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Study of Management Scheme of Energy Problem for Wireless Sensor Networks

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Abstract

Wireless sensor network (WSN) is a combination of wireless communication technology, embedded computing technology, sensor technology, distributed data processing.However, Energy problem is constrained sensor networks continue to work one of the key factors. Therefore, Low duty cycle of wireless sensor network (WSN) is an effective method to save energy. But there are a lot of delay and packet loss rate of the existing low duty ratio in the wireless sensor network. Without fully considering the transmission link quality problems in the current low duty cycle of wireless sensor network.This paper proposes a management scheme for cross-layer wireless sensor network. A good link quality decrease the number of retransmission for communication between nodes.The results is shown that this method can reduce the network delay,energy consumption and packet loss rate. Energy consumption can be reduced used to make up for other communication energy consumption and ensure that the entire network of energy consumption in an acceptable range. It is feasible that exchange low latency and packet loss rate of the whole network and providing reliable data transmission with appropriate energy consumption.Therefore, the delay, packet loss rate and cost of handover are all reduced.

Keywords:*link quality, LQI value, IPv6, wireless sensor network, FFD node,evaluation mechanism.*

1. Introduction

WPAN wireless sensor network (WSN) has greatly expanded the application range of traditional WSN. It has been widely used in areas such as modern agriculture and environmental monitoring. The most notable feature of wireless sensor network (WSN) is its mobility so that WPAN wireless sensor network (WSN) can play a better role with good mobility. Due to the limited resources of wireless sensor networks, it must have the features of low latency, low cost, and low packet loss rate. Therefore, this paper proposes a mobile protocol of wireless sensor network with the following innovation.network architecture is proposed, and distributed IPv6 address allocation algorithm is suggested based on this architecture. In this algorithm, the node obtains address from neighbor nodes within the scope of one jump and no DAD is required. In the process of address configuration, routing backbone network is constructed automatically at the same time, while the nodes can achieve automatic routing by the constructed routing backbone network without the process of routing discovery and routing building. Based on the proposed architecture, this paper proposes a cross-layer mobile handover algorithm. In this algorithm, the mobility handover of network layer and link layer can be carried out simultaneously, so the mobile handover delay and the packet loss rate are reduced.

Generally, sensor network need maintain a long life cycle, even for a few years. Low duty cycle of wireless sensor network (WSN) is an effective means that make the nodes in a state of low duty cycle , and as much as possible into sleep mode to extend the life cycle of existing wireless sensor networks.The main factors affecting the service life of the node is wireless nodes transceiver and listening through massive experiments show time[4].However, Energy problem is constrained sensor networks continue to work one of the key factors.

The duty cycle of nodes is normally a few percent in low duty cycle in the wireless sensor network (WSN), this way in extending the network lifetime, at the same time also made communication delay become bigger between neighbor nodes, which affect the validity of data transmission . For many high real-time requirements of wireless sensor network

application has a great influence, such as military applica-tions, disaster forecast system, etc. Existing research shows that the link quality has a great influence on network laten-cy[5][6],This paper proposes a node dormancy algorithm based on link quality LDW for low duty cycle of wireless sensor network.

2. Network Architecture

Link layer of WPAN WSN uses IEEE802.15.4 which divides the nodes into FFD (Full - function device) and RFD (Reduced - function device).

In the proposed scheme, WPAN wireless sensor network is composed of multiple PANs, each of which is composed of a gateway and multiple FFD sensor nodes and RFD sensor nodes. Gateway is the access router connecting PAN and IPv6 network. The nodes of gateway and FFD sensor nodes are fixed nodes, with routing transfer function while the nodes of gateway and RFD nodes are mobile nodes, without routing transfer function. In a PAN, a gateway and all FFD nodes constitute routing backbone network. Its topology structure is a tree, known as the PAN tree, with the root node as the gateway. RFD sensor nodes communicate with IPv6 Internet by routing backbone network. The fixed nodes of routing backbone network which communicates directly with RFD sensor nodes are called the association nodes of RFD sensor nodes. One RFD node only has one association node at the same time.

According to the features of WSN, IPv6 address structure of the gateway and sensor nodes in this scheme is shown in Table 1:

(128-i) bits	i bits
(128 - I) bits	i bits
PAN ID	Node ID
PAN ID	Node ID

Table 1 TIPv6 address format

In Table 1, IPv6 address of the gateway and sensor node is composed of two parts: The first part is the PAN ID, which is a global routing prefix. The gateway, all FFD nodes in a PAN and all RFD obtaining address form this PAN have the same PAN ID; The second part is Node ID, which is a sensor node uniquely identifying PAN. IPv6 address of the gateway is preset and Node ID 0. In Table 1, the value i is determined by WPAN sensor network scale in practical application and by distribution density of sensor nodes. In this protocol, the value of i is 16, that is a PAN covers 216 nodes at most.

