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An Overview of Mobile Ad-Hoc Networks: Architecture, Routing and Challenges

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Abstract: *MANET is a type of ad-hoc network that can configure itself and change location on the fly. MANET can be built anytime, anywhere using any wireless enable devices (such as: mobiles, laptops, PDAs etc) and connect various wireless networks to provide end to end connectivity. The real time application of MANET are home or office automation, disaster management (such as earthquake, floods and wars) etc. In these applications we will face many challenges such as routing challenges (traffic over flow) and as well energy consumption of mobile nodes with limited battery capacity. In MANET there will be some uncooperative nodes which can break the communication in network. To resolve and detect uncooperative nodes in MANET here we will perform proper routing for nodes. There are various routing protocols available for MANET which is DSR, TORA, AODV and OLSR etc. This paper describes the detection and isolation of contrary nodes while keeping the algorithm simple and quick as possible so it could be run on real time on any device without huge overhead. The solution combines the strength and simplicity of existing implementations of the detection of the uncooperative nodes in MANET.*

Keywords: *MANET, MANET Architecture, Routing Protocols.*

1. INTRODUCTION

In recent years there is increasing demand on working wireless solutions for connecting to the Internet, reading and sending E-mail messages, changing information in a meeting and so on. Wired solutions have been around for a long time but in some disaster situations these wired solution failed so we need a new network that overcome the flaws in wired networks, such network known as Ad-Hoc network. Ad-Hoc means "temporarily" which means there is no permanent network Which means they can be set up anywhere without any need for external infrastructure (like wires or base stations)[2].A MANET is an autonomous system which supports mobile nodes, wireless links for connectivity and without using pre-existing communication infrastructure. A MANET is similar to or is a self-configuring network that is formed automatically by a collection of mobile nodes without the help of a fixed infrastructure or centralized management. Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network is decentralized, where all network activity including discovering the topology and delivering messages must be executed by the nodes they, i.e., routing functionality will be incorporated into mobile nodes. Ad hoc network is a multi-hop wireless network, which consists of number of mobile nodes [1]. These nodes generate traffic to be forwarded to some other nodes or a group of

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nodes. Proposed quality system for detection of uncooperative nodes in adhoc network: Cooperation Of Nodes (CON).

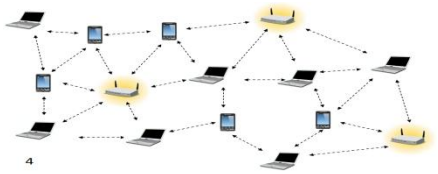


Figure 1: Ad-Hoc Network [3]

2. MANET ARCHITECTURE

MANET architecture consists mainly four parts: Access Point, Cluster Head, Forwarder Node and Mobile terminal.

Access Point: Access points act as a central transmitter and receiver of WLAN radio signals. Access points used in home or small business networks are generally small, dedicated hardware devices featuring a built-in network adapter, antenna, and radio transmitter. Access points support Wi-Fi wireless communication standards. Cluster head: Clusters are dynamically formed by the AP based on the traffic requirements. Mobile terminals which are growing closely together form cluster head. There is Forwarder Node which are responsible for data forwarding among different clusters. The twofold mode of operation defines two outfitted regions: 5 GHz and 60 GHz. The AP always plays the role of the standard access point for the MTs that are tuned at 5GHz [4]. Its 60 GHz channel defines the radius of a smaller cell; every MT that belongs to this cell and is tuned at the specific 60 GHz frequency channel of the AP is part of the so-called AP's cluster. A cluster is defined as the set of equipments synchronized to a particular frame at a specific 60 GHz frequency channel. The AP undertakes the role of the Cluster Head (CH) - described below - inside its cluster. The role of the AP at 60 GHz is similar to the standard at 5 GHz. Any MT may assume the role of a CH for a particular cluster and for a specified time period. CHs are mainly responsible for generating the frame at the chosen 60 GHz frequency channel and forwarding traffic inside their clusters. MT plays the role of a Forwarder Node (FN). A FN needs to switch between different 60 GHz frequency channels and acts as a gateway between adjacent clusters. The AP is responsible for assigning a FN for a specific data session and informing the corresponding CHs.

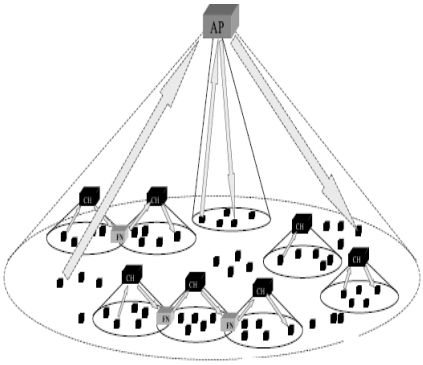
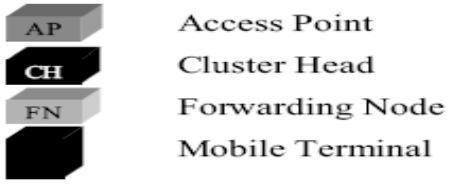


Figure 2: Ad-hoc Network Architecture



3. ROUTING PROTOCOLS

Routing Protocols plays important role in network for data movement among nodes. During this process, at least one intermediate node within the inter-network is encountered.

