A SUCCESSFUL METHOD FOR BUILDING A RELIABLE MOBILE ADHOC NETWORK USING ACO AND QOS

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ABSTRACT
Decentralized wireless networks come in the form of mobile ad hoc networks (MANET). Because it does not rely on pre-existing infrastructure like routers in wired networks or access points in managed (infrastructure) wireless networks, the network is referred to as ad hoc. Instead, each node takes part in routing by sending information to other nodes, therefore the choice of which nodes provide information is decided dynamically based on the connectedness of the network and the routing algorithm being used. Mobile Ad Hoc Networks (MANET) are made up of a number of wireless nodes and function as a dynamic data exchange. Because of node failures, network segmentation, disconnections, and movement, the network topology changes often. Moreover the mobile nodes which are basically resource constrained, exhibit various kinds of faulty behaviors that may be transient or permanent due to the hardware or software problems. In such a situation, the faulty node may not forward packets and the situation becomes worse. Hence fault tolerance is an important design issue to construct a reliable mobile ad hoc network. Due to the presence of faulty nodes, the performance of routing degrades and the reason for the faulty nodes has to be identified to address routing by exploring network redundancies.
Keywords: ACO, Fault tolerance, Link failure, Multipath routing, Node failure, QoS.

INTRODUCTION

MANET, also known as wireless adhoc network or adhoc wireless network, is an acronym for mobile adhoc network. It is often built on top of a link layer ad hoc network and has a routable networking environment. They are made up of a collection of mobile nodes that are wirelessly connected in an autonomous, self-healing network without a permanent infrastructure. Due to the frequent changes in network topology, MANET nodes are free to migrate anywhere they like. When they forward communication to other designated nodes in the network, each node acts as a router. MANET can function alone or as a component of a broader internet. They provide a highly dynamic autonomous topology between one or more various types of transceivers at each node. The main challenge for the MANET is to equip each device to continuously maintain the information required to properly route traffic. MANETs consist of a peer-to-peer; self-forming, self-healing network MANET's circa 2000-2015 typically communicate at radio frequencies (30MHz-5GHz). This can be used in road safety, ranging from sensors for the environment, home, health, disaster rescue operations, air/land/navy defense, weapons, robots, etc.

CHARACTERISTICS OF MANET

Dynamic Topologies

Network topology which is typically multihops, may change randomly and rapidly with time, it can form unidirectional or bi-directional links.

Bandwidth constrained, variable capacity links:

Wireless links usually have lower reliability, efficiency, stability, and capacity as compared to wired network. The throughput of wireless communication is even less than a radio's maximum transmission rate after dealing with the constraints like multiple access, noise, interference conditions, etc.

Autonomous Behavior

Each node can act as a host and router, which shows its autonomous behavior.

Energy Constrained Operation

As some or all the nodes rely on batteries or other exhaustible means for their energy. Mobile nodes are characterized with less memory, power, and lightweight features.

Limited Security

Wireless network are more prone to security threats. A centralized firewall is absent due to its distributed nature of the operation for security, routing, and host configuration.

Less Human Intervention

They require minimum human intervention to configure the network, therefore they are dynamically autonomous in nature. MANET is a re-configurable remote system and doesn't have a fixed foundation. They are self-made and self-composed. These systems are described by unique geography, high hub versatility, low channel data transmission and constrained battery power [Ran 11]. These qualities have cleared another path for structuring and working the directing conventions.

Significant qualities of MANET

Tthe hubs in MANET can join or leave the system whenever, making the system geography dynamic in nature and consequently interfaces in a course might be briefly inaccessible and making the course invalid. The overhead associated with discovering backup courses of action might be high, and deferral in bundle conveyance might be found. Multipath steering tends to this issue by giving more than one course to a goal hub. Source and transitional hubs can utilize these courses as essential and reinforcement courses.

II FAULT TOLERANCE

Fault tolerance approach is used to prevent the malfunctioning node, which would otherwise affect the overall task of the network. Fault tolerance is the ability to react to the unpredicted hardware and software failures [Mah 13]. Reasons for fault:

- Communication Failure
- Nodes leaving the Network
- Attacks of various types
- Compromised nodes behaving in non-cooperative manner
- Selfish nodes behaving in non-cooperative manner
- Altruistic nodes becoming selfish after sometime
- Critical Section Problems and Mutual Exclusion (unable to enter that region)
- Signal interference and packet loss.

III ROUTING PROTOCOL

The existing MANET routing protocols according to [Joh 11] has been classified into two categories: (i) Unipath routing protocols, and (ii) Multipath routing protocols.

Unipath Routing Protocols

In unipath routing protocol, a unique path is being used to transmit a message between the sender and receiver. Unipath routing protocols has been classified as either table based or demand based. Table-based protocols are used to store information about the routes from one node in the network to the other nodes by means of routing table. Easy to implement but due to the frequent movement and dynamic nature of Ad hoc networks, maintaining the routing information in these tables is a very challenging task. On the other hand, On-demand based routing protocols, overcomes the above problems, and makes routing more scalable for dynamic and large networks. On-demand based routing protocols compute the routes only when a need arises. On-demand based routing protocols, consists of i) route discovery phase in which a route is found between two nodes ii) followed by a route maintenance phase in which a broken link in a route is repaired, or a new route is found.

