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Internet of Things Transmission and Network Reliability in Complex Environment

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Abstract: With the realization of the Internet of Things from theory to practical application, the work of ensuring high reliability of the system has become the key to system design, and it is also the obstacle to further promotion of the Internet of Things. This paper makes an in-depth study on the Internet of Things transmission and network reliability in complex environments. In this paper, we use the artificial bee colony algorithm to get the shortest path analysis of each cluster head node. The simulation results show that the algorithm proposed in this paper can effectively reduce the amount of data transmitted to sink by the sensor nodes through cluster head node fusion, improve the efficiency of data collection, energy consumption balance and network reliability, and extend the network life cycle. In addition, the index model of Internet of things reliability index system is established, and the comprehensive evaluation method of using the index is explained. The simulation results show that the proposed algorithm reduces the amount of data transmission and network energy consumption, prolongs the network life cycle, improves the efficiency of data fusion and data transmission reliability. Aodv-sms (abc-pso) routing recovery protocol shows that compared with other routing recovery strategies, packet transmission delay time is less, and the gap between them is more and more large; aiming at the end-to-end reliability and the network capacity, the paper focuses on the analysis of the impact of the change of communication link on the network capacity under the mobile node.

Keywords: *Internet of Things transmission; network reliability; data transmission; transmission path; index system*

1. Introduction

In recent years, the scale of the network has expanded from one laboratory to one building to one, and there has been a strong thing. The Internet of Things system are also exposed: the working environment of the Internet of Things system is complex, and the stability of the communication link is lacking. The Internet of Things terminals are widely distributed, facing the shortcomings of terminal functions and vulnerable to attack.

At this stage, it is the initial stage of the development of Internet of Things at home and abroad. The main research hotspots of many research teams focus on the following aspects: the formulation of relevant standards, the breakthrough of key technologies, and the exploration of commercial applications. Razzaque MA [1] proposed that the Internet of Things (IoT) envisions a future in which digital and physical objects or objects (eg, smartphones, televisions, cars) can be connected through appropriate information and communication technologies to achieve a range of applications. Perera C [2] surveyed more than 100 IoT smart solutions on the market and studied them carefully to determine the technologies, functions and applications used. Bertino E [3] found that based on a general description of the smart home management model of the overall framework, Stojkoska B L R [4] discusses current and future challenges of IoT-based solutions. Perera C [5] studied a variety of popular and innovative IoT solutions, using a framework built around well-known context-aware computing theory to evaluate these IoT solutions. Wang Yunan [6] realized the data recovery by using the data model of the IoT wireless sensor network with time-space correlation to perform the sparse sampling and matrix-filled approximate reconstruction techniques of the matrix composed of data samples. Xue Yuanfei [7] explored the application and design of intelligent vehicle management system for Internet of Things technology through the existing problems in the intelligent management of vehicles and the analysis of requirements. Zhang Qian [8] made a basic overview of the creation and application of Internet of Things technology, comprehensively analyzed the importance of Internet of Things technology in the state maintenance of power equipment, and how to optimize the application of Internet of Things technology in the condition maintenance of power equipment. Make four reasonable suggestions. Liang Yuzhu et al. [9] proposed a mobile population localization algorithm based on extended Kalman filter. The user nodes to be located are treated as a group, and the distance information between them is used to obtain better positioning performance to reduce the effects of environmental noise and wireless signal instability. Wu

Fangsheng [10] and others applied the Internet of Things technology to the traditional warehouse to realize infrared alarm, temperature and humidity monitoring, smoke and flame monitoring and alarm for the warehouse, and can remotely view the real-time information of the warehouse and the safety of the cargo. Ji Manping [11] proposed a ZigBee-based IoT smart home system, which can easily and quickly accept the signals sent by users to realize the transmission of digital signals through the Internet of Things, and study the role of ZigBee technology in the system to promote the system in practice. Based on the laboratory model, Li Bo [12] proposed a design of the parking guidance system in the parking lot based on the Internet of Things. The simulation results show that the design can effectively realize the parking guidance function in the parking lot. Hao Jie [13] uses ZigBee technology to develop a short-range wireless transmission system for the Internet of Things. The system uses the STM32L151 chip as a processing platform, uses the ZICM2410 module to build a sensor network, and completes remote communication through the SIM900B. Based on the Internet of yoghurt production and sales machine, involving the field of vending machine technology, Lu Xingyu [14] solved the existing yoghurt production and sales, which has long production time, large taste deviation of yogurt production, long waiting time for consumers and consumer experience.