The routing concept basically involves, two activities: firstly, determining optimal routing paths and secondly, transferring the information groups (called packets) through an inter network. Ad-hoc routing protocol can be broadly classified as: Proactive and Reactive. Proactive routing protocol are called table driven. In this protocol it is mandatory for all the nodes to keep track of route to all the possible destination nodes while in reactive routing protocol are also called demand on. In these protocol nodes discover route when some other node demand for some destination. In proactive protocol a node has minimum delay because whenever a route is needed for routing a packet it is immediately selected from the routing table where as reactive protocol has more delay because routes are determine on demand. Reactive

protocols often consume low bandwidth then proactive protocol. Some important Proactive Routing Protocol are: Destination-Sequenced Distance-Vector Protocol (DSDV), Wireless Routing Protocol (WRP) and Optimistic Link State Routing (OLSR)..Some important Reactive Routing Protocol are: Dynamic Source Routing (DSR),Ad-Hoc On Demand Distance Vector Protocol(AODV) In this paper we will mainly discuss OLSR,DSR and AODV.

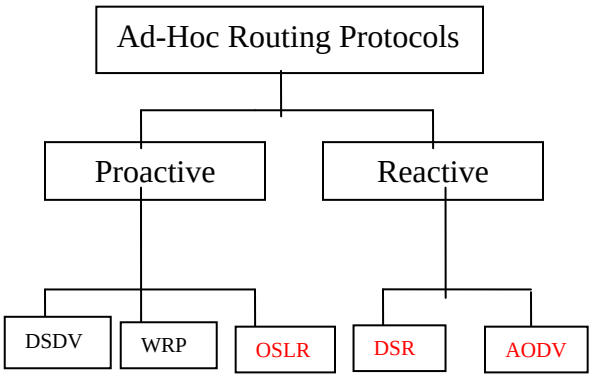


Figure 3: Classification of routing protocols

3.1 DYNAMIC STATE ROUTING

The Dynamic Source Routing protocol (DSR) is a simple, efficient and robust routing protocol designed for use in
Multi-hop wireless ad-hoc networks of mobile node. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration.
The two major phases of the protocol: Route Discovery and Route Maintenance. These phases work together to allow nodes to discover and maintain source routes to arbitrary destinations in the ad hoc network. Each node in the network maintains a route cache in which it caches the routes it has learned. To send data to another node, if a route is found in its route cache, the sender puts this route or a list of all intermediate nodes in the packet header and transmits it to the next node in the path. Each intermediate node examines the header and retransmits it to the node indicated after its id in the packet route. But if the node does not have such a route, then it initiates the route discovery process by broadcasting a Route Request (RREQ) packet. Each intermediate node checks whether it knows of a route to the destination. If it does not, it appends its address to the route record of the packet and forwards the packet to its neighbors. A Route Reply (RREP) is send by the destination on receiving the first RREQ. RREP is sent on a route obtained by reversing the route appended to receive RREQ. RREP includes the route from Source to Destination on which RREQ was received by node destination receives the route request packet. A route request packet reaching such a node already contains, in its route record, the sequence of hops taken from the source to this node.

3.2 AD-Hoc On Demand Distance Vector Routing Protocol.

AODV combines advantage of both Destination Sequenced Distance Vector (DSDV) and Dynamic Source Routing (DSR). It takes the basic On demand mechanism of route discovery and route maintenance from DSR to reduce traffic overhead when routes are established. AODV supports Uni-cast, Broadcast and Multicast without any further protocols and the use of hop by hop routing, sequence number and periodic beacon from DSDV to solve Count-To-Infinity and loop problem by sequence numbers and the registration of the costs. In AODV every hop has the constant cost of one. The routes age very quickly in order to accommodate the movement of the mobile nodes. Link breakages can locally be repaired very efficiently. AODV can be characterizing using five criteria: distributed, hop-by-hop, deterministic, single path state dependent. When a source has data to transmit to an unknown destination, it broadcasts a Route Request (RREQ) for that destination. At each intermediate node, when a RREQ is received a route to the source is created. If the receiving node has not received this RREQ before, is not the destination and does not have a current route to the destination, it rebroadcasts the RREQ. If the receiving node is the destination or has a current route to the destination, it generates
a Route Reply (RREP). The RREP is uni-cast in a hop-by-hop fashion to the source. As the RREP propagates, each Intermediate node creates a route to the destination. When the source receives the RREP, it records the route to the destination and

