Link Failure Detection in Wireless Sensor Networks

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Abstract— In multi-hop wireless sensor network faulty link detection plays an important role in network connectivity and management. Faulty link may impact the performance of network. To maintain a network quality, WSN should detect the fault in network and able to take appropriate action. Existing scheme link Scanner for wireless link collects hop counts of received probe messages at sensor nodes. If a link is faulty there is mismatch between received hop counts and network topology. A new approach is based on the path mismatch along with the hop count mismatch. This proposed approach makes the use of previous hop count mismatch to detect the change in path. The scenario also use the link quality metric ETX to detect the links failure in order to reroute the packet. Proposed approach will be able to detect the link failure in robust and efficient way.

Keywords—Fault link detection, ETX, Number of hops.

1. INTRODUCTION

Wireless sensor network is widely used in many applications such as data acquisition in hazardous environment, critical infrastructures monitoring, military operations etc. In all applications the reliability of the links is also an important aspect. The transmission must be reliable without packet loss. So it is important to detect the fault in wireless sensor network than in wired network.

As the wireless sensor network exist virtually we cannot directly check the fault in network or cannot assist the network. In this case link quality is greatly impacted and it is difficult to find the fault in the network under dynamic condition. Due to link failure multihop networks suffers more harm than single hop network. Failure of sensor node may cause connectivity loss and in some cases network partitioning. In multihop wireless network faulty link detection becomes more difficult due to topology features. A packet has to traverse multiple links to the sink causing localization of faulty link hard. Hence faulty link detection becomes one of the most critical issues in multi-hop network diagnosis.

Using the link status we are able to find different failures like packet loss, routing failure, partition etc. Using multihope network has more number of sensor nodes, which increase the probability of more link failure in WSN. More fault leads to degradation of quality of service. Good quality of service can be achieved by detecting such faulty link and rerouting the data packets to avoid data loss. In existing system [1] the method link scanner is used to detect faulty link in WSN. It uses broadcast massage and every node expected to receive the multiple probe messages through different paths. In each probe message hope count is present from sink to given node. If mismatch between received hope count and expected hope count calculated as per network topology occurs then there is a fault in network. The main issue with this method is broadcasting message can cause network congestion.

To get rid of this issue a new approach is proposed which uses ETX matrix [2] to find the link quality. The ETX is able to calculate the link quality between two nodes based on the number of packet sent by one node and received by the other node. As packet is sent from one node to next node whose ETX value is less that is via more reliable path.

2.LITERATURE SURVEY

Various approaches have been used to design feasible WSNs. Fault link detection is crucial to prolong the network lifetime of WSNs. Many approaches have been proposed to reduce energy consumption and increase network reliability. There is no routing algorithm which will define the network design. An alternative approach to conserve energy is to use clustering technique [4][5] and detection of the link failure along with corrective action.

2.1 A SELF-MANAGING FAULT MANAGEMENT MECHANISM FOR WSN

In this approach a new fault management mechanism was proposed to deal with fault detection and recovery. It proposes a hierarchical structure to properly distribute fault management tasks among sensor nodes by heavily introducing more self-managing functions. The proposed failure detection and recovery algorithms have been compared with some existing related algorithm and proven to be more energy efficient.

The proposed fault management mechanism can be divided into two phases:

- Fault detection and diagnosis
- Fault recovery

2.1.1 Fault Detection and Diagnosis

Detection of faulty sensor nodes can be achieved by two mechanisms i.e. self-detection (or passive-detection) and active-detection. In self-detection, sensor nodes are required to periodically monitor their residual energy, and identify the potential failure. In this scheme, we consider the battery depletion as a main cause of node sudden death. A node is termed as failing when its energy drops below the threshold value. When a common node is failing due to energy depletion, it sends a message to its cell manager that it is going to sleep mode due to energy below the threshold value [6]. This requires no recovery steps. Self-detection is considered as a local computational process of sensor nodes, and requires less in-network communication to conserve the node energy. In addition, it also reduces the response delay of the management system towards the potential failure of sensor nodes[7]. To efficiently detect the node sudden death, our fault management system employee an active detection mode. In this approach, the message of updating the node residual battery is applied to track the existence of sensor nodes. In active detection, cell manager asks its cell members on regular basis to send their updates. Such as the cell manager sends ”get” messages to the associated common nodes on regular basis and in return nodes send their updates. This is called in-cell update cycle. The updatemsg consists of node ID, energy and location information.