At present, the research on the reliability system of the Internet of Things at home and abroad has not received corresponding attention. The existing IoT system is limited to regional applications and single industry applications. There is no relevant research results on the reliability research of the Internet of Things system. At present, China is in the period of rapid development of computers. Computer networks have penetrated into every household and become an indispensable part of people's daily life [15]. Chen Jiang [16] and others constructed a computer network weighted directed network model, analyzing the network characteristics of computer network from three aspects: degree, compactness and network efficiency, and the network structure value of the information forwarding process of an enterprise core network. Verification analysis, tightness, network efficiency, etc. Chen Chen [17] analyzed the factors affecting computer reliability, and found corresponding solutions to optimize the existing network systems and create a more reliable computer network. Wang Shikui [18] and others analyzed the hierarchical functional structure, working mode and communication data type of avionics FC network communication services, and proposed avionics FC network reliability index system for communication service quality, which is avionics FC. The evaluation of network reliability and experimental verification laid the foundation. Wang Peng [19] proposed a system product reliability comprehensive measurement system based on network equipment "fault correlation", network structure "topological association" and network service "effectiveness association". Based on this, simulation software was established and used in a military communication network. Successfully applied. Xiong Ying [20] analyzes the impact of user equipment and network topology on computer network reliability, gives the definition of computer network reliability and reliability, builds a reliability verification system based on dual verification module, and realizes the reliability of computer network. Hu Yansong [21] summarized the theoretical research problems of computer communication network reliability, explored the factors affecting the reliability design of computer communication networks, and introduced relevant reliability implementation measures to improve the reliability design of computer networks. Yu Wenjie [22] aimed at the unreliability of the IoT monitoring system, from the sensor nodes of the monitoring system's sensing layer to the transmission backbone, and analyzed their reliability respectively. The topology selection of the sensing layer, the division of the monitoring area, and the convergence layer. The reliability of the equipment and the redundancy of the equipment were analyzed in detail, and a quantitative analysis formula was given for the reliability of the transmission part. Ma Xiaoyang [23] simplified the scientific infrastructure system into a nonlinear polymorphic system, and established a preliminary model to analyze the reliability of intelligent management of technology infrastructure using Internet of Things technology. Cao Li [24] for the Internet of Things perception layer wireless sensor The network classical clustering LEACH algorithm randomly selects the cluster head, and does not consider the residual energy, node location and node density of the node. Tang Ling [25] and others proposed to optimize the mobile Sink path optimization mechanism of mobile wireless sensor networks based on improved firefly algorithm. The algorithm makes full use of the advantages of mobile Sink's abundant storage space, sufficient energy and strong computing power to ensure network connectivity and improve. Network communication efficiency.

In order to solve the problem of slow transmission speed and low network reliability in complex environment, this paper mainly focuses on the reliability of IoT, and modifies the parameters according to the characteristics of different application systems to evaluate the reliability and evaluate the results. Certain analysis. The method of reliability evaluation of Internet of Things is studied by combining analytic hierarchy process and multi-attribute decision analysis. The reliability index of the Internet of Things is established, and the reliability index of the specific research is proposed. For the reliability of communication between nodes, the electromagnetic interference faced by the Internet of Things is analyzed, and the terminal communication model under electromagnetic interference is established, aiming at the RFID in the Internet of Things. The interference caused by the nodes analyzes the interference probability and the communication related parameters under the interference; the basic model of the mobile internet is established, and the semi-Markov Smooth (SMS) mobile model is selected to describe the movement. The overall connectivity probability of the mobile network is analyzed, calculated and simulated. The survival time of the communication link between nodes under the condition of node movement is modeled and analyzed.

2. Method

2.1 Foundation of Research on Reliability of Internet of Things

The Internet of Things can be viewed as four layers without considering the upper layer application: physical layer, data link layer, network layer, and service layer.

The physical layer is the lowest layer of the Internet of Things. It is the direct interface between network connections and provides the implementation of modulation, demodulation, transmission and reception technologies. The physical layer properties can be divided into two aspects: mechanical properties, communication properties. Mechanical characteristics include packaging and energy consumption of terminal equipment.