can begin sending data. If multiple RREPs are received by the source, the route with the shortest hop count is chosen. As data flows from the source to the destination, each node along the route updates the timers associated with the routes to the source and destination, maintaining the routes
in the routing table. If a route is not used for some period of time, a node cannot be sure whether the route is still valid. Consequently, the node removes the route from its routing table. If data is flowing and a link break is detected, a Route Error (RERR) is sent to the source of the data in a hop-by-hop fashion. As the RERR propagates towards the source, each intermediate node invalidates routes to any unreachable destinations. When the source of the data receives the RERR, it invalidates the route and reinitiates route discovery if necessary.

3.3 OPTIMIZED Link State Routing

Optimized Link State Routing protocol is a proactive routing protocol which is based on link state algorithm. Routes on OLSR are always available immediately. To keep and update topological information of the network at each node, it periodically exchange message on regular basis. OLSR is an optimization on a pure link state routing protocol by compressing the size of information sent in a message and to, reducing the number of retransmission to flood these message in whole network . This protocol use MPR i.e multi point relay technique to efficiently and economically flood control messages.

OLSR uses two control messages: Hello and Topology Control (TC) Hello messages are used for finding the information regarding the link status and the host's neighbors. In Hello message the Multipoint Relay (MPR) Selector set is constructed which describes which neighbors has chosen this host to act as MPR and from this Information the host can calculate its own set of the MPRs. the Hello messages are sent only one hop away but the TC messages are broadcasted throughout the entire network.TC messages are used for broadcasting information about own advertised neighbor s which includes at least the MPR Selector list. The TC messages are broadcasted periodically and only the MPR hosts can forward the TC messages [5].

OLSR protocol is best suited for those applications which allow the small delays in the transmission of the data packets. The best working environment for OLSR protocol is a dense network, where the most communication is concentrated between a large numbers of nodes. OLSR decrease the control overhead forcing the MPR to propagate the updates of the link state. [6]

4. PROPOSED QUALITY SYSTEM FOR DETECTION OF UNCOOPERATIVE NODES IN ADHOC NETWORK: CON

A quality system is defined as it takes the feedback from users and provides the mechanism to build up and determine the quality of the given source based on this feedback. There are several quality system are proposed which alleviate the selfishness and stimulate cooperation in manet.CON stands for Cooperation of nodes i.e. fairness in ad-hoc network. This mechanism works as an extension to on demand routing protocol. Its main objective is to detect and isolate uncooperative nodes in the network. With CON each node has four parts which are: monitor, a trust manager, quality system and path manager. **Monitor** monitored the behavior of the nodes. **Trust manager** of a node sent an ALARM message to nodes to warn them against uncooperative nodes. **Quality System** in CON maintains a table consisting of entry for nodes and their ranking [7]. This ranking of nodes change only when there is enough data of uncooperative node behavior that has occurred adequately many times to rule out coincidence. **Path Manager** performs functions such as: Again rank the path according to the rank of the node in the path; delete those paths that contain nodes that are uncooperative.

In Cooperation of Node quality system each node monitors its neighbors' behavior. If some apprehensive event is detected, immediately the information is given to the quality system. Quality system checked that weather the event is considerable for the node, if it is ,then it again checked whether this event is occurred first time or occurred more frequently than the predefine threshold (level). If a certain threshold (level) is exceeded, the quality system changed the rating of the nodes that caused the event. If the rating turn

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out to be unbearable, the information is relayed to the path manager, which proceeds to eliminate all routes contain the mischievous or uncooperative node from the path cache.

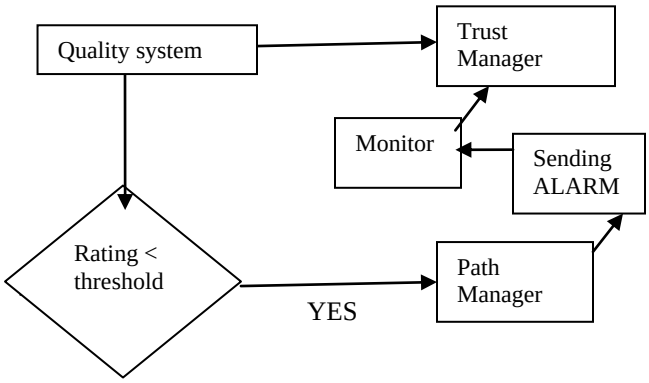

Figure 4: CON Model

5. CONCLUSION

The solution that is presented in this paper is a simple MANET implementation that is base on the Quality System: Cooperation of Node (CON) which enhanced in a way that it provide a fair use environment for the nodes in the network without uncooperative nodes and optimized the topology so that the traffic directed through battery driven node is minimized.

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