Comparative Analysis Of Various Protocols In Topology Based Routing In Mobile Adhoc Networks

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***Abstract*-A mobile ad-hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet. MANETs are a kind of wireless ad hoc networks that usually has a routable networking environment on top of a Link Layer ad hoc network. In this paper we have done comparative analysis of various topology based routing protocols and laid more emphasis on LAR-1 LAR 2 routing protocols. We have also introduced AODV+PGB, a broadcasting mechanism and is aimed at reducing broadcast overhead.**

***Keywords*- LAR-1, LAR-2, MANET, incremental, OLSR,**

I. Introduction

Each device in a MANET is free to move Figure1. Ad-hoc network architecture independently in any direction and will [1] therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. Routing in ad-networks has been a challenging task ever since the wire- less networks came into existence. The major reason for this is the constant change in network topology because of high degree of node mobility. A number of protocols have been developed for accomplish this task.

In ad hoc networks, nodes do not start out familiar with the topology of their networks; instead, they have to discover it. The basic idea is that a new node may announce its presence and should listen for announcements broadcast by its neighbours. Each node learns about nodes nearby and how to reach them, and may announce that it, too, can reach them. Wireless ad-hoc networks have gained a lot of importance in wireless communications. Wireless communication is established by nodes acting as routers and transferring packets from one to another in ad-hoc networks. Routing in these networks is highly complex due to moving nodes and hence many protocols have been developed. In this paper we have selected three main and highly proffered routing protocols for analysis of their performance. Figure1 below represents the scenario of MANET.

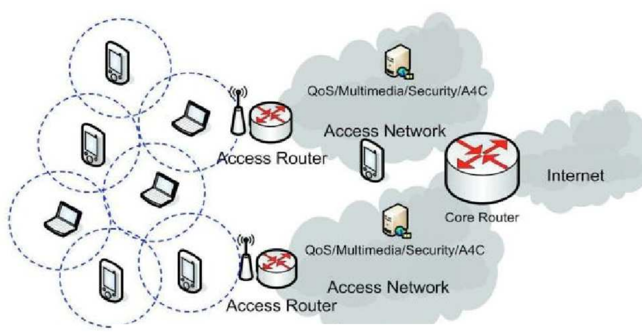

Fig1. Ad-hoc network architecture [1]

Topology based Routing

In packet switching networks, routing directs packet forwarding, the transit of logically addressed packets from their source toward their ultimate destination through intermediate nodes decide which way to route packets between computing devices in a mobile ad-hoc network. In ad hoc networks, nodes do not start out familiar with the topology of their networks; instead, they have to discover it. The basic idea is that a new node may announce its presence and should listen for announcements broadcast by its neighbours. Each node learns about nodes nearby and how to reach them, and may announce that it, too, can reach them. Wireless ad-hoc networks have gained a lot of importance in wireless communications. Several MANET routing protocols have used topology based routing approach. Topology based routing protocols use links information within the network to send the data packets from source to destination . Topology based routing approach can be further categorized in to three groups:

- Proactive Routing
- Reactive Routing

2. MERITS & DEMERITS OF TOPOLOGY BASED ROUTING PROTOCOLS

Topology based routing protocols use link's information within the network to send the data packets from source to destination. Topology based routing approach can be further categorized into proactive (table-driven) and reactive (on-demand) routing

2.1 Proactive (table-driven)

Proactive routing protocols are mostly based on shortest path algorithms. They keep information of all connected nodes in form of tables because these protocols are table based. Furthermore, these tables are also shared with their neighbors. Whenever any change occurs in network topology, every node updates its routing table.

MERITSs

- No Route Discovery is required.
- Low Latency for real time applications.

DEMERITS

- Unused paths occupy a significant part of the available bandwidth.

2.1.1 Fisheye State Routing

FSR [3] is a proactive or table driven routing protocol where the information of every node collects from the neighboring nodes. Then calculate the routing table. It is based on the link state routing & an improvement of Global State Routing. For routing this approach translates into an accurate information in the immediate neighborhood of a node and less detail as the distance increases.FSR is similar to link state (LS) routing in that each node maintains a view of the network topology with a cost for each link. In LS routing link state packets are flooded into the network whenever a node detects a topology change. In FSR nodes maintain a topology table (TT) based on the up-to-date information received from neighboring nodes and periodically exchange it with their local neighbors. For large networks in order to reduce the size of the routing update messages the FSR technique uses different exchange periods for different entries in the routing table.