The Medium Access Control (MAC) controls the access of the upper layer to the channel, completes the access control, and performs functions such as data transmission, error correction, and synchronization. The distribution of nodes in the Internet of Things is dense. Establishing the correct communication link for different data transmissions is the most important function of the data link layer; it is fair and effective to create communication links for each node.

In a mobile ad hoc network, communication between nodes needs to be forwarded by the intermediate node for multi-hop forwarding, and the path needs to be re-updated due to changes in the location of the node.

The performance of the business layer is mainly reflected in: a secure and reliable authentication protocol to ensure the security of the system, high-speed, effective data processing capabilities and unified standards to ensure the effective operation of the system.

2.2 Artificial Ant Colony Algorithm

Assume that the location of the i-th honey source, that is, the solution $X_i(i=1,2,3,\cdots,SN)$ searched by the bee, is represented by a D-dimensional vector $X_i=\{X_{il},X_{i2},\cdots,X_{iD}\}^{\mathrm{T}}$, where D is the number of parameter parameters to be optimized. The initial solution is generated according to the following formula:

$$X_i = X_{\min} + rand(0,1)\cdot\left(X_{\max} - X_{\min}\right) \quad (1)$$

X_{max} and X_{min} are the upper and lower limits of the X value range, respectively. During the bee search for the honey source stage, the lead bee first searches the nectar honey source for neighborhood. When searching for nectar honey sources, first generate a new honey source for each primary nectar honey source neighborhood, and select the appropriate honey source by comparing the advantages and disadvantages of the honey source, that is, the solution with higher fitness. When all the bees in the bee colony complete the honey source search, they accept information (distance from the hive, location, direction, and income of the honey source) to convey to follow by the swing dance. Follow the bees, follow the bee according to the yield of the honey source, select the nectar honey source with higher yield, then follow the bee in the same way, search for a new honey source in its neighborhood, compare the advantages and disadvantages between the honey sources, retain the comparison Good honey source (find a good solution), lead the bee to search for neighborhood honey source according to the following:

$$X'_{ij} = X_{ij} + rand(-1,1)\cdot\left(X_{ij} - X_{kj}\right) \quad (2)$$

In the formula, the parameters $k \in \{1,2,3,\cdots,SN\}$, parameters $j \in \{1,2,3,\cdots,D\}$, rand(-l,l) are randomly generated values in the interval (-1,1). The randomly generated values mainly control the search range of the bee neighborhood of the bee, and search with the bee colony. Gradually close to the global optimal solution, the range of the bee colony search honey source will gradually decrease.

The probability of following the bee to select the honey source is calculated as follows:

$$P_i = \frac{fit(X_1)}{\sum_{n=1}^{SN} fit(X_n)} \quad (3)$$

In the formula, the parameter P_i refers to the probability that the i-th food source (solution) is selected, N is the number of employed bees, and X_i is the position of the i-th honey source. The fitness value is positively correlated with the honey yield. The greater the fitness value, the higher the bee colony yield. The fitness value calculation formula is:

$$fit(X_n) = \begin{cases} \dfrac{1}{f(X_n)}, f(X_n) \geq 0 \\ 1 + \mathrm{abs}(f(X_n)), f(X_n) < 0 \end{cases} \quad (4)$$

Assuming the trail is the column vector of the SN dimension, the i-th element of the trail is used to represent the solution of the current i-th function and the number of times there is no update. If the specified number of cycles is limited, the honey source profitability is not improved, and a new honey source is randomly generated as follows:

$$X_{ij} = X_{\min,j} + \mathrm{rand}(0,1)\left(X_{\max,j} - X_{\min,j}\right) \quad (5)$$

The new solution generated by the calculation replaces the previous solution, and finally the global optimal solution is output. Here, $j \in \{1,2,3,\cdots,D\}$, $\mathrm{rand}(0,1)$ for the value randomly generated in the (0, 1) interval, $X_{\min,j}$ is the currently obtained j-th dimension minimum value, and $X_{\max,j}$ is the maximum value in the obtained j-th dimension.