After joining WPAN, RFD node Z scans all of the channels and receives beacon frames of neighbor gateway/FFD node. It will select gateway/FFD node Y with the minimum depth value to obtain address. The process of RFD node Z obtaining IPv6 address from neighbor gateway/FFD node Y is as follows:

Step 1 RFD node Z sends Addr - Req message to FFD node Y.

Step 2 After receiving the Addr - Req message sent by RFD node, FFD node Y will choose the corresponding record of the smallest undistributed sub-node value and sends back an Addr-Res message to RFD node Z. The message load is the corresponding record of sub-node value k. Meantime, the sub-node distribution state of corresponding record \ is identified as assigned [5, 6] .

Step 3 After receiving the Addr - Res message, RFD node Z will obtain the Node ID according to the formula (1), and then the Node ID will combine with PAN ID of FFD node to obtain its own address. Y is the link node.

Step 4 Address configuration of RFD node Z is completed.

After obtaining IPv6 address, FFD node scans all channels receiving beacon frames of neighbor FFD node to obtain the working channel and the relative position of the neighbor nodes [7-10].

When RFD nodes communicate with IPv6 nodes, packets will first arrive in PAN gateway nodes by PAN tree where locates the link node of RFD nodes, and then the gateway node will record the relationship between RFD node and its link node and will sends the packet to IPv6 node according to IPv6 routing.

If FFD node Y is the link node of RFD node X, when FFD node Y detects that node X will leave its communication range, it will select the FFD node Z,

which is the nearest to node X, as the next link node of node X. Assume that node Y and Z are in the same PAN and gateway node is G, then the mobile switching operation of node Y is follows:

1. FFD node Y sends Handover message to the node X and gateway G separately. The message sent to the gateway G is RFD node X address while sent to the node X is the working channel of node Z.

2. After receiving the Handover message, node G will update the link node of RFD node X from Y to Z, and send back Handover_Ack message to the node Y.

3. After receiving the Handover message of node Y, the node X will directly use the working channel of node Z to realize the layer 2 handover with node Z as its new link node.

4. After node Y receives the Handover-Ack message, if it still has the message that node X is the destination address, then the data will be routing to node Z, and node Z will send the data to node X.

The above process, node X is still at the communication range of node Y, so it can still receive data through the node Y, thus the packetloss rate is reduced.

3. Link Quality Evaluation Mechanism

Link quality evaluation mechanism now is based on sending a large number of the packet and calculate the packet Received rate of the link (PRR), which can intuitively reflect the current link quality. But this kind of statistical methods will waste a lot of bandwidth and energy which needs to send a large number of data packets, that is not suitable for application in wireless sensor networks. With the development of hardware technology, a kind of received signal strength indicator (RSSI) and link quality indica-tor(LQI) can also provide link hardware detection. In the literature of the experimental results show that the value of PRR and LQI has a strong linear correlation.

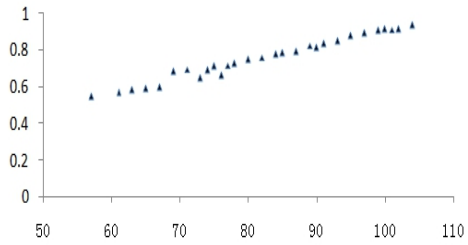

Figure 1 Statistical LQI value relations with PRR

Because the node LQI value comparison conforms to the linear regression relationship in waking moment. So can estimate the next round of LQI value by using node LQI value of last time round and at the moment.Design formula is as followed:

$$LQI(n+1) = (1+a) \times LQI(n) - a \times LQI(n-1) \quad (0<a<1) \qquad (1)$$

Sensor nodes in WSN is divided into two kinds of work and sleep. Node has basic communications functions such as perception, sending and receiving data when in a state of work ,and in idle listening when there is no data communication. Node will be shut down in addition to the timing function of function when nodes are in a sleep state[7].

So can use F means a cycle of node i work scheduling table, if use t means the node i working state of time and use b means the node duration of the work. With the time of work and sleep being separated into some periods, Each time period is the same size, see figure 3. We can use a two-dimensional array (tj, b) represent the node moment of awakening and work time. If the number of node i wake up in a cycle of n times, and the formula for job schedulin g table to node i:

$$F = \{(t_1, b),(t_2, b)(t_n, b)\} \qquad (2)$$

4. Performance Analysis

NS2 can be selected to simulate node dormancy method. According to the chip information, the simulation experiment of LQI value choice in the [50,200] of the random number. Each data transfer cycle is 200 seconds, every second to send 50 data in each cycle, data time interval is 20 seconds to test the entire network latency and packet loss rate. See Table 2.