2.1.2 Fault Recovery

After nodes failure detection (as a result of self-detection or active detection), sleeping nodes can be awaked to cover the required cell density or mobile nodes can be moved to fill the coverage hole. A cell manager also appoints a secondary cell manager within its cell to acts as a backup cell manager. Cell manager and secondary cell manager are known to their cell members. If the cell manager energy drops below the threshold value (i.e. less than or equal to 20% of battery life), it then sends a message to its cell members including secondary cell manager. It also informs its group manager of its residual energy status and about the candidate secondary cell manager. This is an indication for secondary cell manager to stand up as a new cell manager and the existing cell manager becomes common node and goes to a low computational mode. Common nodes will automatically start treating the secondary cell manager as their new cell manager and the new cell manager upon receiving updates from its cell members; choose a new secondary cell manager [8]. The failure recovery mechanisms are performed locally by each cell.

2.2 DISTRIBUTED APPROACH

Distributed approach encourages the concept of local decision-making, which evenly distributes fault management into the network. The goal of it is to allow a node to make certain levels of decision before communicating with the central node. It believes the more decision a sensor can make, the less information needs to be delivered to the central node. In the other word, the control center should not be informed unless there is really a fault occurred in the network.

Node Self-Detection: A self-detection model to monitor the malfunction of the physical components of a sensor node via both hardware and software interface has been proposed by number of researchers. Self-detection of node failure is somehow straightforward as the node just observes the binary outputs of its sensors by comparing with the pre-defined fault models.

Neighbor Coordination: Failure detection via neighbor coordination is another example of fault management distribution. Nodes coordinate with their neighbors to detect and identify the network faults before consulting with the central node. In addition, a node can also query diagnostic information from its neighbors (in one-hop communication range). This allows the decentralized diagnostic framework to scale easily to much larger and denser sensor networks if required.

3. PROPOSED SYSTEM

A new system for the faulty link detection is proposed which is able to detect faulty link in WSN and able to reroute the packet path in order to avoid packet loss. Most of the existing work talks about the nodes failure causing the link failure with the surrounding nodes. Also different techniques have been discussed for the link failure detection, based on the number of hop traveled from source to destination. Existing system is also based on the number of hops traveled by the packet from source to destination. The technique based on the expected transmission count (ETX) which calculates the number of packet transmitted including retransmission to deliver a single packet to the next node over the path is used here.

The ETX is able to calculate the link quality between two nodes based on the number of packet sent by one node and received by the other node.

The two fields are added to the packet to keep the hop count track and to store the id of the node over the path. The total numbers of hops traveled are obtained easily from the number of hop filed in the packet. We add the id of the node over the path to the packet header so that it is easily track the faulty links over the path. This storage of the path in the packet adds some burden to the packet and increases the packet size also.

3.A.Architecture

Fig. 1. Shows the architectural diagram of path travelled by packet. The fault link during path traversal is detected. Depending on the neighbor the path has been changed to cope with the faulty link and to avoid packet loss.

- Description of components

  When network is firstly started wireless sensor network calculates ETX values for each neighboring node. When protocol receives a packet from neighboring node firstly it checks that the current node is the specified destination or not. If the node is multicast destination then it processes the packet. If that node is a forwarding candidate then it checks for the next multicast destination in that region and broadcast packet using candidate list. Every time before sending a packet creates list of multicast destination belonging to the different regions. Then packets are sent, if packets are sent then fault detector gets all the values of all links. Then, increase the hop count in packet. Add node ID to packet. Fault detector selects a node with low ETX for the connecting link. Send packet to the next node. At the destination check for current hop and previous hop count values. If current hop count is not equal to previous hop count, then check for faulty link over path.

