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MANET PROTOCOLS for REDUCING ROUTING OVERHEADS

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ABSTRACT

Mobile ad hoc networks (MANETs) are networks which routing is based on multi-hop routing from a source to a destination node or nodes. These networks have quite a many constrains because of uncertainty of radio interface and its limitations e.g. in available bandwidth. Also some terminals have limitations concerning battery energy in use.This paper deals with the challenges of ad hoc routing protocols and how to overcome routing overhead. We summarized the protocols which reduce the routing overheads and optimize the performance.

KEYWORDS: MANETs, Routing Protocols, Challenges, Routing Overheads.

INTRODUCTION

Mobile ad hoc networks (MANETs) are collections of mobile nodes, which dynamically forms temporary network without pre-existing network infrastructure or centralized administration. These nodes can be arbitrarily located and are free to move randomly at any given time, thus allowing network topology and interconnections between nodes to change rapidly and unpredictably.

MANET is a multi-hop wireless network; mobile nodes in this network generate traffic to be forwarded to some other nodes or a group of nodes. Due to a dynamic nature of ad hoc networks, traditional fixed network routing protocols are not viable. So there is a need for efficient protocols in wireless network environment. Research is still going on to generate appropriate and efficient protocols.

APPLICATIONS OF MANET

i. Creating Personal Area Network with the help of cell phones, laptops, smart watches and other wireless equipment's.
ii. Provides with access to real-time information to the mobile user, even when they are away from their home or office.
iii. MANET can be extended to places which cannot be wired.
iv. MANET can form a temporary network for office, meeting room, or at any place where required without any infrastructure.
v. MANET can use in Military (e.g. to create a network at battle fields), Searching and Reusing of resources.
vi. To make intelligent transportation system, Vehicle may use MANET. (where Vehicle will act as mobile node moving from one location to other location)
vii. MANET can be used in Disaster relief operations.
viii. MANET can be used in Mine site operations.
ix. MANET can be used in Urgent Business meetings.
x. MANET can be used in Robot data acquisition

MANET HAS THE FOLLOWING FEATURES

a. Independent terminal: - In MANET each mobile node is an autonomous node and has the same features, which may function as host as well as router. So usually endpoints and switching are indistinguishable in MANETs.
b. Distributed procedure: - Since the network is infrastructure less network there is no central control of the network operations, the control and management of the network is distributed among all nodes. Each node of this type of network should collaborate amongst themselves and nodes act as a switch as needed, to implement functions like security routing etc.
c. Multi-hop routing: - Routing algorithms in MANETs have either single-hop or multi-hop based on different types of link layer attributes and protocols. Any node can forward a packet to any other node by direct or indirect wireless transmission range. If the packet is transmitted by indirect wireless transmission range it require intermediate node.
d. Self-motivated network topology: - as mobility is an essential feature for MANETs, the network topology may change rapidly and unpredictably and the established path in between nodes can vary with time.
e. Nodes can establish routing path dynamically among themselves.
f. Light-weight nodes: - In MANETs nodes are mobile devices with less processing capability, less memory size, and low power storage. These types of networks need optimized algorithms and mechanisms that implemented communication and computing functions.

CHALLENGES IN MANET

α Routing overhead

In wireless adhoc networks, nodes often change their location within network. So, some stale routes are generated in the routing table which leads to unnecessary routing overhead.

α Dynamic topology

The whole MANET infrastructure is dynamic and is the reason for dynamic connection and disconnection of the variable links.Nodes are mobile and can be connected dynamically in an arbitrary manner. Links of the network vary timely and are based on the proximity of one node to another node.

α Bandwidth optimization

Wireless link continue to have significantly lower capacity than infrastructured networks. In addition, the realized throughput of wireless communication after accounting for the effect of multiple access, fading, noise, and interference conditions, etc., is often much less than a radio's maximum transmission rate. Wireless links have significantly lower capacity than the wired links. Routing protocols in wireless networks always use the bandwidth in an optimal manner by keeping the overhead as low as possible. The limited transmission range also imposes a constraint on routing protocols in maintaining the topological information. Especially in MANETS due to frequent changes in topology, maintaining the topological information at all nodes involves more control overhead which, in turn, results in more bandwidth wastage.

α Security threats

The wireless mobile ad hoc nature of MANETs brings new security challenges to the network design. As the wireless medium is vulnerable to eavesdropping and ad hoc network functionality is established through node cooperation, mobile ad hoc networks are intrinsically exposed to numerous security attacks. Mobility implies higher security risks such as peer-to- peer network architecture or a shared wireless medium accessible to both legitimate network users and malicious attackers. Eavesdropping, spoofing and denial-of-service attacks should be considered.

α Quality of Service

QoS defines a guarantee given by the networkto satisfy a set of predetermined serviceperformance constraints for the user in terms offend-to-end delay, jitter, and available bandwidth.It is a significant technical challengeto define a comprehensive framework for QoSsupport, due to dynamic topology, distributedmanagement and multi-hop connections forMANETs.

