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Survey of Mobile Ad Hoc Network Using Clustering and Fault Detection

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***Abstract**—Mobile ad-hoc networks (MANETs) are a form of wireless networks which do not require a base station for providing network connectivity. Many MANETs' characteristics that distinguish MANETs from other wireless networks also make routing a challenging task. Cluster based routing is a MANET routing schemes in which various clusters of mobile nodes are formed with each cluster having its own cluster head which is responsible for routing among clusters . Routing is a very challenging task in mobile ad hoc network due to their peculiar characteristics like dynamic mobility ,frequent disconnections ,low bandwidth, low battery power. one of the major problems of routing schemes in MANETs is the reduction of routing and other control information overheads required for an autonomous organization in the face of node mobility. Cluster based routing scheme provides a solution to this problem by organizing the nodes into clusters to reduce communication overhead*

***Keywords**— Manet ,Faluts Detection,Adaptive System Level Diagnosis*

I. INTRODUCTION

Mobile ad hoc networks(MANET) represent complex distributed systems that comprise wireless mobile nodes that can freely and dynamically self organize into arbitrary and temporary ad hoc network topologies, allowing people and devices to seamlessly internet work in areas with no preexisting communication infrastructure e.g., disaster recovery environments. An ad-hoc network is not a new one, having been around in various forms for over 20 years. Traditionally, tactical networks have been the only communication networking application that followed the ad-hoc paradigm. Recently the introduction of new technologies such as Bluetooth, IEEE 802.11 and hyperlan are helping enable eventual commercial MANET deployments outside the military domain. These recent revolutions have been generating a renewed and growing interest in the research and development of MANET. To facilitate communication within the network a routing protocol is used to discover routes between nodes.

II. AULTS DETECTION IN MANET

Each mobile in the system can be in one of two states: faulty or fault-free. Faults are *permanent*, i.e. a faulty mobile remains faulty until it is repaired and/or replaced. Faults can be either *hard* or *soft*. When a unit is hard faulted, it is unable to communicate with the rest of the system. In a wireless network, a unit can be hard-faulted either because it is crashed or due to battery depletion. Soft faults are subtle, since a soft-faulted mobile continues to operate and to communicate with the others mobiles in the system, although with altered specifications. However, in order for a diagnosis to be possible, the behavior of soft faulted unit is somewhat constrained. a comparison-based diagnostic model for ad-hoc networks. Comparisons between units exploit the shared nature of the communication. Essentially, a fault-free unit *u* (the *testing unit*) tests its neighbors sending them a test request and waiting for their responses.

III. RELATED WORK

Syeed E. Ali et al fault detection and localization is a well-studied problem in communication networks, as attested by the many techniques designed to address this problem. Fault detection, localization, and diagnosis are crucial to network management as they enable networks to operate reliably, while maintaining performance and availability. To be successful, fault diagnosis methods for MANETs must have the following properties: (1) fault diagnosis must be robust to inherent variability in the MANET network, so the corresponding modules should be intrinsically resilient to temporal and spatial network changes, and work with little adjustment after their installation; (2) since expert knowledge and understanding of the operations and maintenance of ad hoc networks is limited, scarce, and mostly case-based, the reliance of fault detection on this type of knowledge should be limited to avoid undesired influence of overly specific scenarios; (3) since interactions and dependencies between measurements and states of ad hoc network elements are exceedingly complex and difficult to characterize precisely, statistical methods should be used to capture such interactions and dependencies. three types of faults occurring at different communication layers with different signatures. *Hard Failure*: Also referred to as interface failure, which results from failure of the radio device. While this condition is relatively easy to identify at the corresponding node, it is considerably harder to identify at other nodes due to re-routing in ad hoc networks. *Out-of-Range Partition*: This is partition of the network due to node movement. While Out-of-Range partition may resemble a General Failure, the onset of the latter tends to be abrupt, while the onset of the former tends to be more gradual, with higher bit-error-rates, packet drops, and progressively lower signal/noise ratio. *Congestion*: This is a condition where sending nodes load the network with traffic exceeding the available bandwidth. It manifests itself in the form of increased traffic jitter, higher packet drops, increasing latencies, etc.

D. Ben Khedher et al Node failures and message losses are frequent in MANETs. Nodes form a self organizing overlay network that is over layed on the physical network. In an overlay network, a set of nodes, called detectors, periodically sense each other’s heartbeat messages. Every detector also senses the heartbeat messages of a set of nodes. If a detector does not hear from a node after a timeout (possibly due to node failure or message loss), it identifies the failure of the node according to a set of failure detection rules and then reports the failure to all the other nodes. Many applications in MANETs are very promising, such as multimedia conferencing and gaming, and interactive applications such as distance learning. To make these applications fault-tolerant in MANETs, they need a mechanism for detecting failed nodes. This mechanism should detect failed nodes and then inform all the other nodes to recover the network. MANETs are maintained at lower layers by different routing protocols such as AODV and WCA . These protocols may have their own failure detection mechanisms. For example, in AODV, a link failure between neighbors is detected by three unanswered ‘Hello’ messages. AODV does not provide periodic updates of information about node failure and consequently node failure is only reported when a path is requested. Routing protocols are based on the detection of the physical wireless link status to recover routes. They do not focus on the node status and thus applications cannot rely on them for detecting failed nodes. Completeness and accuracy are the key requirements related to the reliability of failure detection architectures. Completeness indicates the report of the failure to non failed nodes. Accuracy implies no false detection, so that a non-failed node will not be stated failed by any non-failed node.

