Fault Link Detection In WSN Using Link Scanner Approach

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Abstract - *In multi-hop wireless sensor network faulty link detection plays an important role in network connectivity and management. Link scan methods can be used for the detection of network partition and other routing errors. Existing system proposed a passive scheme link Scanner (LS) for wireless link. Synchronization, reprogramming, protocol update is necessary to run the sensor network normally. LS passively collect hop counts of received probe messages at sensor nodes. Based on the observation that faulty links can result in mismatch between received hop counts and network topology, LS deduces all links status with a probabilistic model. A new approach 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 uses the link quality metric ETX to detect the links failure. Proposed approach will be able to detect the link failure in robust and efficient way.*

Key Words: *Wireless sensor networks, link detection, network diagnosis, ETX, number of hop, packets.*

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 [1]. So it is important to detect the fault in wireless sensor network than in wired network. Wireless sensor networks are resource-constrained self-organizing systems that are often deployed in inaccessible and inhospitable environments in order to collect data about some outside world phenomenon. For most sensor network applications, point-to-point reliability is not the main objective; instead, reliable event-of-interest delivery to the server needs to be guaranteed (possibly with a certain probability). The unfriendly environment affects the monitoring infrastructure of wireless sensor networks (WSNs). Sensor nodes are expected to operate autonomously in unattended and possibly hostile environments. The lifetime of sensor node may vary from few hours to months or years depends upon the context in which it runs. Thus WSNs are vulnerable to faults where faults are likely to occur frequently and unexpectedly. As faults are unavoidable in the sensor network, it is very necessary to distinguish between faulty and working nodes. For all of these reasons, fault management is a major design challenge in WSN. A new approach is proposed 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. We also use the link quality metric ETX to detect the links failure. Proposed approach will be able to detect the link failure in robust and efficient way.

2. RELATED WORK

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 [2][3] 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 [4]. 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 [5]
- Fault recovery [6]

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 [7].

3. PROPOSED APPROACH

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 [8]. 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.

3.1 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.

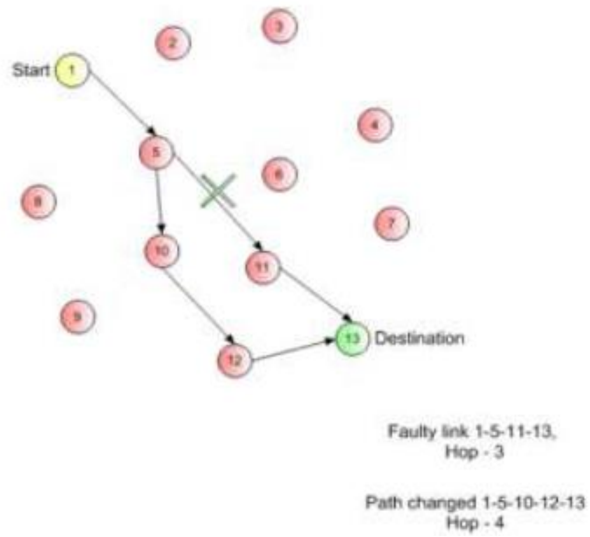

Fig- 1: Architecture Diagram

3.2 Objective

- 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 pack

3.3. Following are components that are included

1. Network creation
2. Packet delivery
3. ETX value
4. Hop count
5. Node ID
6. Defect faulty link

3.4. 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. MATHEMATICAL MODEL

Let S be the fault link detection system, I represents the set of Inputs to system and O gives the set of output generated by the system.
S = { n,S,D , Pf,Pr, P, Nhop, Path, ETX[], N[],ETX[],FL[]}
I = { n,S,D , Pf,Pr, P, Nhop, Path, ETX[] }
O = { N[],ETX[],FL[]}

Create Network:

Let G(V,E) be the graph represents wireless sensor network with V number of vertices and E number of edges. CreateNet() be the function which creates network with specified number of nodes.

N[] = CreateNet(n,S,D);
Where,
N[] = set of nodes in WSN
S= Source node.
D= Destination node.
n = Number of nodes in WSN

ETX calculation:

Let Pf and Pr denote the loss probability of the link in the forward and reverse directions, respectively. Each node measures loss rate of its link to and from its neighbors by broadcasting one probe packet each second and counting number of packets (probes) received in last 10 second. ETX metric value is calculated using following mathematical equation,

ETX[] = ETXCal(Pf,Pr);
Where,
Pf = Loss probability of link in forward direction.
Pr = Loss probability of link in reverse direction.
ETX = etx value of the link.

Fault Detection:

Let FauktDetect() be the function which detect the faulty link over the path.

FL[] = FauktDetect(P, Nhop, Path, ETX[]);
FL = Set of faulty links.
P = Packet.
Nhop = Number of hops traveled.
Path = Complete path traveled by a packet.
ETX [] = etx values of intermediate links.

5. RESULT ANALYSIS

To show the effectiveness of proposed system some experiments are conducted on java based windows machine using Eclipse IDE. RAN caching approach has drawbacks like high cache miss ratio because of small caches & high cache miss ratio because of user mobility. So, introducing hierarchical caching at the gateways of the core network to support mobility of users across cells and increase network capacity. Internet content networks (CDNs) can store millions of videos in a relatively few large-sized caches. So avoid this drawback of CDNs system0020proposes RAN-aware reactive and proactive caching policies that use User Preference Profiles (UPPs) of active users in a cell. Furthermore, system proposes saving of video ids in the cache instead of actual video. So, cache size is reduced tremendously. Our experimental results show that using hierarchical caching can increase cache hit ratio and network capacity compared to caching only in the RAN. We have created graph for this proposed system which shows delay time is less.

6. CONCLUSION

In this method a new technique to defect faulty link in wireless network is used. The technique based on the hop count. If there is change in the hop count received at the destination, then this method checks for the path travelled by the packet. 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.

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