Parameter description	Parameter value

Simulation area	800×8500 m2
Number of PANs	5
MAC protocol	IEEE 802.15.4
Speed(v)	[10m/s, 30m/s]
Speed angle	[0,2π]
Pause time	20s
Transmission range(r)	[50m,200m]
Number of FFD nodes	100
Number of RFD nodes	200
The simulation node number	20
LQI random value	[100,200]
Time slot size/S	2
Packet payload/Byte /Byte	250
Node work cycle/S	200
Number of test cycles	20
Send packets in each cycle	500
Send the packet interval /S	20
The node initial energy/J	1000

Table 2 Parameters of Experiment

This method ensured that the entire network link quality in a good condition by increasing data transmission time which node link quality is good,. Decrease the number of retransmission for node receive and transmit data through t a good link quality, so that can ensure the success of data transmission. This method can transmit less data because node need broadcast LQI value So that has high delayed.

5. Conclusion

This paper proposes a management scheme for cross-layer wireless sensor network. A good link quality decrease the number of retransmission for communication between nodes.The results is shown that this method can reduce the network delay,energy consumption and packet loss rate. Energy consumption can be reduced used to make up for other communication energy consumption and ensure that the entire network of energy consumption in an acceptable range. It is feasible that exchange low latency and packet loss rate of the whole network and providing reliable data transmission with appropriate energy consumption.Therefore, the delay, packet loss rate and cost of handover are all reduced.

References

[1] McKnight D H, Choudhury V, Kacmar C, "Developing and validating trust measures for e-commerce: An integrative typology", Information Systems Research, Vol. 13, No. 3, 2002, pp. 334-359.

[2] Phelps J, Glen N, Elizabeth F, "Privacy Concerns and Consumer Willingness to Provide Personal Information", Journal of Public Policy & Marketing, Vol. 19, No. 1, 2000, pp. 27-41.

[3] Rust R T, Kannan P K, Peng N, "The Customer Economics of Internet Privacy", Journal of the Academy of Marketing Science, Vol. 30, No. 4, 2002, pp. 455-464.

[4] Yardley S, Teunissen P W, Dornan T, "Experiential learning: transforming theory into practice", Medical teacher, Vol. 34, No. 2, 2012, pp. 161-164.

[5] Liu J, Wang Q C, Zhou L, "Discussion and Practice of “Experience”-based Teaching Method Reform of Management Information System", University Education, Vol. 5, No. 8, 2014, pp. 120-121.

[6] Li Y, Jia F, Liu H D, "Exploration of Experiencing Teaching in College Engineering Materials", Time Education, Vol. 15, No. 8, 2015, pp. 63-69.

[7] Jianzhong LI, Hong GAO, "The research progress of wireless sensor network", Research and development of the computer, Vol. 45, No. 1, 2008, pp. 1-15.

[8] Li CUI, Hailing JU, Aoyong MI, Tianpu LI, Wei LIU, Ze ZHAO, "The research progress of wireless sensor network", Research and development of the computer, Vol. 42, No. 1, 2015, pp. 163-174.

[9] Akyildiz I.F., Su W, Sankarasubramaniam Y and Cayirci E, "Wireless sensor networks: a survey", Elsevier Journal of computer Networks, Vol. 38, No. 4, 2002, pp. 393-422.

[10] Su JS, Hu QL, Zhao BK, Peng W, "Routing techniques on de-lay/disruption tolerant networks", Ruan Jian Xue Bao/Journal of Software, Vol. 21, No. 1, 2010, pp. 119-132.

[11] Wang J, "A PLP ROUTING PROTOCOL BASED ON LINK QUALITY", Journal of Investigative Medicine, Vol. 63, No. 8, 2015, pp. 253-259.

[12] Aimin HOU, Zhifeng HAO, Xiaoli CHEN, etc, "Adaptive genetic algorithm of undirected Hamiltonian graph", Journal of south China university of technology, Vol. 39, No. 2, 2011, pp. 55-59.

[13] Jian ZHU, Hai ZHAO,Xiyuan ZHANG, etc, "The wireless link quality evaluation model based on the LOI measure", Journal of northeastern university, Vol. 29, No. 9, 2008, pp. 1262-1265.

[14] Gu Y, He T, "Dynamic switching-based data forwarding for low-duty-cycle wireless sensor networks", IEEE Trans. on Mobile Computing, Vol. 10, No.12, 2011, pp. 1741-1754.