Heartbeat protocols are widely used for failure detection in network systems In these protocols, a node periodically sends a heartbeat message (“I am alive”) to a detector node. If the time between consecutive heartbeat messages exceeds a timeout value, then the node is considered failed. Heartbeat architectures are used in many areas: system diagnosis, network protocols, reaching agreement, and fault detection in computer networks. The heartbeat style is composed of three phases: heartbeat exchange, digest exchange and health-status-update diffusion. In the first phase, every node in the cluster broadcasts a heartbeat message to its cluster-head while the cluster-head broadcasts a heartbeat message to its members. In the second phase, every node in a cluster sends the cluster-head a digest message

Ann T. Tai et al The growing interest in ad hoc wireless network applications that are made of large and dense populations of lightweight system resources calls for scalable approaches to fault tolerance. Moreover, the nature of these systems creates significant challenges for the development of failure detection services (FDSs), because their quality often depends heavily on reliable communication. a cluster-based communication architecture to permit the FDS to be implemented in a distributed manner via intra-cluster heartbeat diffusion and to allow a failure report to be forwarded across clusters through the upper layer of the communication hierarchy. Failure detection services (FDSs) are thus important for ad hoc wireless network applications that are built on large and dense populations of lightweight resources. Nonetheless, the development of such services leads to greater challenges than those involved in the development of failure detectors for traditional distributed systems. Specifically, the large size and high population density of such networks often lead to scalability problems. clustering approaches have become an emerging technology for building scalable, robust, and energy-balanced ad hoc network applications . The main purposes of clustering algorithms are 1) to permit the communication in ad hoc wireless networks to be scalable to node populations, and 2) to deal with mobility

IV. Clustering

Clustering

In mobile ad hoc network , clustering can be defined as a notional arrangement of the dynamic nodes into various groups. These virtual collections of nodes are grouped together regarding their relative transmission range proximity to each other that allows them to establish a bidirectional link. The diameter size of the clusters determines the control architectures as single-hop clustering and multi-hop (K-hop) clustering. In single-hop clustering every member node is never more than 1-hop from a central coordinator - the cluster head. Thus all the member nodes remain at most two hops n distance away from each other within a logical cluster. In multi-hop clustering, the limitation or restriction of an immediate proximity to member nodes from the head is removed, allowing them to be present in serial k-hop distance to form a cluster.

Ordinary nodes (cluster member): As the name suggests, ordinary nodes do not perform any other function beyond a normal node role. They are members of an exclusive cluster independent of neighbors residing in a different cluster.

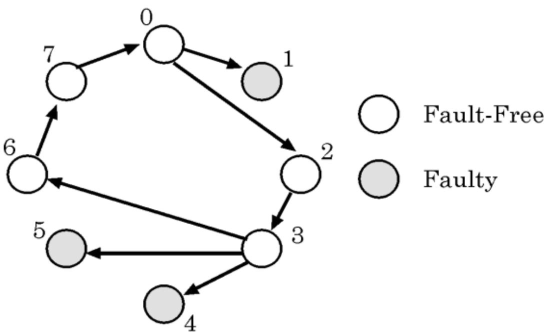
Cluster Gateway Nodes: Is a node that works as the common or distributed access point for two cluster heads. When a node remains within the transmission range of two cluster heads.

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 essential control functions such as channel access, routing, calculation of the routes for longer-distance messages, bandwidth allocation, forwarding inter-cluster packets, power control and virtual-circuit support. This support or backbone takes the form of connected cluster heads, in managerial role; linked

either directly or via gateway nodes and they will have the subordinate nodes of that cluster linked to them. Another function of cluster heads is internal node communication, to forward inter
cluster messages. To send a packet an ordinary node must first direct it to its 'superior' its directly connected cluster head.

V. ADAPTIVE SYSTEM LEVEL DIAGNOSIS

The field of distributed system-level diagnosis has flourished for years. Bianchini and Buskens introduced the Adaptive Distributed System level Diagnosis (Adaptive DSD) algorithm, and also its implementation in an Ethernet environment. Adaptive DSD has diagnosis latency of N testing rounds for a network of N nodes. Consider a system consisting of N units, which can be faulty or fault-free. The goal of system-level diagnosis is to determine the state of those units . For almost 30 years, researchers have worked on this problem. An adaptive approach, which requires fewer tests, is to assume that each unit is capable of testing any other, and to issue the tests adaptively, i.e., the choice of the next tests depends on the results of previous tests, and not on a fixed pattern. The Adaptive Distributed System-level Diagnosis algorithm, Adaptive-DSD is, at the same time, distributed and adaptive. Each node must be tested only one time per testing interval. All fault-free nodes achieve consistent diagnosis in at most N testing rounds. There is no limit on the number of faulty nodes for fault-free nodes to diagnose the system. Adaptive-DSD is executed at each node of the system at predefined testing intervals. Each time the algorithm is executed on a fault-free node, it performs tests on other nodes until it finds another fault-free node, or it runs out of nodes to test. A testing round is defined as the period of time in which all nodes of the system have executed Adaptive-DSD at least once. After one testing round, if there are at least two fault-free units, the testing graph has the format of a ring, as shown in Fig. In the example shown in Fig, node 1, node 4, and node 5 are faulty, and the rest are fault free. Node 0 tests node 1 and finds it faulty, so it goes on and tests node 2, which is fault-free, and then stops testing. Node 2 then tests node 3 as fault-free, and so on.



VI. CONCLUSIONS

The failure detection algorithm coupled with suitable clustering algorithm make a very efficient failure detection service for wireless ad-hoc networks. Clustering divides whole network into two level communication architecture namely intra-cluster and inter-cluster. Two types of message overheads are required to maintain such as intra-cluster and inter-cluster. The disadvantage of the clustering approach is that CH itself may fail, hence it becomes necessary that the presence of leader is also need to be monitored and in case of its failure another node takes over the CH.

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