Review of Fault Detection Algorithm in WSN and MANET

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Abstract— **Wireless sensor networks would form an central part of the next development in automation and many other areas too. A wireless communication system to operate efficiently in the industrial/factory floor environment has to guarantee low and probable delay of data transfer (typically, less than 10 ms for real time applications), high reliability, provision for large number of sensor/actuators (typically over 100 in a cell of a few meters radius, in a low size manufacturing environment), and low power consumption. Faults occurring in sensor nodes are familiar due to the sensor device itself and the unkind environment where the sensor nodes are deploy WSNs are mainly affected by the crash of sensor nodes. MANET nodes may experience two types of faults that would direct to the degradation of performance. One type is function fault, which normally results in the stop working of individual nodes, packet failure, routing failure or network separation**
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***Keywords*—** WSN, MANET, Fault Model, Fault Diagnosis

I. INTRODUCTION

1.1. MOBILE AD HOC NETWORK

Ad hoc is a Latin Phrase importance "for this". It mainly denote a solution designed for a precise problem or task, not proposed to be able to be modified to other purposes , non-generalizable[8]. Common examples are administrations, committees, and commissions formed at the national or international level for a specific task. The term ad hoc networking usually refers to a system of network elements that combine to practice a network requiring little or no planning. The growing use wireless movable devices such as phones and laptops is important to the possibility for natural or ad hoc wireless communication known as (MANET).

A mobile Ad hoc network (MANET) is a self-configuring network that does not require any pre-existent (static) Infrastructure, which decrease their deployment time and cost also. As each node in this network is able to move which makes the network to change its topology constantly. The infrastructure-less mobile nodes in ad hoc networks lethargically form routes among themselves to make own wireless network on that instant as shown in Fig 1.1 Mobile Ad-Hoc Network (MANET) is one of the best active research topics through the last ten years. With the improvements in wireless technologies and growth of mobile devices, ad hoc networks will play a vital position in enabling present and future communication. For together video and data communication, a mobile radio technology has practiced a rapid growth. A MANET is a dynamic wireless network designed by a set of mobile hosts which communicate along with themselves by means of the air without any pre-existing structure.

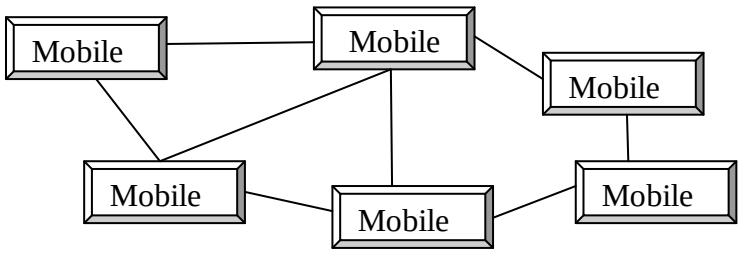

Figure1.1: Mobile Ad-Hoc Networks

1. Hierarchical network architecture: This partition the whole network into Sub-networks. Each of the sub-network themselves then with dynamism elects a node between themselves which acts as gateway to the other sub-network. This builds a hierarchy amongst the nodes and the hierarchy can be one-tire or multiple tier one. The advantages of:

- Easy mobility management events.
- Better manageability.

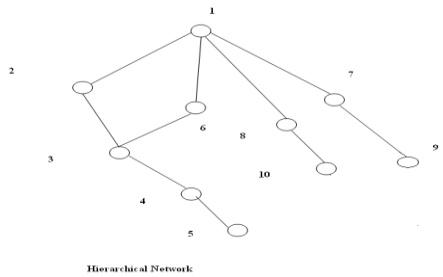

Figure 1.2: Hierarchical Network

2. **Flat-routed architecture:** In this approach all the nodes are identical in terms of liability, and there is no concept of special gateways. The advantages are:

- Increased reliability due to no single point of failure and alternative route in the network.
- most favourable Routing
- Reduced use of wireless resources.
- All nodes have one type of equipment.