Relative to each node the network is divided in different scopes

Pros

- Scales well to large network sizes

Control traffic overhead is manageable Changing in the routing table will not occur even if there is any link failure because it doesn't trigger any control message for link failure

Cons

- Route table size still grows linearly with network size
- As mobility increases routes to remote destinations become less accurate
- What happens if the target node is out of the scope of all nodes in the source nodes scope

2.1.2 OLSR

Optimized link state routing (OLSR) [2] maintains routing information by sending link state information. After each change in the topology every node sends updates to selective nodes. By doing so, every node in the network receive updates only once. Unselected packets cannot retransmit updates; they can only read updated information.

2.1.3 STAR

Source-Tree Adaptive Routing (STAR) [4] is another link State protocol. In STAR, preferred routes to every destination are saved in each router. It reduces overhead on the network by eliminating periodic updates. There is no need of sending updates unless any event occurs. This protocol can be suitable for large scale networks but it needs large memory and processing because it has to maintain large trees for whole network. For STAR, there are mainly two alternative mechanisms to discover neighbours:

1. Hello Messages: Hello messages are sent by each node periodically to inform neighbours of its existence. Such messages can be small packets, not needing to contain any routing information. When a node receives a hello message from another node that it does not know previously, it discovers a new neighbour. If a node does not receive any message (update or hello) from a neighbour for a certain period of time, it determines that this neighbour is broken or out of its range.2. Neighbour Protocol: A neighbour protocol can be implemented at the link layer. It notifies STAR of the existence of new neighbours or the loss of connectivity to an existing neighbour. With the support of a neighbour protocol, no hello messages are needed.

2.2.1 DSDV

Destination Sequence Distance Vector Routing (DSDV) [2] use Distance Vector shortest path routing algorithm, it provides loop free single path to the destination. DSDV sends two types of packets "full dump" and "incremental". In full dump packets, all the routing information is send while in incremental only updates are send. It decreases bandwidth utilization by sending only updates instead of complete routing information. The incremental still increases the overhead in the network, because these incremental packets are so frequent that makes it unsuitable for large scale networks.

2.2.2AODV

Ad Hoc On Demand Distance Vector routing protocol [5] is a reactive routing protocol which establish a route when a node requires to send data packets. It has the ability of unicast & multicast routing. It uses a destination sequence number (DestSeqNum) which makes it different from other on demand routing protocols.

Pros

- An up-to-date path to the destination because of using destination sequence number.
- It reduces excessive memory requirements and the route redundancy.
- AODV responses to the link failure in the network.
- It can be applied to large scale adhoc network.

Cons

-More time is needed for connection setup & initial communication to establish a route compared to other approaches.

-If intermediate nodes contain old entries it can lead inconsistency in the route.

-For a single route reply packet if there has multiple route reply packets this will lead to heavy control overhead.

- Because of periodic beaconing it consumes extra bandwidth.

2.2.3 Dynamic Source Routing (DSR)

The Dynamic Source Routing (DSR) [6] is one of the purest examples of an on-demand routing protocol that is based on the concept of source routing. It is designed specially for use in multihop ad hoc networks of mobile nodes. It allows the network to be completely selforganizing and self-configuring and does not need any existing network infrastructure or administration. DSR uses no periodic routing messages like AODV, thereby reduces network bandwidth overhead, conserves battery power and avoids large routing updates. Instead DSR needs support from the MAC layer to identify link failure. DSR is composed of the two mechanisms of Route Discovery and Route Maintenance, which work together to allow nodes to discover and maintain source routes to arbitrary destinations in the network. DSR has a unique advantage by virtue of source routing. As the route is part of the packet itself, routing loops, either short – lived or long – lived, cannot be formed as they can be immediately detected and eliminated. This property opens up the protocol to a variety of useful optimizations

2.2.4 Temporary Ordered Routing Algorithm (TORA)

The Temporally Ordered Routing Algorithm (TORA) is a highly adaptive, efficient and scalable distributed routing algorithm based on the concept of link reversal [7]. TORA is proposed for highly dynamic mobile, multi-hop wireless networks. It is a source-initiated on-demand routing protocol. It finds multiple routes from a source node to a destination node. The main feature of TORA is that the control messages are localized to a very small set of nodes near the occurrence of a topological change. To achieve this, the nodes maintain routing information about adjacent nodes. The protocol has three basic functions: Route creation, Route maintenance and Route erasure. TORA can suffer from unbounded worst-case convergence time for very stressful scenarios [8,9]. TORA has a unique feature of maintaining multiple routes to the destination so that topological changes do not require any reaction at all. The protocol reacts only when all routes to the destination are lost. In the event of network partitions the protocol is able to detect the partition and erase all invalid routes

