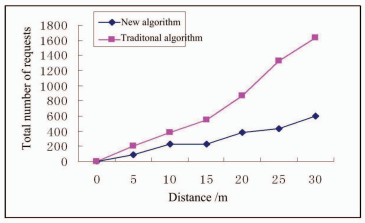

Figure 2. Total number of requests for two algorithms

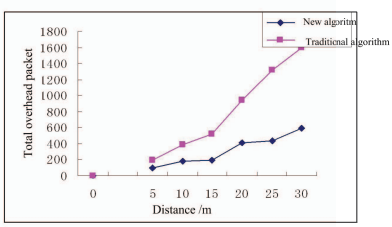

Figure 3. Number of packets for two algorithms

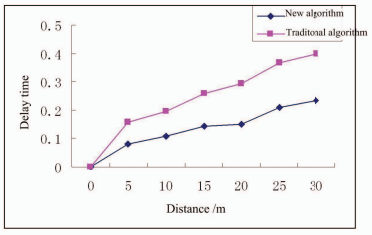

Figure 4. Delay time of two algorithms

From the analysis of Figure 1, data efficiency performance is good for the two algorithms. With the increase of the nodes distance, this algorithm has better data efficiency, the data efficiency can achieve 96%, and it has a very high throughput. In Figure 2, we can

conclude that the request number of new algorithm is less than the traditional algorithm, and it shows that the robustness of new algorithm is perfect. It can be seen from Figure 3 the number of packets is less than the traditional method, with the increase of the distance, it decreases significantly. It can be seen from Figure 4 delay of this algorithm is less than the traditional algorithm. The simulation experiments prove that this algorithm can effectively reduce the congestion and fluctuation under the conditions of wireless network, the time delay is short, and the fluctuation is suppressed, it has application value in practice.

5. Conclusions

In this paper, an improved a routing optimization algorithm is proposed based on race condition and game theory. The execution sequence model of wireless routing is established, and related race condition is described accurately. The race condition analysis algorithm is proposed, it can effectively deal with the fluctuation problem of embedded wireless routing in execution of resource selection process. The game theory is introduced into the dynamic source routing algorithm, and the non related routing is increased from the source node to the destination node. The link bandwidth of wireless routing in embedded condition is analyzed, and the optimal routing is obtained. Analysis and simulation results show that the routing optimization method can reduce network delay, enhance the data transmission efficiency. The quality of service of wireless network can be improved by this method.

6. References

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