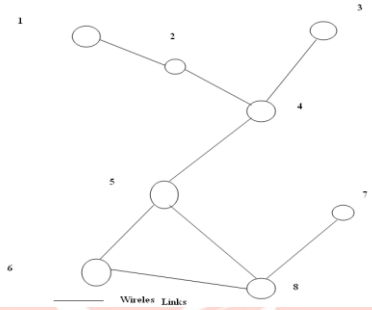

Figure 1.3: Flat architecture

1.1.1 WSN

A wired network depends on physical cables to move data. As it is assumed that in a wireless network, the communication amongst different network modules can be either wired or wireless. As wireless communication does not have the control of physical cables, it allows a plain freedom for the hosts and/or routers in the wireless network to move. This is the compensation of a wireless network [2]. Wireless LANs contemporaneous the following productivity, accessibility, and cost compensation over the wired networks: [3]

Mobility: Wireless LAN systems can make available LAN users with access to real-time info anywhere in their organization. Mobility maintenances productivity as well as service opportunities which are not promising with wired networks.

There are many hotels, universities and public places with public wireless connection. These free us from having to be at home or at work to get contact the Internet.

Reduced Cost-of-Ownership: Although the initial investment necessary for wireless LAN hardware can be greater than the cost of wired LAN hardware, but overall installation costs and life-cycle expenditures can be extensively lower. Long-term cost profits are greatest in vigorous environments requiring common moves and changes.

- Installation Speed and Simplicity: It is very informal and quick procedure to install a wireless LAN system and thus permits to get rid of the requisite to pull cable through walls and ceilings.
- Scalability: Wireless LAN systems can be constructed in various different types of topologies to fulfil the requirements of particular applications and installations. Configurations can be smoothly changed and range from peer-to-peer networks suitable for few numbers of users to full organisation networks of thousands of users that enable travelling over a broad area.

ii.FAULTS

Wireless Communication System is play a big significant role in information systems and its management is very main and dynamic. Dissimilar kinds of managements can be there like organization management, fault management, presentation management and security management etc. Fault management is most important.

A node turns into faulty because of battery discharge, crash and restraint in age. The occurrence of faulty node affects the efficiency and throughput of the network, and thus creating the network changeable. Faulty nodes cannot

communicate with the other mobiles or behave unpredictably and send astonishing results. Thus it unreasonably consumes energy and cause inconsistency.

1.2.1 TYPES OF FAULTS

Every node in the system can be in one of two states faulty or fault-free. In order to interchange information, a node involves multiple hops in the WSNs[4] because of the limited transmission power in the network. Due to restrictions like unreliability of wireless medium, unpredictability of environment, resource controlled nodes and dynamic topology, WSN are prone to many types of faults.

Based on the Duration- Based on time faults can be of three types:

- **Transient fault**: A transient fault can vanish without any visible event; it looks in a network for short time. The free of transient faults from system is addressed using repeated-round techniques. A probabilistic model used for the stroke of faulty periods, and a fault analysis is used to obtain the optimum repeat period.
- **Intermittent fault**: It is challenging type of transient fault; can't forecast its appearance and disappearance in the network. An intermittent fault is happened by a number of issues. These factors can only be recognized when malfunction is occurred. Intermittent faults are hard to identify and repair.
- **Permanent fault**: Once it looks in network it remains until it detached and repaired by some external administrator. Everlasting faults are modest to deal.

Based on the Behavior-Based on performance faults can be of two types:

- **Soft Fault**: Soft faulted units can communicate with its neighbouring parts but with unpredicted behaviours and always give inappropriate response.
- **Hard fault**: Hard faulted parts cannot communicate with its neighbours. It neither sends nor receives any information from the network.

Based on the Occurrence -Based on existence faults can be of two types:

- **Static fault**: All faulty nodes are faulty from the starting of analysis session. The fault-free node can't be faulty during analysis session.
- During analysis session. It is hard to diagnosis because any node may fail after it diagnosed fault-free by several fault-free node.
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1.2.2 FAULT DIAGNOSIS

Fault diagnosis put extra burden on the sensor node besides with their standard task and it will also consume more energy of the sensor nodes. Various techniques have been optional to solve this problem, but they still cannot satisfy the specific need of MANET Fault identification is one of the significant parts in many protocols. When any changed behavior is shown by system or nodes of the network, a diagnosis function is on the go to find out which node(s) has (have) shown irregular behavior. This is called as Diagnosis; diagnosis is categorized based on the existence of fault. It is basically classified as static diagnosis and dynamic diagnosis.

Static diagnosis, the faults are not happening during the diagnosis session.
Dynamic diagnosis, the faults can arise during the diagnosis session, which is challenging to handle because node can be faulty after it has been diagnosed as fault-free by extra node.