2.2.5 AODV +PGB

To improve AODV in VANET, [10] proposed AODV-PGB, which aims to reduce control message overhead and obtain stable routes by modifying RREQ broadcasting mechanisms. This protocol uses the location and power of received signal information when intermediate nodes rebroadcast RREQ to establish a routing path. Intermediate nodes of the zone defined by signal power and location information rebroadcast the RREQ packet with delay, thus avoiding collision. That quickly establishes a routing path and reduces the hop count between source and destination. Another disadvantage of AODV is that the node informs the end nodes of the path loss by sending an unsolicited Route-Error (RERR) packet until the end nodes acknowledge the notification when a path break is detected at an intermediate node [11]. AODV incorporates two types of routing repair methods: local repair and reconfiguration. A local repair protocol operates when the hop count between the intermediate node and the destination node is less than MAX_REPAIR_ TTL. The intermediate node broadcasts a RREQ after increasing the sequence number. However, if the hop count is greater than MAX_REPAIR_TTL or the intermediate node does not receive a RREP during the discovery period, the intermediate node transmits a RERR to the source node to reconfigure the routing path. AODV therefore incurs overhead and delay when reconfiguring or locally repairing a new route, because the AODV protocol requires additional overhead such as RERR, RREQ, and RREP on a global network. This is more serious in VANET because it has frequency routing path loss. AODV(-PGB) waits for the construction of new routes when the existing route is broken. The frequent route failures result in a significant amount of time needed to repair existing routes or reconstruct new routes [12]. In VANET, path loss frequently occurs due to the high speed of vehicles. Therefore, maintenance and repair of established routing paths is necessary for the effective use of AODV(-PGB) in VANET

2.2.6 LAR

Location-Aided Routing (LAR) protocol is an approach that decreases overhead of route discovery by utilizing location information of mobile hosts. Such location information may be obtained using the global positioning system (GPS) [1], [6], [7], [8]. LAR uses two flooding regions, the forwarded region and the expected region. LAR protocol uses location information to reduce the search space for a desired route. Limiting the search space results in fewer route discovery messages [1], When a source node wants to send data packets to a destination, the source node first should get the position of the destination mobile node by contacting a location service which is responsible of mobile nodes positions. This causes a connection and tracking problems [8], [10]. Two different LAR algorithms have been presented in LAR scheme 1 and LAR scheme 2. LAR

scheme 1 uses expected location of the destination (so-called expected zone) at the time of route discovery in order to determine the request zone. The request zone used in LAR scheme 1 is the smallest rectangle including current location

of the source and the expected zone for the destination. The sides of the rectangular request zone are parallel to the X and Y axes. When a source needs a route discovery phase for a destination, it includes the four corners of the request zone with the route request message transmitted. Any intermediate nodes receiving the route request then make a decision whether to forward it or not, by using this explicitly specified request zone. Note that the request zone in the basic LAR scheme 1 is not modified by any intermediate nodes. On the other hand, LAR scheme 2 uses distance from the previous location of the destination as a parameter for defining the

request zone. Thus, any intermediate node J receiving the route request forwards it if J is closer to or not much farther from the destination's previous location than node I transmitting the request packet to J. Therefore, the implicit

request zone of LAR scheme 2 becomes adapted as the route request packet is propagated to various nodes.

TABLE 1:
COMPARISON OF THE FOUR ROUTING PROTOCOLS

parameters	**AODV**	**DSR**	**TORA**	**LAR**
Source routing	No	Yes	No	Yes
Topology	Full	Full	Reduced	Reduced
Broadcast	Full	Full	Local	Full
Update Information	Route Error	Route Error	Node's height	Route Error
Update Destination	Source	Source	Neighbour's	Destination
Method	Unicast	Unicast	Broadcast	Broadcast
Storage Complexity	O(E)	O(E)	O(Md*A)	O(N)

Md-Number of maximum desired destination
E-communication pairs
A-average number of adjacent nodes N-number of nodes in the network

3. CONCLUSION

In this paper, we presented a performance comparison of different proactive (FSR, DSDV, OLSR,STAR) and reactive protocols(AODVTORA LAR DSR, AODV+PGB) as a function of network and area size.

The performance of AODV was very good in all network sizes, even though the routing overhead

is higher than in DSR. We presented two location-aided routing (LAR) protocols. These protocols limit the search for a route to the so-called request zone, determined based on the expected location of the destination node at the time of route discovery. The modified LAR1 protocol performs well in static and dynamic modes, it outperforms both AODV and LAR1 protocol at all levels (network life time, network overhead, reliability);

AODV+PGB – Preferred Group Broadcasting (PGB) is a broadcasting mechanism and is aimed at reducing broadcast overhead associated with AODV's route discovery The AODV protocol will perform better in the networks with static traffic with the number of source and destination pairs is relatively small for each host. It uses fewer resources than OLSR, because the control messages size is kept small requiring less bandwidth for maintaining the routes and the route table is kept small reducing the computational power. Both protocols scalability is restricted due to their proactive or reactive characteristic.

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