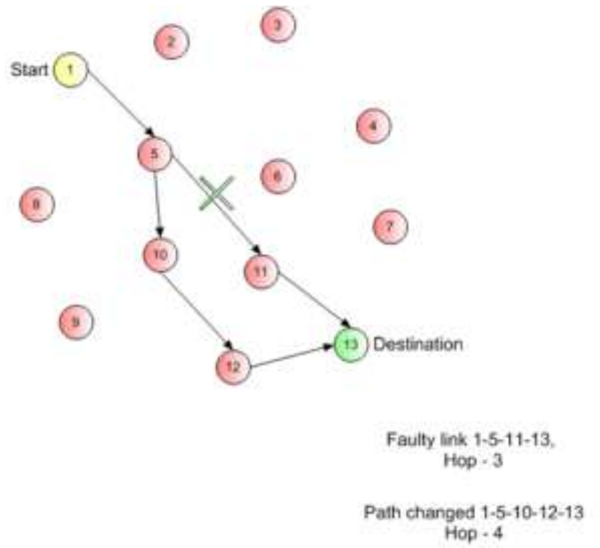

Fig. 1. Architecture Diagram

3.B.Objectives of Proposed System

- The first objective of the proposed system is to find the faulty link in WSN. The technique based on the expected transmission count (ETX) which calculates the number of packet transmitted including retransmission to deliver a single packet to the next node over the path is used. The ETX is able to calculate the link quality between two nodes based on the number of packet sent by one node and received by the other node.
- The other objective of proposed system is to find the alternate path to route the packet in order to reduce packet loss due to faulty link.

3.C.Proposed Routing Algorithm

Input: ETX[], Packet P[];
Output: Packet, faulty link fl[].

1. If packet is to be sent then

2. Get all ETX values of the all links

3. Increase the hop count in packet.

4. Add node id to packet.

5. Select a node with low ETX for the connecting link.

6. Send packet to the next node.
7. At destination check for current hop count and previous hop count values.

8. If current hop count is not equal to previous hop count

9. Then check for faulty link using the path stored in packet.

10. Detect faulty link over path and Store fl[].

11. Else

12. Repeat above steps at each node.

4.CONCLUSION

In this paper we have reviewed different approaches to detect the fault in wireless sensor network. The proposed technique is based on the expected transmission count (ETX) which calculates the number of packet transmitted including retransmission to deliver a single packet to the next node over the path. The ETX is able to calculate the link quality between two nodes based on the number of packet sent by one node and received by the other node. Based on this path our method can easily trace and detect the faulty links. Also as it uses link quality method for the selection of next hop, this increase the reliability of the path and helps to increase packet delivery ratio and reduce the routing overheads.

REFERENCES

[1] Qiang Ma1, Kebin Liu, Xiangrong Xiao, Zhichao Cao, and Yunhao Liu1, "Link Scanner: Faulty Link Detection for Wireless Sensor Networks" , IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, VOL. 14, NO. 8, AUGUST 2015.

[2] D. S. J. De Couto, D. Aguayo, 1. Bicket, and R. Morris, A high throughput path metric for multi-hop wireless routing, in Proceedings of ACM MOBICOM, 2003, pp. 134-146.

[3] Q. Cao, T. Abdelzaher, J. Stankovic, K. Whitehouse, and L. Luo, "Declarative tracepoints: A programmable and application independent debugging system for wireless sensor networks," in Proc. ACM SenSys, Raleigh,NC, USA, 2008, pp. 85–98.

[4] W. Dong, Y. Liu, Y. He, T. Zhu, and C. Chen, "Measurement and analysis on the packet delivery performance in a large-scale sensor network," IEEE/ACM Trans. Netw., vol. 22, no. 6, pp. 1952–1963, Dec. 2014.

[5] N. J. A. Harvey, M. Patrascu, Y. Wen, S. Yekhanin, and V. W. S. Chan, "Non-adaptive fault diagnosis for all-optical networks via combinatorial group testing on graphs," in Proc. IEEE INFOCOM, Anchorage, AK, USA, 2007, pp. 697–705.

[6] S. Marti, T. J. Giuli, K.Lai, and M. Baker, "Mitigating routing misbehaviour in mobile ad hoc networks," in ACM Mobicom, 2000, pp. 255-265.

[7] F. Koushanfar, M. Potkonjak, and A. SangiovanniVincentelli, "Fault tolerance techniques in wireless ad-hoc sensor networks," UC Berkeley technical reports 2002.

[8] Luo Junhai ,Xue Liu, Ye Danxia "Research on multicast routing protocols for mobile ad-hoc networks". Elsevier L. Junhai et al. Computer Networks 52 (2008) 988997.