The Heartbeat Approach: The best universal method for monitor crash faults is the heartbeat device. The traditional heartbeat method [3] is based on the constant monitoring of a node to know whether it is living or not. Thus, each mobile transfers periodically an "*I Am Alive*" message to mobiles that monitor its state. After the running out of a timeout, if a mobile *x* does not accept such a message from one of the neighbours, say *y*, it is in charge of identifying its failure, then it starts questioning it as being faulty. Mobile *x* adds *y* to a list of supposed nodes, and will eliminate it from this list once it receives later *y's* with "*I Am Alive*" message. The two chief parameters by which the heartbeat mechanism can be considered are as follows:

• *The heartbeat period* Δ that signifies the time between two successive "*I Am Alive*" messages.
• *The timeout delay* Δ *to* which denotes to the time between the last reception of an "*I Am Alive*" message from *v*, and the time where *u* starts distrusting *v*, until *u* starts receiving again *v's* "*I am Alive*" messages.

The classical heartbeat approach has two chief weaknesses. The first one is that the finding time depends on the last heartbeat. This weakness may have a negative influence on the accuracy of the failure detector since untimely timeouts may occur. The second weakness is that it depend on a fixed timeout delay that does not take into account the network and system's load. That is, a node may be incorrectly supposed as faulty if it slows down because of heavy workload or if the network agonizes from links failure that may delay the delivery of "*I Am Alive*" messages.

iii.RELATED WORK

2015 Jie Wu, et al WSN named clustered agreement time organization (CCTS). This algorithm is developed on the base of the distributed agreement time organization (DCTS) algorithm. However, to obtain faster meeting in the clock management of node and better energy efficiency, the clustering technique is included into the algorithm. The CCTS contain two parts: 1) intra cluster time organization and 2) inter cluster time organization. In the intracluster time

organization, the better DCTS is applied. The cluster head is in charge for exchanging messages within the cluster. The standard value of distort costs parameters of intra cluster fundamental clock and the average value of intra cluster fundamental clocks are used to update the distort compensation parameter and offset compensation parameter, respectively. In the inter cluster time synchronization, cluster heads replace messages via gateway nodes. To modernize the clock compensation parameters of the network fundamental clocks, clock costs parameters of intra cluster fundamental clocks of every cluster head are assigned with equivalent weights based on the size of each cluster. The reproduction results show that the future algorithm reduces the communiqué traffic compare with the DCTS algorithm, and improve the convergence rate suitable to the combination of clustering topologies

2014 Ravindra Navanath Duche et al The proposed method of fault detection is based on RTD time size of RTPs. RTD times of discrete RTPs are compare with threshold instance to determine failed or out of order sensor node.. In order to confirm the scalability of this idea, WSNs with huge numbers of sensor nodes are implement and virtual in open source software NS2. Generalized model to set up the fault detection scrutiny time for WSNs by using discrete RTPs is suggested. Different experiments are performed in hardware and software based on RTD time capacity. Analysis time in every cases of fault detection is determined with the help of comprehensive model. Result scrutiny in hardware and software indicate that RTD time measurement results in together cases are quite the same, validating the real time applicability of this method.

2013 Hong-Chi Shih et al find a fault node recovery (FNR) algorithm to enhance the lifetime of a wireless sensor network (WSN) when some of the sensor nodes shut up, either for the reason that they no longer have battery energy or they have reached their prepared threshold. Using the FNR algorithm can result in smaller number replacements of sensor nodes and additional reused routing paths. Thus, the algorithm not only enhance the WSN lifetime but also reduces the price of replace the sensor nodes.. The algorithm proposed is based on the GD algorithm, with the objective of replace fewer sensor nodes that are inoperative or have depleted batteries, and of reuse the greatest number of routing paths. These optimizations will ultimately augment the WSN lifetime and decrease sensor node replacement cost.

iv.CLUSTERING

The fault diagnosis algorithm fixed with appropriate clustering concepts make a very capable fault diagnosis service for wireless sensor networks. In WSN , clustering [9] can be distinct as a notional arrangement of the vigorous nodes into a variety of groups. These virtual collections of nodes are grouped composed regarding their relative transmission range immediacy to each other that allows them to create a bidirectional link. The thickness size of the clusters decides the control architectures as single-hop clustering and multi-hop clustering. In single-hop clustering each member node is never more than 1-hop from a significant coordinator - the cluster head. Therefore all the member nodes keep on at most two hops n distance away from each other within a logical cluster. In multi-hop clustering, the limitation or restriction of an instantaneous proximity to associate nodes from the head is removed, allowing them to be existing in serial k-hop distance to form a cluster.

