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Satellite local node state awareness and adaptive forwarding routing algorithm

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Introduction

The satellite is in an exposed space environment, and its orbit parameters are open and fixed. Therefore, the satellite is vulnerable to hard destruction and network attack. In addition, due to the satellite's number being so limited, each LEO(Low Earth Orbit) satellite is usually responsible for a wide area. However, the amount of traffic in each region is very different. The storage and computing resources of satellites are also limited. As a result, on the one hand some satellite nodes start to be heavily congested , on the other hand, some satellites have little traffic passing through. To solve the problem of satellite network load balancing, this paper proposes a satellite local node state awareness and adaptive forwarding routing algorithm (LAAR).

Principle

Polar orbit has good coverage for high latitude area. It can make up for the poor coverage effect of synchronous orbit. Its topology is relatively stable and regular. In order to better analyze the transmission conditions, it can be abstracted as a grid topology. Satellite network model integrating transmission delay and real-time congestion as shown in Figure 1.

Different from the traditional routing algorithm, the proposed algorithm takes the nodes congestion degree real-time change into account. Therefore, by sending and receiving congestion reports, the nodes on the network can perceive the real-time status of the surrounding nodes. The forwarding direction can be selected according to the network status at that time.

Each node shall build and update the state of the surrounding nodes, and the specific process is as Figure 2.

Perception of the surrounding nodes state is a necessary condition for forwarding. And selecting forwarding direction is a process of constantly excluding other suboptimal directions. The specific process select forwarding direction is as Figure 3.