2.3 Internet of Things Transmission Path Optimization Algorithm

(1) Weight design

When studying radio station association problems, if the station's nearest access is simply implemented, the objective function can be established as:

$$\text{MAX}\, SNR_{c_i a_j} \cdot x_{c_i a_j}, i = 1,\ldots,M; j = 1,\ldots,\text{N} \quad (6)$$

The decision variable x_{ciaj} represents the associated solution of the station ci and AP aj, which is the channel SNR value. When considering only the station load strength or APs and the channel SNRs between stations, the objective function can be established separately:

$$\text{MAX} \sum_{c_i \in C} q_{c_i} \text{NUM}\left(\text{bw}\left(c_i\right)\right), i = 1,\ldots,\text{M} \quad (7)$$

(2) Spectrum allocation

The solution of problem P2 eliminates the constraint of problem P1, considering the optimal correlation between the station load strength and the APs and the channel SNRs between stations. At this time, the problem P1 can be transformed into the pure spectrum allocation problem P3 in the cluster, and the modeling P3 is a convex integer programming problem.

$$\text{MAX} \sum_{c_i \in C} \text{SNR}_{c_i a} \text{NUM}\left(\text{bw}\left(c_i\right)\right), i = 1,\ldots,\text{M} \quad (8)$$

In the single-user two-hop multi-relay SWIPT network, the source node wants to transmit information to the destination node, but the distance between the source node and the destination node is relatively long, so the relay cooperation is used to help information forwarding. The network model does not consider the information transfer of the direct link, because the direct link signal fading is more serious. First, the source node sends a radio frequency signal to the V relays, and the relay obtains link state information of the M antennas of the source node from the received radio frequency signals, and then feeds back the link state information of the M antennas to the source node. The source node compares the received link state information of the M antennas, and selects one antenna from the M antennas that maximizes the link power gain. Secondly, the source node transmits the radio frequency signal to the relay by using the selected antenna, and the relay adopts the TS receiver structure to simultaneously receive information and energy. Finally, the relay uses the collected energy to decode the forwarding information to the destination node. In terms of time T, T is normalized to 1, and the time allocation scheme of system operation is αT ($0<\alpha<l$). The relay collects energy from the RF signal transmitted by the source node, after the $(l-\alpha)T/2$ time relay receives information from the RF signal transmitted by the source node, and during the remaining $(l-\alpha)T/2$ time, the relay forwards the information of the source node to the

destination. Node, α is the time switching factor.

(3) Routing Fault Tolerance Protocol

AODV-SMS: ASDV route recovery strategy for mobile Sink. It is a protocol adjusted based on the change of communication distance. The Sink movement, the original invalid path will be searched for a new path.

2.4 Extreme Learning Machine Algorithm (JORS) based on the Internet of Things

(1) Network model

Suppose there are N different samples $(x_i, t_i), 1 \leqq i \leqq N$, where the number of input layer nodes $x_F = [x_{il}, x_{i2}, \cdots x_{tm}]^T \in R^m$.

Then,

$$\sum_{i=1}^{L} \beta_i g(w_i \cdot x_i + b_i) = O_j, j = 1, 2, \cdots, N \quad (9)$$

Wherein, $\omega_i = [\omega_{il}, \omega_{i2}, \cdots, \omega_{im}]^T$, it represents an input weight vector connecting the network input layer and the i-th hidden layer node, and $O_F = [O_{il}, O_{i2}, \cdots, O_{in}]^T$ represents a network output value.

(2) LEACH agreement

In the cluster establishment phase, each node will have a random number between 0 and 1. After the node random number is generated, it is smaller than the current set threshold T(n), then the node can become the cluster of this round. When electing a periodic cluster head, if it is determined that a node is a cluster head, then there is a threshold T(n)=0 at this time, and the node does not repeat the cluster head in the subsequent election process. For ordinary nodes, the election is also based on T(n). The number of rounds of cluster head elections has been increasing. As a result, indicating that the value of T(n) is increasing, so the cluster head is not elected. Nodes have a greater chance of becoming cluster heads. Only one node left without cluster head selection, then get T(n)=1, because the random number generated by this node must be smaller than 1, so this node will become the new cluster head at this time. The following formula represents the threshold T(n) calculation relationship:

$$T(n)=\begin{cases}\dfrac{p}{1-p(r\bmod 1/p)} & \text{if } n\in G\\ 0 & \text{otherwise}\end{cases} \quad (10)$$

ρ - the proportion of the expected number of cluster heads in each round in the total number of nodes;

R——the number of cycles;

G - The set of cluster head nodes is not selected in the remaining 1/ρ rounds.

