Analysis of Energy-aware M2M Routing Protocol for Internet of Things with Low Energy Consumption

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Abstract: At present, the development speed of M2M routing protocol is accelerating, and M2M communication based on cellular Network system has become a very important component of mobile communication. However, the problem of high energy consumption caused by M2M of cellular Network has been an important factor affecting the rapid development of this technology. In order to effectively reduce the Network energy consumption and achieve the balance of load capacity, energy aware M2M protocol routing with low energy consumption for the Internet of things is proposed, which reduces the energy consumption of the Network.

1. Introduction
M2M can be defined as the communication process between machine and machine in macro sense. The communication process mainly includes the communication between machine and machine, the communication between human and machine, and the communication between mobile Network and machine. From a narrow point of view, M2M only represents the communication between machine and machine. Using wireless Network as the basis, it realizes the information exchange between different mechanical equipment and IT equipment. M2M, as a widely existing way in the Internet, focuses on one or more different entity structures, and does not need the intervention of human factors. The most remarkable feature of M2M is that it can realize a low mobility and burst processing of communication services in a relatively small data communication state. In the process of work, a variety of Networks are needed as support, which mainly cover cellular Networks such as GSM, CDMA and TD-SCDMA. With the rapid development of M2M technology in cellular Network, M2M communication has slowly developed into the main form of mobile communication, which can not effectively meet the development standard of M2M service based on H2H communication service. However, the large energy consumption problem caused by M2M in the working process seriously affects the rapid development of this technology. In M2M Network system, real-time data sharing with fast and stable transmission are effectively realized through self-organization. Therefore, a low-energy consumption routing strategy is proposed to solve this problem.

2. Energy aware M2M protocol routing with low energy consumption

2.1 Basic structure of M2M Network
M2M Network structure mainly collects different types of information through mobile terminals and corresponding sensor devices. At the same time, it uses wireless sensors or wired communication to transmit the information to the terminal management system for aggregation and information
processing. After data processing is completed in the terminal system, the data is sent to the base station center for use, the specific process as shown in Figure 1:

![Figure 1 Basic structure of M2M Network](image)

As can be seen from the transmission process in figure 1, the Network structure based on M2M mainly covers intelligent communication equipment such as sensors, brakes and RFID tags, while the M2M gateway is mainly responsible for obtaining the most original data information from intelligent communication equipment and initializing the operation through the Network system. The M2M Network implements an effective connection between the smart device and the M2M gateway, and the communication Network realizes efficient transmission of Network data between each other. The remote client and application implement accurate processing of some data, realize the visualization of data and provide users with specific data transmission functions.

### 2.2 Energy consumption objective function

AODV routing protocol belongs to an on-demand routing protocol, which can realize effective connection between two different routes. Based on this connection system, data transmission between two routes can be carried out until the link is completely broken. Therefore, in this part, the nodes will exercise early because of excessive energy consumption, and can not be effectively used in the requirements of M2M Internet of things standards. In M2M Network system, data is transmitted efficiently by retransmitting. The data sent by one node is transmitted directly to the next target node. After receiving the data, the target node will confirm to the source node of the data. If the corresponding data is not received by the node, or the data is not fully received by the target node, then the target node will confirm to the source node of the data. The data transmission node needs to continue to transmit data to the source node. After the target node receives the correct data or has reached the upper limit of repetitive transmission, the whole data transmission process ends.

### 2.3 Protocol design

Based on the effective design of AODV energy routing protocol, it needs to be improved from two aspects, on the one hand, the energy consumption of the next node in the data transmission process is analyzed, on the other hand, several different communication routes are established at the same time, because data cannot be transmitted normally because the route in a communication line is broken.

In the selection type of the next node of the data transmission, it is necessary to effectively find out whether there is routing information of the target node in the routing table in the process of sending the data of the source node to the target node, and if it does not exist, the source information needs to be resent. If the node information already exists, the source node needs to be re-searched, and the minimum transmission energy consumption and the minimum information reception signal are found through the corresponding calculation formula, thereby realizing the transmission process of the lowest energy consumption.

A number of paths for path loops to transmit are established. Each node contains the source node for effective setting. If there is no buffer information queue, it is necessary to establish a number of different routing loops. In the process of establishing, RREQ is included in the request of the source.
node for data transmission routing to all neighboring nodes. When the intermediate node receives data information, it is necessary to judge whether it has received such information by REQID of RREQ and the IP information address of the source node. If such information has been received, it is necessary to abandon the continuing transmission. If there is no corresponding information, it is necessary to establish an effective routing system in the previous routing system. At the same time, it is necessary to check whether there is a routing of the target node in the routing table. If not, it is necessary to request the operation process containing RREQ in the new round of data transmission process. Otherwise, the generated RREP needs to be sent directly to the source node along the reverse path.

In router discovery, if the number of the next node corresponding to one of the nodes is less than 1, it is necessary to set up multiple routing loops between any nodes in the Network to start the router working process. This way can effectively improve the stability and reliability of Network data transmission, and at the same time it can further improve the Network data transmission, reduce the comprehensive energy consumption of the Network, and achieve the balance of the load of each node.

3. Maintenance of route break

Under the condition of AODV Network protocol technology, the process of routing signal discovery has been changed effectively, the energy consumption of the previous node is considered in the selection of the next node, and the energy consumption of sending and receiving data of the node is effectively repaired by breaking the circuit, which effectively improves the communication quality of the sensing link. The monitoring and repairing work of routing breakdown problem is mainly through the nodes in the Network to effectively monitor their own energy consumption. When the residual energy of a node in the Network is less than 30% of the original value, then the node is likely to have the problem of link breakdown. RREQ data transmission includes all upstream nodes in this process. After contacting the information sent by the next node, it is necessary to delete the data information from the next node in the routing and send RRER nodes at the same time, which may cause link breakage. After the circuit breakage problem occurs, the amount of data received by the RRER is equal to the amount of information sent centrally by the previous node. Therefore, the node needs to be deleted, and the node deletion and link repair process are as shown in figure 2:

![Figure 2 Node connection topology](image)

In Figure 2, according to the energy consumption sending and receiving capacity of each source node, the data transmission path with the smallest energy consumption is S→B→E→F. If it is found that the remaining energy in one cylinder of the node is less than 30%, then the node that needs timely notification to the upstream is B node, usually, B node deletes the route from B to E. At this time, when information is sent from point S to node B, the existence of the next node can be effectively judged. Here, it mainly means that the last point starts this street as a transmission node for data transmission. At this point, the starting path changes to S→B→G→D, and the routing repair work is started in the node part. If it is impossible to directly transfer to the next node for transmission at the location of node B, the information will be directly transferred to S node, and other characteristics of the source node will be re-selected for data transmission.
4. Conclusion
In order to effectively reduce the overall energy consumption of the M2M Network of the Internet of things, a low energy consumption routing protocol of M2M under the data transmission environment of the Internet of things is obtained through the analysis in this paper. Through the research, we can conclude that in the work of discovery and routing repair, high energy consumption improvements have been achieved. Especially in routing discovery, we can effectively reduce the total consumption of the Network by considering the actual sending nodes and energy consumption, effectively reduce the energy consumption of each node in M2M routing protocol, and ensure the whole transmission process proceeds steadily.

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