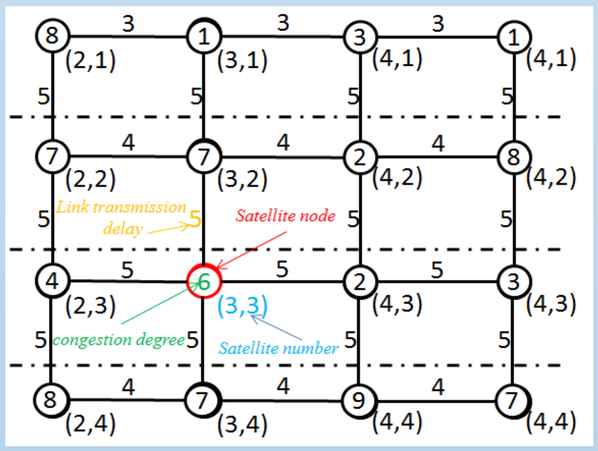

Fig. 1. Satellite network model

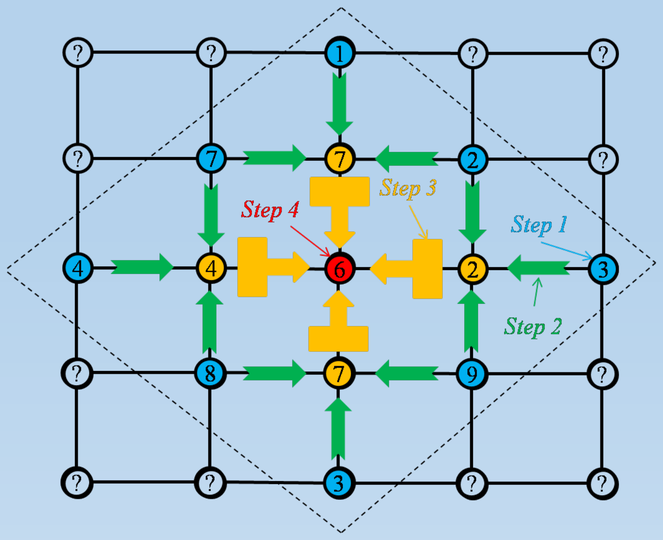

Fig. 2. Node status notification

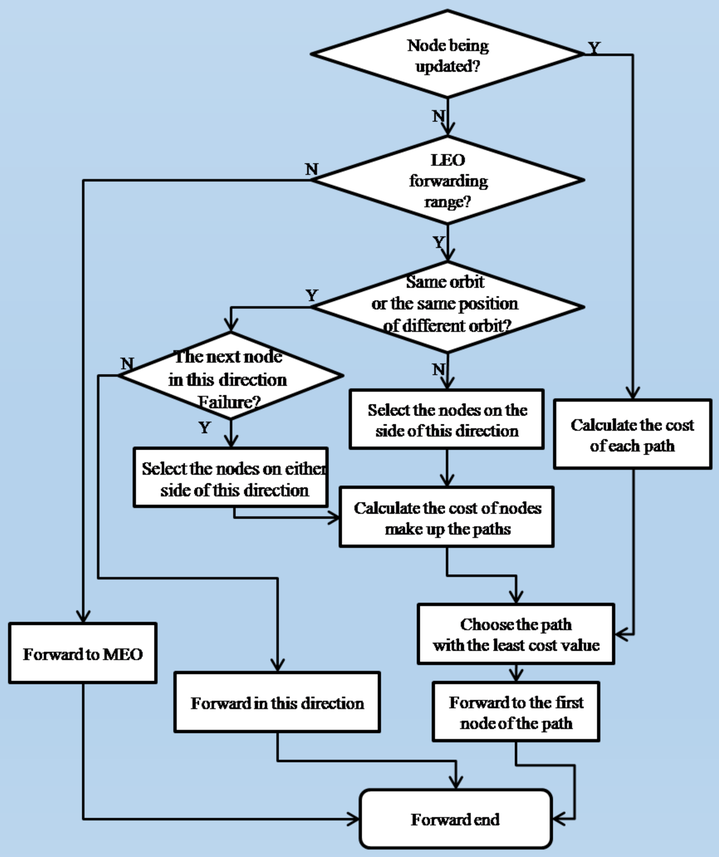

Fig. 3. The process of select forwarding direction

Simulation and Result

According to Fig. 4 and Fig. 5, it can be concluded that the proposed algorithm has a great advantage over DTDR in terms of end-to-end delay, and is also slightly better than ANSR. In terms of packet loss rate, when the network load is low, the packet loss rate is also very low. When reaching a certain degree, the DTDR's packet loss rate is increasing obviously. The proposed algorithm and the ANSR rise compared with the DTDR are not so obvious. Although the ANSR's packet loss rate is also slightly lower than the proposed algorithm, the gap is so small that it's negligible. So in terms of packet loss rate, our algorithm also has good performance.

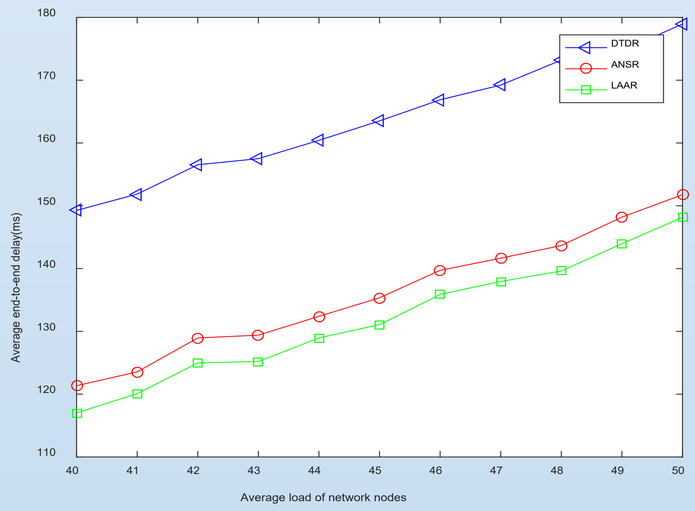

Fig. 4. Comparison of end-to-end delay

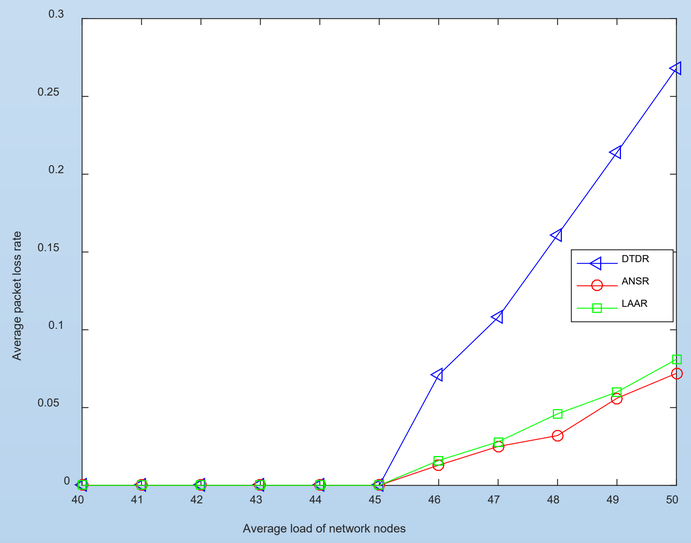

Fig. 5. Comparison of packet loss rates

Conclusion

In this paper, we put forward a network model and LAAR algorithm. The algorithm solves the problem that the traditional routing algorithm is insensitive to the dynamic change of satellite network state. The test results show that the algorithm can better select the optimal path if the precision is 100 and apply to the 4×4 network. Compared with the other two algorithms, it can be seen that our algorithm achieves shorter end-to-end delay and lower packet loss rate.

Acknowledgements

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