3. Experiment

3.1 Experimental platform

In order to unify the experimental environment, this paper adopts the now popular language python, and Python is very convenient to use in natural language processing tasks. With many practical and convenient libraries, this paper uses Gensim library to complete the training process. From the data preprocessing of the text to the completion of the training, the environment of the whole experimental process is shown in Table 1.

Table 1 Data preprocessing and extraction feature experimental environment

lab environment	Environmental configuration
operating system	Centos6.5
CPU	Intel Core I5-650 3.20 GHz
RAM	8GB
Programming language	Python3.6
Word segmentation tool	ICTCLAS2016
Training tool	Word2vec

3.2 Internet of Things Reliability Index System

(1) Great indicators

For the maximal indicator, the larger the value, the better. For the nonlinear indicator processing model:

$$\begin{cases} f(x)=1 & x\geq Q_{\max}\\ f(x)=Re^{(x-Q_{\min})/(Q_{\max}-Q_{\text{man}})} & \text{others}\\ f(x)=0 & x\leq Q_{\min}\end{cases} \quad (11)$$

The linear indicator processing model is:

$$f(x)=(x-Q_{\min})/(Q_{\max}-Q_{\min}) \quad (12)$$

(2) Very small indicators

For very small indicators, the smaller the value, the better. For the nonlinear indicator processing model:

$$\begin{cases} f(x)=0 & x \geq Q_{max} \\ f(x)=Re^{(Q_{max}-x)/(Q_{max}-Q_{min})} & \text{others} \\ f(x)=1 & x \leq Q_{min} \end{cases} \quad (13)$$

The linear indicator processing model is:

$$f(x)=(Q_{max}-x)/(Q_{max}-Q_{min}) \quad (14)$$

(3) Intermediate indicators

For intermediate indicators, the value is best when the value is in the middle value, and the effect will increase if the value increases or decreases. For the nonlinear indicator processing model:

$$\begin{cases} f(x)=Re^{2(x-Q_{min})/(Q_{max}-Q_{min})} \\ f(x)=Re^{2(Q_{max}-x)/(Q_{max}-Q_{min})} \\ f(x)=0 \end{cases} \quad (15)$$

The linear indicator processing model is:

$$\begin{cases} f(x)=2(x-Q_{min})/(Q_{max}-Q_{min}) \\ f(x)=2(Q_{max}-x)/(Q_{max}-Q_{min}) \\ f(x)=0 \end{cases} \quad (16)$$

Q_{max} represents the maximum value of the indicator, Q_{min} represents the minimum value of the indicator, Q_{mid} is the intermediate value of the indicator, and R is the normalization function.

4. Results

4.1 Analysis of the Internet of Things transmission path

The three algorithms for mobile wireless sensor network data collection mobile Sink path planning are shown in Table 1 and Table 2.