α Autonomous

No centralized administration entity is available to manage the operation of the different mobile nodes

α Power Consumption

Devices used in these networks have restrictions on the power source in order to maintain portability, size and weight of the device. Mobile nodes rely on battery power, which is a scarce resource. Also storage capacity and power are severely limited.

- α Hidden terminal problem

  The hidden terminal problem refers to the collision of packets at a receiving node due to the simultaneous transmission of those nodes that are not within the direct transmission range of the sender but are within the transmission range of the receiver.
- α Packet losses due to transmission errors

  Ad hoc wireless networks experiences a much higher packet loss due to factors such as increased collisions due to the presence of hidden terminals, presence of interference, uni-directional links, and frequent path breaks due to mobility of nodes.
- α Device discovery

  Identifying relevant newly moved in nodes and informing about theirexistence need dynamic update to facilitate automatic optimal route selection.
- α Mobility-induced route changes

  The network topology in an ad hoc wireless network is highly dynamic due to the movement of nodes; hence an on-going session suffers frequent path breaks. This situation often leads to frequent route changes.
- α Scalability

  Scalability can be broadly defined as whether the network is able to provide anacceptable level of service even in the presence of a large number of nodes.
- α Infrastructure-less and self operated

  Self healing feature demands MANET should realign itself to blanket any node moving out of its range.
- α Poor Transmission Quality

  This is an inherent problem of wireless communication caused by several error sources that result in degradation of the received signal.
- α Ad hoc addressing

  Challenges in standard addressing scheme to be implemented.

PROTOCOLS USED IN MANET TO OVERCOME THE ROUTING OVERHEAD

Routing problems have become highly challenging because of the popularity of mobile devices. In the past decades, many excellent power aware routing protocols/algorithm has been proposed for mobile Ad-hoc networks. However, most of the existing results rely on the knowledge of certain global information such as, the remaining any of all nodes and minimum transmission power used between every pair of nodes.Dueto node mobility in MANETs, frequent link breakages may lead to frequent path failures and route discoveries, which could increase the overhead of routing protocols and reduce the packet delivery ratio and increasing the end-to-end delay [X. Wu et al]. Thus, reducing the routing overhead in route discovery is an essential problem. The following protocols are developed to reduce the routing overhead problems.

- ✓ DSDV (Destination Sequenced Distance Vector)Routing Protocol
- ✓ WAR (Wireless Ad-hoc Routing Protocol)
- ✓ TBRPF (Topology Broadcast Based on Reverse Path Forwarding Routing Protocol)
- ✓ WRP (The Wireless Routing Protocol)
- ✓ STAR (Source Tree Adaptive Routing Protocol)
- ✓ LAR (Location Aided Routing Protocol)
- ✓ AODV (Ad-hoc On Demand Distance Vector Routing)

DSDV (DESTINATION SEQUENCED DISTANCE VECTOR) ROUTING PROTOCOL

DSDV is a table driven routing protocol, in which each node maintain a table that contain the shortest distance. DSDV is a modification of the conventional Bellman-Ford routing algorithm. It addresses thedrawbacks related to the poor looping properties of RIP in the face of broken links. The modification adapted inDSDV makes it a more suitable routing protocol for adhoc networks [3]. In DSDV table updates with increasing sequence number. Sequence number is used to avoid the formation of loops, this sequence number generated by the source node. There are two ways to update tables- incremental update and full-dump. In incremental update it takes single network data packet unit

(NDPU). In full-dump it takes multiple network data packet units (NDPU). The objective of this protocol is to find optimum routes with minimum delay. In this method route and up-to-date view of network are available for all the nodes.This protocol has some drawbacks like Count to infinity problem and slow convergence of routing protocols. To overcome these problems many improvements of DSDV have been developed. One of it is WAR [1].

WAR (WIRELESS AD-HOC ROUTING) PROTOCOL

Wireless routing protocol is the extension of DSDV. It inherits the properties of distributed Bellman-Ford algorithm. This routing protocol is designed to remove **count** to infinity problem. Like DSDV, WAR also provides the up-to-date view of network. WAR uses a set of tables to maintain more accurate information. These tables are - Distance table, Routing table, message passing retransmission table and link cost table. Distance table contain the network view of the neighbors of a node. Routing table provide up-to- date view of the network for all known destination. It also keeps the shortest distance, predecessor node, successor node and a flag which indicate the status of the path. Link cost table contain the cost. Message retransmission list maintain the information of all messages. A unique feature of this algorithm is that it checks the consistency of all its neighbors every time it detects a change in link of any of its neighbors. Consistency check in this manner helps eliminate looping situations in a better way and also has fast convergence. As it has to store all the details of neighbours, it requires lot of memory and it is not suitable for large mobile ad-hoc-network[7].