Multipath Routing Protocols

Due to the continuous changing infrastructure in MANET, the routes that were once considered to be the “best” may no longer remain as the “best” at a later time. Therefore, the routes are to be continuously re-computed.Multipath routing protocols have the advantage of the inherent redundancy i) which helps to find multiple routes from a source node to a destination node, ii) also increases the reliability during the transmission of information, and iii) also ensures that at least one of the paths will be able to successfully deliver the packet. This further ensures its success as a fault-tolerant routing

algorithm which provides route resilience when there are route failures in the network. However, multipath routing faces unnecessary overhead when duplicate packets are sent through different routes.

IV METHODOLOGY FOR FAULT TOLERANCE IN MANETS

Fault Tolerance

[Mah 13] The topology changes rapidly due to the high mobility of nodes and hence reliability on the transmission of message is an important concern in MANET. Therefore strategies should be considered to deliver the packets even in the presence of node failures/link failures in adversarial environment. Fault tolerance is used to enhance system reliability and the areas where fault tolerance is needed are as follows:

Fault tolerance in Node Failures

Every node in the network can communicate directly with other nodes in the network, if it is a single hop, or uses the middle node as a router to pass the information to the next node in case of multi hop, provided if they are within the transmission range. A node failure can take place if the nodes are not within the transmission range. To get rid out from the problem of node failure, many algorithms and protocols have been suggested by different authors.

Fault tolerance in Link failures and Network Failure

In MANET, Fault tolerance in Link failure and Network failure occurs, due to the fully or partially failed components in the network because of malfunction otherwise natural disaster. If a node moves away from the cluster, link failure will occur and in order to continue effectively many approaches have been proposed.

Fault tolerance in Transmission

Power and Energy Transmission power and energy are the important issues in Mobile Ad Hoc Networks. Battery is mostly used to send and receive messages, also used for the route selection, discovery and to repair the failures in the link of the network. If the battery gets drain, then failure occurs. To have constant working, many authors had presented their contribution towards it.

Routing protocols

The nodes in MANETs can communicate directly with other nodes if they are within the transmission range and makes use of router otherwise. Thus the node can act as both host and router. In MANET, since the nodes are joining and leaving the network, the continuously changing infrastructure, imposes problems in routing. The different types of error that can occur in MANET are as follows:

- Transmission error
- Node failures
- Link failures
- Route breakages
- Packet loss due to congested nodes/links According to [Raj 12],

Fault tolerant routing protocols have been classified into 2 types.

Proactive

They provide protection proactively (before the fault occurs) by:

- Suitably selecting optimum paths with least possibility of Faults.
- By caching important data
- By using erasure codes or redundant data.

Reactive

They provide protection proactively (after the fault occurs) by:

- Using Retransmission techniques
- Using Effective Route maintenance techniques
- Using Alternate path techniques.

Multipath routing protocols can be used for achieving fault tolerance in which proactive or reactive techniques can be used. **Dynamic Source Routing (DSR) [Dhe 13]:** DSR is a reactive protocol that is based on source route approach. The protocol is uses Link state algorithm in which the source initiates route discovery on demand basis. Mobile nodes are required to maintain route caches that contain the source routes of which the mobile is aware. Entries in the cache are continually updated as new routes are learned. Records the entire path from source to destination into the routing table and selects the shortest path. **Ad hoc On demand Distance Vector (AODV) [Dhe 13]:** AODV is a reactive routing protocol. It minimizes the number of broadcasts by casting routes based on demand. Every mobile node functions as a specialized

router. Routing tables are maintained in the intermediate nodes, with routing information being fetched as request is made on demand. **Ad hoc Multipath On demand Distance Vector (AOMDV) [Pun 12]:** AOMDV employs multiple loop free and Link disjoint path. In AOMDV only disjoint nodes are considered in all the paths, thereby achieving path disjoint. **Robust Fault Tolerant Protocol (RFTA) [Jay 12]:** Used AOMDV as a base and tried to improve the fault tolerance and achieved efficient routing in MANET. Multipath routing protocols has the ability to find node-disjoint, link-disjoint, or non-disjoint routes. Node-disjoint routes have no nodes or links in common. Link-disjoint routes have no links in common but have many nodes in common. Non-disjoint routes can have both nodes and links in common. **Position Based Routing Protocol [Roi 05]:** The node in the position based routing protocol can determine its physical location. The location of each node is stored at some other nodes, which act as a location servers for that node. When a node wishes to send packets to another node, issues location queries to discover the target's location and then forward packets to that location. Reliability is measured as the success rate of location queries. **Ant Colony Optimization (ACO) [Ani 09]:** A probabilistic technique searching for optimal path in the graph based on behavior of ants seeking a path between their colony and food source. Each ant moves at random and pheromone is deposited on path. More pheromone on path increases probability of path being followed and the shortest path is discovered via pheromone trails. ACO algorithms are the part of swarm intelligence that is made up of simple individuals, **co-operate through self- organization. Congestion [Raj 12]:** Congestion in MANET happens due to limited resources. Dynamic topology and wireless channels leads to interference and fading during packet transmission. Packet losses and bandwidth degradation are caused due to congestion and thus time and energy is wasted during its recovery. Congestion can be prevented using congestion-aware protocol through bypassing the affected links. The multipath routing is more effective when compared to single path routing since it provides load balancing, fault-tolerance and high aggregated bandwidth. Table 1 and Table 2 provides a summary of various fault tolerant routing protocols by considering the objectives, parameters used, routing protocol and simulator used.

CONCLUSION

Having seen the relevant works, each seems to provide excellent results on fault-tolerant directing conventions in certain angles, by taking into account various limits, such as throughput, end-to-end latency, routing loads, delivery percentage, package drop, and energy usage. To design more engaging lenient guiding conventions, additional restrictions like transfer speed, jitter, separation, stay duration, and others can be taken into account.

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