Table 2 Distance, signal to interference ratio and bit error rate

distance	1	2000	4000	6000	8000
SIR(DB)	21	12	9	7	3
Pbit	1	10	92	850	8700

Table 3 Communication reliability and transmission path reliability

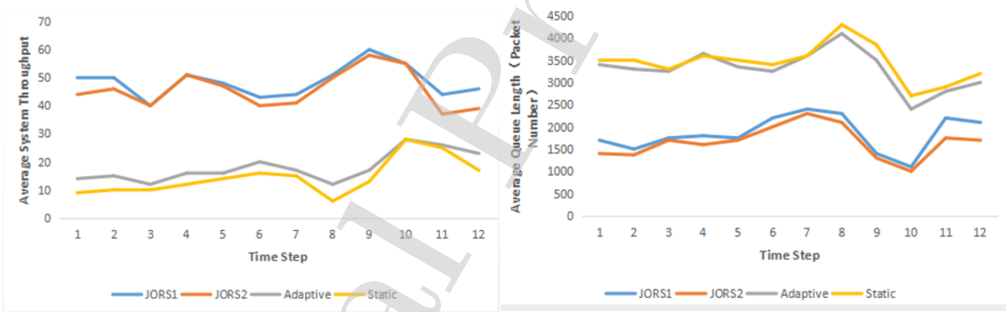
f	0.0042	8.96	6200	7870	94000

R1	921	920	865	805	124
R2	923	923	923	923	923
R	850	849	798	743	114

It can be seen from Table 1 and Table 2 that the random moving data collection path planning method is very random and disorderly, while the ant colony algorithm has a better data collection path planning method, and the path of the mobile Sink traversal is relatively short, but when some cluster head nodes collect data, it is not the shortest path, or a little round, and the bee colony algorithm is better in path planning, and can find the shortest moving path. The random walking path is very random. The ant colony algorithm finds the optimal path. When the iteration number is 40 times, the shorter path is found. The average is 2400m, and the bee colony algorithm finds the optimal path. The shortest path is found. The path planning length is about 1800m.

4.2 Reliability Analysis of IoT Communication Energy Consumption

The results of the algorithm is shown in Figure 1.



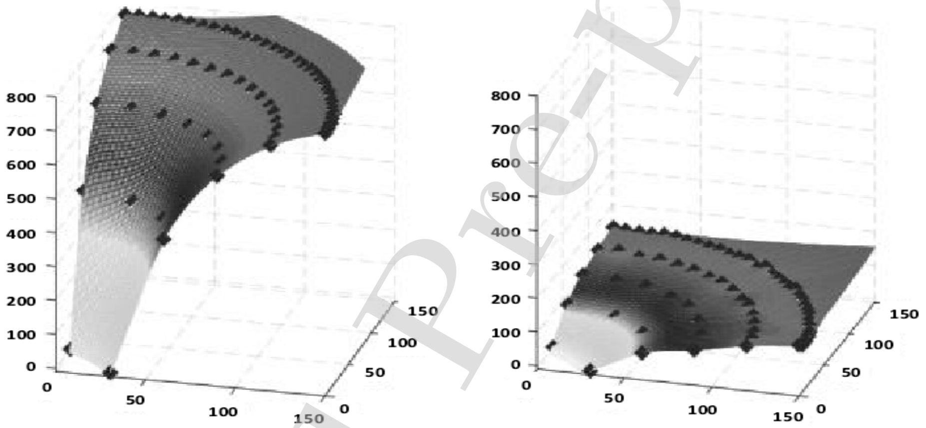
(a) (b)

Figure 1 Comparison of the algorithms in the system

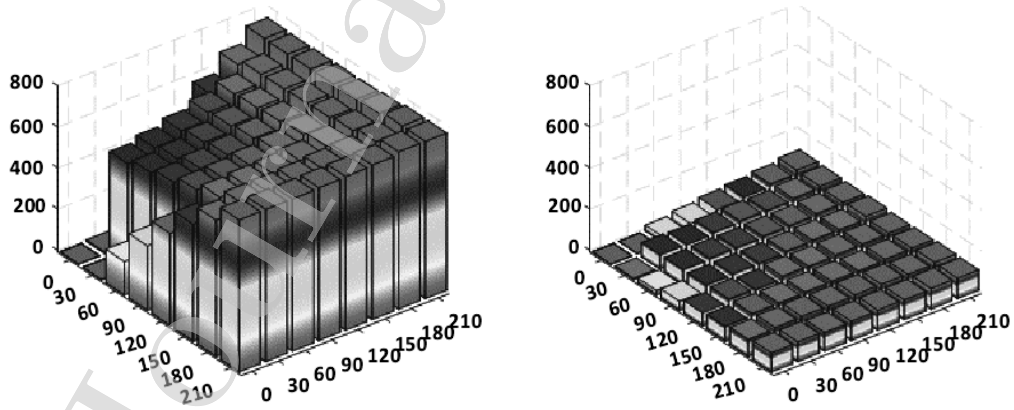
It can be seen from Figure 1 that as the number of simulation rounds increases, the network energy consumption of the algorithm increases gradually. Taking the 400 rounds as a reference, the extreme learning machine algorithm is 32.8%, 22.8% and 12.8% higher than other algorithms. The algorithm reduce excessive node energy consumption. It can be seen from the network energy consumption. Over time, energy consumption increases sharply. The algorithm reduces excessive data. Node energy consumption.This is enough to show that the larger the network size, the longer the delay and the length of the transmission path taken by the source node to the destination node, and the more the multipath routing recovery strategy can comprehensively consider the remaining energy, communication distance and network load of the transmission link neighbor nodes. Equilibrium, choose a more suitable communication node to form a path, and make the energy longest life.