TBRPF (TOPOLOGY BROADCAST BASED ON REVERSE PATH FORWARDING) ROUTING PROTOCOL

TBRPF was proposed for several hundred of mobile nodes or high mobility in MANET. In TBRPF each mobile node in network keeps incomplete global topological information. To reduce routing overhead TBRPF adopts following optimization steps:

- ✓ "Hello" messages are exchanged among neighboring nodes periodic and differential. Only the changes of neighbor status are included in "hello" message.
- ✓ A part of spanning tree is broadcast to its neighbors if mobile node '*A'* finds itself is on the path from its neighbor '*B'* to a destination '*C'* in the '*A'* rooted spanning tree, it will put node '*C'* and its adjacent links in the reportable topology sent to neighbors.
- ✓ Whenever required like network topology updated, mobile node mobility etc, it will update with *"hello"* message.

WRP (THE WIRELESS ROUTING PROTOCOL)

The Wireless Routing Protocol (WRP) described in [6] is a table-based protocol with the goal of maintaining routing information among all nodes in the network. Each node in the network is responsible for maintaining four tables:

- Distance table
- Routing table
- Link-cost table
- Message retransmission list (MRL) table

Each entry of the MRL contains the sequence number of the update message, a retransmission counter, an acknowledgment-required flag vector with one entry per neighbor, and a list of updates sent in the update message. The MRL records which updates in an update message need to be retransmitted and which neighbors should acknowledge the retransmission.

In WRP, routing nodes communicate the distance and second-to-last hop information for each destination in the wireless networks. WRP belongs to the class of path-finding algorithms with an important exception. It avoids the "count-to-infinity" problemby forcing each node to perform consistency checks of predecessor information reported by all its neighbors. This ultimately eliminates looping situations and provides faster route convergence when a link failure event occurs. Elizabeth M. Royer et.al identified that the complexity of maintenance of multiple tables demands a larger memory and greater processing power from nodes in the wireless ad hoc network [6].Elizabeth M. Royer et al proved that at high mobility, the control overhead involved in updating table entries is almost the same as that of DSDV and hence is not suitable for a highly dynamic and for a very large ad hoc wireless network as it suffers from limited scalability [6].

STAR (SOURCE TREE ADAPTIVE ROUTING) PROTOCOL

It applies Least Overhead Routing Approach (LORA) rather than the optimum routing approach (ORA) and the nodes running TORA send updates only when it is require and not periodically. Each node sends routing information updates only when it detects new nodes, when the entire path is lost to for a specific destination, or when detects some topology changes which may lead into routing loops [6]. Updates are sending like source tree, which contains its own preferred paths to all destinations. Upon receiving the source trees from neighbors, a node aggregate these source trees with its information about its adjacent links to produce a partial topology graph. This way every node in the network should have a path to every destination. If a node does not have a path to a particular destination which the node wants to send packets to it, the node initiates a path absence message to its neighbors. A neighbor which has a path to this destination sends its own source tree in response. Otherwise, a neighbour forwards the message to its neighbors and so on until some alternate path is replied. This is considered as the link break maintenance mechanism in STAR.

LAR (LOCATION AIDED ROUTING) PROTOCOL

LAR [9] tries to reduce the routing overhead which is present in traditional flooding algorithm by using Location Information.

In LAR it is already assumed that each mobile nodes known its location in network through GPS. LAR works according to the following steps.

- ✓ The source mobile node puts the location information of self and destination node in the routing request packet.
- ✓ Routing requested packet broadcast within the required zone.
- ✓ On receipt of route request packet, the destination mobile node sends reply with its current location to source.
- ✓ If because of some error, LAR fails to find out route to the destination, routing protocol resorts to flooding of routing message throughout the MANET.

AODV (AD-HOC ON DEMAND DISTANCE VECTOR ROUTING)

AODV uses a very special technique to maintain routing information. AODV protocol is both an on-demand and a table-driven protocol. It adopts flat routing tables, one entry per destination. It is in difference to DSR, which can maintain multiple route cache entries for every one destination.

Unlike DSR The packet size in AODV is uniform. In AODV there is no need for system-wide broadcasts due to local changes; unlike DSDV.AODV has multicasting and uncasing routing protocol property within a uniform framework. Source node, destination node and next hops are addressed using IP addressing. To overcome the routing overheads AODV builds routes using a route request /route reply cycle[10]. This could improve the scalability of MANETs by limiting the routing overhead when a new route is requested [H. AlAamri et al].

CONCLUSION

Routing is process of building maps and giving directions. MANET is formed by mobile nodes that have limited batteryand CPU power, since there is expected to route (or relay) packets on behalf of other nodes. This is true irrespective to routing protocols they use in the networks. In MANET's the network topology changes frequently and unpredictably due to arbitrary mobility of nodes. This failure leads to frequent path failures and route reconstructions, which cause an increase in the routing control overhead.Routing Overhead is calculated by number of many extra messages, were used to establish the path. AODV and STAR builds routes between nodes only as desired by source nodes which reduces the routing overhead. Using local information LAR reduces routing overhead problem. Though thereareseveralprotocols to address routing overhead problems still we need protocols which improve the performance when the network is in high density or the traffic is heavily loaded.

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