Cluster member: As the name suggests, cluster member do not perform any other function further than a normal node role. They are members of an select cluster independent of neighbours residing in a different cluster.
Cluster Gateway Nodes: Is a node that works as the ordinary or distributed entrée point for two cluster heads .When a node remains within the transmission range of two cluster heads.
Cluster head nodes: for any efficient cluster (subsets of nodes in a network satisfying a particular property) operation there must be a support or backbone to sustain all necessary control functions such as bandwidth allocation, power control and virtual-circuit support channel access, routing, calculation of the routes for longer-distance messages, and forwarding inter-cluster packets,. This support or backbone takes the form of connected cluster heads, in managerial role; linked each directly or via gateway nodes and they will have the subordinate nodes of that cluster linked to them. Another purpose of cluster heads is internal node communication, to onward inter-cluster messages. To send a packet an normal node must first direct it to its 'superior' its straight connected cluster head.

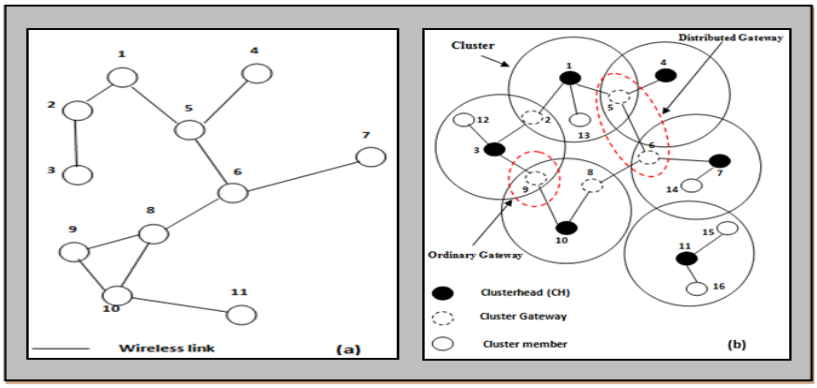

Figure 4.1: Nodes in flat and cluster structure. (1) Flat structure. (2) Cluster structure
4.1 Advantages of Clustering Structur

The cluster architecture in MANET with a big number of mobile terminals ensures efficient performance. The cluster structure provides a certain amount of benefits, some of which are mentioned below:

1. Aggregation of Topology Information

Due to of the fact that the number of nodes of a cluster is lower than the number of nodes of the whole network, this way the clustering procedure assist in aggregating topology information. Thus, with this system in place now each node is only required to store a small portion of the entire network routing information.

2. Efficiency and Stability

The significant quality of a cluster structure is that it causes a MANET to seem smaller and more stable in the aspect of each mobile terminal. So, now in this system, when a mobile node switches its attaching cluster, only mobile nodes residing in the equivalent clusters are required to modify their data structures.

3. Communication Coordination

The process of clustering restrictions the reach of inter-cluster interactions to cluster heads and also averts unnecessary exchange of messages amongst the mobile nodes and thus can also conserve communication bandwidth.

4. Routing Efficiency

In flat architecture of MANET every node bears equal responsibility to act as a router for routing the packets to every other node so a great amount of message flooding takes place in order to obtain better routing efficiency. In return, such communication flooding reduces the MAC layer efficiency to a certain extent. Cluster structure can be one possible solution to improve such MAC layer competence and makes the routing process easier.

5. Spatial Reuse of Resources

A cluster increases the system capacity; by the way that the information is stored once on the cluster head, which facilitates the spatial reuse of resources. Two clusters can distribute a similar frequency or code set if they are not adjoining clusters, this can be facilitated with the non-overlapping multi-cluster structure. Likewise, there can be a better coordination by a cluster head of its transmission with the assistance of a specialized mobile node residing in it. This change in the existing system can save much of the resources, which are used for retransmission resulting from decreased transmission collision. [4]

VII.CONCLUSION

In this paper we provided a detailed study of faults that occurred in WSN and MANET. This concise study provides a valuable knowledge input for future application to prevent the same kind of issues from occurrence. In real wireless sensor networks and MANET, the sensor nodes use battery influence supplies and thus have incomplete energy resources. In adding to the routing, it is important to research the optimization of sensor node substitution, reducing the substitution cost, and reusing the most routing paths when some mobile nodes are non-functional.

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