4.3 Reliability Analysis of Internet of Things Network

By comparing the number of data packets received by the Sink node, it can be seen that the multi-path routing recovery mechanism considers the neighboring node residual energy, data transmission distance and network load balancing to select an appropriate transmission path, and reduces the occurrence of "overheating" in individual transmission paths. The node phenomenon allows Sink to receive more packets than other protocols. Figure 2 is a reliability analysis diagram of the Internet of Things network.



(a)



(b)

Figure 2 Network Reliability Analysis

As the number of sensing nodes increases, the multipath routing recovery algorithms increases the transmission path to the destination node, and simultaneously considers the transmission when constructing a new transmission path. The remaining energy of the link neighbor node, the communication distance and the network load balance, alleviate the blocking of the data packet queue, improve the success rate of data packet transmission, and reduce the transmission delay of the data packet. The AODV-SMS (ABC-PSO) route recovery protocol shows that packet transmission delays are less time-consuming than other route recovery strategies, and the gap between them is increasing. This is enough to show that the larger the network size, the longer the delay and the length of the transmission path taken, and the more the multipath routing recovery strategy can comprehensively consider the remaining energy, communication distance and network load of the transmission link neighbor nodes. Equilibrium, choose a more suitable communication node to form a path, and make longest life.

4.4 IoT data transmission delay analysis

The data transmission delay mainly includes the route discovery delay, the waiting delay at the connection, the transmission delay, and the data retransmission delay of the MAC layer. Figure 3 is an analysis diagram of the IoT data transmission delay.

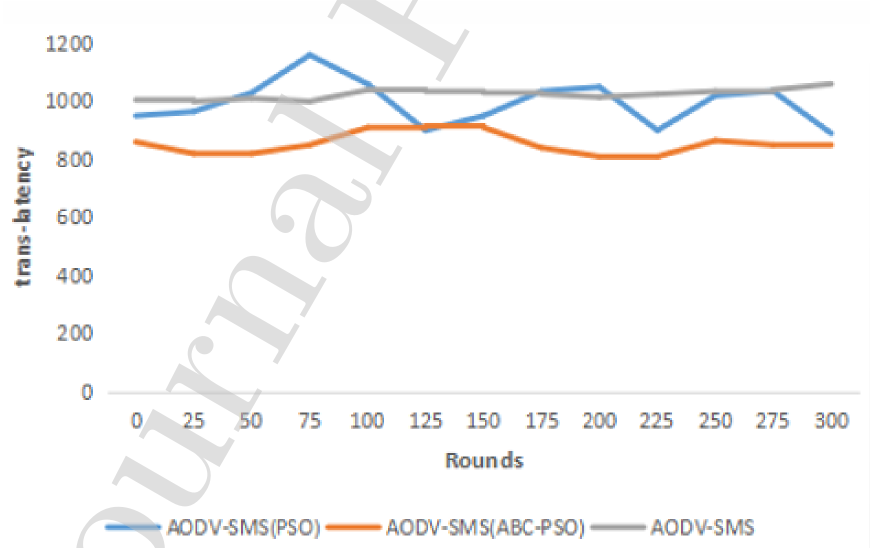


Figure 3 data transmission delay diagram

As can be seen from Figure 3, the AODV-SMS protocol end-to-end transmission delay is better than the original AODV-SMS (PSO) and AODV-SMS (ABC-PSO) multipath routing recovery in the case of a low number of nodes (100 nodes). The path mechanism is slightly larger. Mainly because the data transmission congestion is not serious when the number of nodes is low, the transmission delay of AODV-SMS (PSO) and AODV-SMS (ABC-PSO) multi-path transmission route recovery mechanism is not much different, the proposed algorithm end delay is less than the AODV-SMS method. It can also be seen that as the number of sensing nodes increases, the multipath routing recovery algorithms increases the transmission path to the destination node and constructs a new transmission. In the path, comprehensively consider the remaining energy of the transmission link neighbor nodes, communication distance and network load balancing, alleviate the blocking of the data packet queue, improve the success rate of data packet transmission, and reduce the transmission delay of the data packet. The AODV-SMS (ABC-PSO) route recovery protocol shows that packet transmission delays are less time-consuming than other route recovery strategies, and the gap between them is increasing. This is enough to show that the larger the network size, the longer the delay and the length of the transmission path taken by the source node to the destination node, and the more the multipath routing recovery strategy can comprehensively consider the remaining energy, communication distance and network load of the transmission link neighbor nodes. Equilibrium, choose a more suitable communication node to form a path, and make the energy longest life.

5. Discussion

It can be seen from Table 1 and Table 2 that the random moving data collection path planning method is very random and disorderly, while the ant colony algorithm has a better data collection path planning method, and the path of the mobile Sink traversal is relatively short, but when some cluster head nodes collect data, it is not the shortest path, or a little round, and the bee colony algorithm is better in path planning, and can find the shortest moving path. The random walking path is very random. The ant colony algorithm finds the optimal path. When the iteration number is 40 times, the shorter average is about 2400m, and the bee colony algorithm finds the optimal road. The shortest road is found. The path planning length is about 1800m.

The multipath routing recovery algorithms increases the transmission path to the destination node, and simultaneously considers the remaining energy of the transmission link neighbor nodes when constructing a new transmission path. Distance and network load balancing, easing packet blocking of packets, improving packet transmission success rate, and reducing packet transmission delay.

By solving the problem of multi-path data transmission in mobile wireless sensor network, artificial bee colony training optimization, particle swarm coordinated update evolution, optimal particle selection, etc., the problem is solved by using the information provided by the original path to quickly recover an efficient and reliable route. Transmission path, providing faster global convergence performance and more accurate solutions for network optimization

6. Conclusion

With the development of IoT-related technologies such as radio frequency identification, sensor networks, and embedded, the Internet of Things has developed vigorously, and the Internet of Things application system has moved from the laboratory to the people's lives. The reliability of the Internet of Things has become a problem that has to be taken seriously. This paper has carried out detailed analysis and research on the reliability of the Internet of Things, and has made the following progress:

(1) Using the artificial bee colony algorithm for the mobile Sink to obtain the shortest path to access each cluster head node, the other nodes transmit the data to the nearest cluster head node for temporary storage by means of multi-hop routing, and then transmit to the mobile Sink. This is enough to show that the larger the network size, the longer the delay and the length of the transmission path taken, and the more the multipath routing recovery strategy can comprehensively consider the remaining energy, communication distance and network load of the transmission link neighbor nodes. Equilibrium, choose a more suitable communication node to form a path, and make longest life.

(2) Established the indicator model of the reliability index system of the Internet of Things, and explained the method of comprehensive evaluation using indicators. Sink constructs the network structure after the cluster head group, and collects samples matching the sample database and the information of the nodes in the cluster for network training. The cluster head node uses the trained network model to fuse the test data and finally transfers the processed data to the Sink.

(3) The communication between nodes and nodes in information transmission is the basis of information transmission and the basis of network reliability. Firstly, the model of transmission path is established based on nodes and communication. The reliability of transmission path is studied by Markov method. . The collision model between time domain and frequency domain is established for the same-frequency interference problem between RFID and nodes in communication. Under the assumption that the node service satisfies the Poisson distribution, the communication error rate, delay and capacity under interference are studied. The reliability of communication between network nodes. The AODV-SMS (ABC-PSO) route recovery protocol shows that packet transmission delays are less time-consuming than other route recovery strategies, and the gap between them is increasing.

(4) Established a dynamic topology network model, focusing on the end-end reliability, node connectivity, and network capacity of the network. For the end-end reliability, this paper improves the method of node traversal to find the upper and lower limits of reliability. The improved method is closer to the calculation of actual network reliability. Aiming at the reliability of mobile network, this paper proposes the reliability index of node connectivity and the corresponding calculation method. Experiments prove that node connectivity is an important embodiment of mobile network reliability. For the network capacity, this paper focuses on the impact of the change of the communication link under the node movement on the network capacity. This is enough to show that the larger the network size, the longer the delay and the length of the transmission path taken by the source node to the destination node, and the more the multipath routing recovery strategy can comprehensively consider the remaining energy, communication distance and network load of the transmission link neighbor nodes.

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